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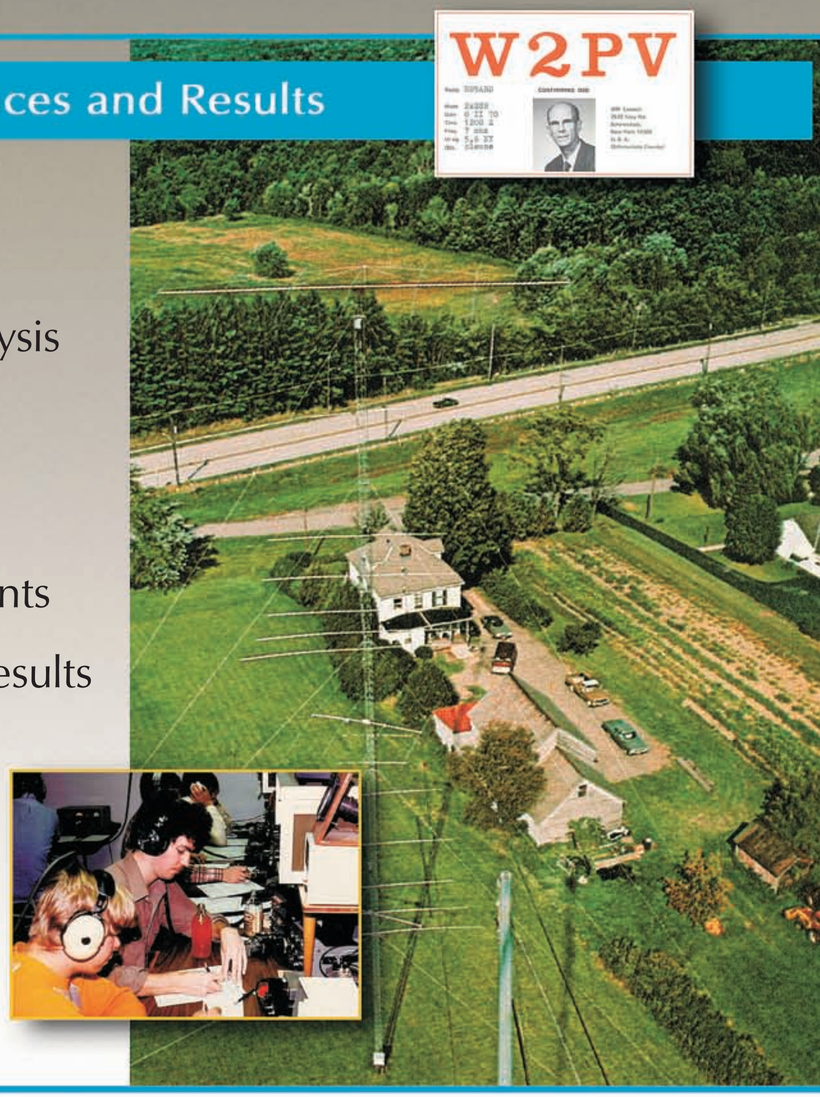
Reflections, Remembrances and Results



Jim Lawson, **W2PV**'s, QSL card from 1970 (top). The W2PV station, with the 20 meter array in the foreground, as seen on the cover of the October 1977 issue of *QST*. **Phil Koch**, **K3UA**, and **Dave Jordan**, **KC1Q** (now **K1NQ**), work 10 meters at W2PV during the 1981 CQWW CW contest (left).

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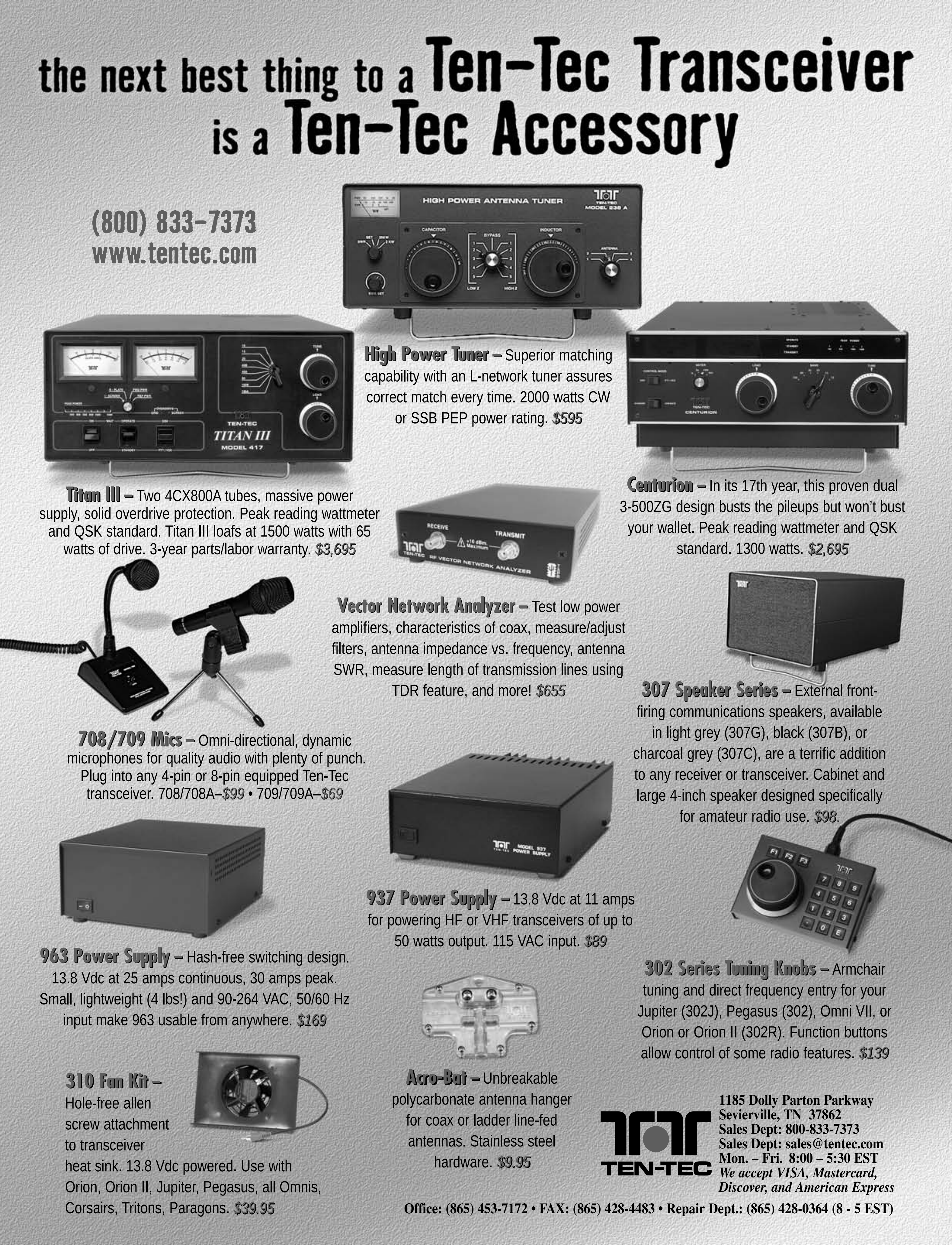
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Editorial

By Carl Luetzelschwab, K9LA

Station Profile column

Having written 15 Station Profile columns beginning with the November/December 2001 issue of *NCJ*, Mark Beckwith, N5OT, has decided to retire. Thanks, Mark, for your five years of describing top-notch contest stations to *NCJ* readers. We've learned much from your columns with respect to what fellow contesters are doing to move contest station technology forward.

Scott Robbins, W4PA, will continue the Station Profile column. He will alternate between his person Profile column (like the one in this issue) and the Station Profile column (his first one will be in the January/February issue).

Packet Issues

The March/April 2006 Editorial touched on the subject of *PacketCluster* self-spotting, and the efforts of Dave Robbins, K1TTT, to expose those who intentionally use *PacketCluster* contrary to the rules of the specific contest. I'm sure there are unintentional instances of this issue, most likely by newcomers not familiar with *PacketCluster* use in a contest. So a short review is in order for those unclear on the subject.

Many contests have two categories for those who are the only operator physically present at their station working other contesters: Single Op and Single Op Assisted.

Single Op means you do all the work with no help from anyone else inside or outside your shack. You run stations all by yourself, you scan the band all by yourself to S&P (Search and Pounce), you log all by yourself, you turn the rotor all by yourself — everything.

Single Op Assisted means you can enlist the help of others outside your shack — specifically through the use of spots from *PacketCluster*. In essence, you're using the ears and abilities of others to help you do better in the contest. Thus you are not a true 'single op' anymore. You are a single op with assistance from *PacketCluster* — thus the category Single Op Assisted.

It is very important to read the rules of the specific contest to understand what you can and can't do. Some contests don't even have a Single Op Assisted category — for example, the *NCJ* NAQP contests only have Single Op and Multi-Operator Two-Transmitter categories. So if you're all by yourself in an NAQP contest and you use *PacketCluster* to receive spots to your advantage, you're really in the Multi-Operator Two-Transmitter category (even though you only have one transmitter).

I should also mention that it is generally acceptable to send out spots as a Single Op. You're not helping yourself in any way by just sending out spots. As long as you're not using received spots (turn the monitor around so it doesn't face you or turn off the monitor), you're still Single Op. Having said this, it is strongly recommended that you simply disconnect *PacketCluster* if you're a Single Op — it totally removes any temptation to "take a quick peek."

In summary, it is your responsibility to understand the rules of the specific contest you're operating in and to obey all those rules — operating category with respect to *PacketCluster* use, output power, number of transmitters on the air and such. I have always believed that a contest win by the rules is the only way to win.

Log Submission for Blind Contesters

Bruce Horn, WA7BNM, received an interesting e-mail from Tom Behler, KB8TYJ. Tom is blind, and up until now has been e-mailing his NAQP contest logs to Bruce. Tom recently decided to try submitting his Cabrillo logs via the Web submission form. Tom reports that the Web form works great with his speech screen reader. He adds that the Web form is actually easier than going the e-mail route.

If you know of any contesters who would benefit from Tom's experience, please have them contact Tom at **kb8tyj@arrl.net**.

Paper Logs for the NAQP Contests

Although the NAQP contests still accept paper logs (due to the purpose of the contest to attract newcomers), the long term goal is to continue to decrease the amount of paper logs. That sure helps the log checking process.

NCJ encourages contest clubs to reach out to their members who still log on paper to either help them with the transition to computer logging, or to offer to convert those paper logs to electronic format. This concept could be expanded further by contest clubs volunteering to handle the paper logs for any entrant in their geographic area, whether currently a member or not. In addition to helping the NAQP contest managers, this could also attract new contesters into your club.

This might even make a good program for a club meeting — a presentation on the transition to computer logging if your club hasn't already discussed this.

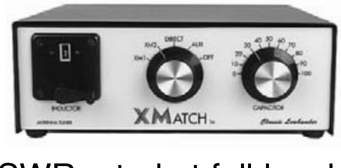
K3NA's Audio Adjustment Series

In the May/June issue, Eric Scace, K3NA, wrote an informative feature about adjusting your transmit audio chain for proper operation. In this issue, Eric follows-up with a feature about adjusting your receive audio chain for proper operation. Judging by the poor audio heard from some stations during phone contests, these two features should be required reading to dispel the myth that "excessive" loudness is required in contests.

Errata

On page 5 of the September/October *NCJ*, I incorrectly identified N5TJ as Jeff Stein. He's really Jeff Steinman. Sorry Jeff! NCJ

THE TUNER



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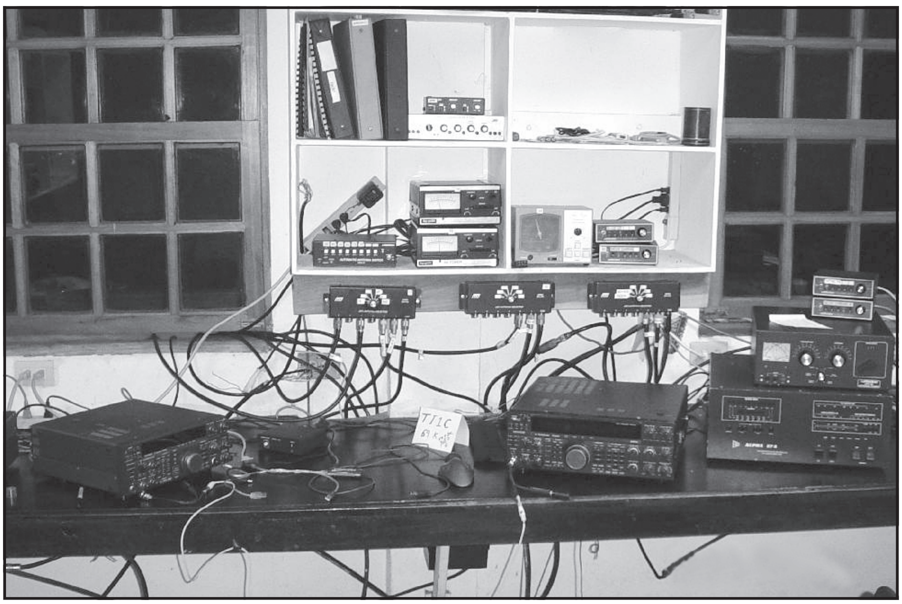
NCJ Snap Shot — The TI1C Contest Station

The following photos are from a presentation by Robert Wood, W5AJ, which was given at HamCom 2006 in June, detailing Robert's visit to Carlos Fonseca's, TI2CF, contest station TI1C, in Costa Rica. The Lone Star DX Association (LSDXA) sponsored the forum.

As can be seen from the pictures, Carlos has put together an impressive contest station, especially on the low bands. For more images, please contact W5AJ, at **rwood90@clearwire.net.**

Work is being done on the six element 10 meter Yagi at about the 90 foot level. In the background is the 3 element 80 meter Yagi — it's on a 60 foot boom at 240 feet.



A view of the station's operating position.

The house with several of the towers in the background. The center tower now has a 3 element 20 meter Yagi at 120 feet. Note the vertical wires in this picture — these are part of the 160 meter wire array. NCJ

Carlos Fonseca, TI2CF, (left) and Robert Wood, W5AJ, (right).

Can I Hear You Now? Adjusting the Receive Audio Chain—Part 1

Eric L. Scace, K3NA
k3na@arrl.net

Far too many contesters struggle unnecessarily to copy signals through self-inflected interference and audio impairments. And far too many of us finish the contest with temporary hearing damage that, over the years, accrues to permanent hearing loss. This article outlines improvements for received signal clarity and hearing protection at contest stations.

Dynamic Range of Receiver Audio

Modern contest-grade receivers provide excellent operation over a wide range of incoming signals. Let's begin by examining how a modern receiver transforms that range of incoming radio signals to audio, taking the Orion transceiver as an example.

In a crowded contest band, several strong interfering signals may be present nearby while the operator tries to copy a weak one. Figure 1 graphs the audio output of a receiver in this situation, with audio frequency on the X axis and signal strength (in dB above the average band noise level) on the Y axis. A dotted line shows the receiver's instantaneous internal noise level as a function of frequency. In this example, the operator correctly adjusted the receiver so that the band noise from the antenna (solid line) hovers a few dB above the receiver internal noise floor. The operator tuned an interesting weak signal (white line) to 450 Hz. Two other strong signals (gray lines), annoying multi-op stations calling CQ TEST, squat nearby at 1100 and 1550 Hz. In the figure the receiver created two artificial signals from strong signal mixing products (black lines), one of which sits underneath the interesting weak signal at 450 Hz. (I assume other artificial signals, such as IMD and reciprocal mixing noise, to be negligible and these are not included in the figure.) Fortunately for the operator, the two mixing products remain weaker than the band noise and so go unnoticed.

Dynamic range measurements help describe how a receiver performs in such situations. Sherwood Engineering measured the Orion I receiver's close-in dynamic range at 93 dB, and the Orion II at 95 dB.[1] "Close-in dynamic range" here means signals separated by 2 kHz, but falling outside the Orion's roofing filter passband used in the test. Dynamic range degrades to 85 dB in Sherwood's tests when the signals all fall within the roofing filter passband. The Orion's close-in dynamic range currently stands as the best on the market for commercial transceivers. Radio design continues to advance and we can expect even better close-in dynamic range in the future.

To put this range into perspective, the scenario of Figure 1 could describe a quiet 20m band with antenna noise near the receiver noise floor, a weak signal that doesn't move the S-meter, and those loud signals running S9+30 dB. As DXers and contesters, we wish to fully exploit the dynamic range of the receiver and easily copy that weak interesting signal.

As we will see in this article, safely exploiting the full dynamic range of the receiver requires proper adjustment of the receiver audio chain: the connection between the receiver headphone jack and the operator's inner ear.

Figure 2 illustrates a simple receive audio chain. The operator connected an ordinary headset directly to the receiver headphone jack. This configuration exemplifies a single-op one-radio or multi-op station. Even this simple case contains six factors influencing the quality of signals conveyed from the receiver to the brain. The operator must understand and control each factor to exploit fully the dynamic range of the receiver.

Receiver Audio Output

I made some simple measurements of headphone voltages using a Heil Pro II headset, an Orion radio, and an oscilloscope. The first measurements examined the receiver's apparent noise floor by disconnecting the antennas. I set the audio gain control so that, while wearing the headset, I could hear the receiver's noise floor just above the ambient noise of a quiet room. The scope measured this noise signal at about 1 μV_{P-P}.

Next, I attached an antenna and tuned in a strong broadcast carrier near the 40-meter band. This very loud audio signal measured 40mV$_{P-P}$, +92 dB over the just-audible hiss.

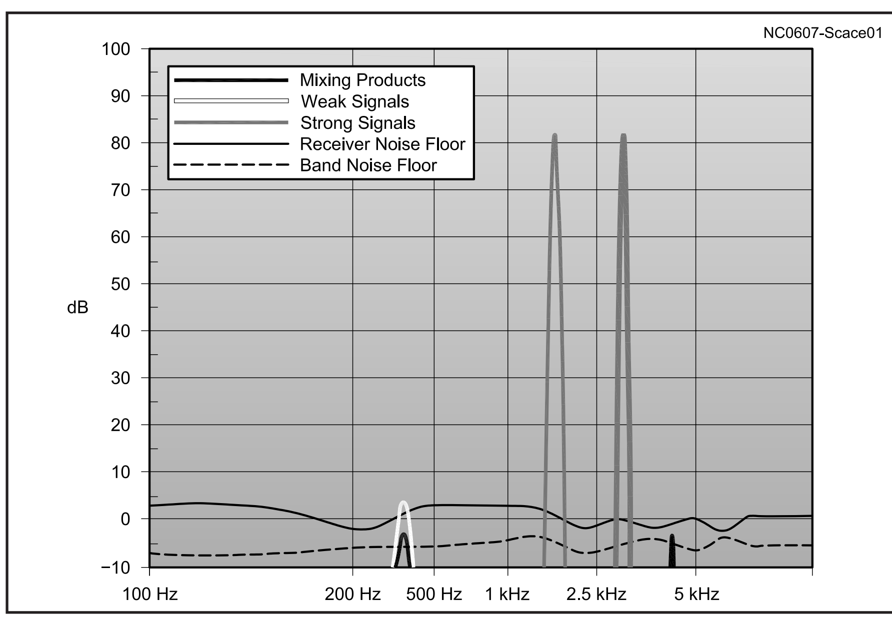


Figure 1—Receiver audio output example. Vertical scale in dB relative to average band noise.

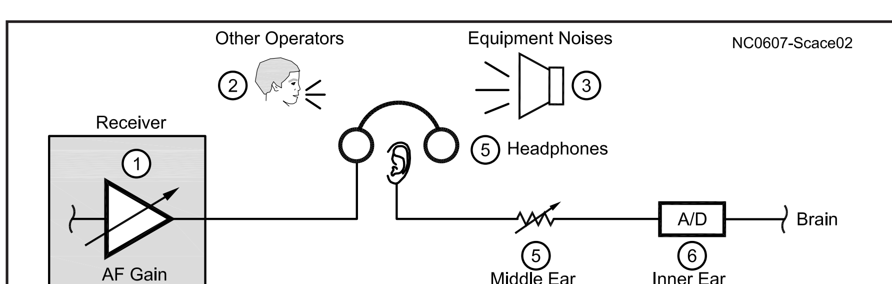


Figure 2—Simple receive audio chain.

Increasing the audio gain demonstrated the Orion could produce as much as $2V_{P-P}$ before distorting – over 120 dB above the receiver noise floor level and stunningly loud. I couldn't wear the headphones at this level.

This little exercise demonstrated that the Orion can easily deliver its 93 dB receiver dynamic range to the headset with plenty of additional headroom. Safely maintaining these large dynamic ranges between receiver and brain requires special attention to safety.

Ear

The ear exhibits the widest range of sensitivity of the five human senses. Point 6 in the Figure 2, the inner ear, functions as a biological analog-to-digital converter. This portion of the ear transforms analog sound energy (represented as pressure waves in the cochlear fluid) into nerve pulses. Like any converter, the inner ear has a minimum threshold below which it cannot detect weaker sounds. The average threshold of hearing varies by frequency. The most sensitive point ("acute threshold") lies between 3–5 kHz, a result of resonance in the outer ear canal. For measurement convenience, acute threshold as a function of frequency has been defined as "A-weighting" and each point is defined as 0 dBA for that frequency.

In Figure 3, the operator adjusted the audio gain so that band noise hovers just above the acute threshold of hearing in the frequency range beginning at 300 Hz. A little further up the audio spectrum at 1 kHz, band noise stands about 15 dBA. "dBA" represents dB above the acute threshold of hearing at the frequency of interest. This might typify ideal CW reception in a perfectly quiet environment. In absolute terms, at this setting the band noise is just louder than the sound of a mouse running across a wood floor, or a mosquito buzzing 3 feet away!

The inner ear also has maximum limits, above which pain and damage occur. Figure 3 also shows the threshold of pain. The two loud signals fit below this threshold – but, at +98 dBA, represent a danger discussed more fully below.

Attenuation Reflex

To reduce risk of damage, the middle ear contains two muscles that function together as an attenuator. As signal strength increases, these muscles tighten the eardrum and shift parts of the middle ear's bone structure to reduce the strength of signals reaching the cochlea.[2] This protective attenuation reflex kicks in when sound levels reach 75–90 dBA. One medical reference cites 80 dBA as a typical triggering threshold for the attenuation reflex for frequencies between 200–4000 Hz. Figure 3 includes a dotted line showing the threshold of the attenuation reflex.

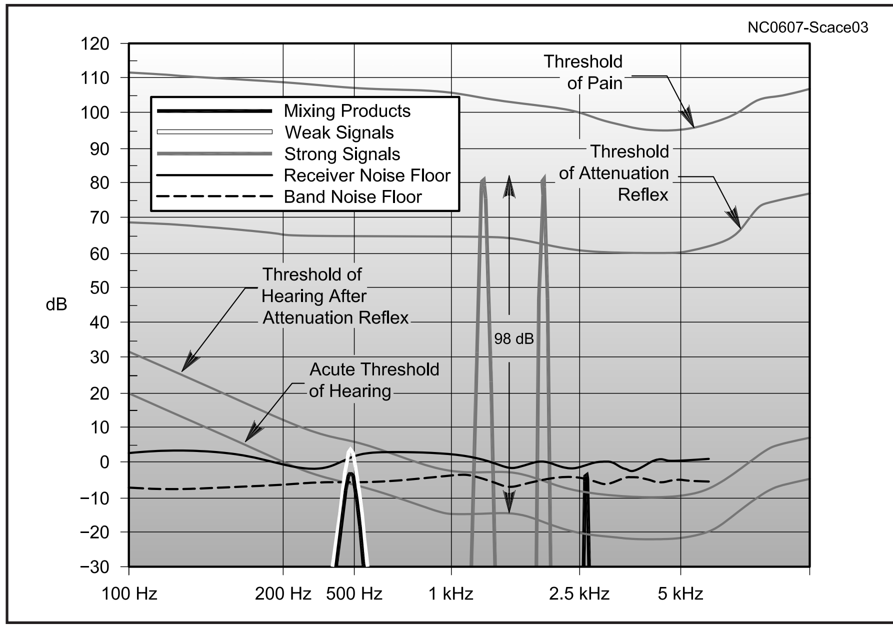


Figure 3—Positioning received signals within the dynamic range of average human hearing. Strong signals above the threshold of the attenuation reflex raise the threshold of hearing, masking the weak signal at 450Hz.

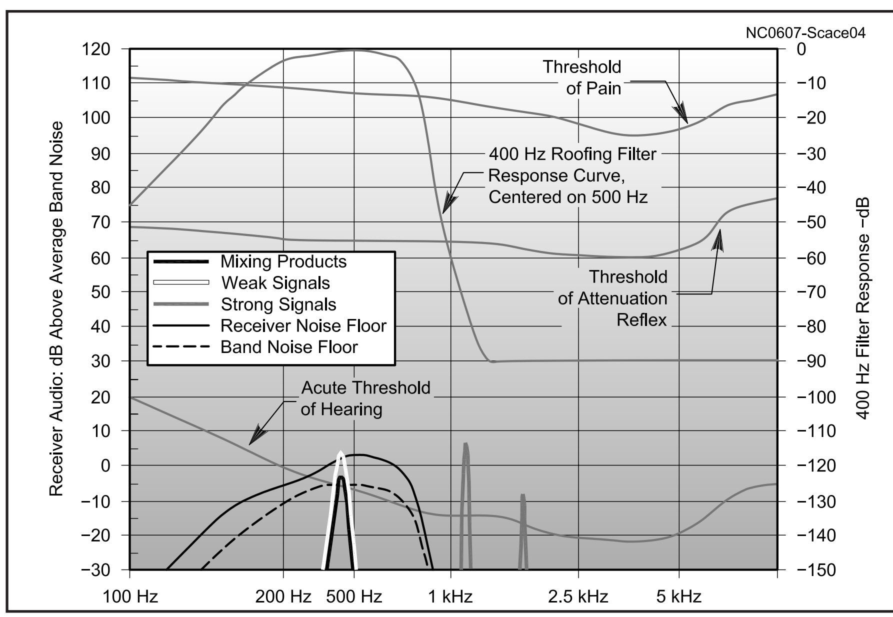


Figure 4—Using a 400Hz filter restores the threshold of hearing to the acute level, unmasking the weak signal. The filter's response curve is plotted against the vertical scale on the right.

The two strong signals have crossed the threshold for the attenuation reflex. The reflex reduces signal strength to the inner ear at a rate of –0.6 dB per dB. With these signals about 18 dB above the threshold of attenuation, those muscles will attenuate the operator's hearing by –12 dB. A line in the figure graphs the new threshold of hearing after the attenuation reflex kicks in. Note that the interesting weak signal has disappeared below the threshold!

The operator can restore the weak signal back above the threshold of hearing by one of the following steps:

- Increase the receiver AF gain. A +10 dB increase will bring the weak signal back above the threshold, but also brings the loud signals closer to the threshold of pain. For reasons explored later, this is a dangerous approach.
- Reduce the receiver bandwidth to weaken those strong signals. Figure 4 shows the audio spectrum, including the effects of an Inrad 400 Hz bandpass roofing filter centered at 500 Hz. (I assumed an ultimate rejection of –90 dB in the stopband.) The filter pushed the strong sig-

nals well below the threshold for the attenuation reflex. The operator now hears band noise over a small range of 350–800 Hz, and again hears the weak signal.

Similarly, a notch filter wide enough to weaken both offending signals by at least –15 dB could push those signals below the attenuation reflex threshold.

When optimizing the receive audio chain, the operator should:

• Place the band noise very close to the acute threshold of hearing; and,

• Avoid triggering the attenuation reflex by keeping the strongest signals within 80 dB above the threshold of hearing.

When transmitting, reduce the CW sidetone and voice monitor signals to the lowest practical level and well below the attenuation reflex threshold. In a 48-hour contest, you will make over 10,000 transmissions, totaling one-third to one-half your operating time. You don't need a loud sidetone to send CW accurately or to know when the memory keyer approaches the end of its message. Give your ears some hours of rest!

Hearing Damage

While examining these charts, one might fairly ask why we cannot exploit the 25 dB of headroom between the attenuation reflex threshold and the threshold of pain. So what if the attenuation reflex reduces signals by ten or twenty dB? Just turn up the receiver gain to compensate! And, unfortunately, this is exactly what most of us do. At the end of a 48-hour contest, the operator removes his headphones to find the rest of the world sounds a bit muffled. Maybe he even has a bit of ringing or white noise in the ears. Damage to the cochlea has occurred, and some of that damage is irreversible. This damage occurs from both long- and short-term events during the contest.

Whenever sounds above the threshold for the attenuation reflex are present, a risk exists for temporary or permanent hearing loss. The USA National Institute for Occupational Safety and Health established these limits for safe exposure to noise in the workplace:

80 dBA: 25.4 hours.[3]
85 dBA: 8 hours.
90 dBA: 2.5 hours.
100 dBA: 15 minutes.
110 dBA: 90 seconds.

Contesters interested in preserving their hearing for a lengthy contesting career should observe these limits. That means keeping receiver gain at the lowest practical settings. If you typically operate with the band noise 30 dB above the acute threshold of hearing on a quiet band, and tune across an S9+20 signal, you're hitting that 100-dBA level and chewing up safe exposure time rapidly.

Over the course of a single contest, lengthy exposure to sounds above 80 dBA degrade the cochlea's threshold of hearing, reducing further the ear's dynamic range. If, over the course of the contest, you accumulate eight hours exposure to 100 dBA, for example, you will lose about 40 dB of dynamic range from threshold shift. Twelve to 48 hours after the end of the contest most of this shift disappears, but a small amount remains as a permanent loss in hearing. Over time, repeated exposure accumulates these permanent loses.

The protective attenuation reflex also has limits to its effectiveness:

• Maximum attenuation runs as much –20 dB for children and teenagers (which partially explains why they tolerate louder music). As we age, the attenuation reflex degrades gradually toward –10 dB, providing less protection.

• The attenuation reflex does not act instantaneously. When new signals just over the threshold appear, 150 milliseconds elapse before attenuation develops. If a very loud sound suddenly begins, the reflex still requires 25–35ms to activate. Gunshots, a dropped wrench on concrete or a big signal suddenly firing up on frequency will slam into the inner ear at full power.[4]

I hope you have been convinced about the importance of keeping audio signals largely within the 80 dB range between the acute threshold of hearing and the threshold of the attenuation reflex.

Ambient Noise

One of the biggest challenges in maintaining audio signals within the safe range comes from our radio room. Points 2 and 3 of Figure 2 identify two typical troublemakers: other operators and equipment noise.

Normal speech runs about 60 dBA. An excited SSB operator sitting next to you can yell at 90 dBA, already triggering the attenuation reflex! If you were not convinced by last month's discussion of the transmit audio chain to speak quietly into the microphone, these numbers should get your attention.

Equipment cooling fans tend to be as much as 20 dB louder at lower frequencies (300 Hz and below) compared to midrange frequencies around 5 kHz. A single quiet muffin fan, mounted in a cabinet and moving a modest amount of air, averages 25–35 dBA in the frequency range most commonly used for copying CW. Equipment noise in your shack likely stands substantially above that number, depending on the type of equipment, location, and orientation. In comparison, the ambient noise level in a library runs around 40 dBA. Let's pick a 40 dBA figure as illustrative for this discussion, recognizing that it represents very quiet radio room.

Absent any controls on ambient noise, the operator will set the receiver gain until the band noise becomes audible over the ambient noise levels in the room. At a station with a library-like ambient noise environment, the operator may set the receiver gain so that the band noise level runs about 45 dBA to listen on a speaker or headphones with no isolation from room noise. This gives him about 35 dB of audio range to play with before signals start triggering the attenuation reflex. That's not very much! If the band noise sits around S1 on the meter, any signals over S8 trigger the attenuation reflex, perhaps covering up weaker signals of interest. More importantly, loud signals consume the available budget of safe listening time before temporary or permanent hearing damage occurs… and, as an experienced contester, think of how much of the time you listen to signals at S8 and above.

You can do the arithmetic for SSB contest at a multi-op station: the situation is grim. No wonder we finish the contest with muffled hearing and tinnitus (ringing in the ear).

We can do a lot to improve matters. Our goal: to reduce ambient noises down to 0 dBA.

Reducing Ambient Noise

The first step focuses on the radio room. As pointed out in a sister article in the preceding issue of *NCJ*[5], a noisy radio room clutters up your SSB transmitted signal, reducing intelligibility. And now we see a noisy radio room reduces your audio dynamic range on reception.

Relocate or re-orient equipment that generates noise. An amplifier with a noisy blower might benefit from dense foam blocks underneath to reduce sound transmission to the shelf. Wayne Hillenbrand, N2FB, relocated his amplifier cooling fans behind a partition, using a duct to bring air to the amplifier chassis. If the operating position sits in the cellar near a noisy furnace, consider a dividing partition containing fiberglass insulation batts or other sound-absorbing material.

In a multi-op environment, separate the operators as much as possible. On-duty operators should adjust their equipment so they can speak quietly into the microphone, and should use voice memory keyers as much as possible. Off-duty operators should take their conversations into a different room.

To be continued…

Notes

[1]See **www.sherweng.com/table.html**

[2]Stevens, S. S., & Warshofsky, Fred, eds. *Sound and Hearing*, Time-Life Books, NY, 1965.

[3]Time weighted average. See **www.cdc.gov/niosh/98-126a.html** and **www.aearo.com/pdf/hearingcons/earlog11.pdf** for more details.

[4]Just before speaking, the attenuation reflex automatically kicks in to protect the cochlea from one's own voice. One can exploit this fact to protect oneself when anticipating a loud noise (start of a power tool, canon fire, etc): simply start humming a few seconds in advance! The act of humming triggers the attenuation reflex, preparing the ear for the following loud noise.

[5]Scace, Eric K3NA, "Can You Hear Me Now? Adjusting the Transmit Audio Chain", *National Contest Journal*, 2006 May/June, p. 23 ff; ARRL, Newington CT.

NCJ

My Trip to WRTC2006

Charlie Wooten, NF4A

I could not believe it when I received the e-mail from Roger, G3SXW that I had been selected as a referee for WRTC2006! I had applied (along with many) in February but never expected to be selected. After all, I am a small-time contester with a mediocre station, but the contest gods smiled on me!

In early May, I called Delta Air Lines and made reservations for Jennifer (my wife) and me to go to Brazil. We would fly from Panama City, Florida to Atlanta, to Sao Paulo (all on Delta), and then Varig Airlines into Florianopolis; the return trip would be the same route reversed. After I recovered from the trauma of hearing the cost of two tickets ($3200), I gave the agent my credit card number and locked in the flights.

In May, right around the Dayton Hamfest, G3SXW sent an e-mail out to all selected referees wanting to get volunteers to record the audio of the contest. Technically, it was no big deal. The free program selected by the judges would record 10MB files (about 40 minutes) and then automatically start another file; it also recorded a real-time date/time stamp that was displayed upon playback of the file. The whole contest could be stored on a 512MB USB "thumb" drive! I volunteered and was selected to be one of the 12 "recording referees". I have a nice laptop computer, less than a year old, running Windows XP Pro so it was very simple to set up. This was a pilot project, and especially after the controversy over the YT6A "uniques", I am sure it will be fully implemented in future WRTCs.

Charlie Wooten, NF4A, Olli Rissanen, HP1WW, and Marko Myllymako, N5ZO.

Starting to Get Excited

As the days went by, both Jennifer and I became more and more excited about going. We had to send our passports to the Brazilian Consulate in Miami for visas. These cost $110 each, plus separate Express Mail postage (both ways), for a grand total of almost $260. We could not use FedEx or DHL — it had to be US Express Mail and the funds had to be paid *only* via a USPS money order. The Brazilians have very strict and specific rules for US citizens to obtain visas. Hams coming from almost everywhere else in the world could enter Brazil with just their passports!

We got the word in mid-June that Varig (our connection within Brazil) was on the brink of bankruptcy. Oms Atilano, PY5EG, strongly suggested that everyone coming to Brazil have a backup ticket on another airline if any Varig flights were involved in their initial reservations. John, K4BAI, who was already scheduled to be on the same flight as us from Atlanta to Sao Paulo, e-mailed me and told me to go to the GOL Airlines Web site and reserve a ticket there for our flights to and from Sao Paulo and Florianopolis. I did so, and we had our "plan B" in place (for another $400). Luckily, GOL has liberal refund policy, unlike many US airlines who basically say "no way" when you want to change or cancel a ticket. We could get back all but 20 percent, which was fine with me.

The Big Day

The big day finally came and we departed Panama City on the afternoon of July 4. Our flight to Atlanta was on time and we arrived there and proceeded to the E concourse, where all international flights arrive and depart Atlanta. We had a three hour layover, so we went to the Delta Crown Room and waited (one of the perks of having to fly a lot). About an hour before departure, we went to the gate where we met up with K4BAI and KU8E, who were also on the flight. The flight to Sao Paulo departed in the evening in Atlanta and arrived in the early morning in Sao Paulo. I think I may have slept for an hour during the nine hour flight. I was excited and couldn't sleep.

After arriving in Sao Paulo, we cleared customs and transferred our luggage to Varig for the flight later in the morning to Florianopolis. On the way to the Varig counter, we met many other hams who had arrived from all over the world. We discovered that the PY hams had set up a hospitality room in the airport so we would have a place to comfortably wait for our flights. The Varig flight to our final destination went without any problems, and we arrived on time in Florianopolis; there were probably 20 to 30 other hams on the flight. We were greeted at the airport by several PY hams who directed us to a large air-conditioned bus. Our bags were loaded in the compartments underneath the bus and we were on our way to the five-star resort that would be our home for the next six days. The bus ride was about 45 minutes. It is amazing how large a city Florianopolis is. I would estimate the population to be around 400,000 people. There were many 10 and 20 story buildings. I had never heard of Florianopolis before the WRTC — the only cities in Brazil that I really knew anything about were Rio, Sao Paulo, Recife and Brasilia.

Getting Ready to Get Ready

We checked into the Costao do Santinho resort and put our things away in the room and proceeded to the WRTC

HQ room in Villa 6. There we were greeted by PY5EG and many other hams from the four corners of the earth. There was an area to use wireless Internet to catch up on e-mail, coffee and plenty of beer, meeting rooms, and of course the PP5 WRTC HQ station, which I had a chance to operate for a short time later. There were two Yaesu FT-9000s there to operate, plus beams for 40-10 meters. I really hit the ground running, since there was a referees' meeting scheduled about one hour after we arrived.

Roger, G3SXW went over the general duties of the referees, and we had some discussions about certain "what if" scenarios. The rest of the afternoon was free until the evening when the opening ceremony was held. The meals at the resort were nothing short of gourmet. Even when feeding a group of 300-400 people, the food was so much more than the "rubber chicken" we get in Dayton at the contest and DX dinners. The meals were served buffet-style, but this wasn't your $5.99 all-you-can-eat type buffet. It was all you can eat, but the similarity ended there. The tables were loaded with gourmet appetizers, salads, entrées and deserts. There was a bottomless glass of beer, bottled water, or *Caipirinha*, a local drink made with limes, sugar and sugar cane rum. Yummy!

We had a meeting Friday morning of all participants and referees; each team was assigned referees, and the secret envelope with the call sign was given to each referee. We were then introduced to our host who would take us to our locations later in the day. I drew the team of Olli Rissanen, HP1WW, and Marko Myllymaki, N5ZO. They are both Finnish hams who work for Nokia, currently working in the US, Panama and Brazil. Our host was PP5CLX. After introductions, we all agreed to meet at 2 PM to proceed to our locations to setup.

Our location, number 37, was about a 30 minute drive from the resort, so we decided that after setup and check out, we would go to the grocery store and then return to the resort to sleep Friday night. In PY, the WRTC started at 9 AM local time, and we agreed to meet at 6:30 AM on Saturday morning to return to the site. Many others weren't that lucky and had to "camp out" at their operating locations on Friday night. Others were luckier, and were provided comfortable sleeping accommodations at their operating site.

Set Up

It was 2:30 PM on Friday afternoon, and our host was not at the predetermined location to pick us up.....then 2:45, then 3:00, then 3:30......finally, a few minutes before 4:00, our host finally showed up and we were whisked off with all the equipment to the site. (The starter on his car had failed and he had to borrow a vehicle to come pick us up.) The site was a "summer camp" for school kids and the operating room was a vending area (the machines had been removed) in the camp canteen. The room was completely vacant except for three plastic tables and about six plastic chairs. There were plenty of electrical outlets, since vending machines were normally plugged in on all three walls of the room.

Olli and Marko surveyed the situation and started to assemble their station. Marko went to work setting up the tables and placing equipment while Olli went outside and located the tower that held a log periodic for 20, 15 and 10, in addition to a 2 element 40 meter beam. There was also an 80 meter dipole. The rules allowed the teams to reorient and fine tune the 80 meter dipole as they saw fit. Olli immediately climbed into a tree and moved one end of the inverted-V to a higher angle. He then moved the other leg to a soccer goal post. After the equipment was set up, he did add about four inches of wire to each end of the dipole. The coax cables for the beams and dipoles were rolled up and tie-wrapped to the bottom of the tower, and these cables were unrolled and routed across the ground to the air vents on the back wall of the operating room. The cables were fed through the wall and connected to the "6-pack" and all the antennas were checked. All SWRs were well within spec — so far, Murphy had stayed away.

The Contest Begins

The team used a pair of Icom IC746Pro transceivers. All stations were given the use of an Acom linear amplifier that would put out about 800 W. It was well after dark when we (they) finally finished getting everything checked out. QSOs were made on several bands and on both CW and SSB to check the logging, computer control of the radios, and for my part, the audio recording for the referee's computer. The audio level coming to the computer was a little hot so I installed a couple of resistors in series with the audio feed to knock the level down about another 10 dB. Thus another problem was resolved and still no Murphy. The radios played very well and we got great signal reports from NA, JA and EU stations. We left the site around 9 PM and went to a local grocery store (*mercado*) to buy provisions. We made it back to the hotel around 10 PM. Luckily, the restaurant was open until 11, so we were able to eat a hot meal and relax before retiring to our rooms. We had to meet our host at 6:30 the next morning.

That 6:30 came very early, and believe it or not, our host was only 10 minutes late (whew!). We hurried to the site and found everything in place and still fully functional. I was able to grab one of the radios for about 15 minutes about 90 minutes before the contest and make a few contacts using CW on 40 and 20 as PP5/NF4A.

Ten minutes before the contest, I gave the envelope containing the call sign to Olli and he tore it open —their call for WRTC2006 would be PT5O! For the next few minutes leading up the contest, Olli and Marko programmed the contest logging software they were using (*Win-Test* by F6BEE). They could not transmit or listen to the bands for that 10 minute period leading up to the contest.

Finally 1200 UTC came, and they were off to the races. The bands were in great shape, including 40, 20 and 15, and later in the morning 10, too. They started off on 15 CW and the first contact was with W1ZT. During the next 24 hours, many FCG members were worked, including (in no particular order) W4FDA, N4PN, K4JAF, KØLUZ, K1TO, WD4AHZ, K4LQ, K4EJ, N4WW, K1PT and K5KG. I may have missed a few as I just scanned thru the Cabrillo file quickly to pick these up. WD4AHZ, N4WW and K4LQ had numerous QSOs on various bands with PT5O. There was a great 10 meter opening around 1400 UTC to EU, and later JAs were plentiful on 15, and later on 40.

Every hour, I was required to send an SMS message to HQ with the score. This was then put onto the real-time Web scoreboard.

Murphy finally showed up around 0200 UTC and smoked the front end of radio B. It was left on 40 meter CW during an operator change. Olli took a bathroom break before returning to radio B and Marko had changed frequency to 40 while he was away, and that was all it took. The remainder of the contest was done strictly with radio A. Later we found out that around 10 or 12 others had lost radio B during the contest — it was bound to happen since amplifiers were being used. Dave Sumner, K1ZZ, the head judge, came by the location and checked everything out some time during the night, as did Dave Bell, W6AQ, who is producing a video about WRTC2006.

The final contact was made at 1158 GMT on Sunday morning with VE3FJ on 20 CW. I sent the final SMS score into HQ and we tore everything down and headed back into the resort.

Back With the Others

Since we were so close to the resort, we were one of the first groups to return, arriving around 1 PM. I turned in the audio log and the Cabrillo file that was stored on separate USB thumb drives. It was now time for a nap. One of the drawbacks of being a referee is that you cannot sleep or even doze off — even bathroom breaks have to be at an absolute minimum. Thank goodness for caffeine! I was really tired, since I had stayed up late most nights earlier in the week discussing the finer points of contesting over beers and *Caipirnhas*, plus I had been up since about 5 AM Saturday.

I got up late Sunday afternoon and took a shower. Then Jennifer and I went to eat at one of the restaurants at the resort with K1IR and his wife Sue. Jennifer and Sue struck up a pretty good relationship. There was a group of 4 or 5 wives, including the wives of K1DG, VE7ZO, K1IR, and my wife Jennifer, who had done things together during the week.

On Monday, a group of 25 to 30 of us went on a cruise around the waters surrounding greater Florianopolis. We had a blast on the cruise, and K1DG even got to drive the boat for about 5 minutes!

The final ceremony was held Monday night. There was traditional music and dancers in traditional Carnival costumes. The awards were given out with VE3EJ and VE7ZO bringing home the bacon. The party went on until the wee hours.

Tuesday was departure day and our flight was scheduled for 4:30 PM. Luckily I had purchased the "plan B" tickets on GOL, as Varig was indeed no longer flying. We were able to smoothly change to our GOL flight, and then in Sao Paulo after a nice meal in the airport with K4BAI and KU8E, we boarded our Delta flight to Atlanta at 10:55 PM. We arrived the next morning in Atlanta, cleared customs and we were back in Panama City at 9 AM.

An Amazing Experience

The WRTC experience was one that I will never forget. It was amazing just to be around such talented contesters. I can only hope that some of that talent rubbed off on me! I could really use it.

I am already looking forward to the next WRTC in Russia. I hope to participate in some way. I already have it planned out: go to Croatia in mid-June to see both ham and non-ham friends that Jennifer and I have in Zagreb, take the train to Freidrichshafen for the Hamfest, then to Bratislava to see my good friend Milan, OM3WW, then on to Russia for the WRTC!!!

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The W1AW/4 IARU 2006 Story

Kirk Pickering, K4RO
k4ro@k4ro.net

The Tennessee Contest Group (TCG) was honored to represent the United States and the ARRL during the 2006 IARU contest using the call sign W1AW/4. The idea of the TCG hosting a HQ operation for the IARU contest began back in 1998. A TCG meeting was held at the QTH of Doug Smith, W9WI. The IARU contest had recently taken place, and the question came up: "How does a club get to be W1AW or NU1AW for a weekend?"

The current TCG leaders at that time, Tom Delker, K1KY, and Mark Speck, KØEJ, sent a request to the ARRL. They asked that the TCG be considered as HQ hosts for a future IARU. They followed up with personal inquiries to Dave Sumner, K1ZZ, CEO of the ARRL and Secretary of the IARU, who assured them that TCG was "on the list." Every year we wondered, "Are we still being considered?" Some of us had given up hope, figuring that we were not high profile enough, or that our stations were not big enough to be considered.

Fast forward about eight years. It's now May 2006, and the TCG had long ago given up hope on being selected to host W1AW/4. The usual suspects were plotting their single-op strategies, while others were planning family events for July. Seemingly, out of the clear blue sky, we received the notice — the TCG could operate W1AW/4 in 2006 if we were ready, willing and able! Wow! Our dream had come true. Then the reality set it in — we only had about two months to prepare for the operation. We had never attempted anything of this magnitude. We did not have a single Multi-Multi station in Tennessee, let alone two. Some of our star operators would not be available at all. We had a big challenge ahead of us. With the World Radiosport Team Championship (WRTC) event going on at the same time, the world stage would be brightly lit indeed.

We made the decision to go ahead and accept the challenge, despite what we felt were our limitations and the short time we had to prepare. The current TCG leaders, Nathaniel Swartz, K1GU, and Greg Tomerlin, K4KO, selected TCG charter members Doug, W9WI, and Ric Painter, WO4O, to serve as station and operator coordinators. Doug had done previous W1AW-IARU efforts from both K4VX and WØAIH, and we leaned very heavily on his experience; Ric has proven himself a team builder since the TCG's inception. They both had a lot of tough choices to make, trying to balance everyone's personal desires and agendas, while maximizing our success and our enjoyment. Jeff Yaeger, K4JNY, also deserves special mention for both doing a tremendous amount of station work; he kept us highly motivated, making sure we put forward our best efforts.

We had two primary goals: 1) to cover all 12 band-modes 24 hours straight, and 2) to give the W1AW/4 multiplier to as many IARU participants as possible. In the end, we wound up using seven stations and 37 operators. Our hope was that we could make up for our lack of super-stations by using a lot of small teams.

The contest itself was either very exciting or very boring, depending on which chair you were in at the time. Some operators were cranking out QSOs at more than 150 an hour, while others were CQing into seemingly dead bands. We tried to maximize our resources and talents, putting the biggest stations and best operators on the busiest bands. The real heroes were those operators who spent hours CQing endlessly into dead bands. These guys had the mettle to hang in there and scratch out every last QSO.

The WRTC event added another element of excitement to the contest. The PT5 and PW5 ops in Brazil were top notch, and the live scoreboard from the Ohio group let us keep up with the action. In the end, we had over 9000 QSOs in the log before dupes. Not bad for a 24 hour contest from Tennessee.

Mark Speck, KØEJ, gives a big thumbs up, while Joel Woods, NA4K, looks on. These two were operating at the K4BP station.

Table 1

W1AW/4 Score — 2006 IARU HF World Championship

Call: W1AW/4
Operator(s): Tennessee Contest Group
Stations: N4DD, K4RO, K4JNY, K4CM, K4BP, K1KY, K1GU

Class: Headquarters HP (ARRL)
QTH: TN (Zone 08)
Operating Time (hrs): 24

Band	*CW Qs*	*Ph Qs*	*Mults*
160	266	12	14
80	558	293	39
40	1229	1047	67
20	1735	1549	97
15	747	804	65
10	253	391	17
Total:	4788	4196	299

Total Score = 6,881,186

Table 2

W1AW/4 Station List

Band	*Station*	*County*	*Grid*	*Antenna(s)*
10 CW	K1KY	Sumner	EM66	2 verticals, converted 6L "Moonraker" CB
10 SSB	K1GU	Blount	EM75	4L SteppIR
15 CW	K4RO	Cheatham	EM66	3/3
15 SSB	K4JNY	Bradley	EM75	6/6, 4L, 4L
20 CW	K4BP	McMinn	EM75	5/5, 3L
20 SSB	K4JNY	Bradley	EM75	4/4, 4L
40 CW	K4JNY	Bradley	EM75	4L, 2l
40 SSB	K1GU	Blount	EM75	2L
80 CW	K4RO	Cheatham	EM66	vertical, sloper, Beverage
80 SSB	K1KY	Sumner	EM66	vertical, loop
160 CW	N4DD	Sullivan	EM86	inverted-L
160SSB	K4CM	Rutherford	EM65	slopers x 3, Beverage

Table 3

W1AW/4 Operator List

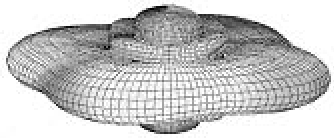
@ K1GU: K1GU, W4HZD, W4PV, KE4OAR, N2WN, AB4GG, KN4Q
@ K1KY: K1KY, NQ4U, NY4N, KC4FAN, AD4CJ, K4DZR, K4RNT
@ K4RO: K4RO, WO4O, K4AMC, K3CQ
@ N4DD: N4DD, N4IR, N4DW, N4UW
@ K4CM: K4CM, N4DBG, KI4KZV, N4KN, NB4M
@ K4BP: K4BP, NA4K, KØEJ, KI4ES
@ K4JNY: K4JNY, W9WI, W4NZ, KE4MBP, AA4NU, KD4HIK

The K4JNY station crew: Jeff Yaeger, K4JNY; Ted Bryant, W4NZ; Billy Cox, AA4NU; Ken Starry, KD4HIK, and Doug Smith, W9WI.

Tennessee is about 500 miles across, and some operators traveled several hundred miles to the nearest host station. Not every station had 24/7 Internet access, so we were not able to maintain the kind of inter-station communications that we would have liked to. Jimmy Floyd, NQ4U, set up a chat room where we passed frequency and score info, and we used PacketCluster TALK messages occasionally. Each station host chose software based on experience and operator preference. I believe at least four different logging programs were used. We could have paid more attention to inter-station communications, but the lack of Internet access at every site imposed limits on what we could do. Ultimately, a distributed wide-area-network solution would have been preferred. Hats off to the Mad River Radio Club and the North Coast Contesters on a job very well done.

Thanks to all of the folks in the TCG who pulled together to make this dream come true. Thanks to the ARRL staff and Dave, K1ZZ, for granting us the opportunity. Most of all, thanks to all of the great operators who called in to keep us busy and keep us having fun. NCJ

A picture is worth a thousand words...



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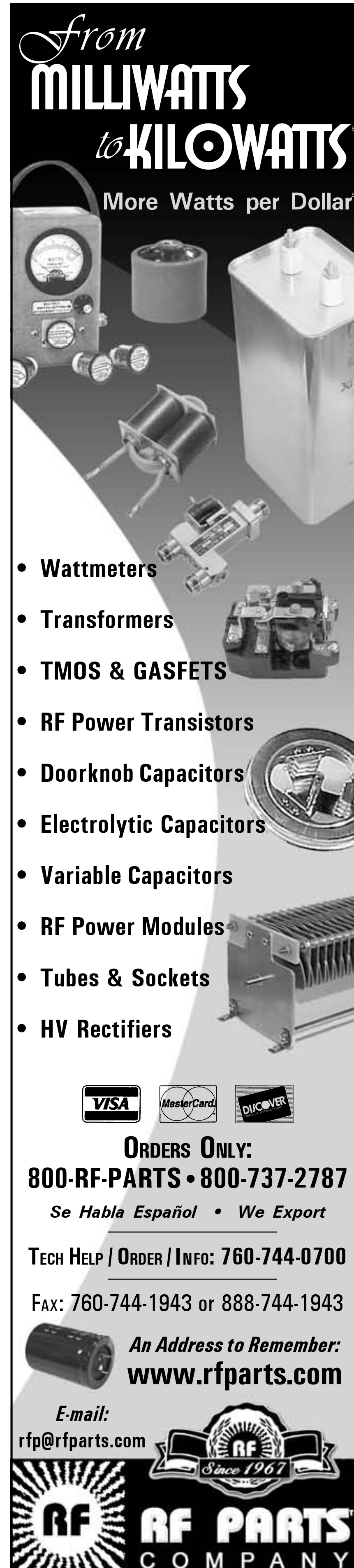

Secrets of Success: Lessons from WRTC2006—Part Two

Eric L. Scace, K3NA
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Second Band Transition: 2000-2226 UTC

Table 6 shows the order of departure from 15 meters. Unlike the 10 meter departures, teams that continue to check 15 meters pick up just a handful of additional contacts and multipliers. Only the German team makes a short run, 10 European QSOs in six minutes at 2128 UTC, demonstrating the band still has propagation long after other teams have given up its 100 QSOs/hour for something else.

Most teams stick largely to 20 meters after their departure, but check 40 meters for any early multipliers. UT4UZ and UT5UGR make the first serious swipe through 40 meters, which temporarily improves their weak multiplier total.

9A8A and 9A5K, the team last to leave 10 meters at 1922 UTC, abandons 15 meters first at 1958 UTC.

K1DG and N2NT manage the overall transition quite well, gathering the largest number of contacts and multipliers during these first post-sunset hours. They sit comfortably in second (Table 7) at 2226 UTC.

VE3EJ and VE7ZO spend most of these hours in third. In the last fifteen minutes of the period they run a list of nine HQ multipliers on 40 meters CW, choosing to give up a hot 20 meters SSB run rather than interleave the multipliers into the run. They fall back into fifth place and will have to claw their way back up; however, as the last team to arrive on 40 meters, the virgin band holds great promise — if they can only find a run frequency among the chaos of contesters. On repeated occasions through the night they make three or four false starts on different frequencies, only to surrender each one to the interference, with zero contacts to show for the time invested. Around the beer keg after the contest, no one reports an easy time here. Forty meters, she is the dominatrix of all bands: punishing, cruel, yet so rewarding!

Just as teams abandon 10 meters and 15 meters at widely different times, they make their first appearance on 40 meters in staggered groupings. YT6A and YT6T arrive first at 2049 UTC. Three

Table 6

Team performance on 15 meters, in order of departure from that band. Columns on right summarize contacts made during the range of times for teams' final 15 meters QSO.

	Total 15m	Last QSO	**QSOs/mults worked 1959–2201 UTC**			
Team	QSO/mult	on 15m	40m	20m	15m	total
9A8A and 9A5K	811/53	1958 UTC	1/1	289/30	—	290/31
IK2QEI and IK2JUB	750/56	2000 UTC	—	293/**40**	2/0	295/40
VE3EJ and VE7ZO	**961**/56	2016 UTC	—	**339**/32	1/1	**340**/33
K1DG and N2NT	730/**60**	2049 UTC	11/11	250/17	6/6	267/34
UT4UZ and UT5UGR	841/51	2049 UTC	**63/23**	244/15	4/4	311/**42**
N6MJ and N2NL	804/54	2125 UTC	13/13	305/12	4 2	322/27
DL6FBL and DL2CC	594/56	2134 UTC	—	280/12	14/4	294/16
YT6A and YT6T	522/47	2201 UTC	10/10	178/16	**25**/**8**	213/34

Table 7

Standings at 2226 UTC, and QSOs and multipliers worked between 2000 and 2226 UTC. The large number of new multipliers from virgin bands (40 meters and, for some stations, 20 meters) combines with fat runs to produce large equivalent QSO rates. In each column, bold highlights the largest entry.

	At 2226 UTC			*e-QSOs behind*	**QSO/mult worked during 1500–2000UTC**				
Team	*Points*	*QSOs*	*Mults*	*next team*	*80m*	*40m*	*20m*	*total*	*e-QSO/hr*
N6MJ and N2NL	**1,039,230**	1424	**162**	—	53/22	135/6	2/0	190/28	254.6
K1DG and N2NT	976,320	1363	160	-87.8	58/22	352/17	6/6	**412**/**45**	283.2
9A8A and 9A5K	943,452	1400	146	-48.8	23/19	325/**35**	—	348/54	297.2
UT4UZ and UT5UGR	895,855	**1443**	139	-76.7	**120**/**31**	242/15	4/4	366/50	**309.7**
IK2QEI and IK2JUB	880,383	1255	159	-22.1	24/21	294/40	—	318/61	278.2
VE3EJ and VE7ZO	878,772	1422	134	-2.6	10/10	**354**/32	1/1	365/43	287.2
DL6FBL and DL2CC	816,504	1164	156	-88.8	10/10	284/15	14/4	308/29	193.7
YT6A and YT6T	652,125	1070	141	-269.7	15/15	229/19	**23**/**8**	267/42	208.9

Table 8

Standings at 0100 UTC, and QSOs and multipliers worked between 2226 and 0100 UTC. In each column bold highlights the largest entry

	At 0100UTC			*e-QSOs behind*	**QSO/mult worked during 2226–0100UTC**				
Team	*Points*	*QSOs*	*Mults*	*next team*	*80m*	*40m*	*20m*	*total*	*e-QSO/hr*
N6MJ and N2NL	**1,378,650**	1588	**195**	—	**24**/**16**	138/17	2/0	164/33	152.3
VE3EJ and VE7ZO	1,273,158	1602	174	-132.7	9/9	**168**/**28**	4/3	**180**/**40**	**193.4**
K1DG and N2NT	1,258,284	1527	188	-18.1	17/9	144/16	5/**4**	166/29	133.3
9A8A and 9A5K	1,227,222	1549	174	-39.2	10/8	140/21	—	150/29	139.6
IK2QEI and IK2JUB	1,128,195	1427	174	-125.3	19/8	151/16	4/0	174/24	122.1
UT4UZ and UT5UGR	1,084,845	**1608**	155	-64.3	12/1	151/15	3/1	166/18	112.9
DL6FBL and DL2CC	1,022,580	1277	180	-77.8	2/2	102/22	9/0	113/24	100.2
YT6A and YT6T	902,020	1243	170	-166.1	9/7	123/21	**45**/2	177/30	137.5

others pass through between 2115-2135 UTC, with only UT4UZ and UT5UGR staying long enough to run 86 contacts. The remaining four teams appear shortly after 2202 UTC but set right to work on a running frequency. Twenty meters, now largely forgotten as the teams tear into fresh meat on 40 meters, will see only sporadic activity through the night.

Stefano, IK2QEI, explains: "I had to change several times my strategy because of low propagation… I tried to be early on 40 meters for working the European opening… [In fact, the Italian team arrives on 40 meters with the last group. — K3NA] I wanted to come back after to 20 meters to work the USA opening during the night, but after 2300 UTC, 20 meters closes."

The darkening sky drives some teams to 40 meters involuntarily. Street lights pop on all over the state of Santa Catarina. More than a few operators stab at their radio's noise blanker controls as noise levels rise. UT4UZ and UT5UGR, DL6FBL and DL2CC, and N6MJ and N2NL will soon abandon 10 through 20 meters to the hash. In N6MJ and N2NL's case the buzz disappears later in the night, suggesting it radiates from nearby house lighting. As people go to bed, house lights go off, cleaning up the band a bit.

Third Band Transition: 2226-0100 UTC

During these 2.5 hours, teams make their first moves on 80 meters. Unlike the other bands, 80 meters doesn't develop into a running band until much later in the night, and only a few of these teams manage to assemble significant runs. Not surprisingly, as seen in Figure 2, the 80 meter QSOs made by early arrivals amount to small beer; darkness has not yet arrived to North America and intra-European interference remains high over there.

First to arrive, K1DG and N2NT make a local 80 meter contact at 2254 UTC, but conclude the band is not open for DX yet; they return 44 minutes later. Others start tasting the band during the 2300 UTC hour, with DL6FBL and DL2CC last to arrive at 0008 UTC. Only N6MJ and N2NL stick with the band long enough to build a significant multiplier total by 0100 UTC, perhaps sacrificing valuable time on 40 meters.

Having stuffed their log with QSOs from the declining 20 meter band and being last to leave, 40 meters now represents new territory to VE3EJ and VE7ZO. This team rebounds up the ranks. At 0010 UTC, a quick detour to 80 meters adds enough multipliers to lift their score above K1DG and N2NT to regain second place. At this moment not only does the *CTWIN* HQ multiplier bug crash the Canadians' logging computers again, but also 80 meters turns out to be "hot:" not with contacts, but with RF in the shack. Stray pickup causes the computer to alter past data in the log! The Canadians flee back to 40 meters. John believes no QSOs were lost, but reduced transmitter power does not encourage attempts to run the band. After sunrise the next morning, they discover one leg of the 80 meters trap inverted V touching the tower's top guy wire, very likely the cause of RFI back in the shack.

Table 8 also shows DL6FBL and DL2CC struggling, with a serious deficit on 40 meters. Having arrived on 40 meters at 2204 UTC, rather later than most teams, the Germans discover a high, varying SWR on the 40 meter beam during transmission. After the end of a transmission, received signals briefly seem ok but then degrade many dB. The running operator returns to 20 meters for a bit; the other operator finds no obvious problem. The host climbs the tower to look for trouble and the team stops sending at 2340 UTC to allow for testing. The host discovers a hot-to-the-touch PL-259 connection between the feed line and antenna. No easy repair seems possible, so the station gets back on the air at 2356 UTC. Forty meters will prove a struggle for the remainder of the night. This, in combination with S9 static crashes on 80 meters, portends a long, slow and frustrating night for the team.

YT6A and YT6T finally touch their lowest point in the standings. Together with the Germans, their multiplier total stands well above what one would expect from their relatively low raw QSO numbers. With radios now on different antennas, they continue to mine the dregs of 20 meters in parallel with a good 40 meter run and start creeping up on the Germans.

UT5UZ and UT5UGR continue to fall behind on multipliers, now 40 multipliers behind the leaders. Their raw QSO totals in Table 8 remain higher than any other team, a few dozen ahead of the current first and second place teams, and at least 75 ahead of the rest of the gang.

By 0100 UTC, on the strength of their multiplier totals, N6MJ and N2NL accrue a commanding lead in score. Although VE3EJ and VE7ZO stand in second place, 133 equivalent-QSOs separate them from the leaders. K1DG and N2NT continue to dog the Canadians, 18 equivalent QSOs behind.

Time of first 80 meter QSO	*Team*	*80 meter QSOs before 0008 UTC*
2254 UTC	K1DG and N2NT (first QSO)	see text
2316 UTC	N6MJ and N2NL	+11
2338 UTC	K1DG and N2NT (second QSO)	+ 7
2341 UTC	9A8A and 9A5K	+ 9
2354 UTC	YT6A and YT6T	+ 5
2356 UTC	UT4UZ and UT5UGR	+ 6
2357 UTC	IK2QEI and IK2JUB	+11
0000 UTC	VE3EJ and VE7ZO	+ 5
0008 UTC	DL6FBL and DL2CC	—

Figure 2

Table 9

Standings at 0300 UTC, and QSOs and multipliers worked during the preceding two hours. In each column bold highlights the largest entry.

	At 0300UTC			*e-QSOs behind*	**QSO/mult worked during 0100–0300UTC**				
Team	*Points*	*QSOs*	*Mults*	*next team*	*80m*	*40m*	*20m*	*total*	*e-QSO/hr*
N6MJ and N2NL	**1,518,230**	1680	**205**	—	**15**/2	72/7	5/1	92/10	76.7
VE3EJ and VE7ZO	1,430,130	1677	190	-103.3	3/1	59/10	**13**/**5**	75/16	92.1
K1DG and N2NT	1,413,030	1621	201	-19.6	13/4	81/8	1/1	95/13	88.8
9A8A and 9A5K	1,364,868	1624	186	-218.8	9/**7**	66/5	—	75/12	81.9
IK2QEI and IK2JUB	1,224,692	1497	191	-25.1	10/2	47/16	7/0	64/**18**	59.0
UT4UZ and UT5UGR	1,209,500	**1709**	164	-21.5	9/1	94/8	—	103/9	89.2
DL6FBL and DL2CC	1,117,452	1362	196	-112.2	8/2	77/**13**	1/1	86/16	58.7
YT6A and YT6T	1,055,954	1378	181	-70.8	11/4	**120**/6	4/1	**135**/11	**100.5**

Stasis: 0100-0300 UTC

Table 9 summarizes team performance during the next two hours, through which no changes occur in relative position. Each team generally focuses on 40 meters to Europe, with the occasional 80 meter QSO. Greg Cronin W1KM, with his four-square array in a Massachusetts salt marsh, claims the bottom spot on the band for his run frequency. He serves up the first 80 meter North American contact for six of these eight teams.

VE3EJ and VE7ZO make just one detour to 80 meters for a little S&P, but the RFI in the station does not encourage them to linger. Compared to other teams in Table 9, VE3EJ and VE7ZO did poorly on 40 meters. Attempts to run low in the band typically lasted just five minutes. Big-signal contest stations in North America and Europe, pointed at each other, probably dominated this band segment, making a weaker signal off the side from Brazil less noticeable and less able to hold a frequency. Nonetheless, VE3EJ and VE7ZO creep closer to the leaders on the strength of their new multipliers.

K1DG and N2NT keep pace with the Canadians and also gain on the leading N6MJ and N2NL. These top three teams open an enormous lead over the rest of the pack. The fourth place 9A8A and 9A5K falls to 219 equivalent QSOs behind K1DG and N2NT.

At the Italian team's site up on the northern coast, motors pumping salt water through their site's shrimp farm raise the noise floor on 80 meters to S9. The team uses the radio's noise reduction controls to limit the damage and stay very close behind the fourth place Croatians.

UT4UZ and UT5UGR and YT6A and YT6T shovel the largest numbers of contacts into their logs, but both teams log a disproportionately small number of new multipliers. Although UT5UZ and UT5UGR continue to maintain the overall lead in total QSOs, their very weak multiplier total keeps them far down in the standings.

Role of SSB

Overall, SSB plays a much smaller role in this WRTC compared to past events, and will figure even less in the hours to come on the lower frequencies. Multipliers count just once per band here in Brazil, not per band-mode (as in 2002 in Finland). The standings depend solely on points scored in the contest with no special consideration for balance between modes (as was the case in 2000 in Slovenia). As a result, one properly switches to SSB for a strictly tactical reason: because the equivalent QSO rate, right now, is momentarily better than on CW. At the end of the contest, the percentage of stations logged on SSB varies over a 2:1 range among these top teams (see Figure 3). Only DL6FBL and DL2CC will log more than one contact on 80 meters SSB. The emphasis (or lack thereof) on SSB appears uncorrelated with the final standings.

Winning Recovery: 0300-1000 UTC

Local midnight brings a nearly full moon high overhead, setting the scene for two tremendous comebacks.

Minutes before 0300 UTC, VE3EJ and VE7ZO tie for second with K1DG and N2NT, both teams trailing –6 percent behind the score of N6MJ and N2NL. Seven hours later, the Canadians stood 7 percent ahead of N6ML and N2NL, dramatically moving forward. What happened?

Table 10 lists the contacts and multipliers made by each team during this period. The reason for the change in ranking of VE3EJ and VE7ZO, together with YT6A and YT6T, becomes obvious: these teams work significantly more contacts than the rest of the competition, and N6MJ and N2NL simply come up short. Only N6MJ and N2NL's large lead at 0300 UTC and the similar weak performance of the #3 team, prevent a further collapse in the standings. Why did these excellent operators perform so differently from others? Table 11 hints at some answers.

The top team in this list, YT6A and YT6T, spends far more time running than the other teams. They collect about a third of their 501 contacts from 80 meter runs. On 40 meters, this team sticks to the middle of the CW band, spending 2.5 hours at the start of the period on 7021 kHz, and later returning for another 1.75 hour streak. During runs, the operators interleave contacts with new multipliers and ordinary stations on other bands. These 44 interwoven contacts far exceed those of other teams. These operators find just two QSOs by S&P. All these contacts include a greater proportion of five point DX, which together with 29 new multipliers, lifts them from far down the standings to fifth place. Soon, at 1018 UTC, this team will briefly pass the Italians to become fourth. Over the past 11 hours, this team has made a tremendous recovery, mastering their QSO interleaving technology. They will finish the contest third in total contacts after deductions — an outstanding result Considering their heavy deductions for uniques and errors (representing 4.5 hours of operating time at the end of the contest).

For the Canadians, 40 meters provides almost all of their 511 contacts. VE3EJ and VE7ZO runs 7016 kHz for about 1.5 hours, but the majority of streaks show that a single frequency supports a run for just 5–10 minutes. Like the YT team, these operators avoid the bottom part of the 40 meter CW band. Unlike the YT team, the Canadi-

Team	*80 meters*	*40 meters*	*20 meters*	*15 meters*	*10 meters*	*All Bands*
VE3EJ and VE7ZO	—	13%	34%	44%	49%	31%
N6MJ and N2NL	1%	10%	17%	33%	8%	20%
K1DG and N2NT	—	9%	31%	41%	6%	25%
UT4UZ and UT5UG	1%	7%	32%	36%	9%	23%
IK2QEI and IK2JUB	<1%	11%	39%	24%	27%	22%
DL6FBL and DL2CC	<1%	6%	26%	51%	13%	27%
9A8A and 9A5K	—	17%	49%	58%	1%	40%
YT6A and YT6T	—	3%	59%	11%	15%	18%

Figure 3

Table 10

Standings at 1000 UTC, and QSOs and multipliers worked during the preceding seven hours. In each column bold highlights the largest entry.

	At 1000 UTC			*e-QSOs behind*	**QSO/mult worked during 0300–1000 UTC**				
Team	*Points*	*QSOs*	*Mults*	*next team*	*80m*	*40m*	*20m*	*total*	*e-QSO/hr*
VE3EJ and VE7ZO	**2,118,096**	**2184**	216	—	53/10	**454**/15	1/1	508/26	72.5
N6MJ and N2NL	1,973,340	1987	**228**	-145.8	49/11	258/12	—	307/23	41.3
K1DG and N2NT	1,812,456	1953	216	-173.4	81/8	245/6	6/1	332/15	45.4
IK2QEI and IK2JUB	1,736,217	1886	217	-82.8	113/12	264/13	14/**13**	391/26	53.5
YT6A and YT6T	1,695,540	1880	211	-45.2	**131**/15	369/14	1/1	502/**29**	**74.4**
DL6FBL and DL2CC	1,683,584	1715	224	-12.2	73/15	280/13	—	353/28	49.9
9A8A and 9A5K	1,663,038	1836	208	-22.7	41/8	263/13	3/2	307/22	43.2
UT4UZ and UT5UGR	1,635,270	2085	183	-35.4	53/9	324/10	—1	377/18	53.7

Table 11

Team running time and other metrics during 0300-1000 UTC, ranked in order of average equivalent QSO per hour rate. In each column, bold highlights the largest entry.

Team	*0300-1000 UTC e-QSO/hour*	**Time (h:mm) spent running** *80m*	*7000-12.5*	*7012.5-25*	*>7025*	*SSB <7100*	*SSB >7150*	*total*	*Change in rank*	*% S&P*	*% Interleave*	*% Run*
YT6A and YT6T	**74.4**	**1:43**	0:17	**4:11**	—	0:08	—	**6:19**	**> 8 → 5**	0.4	**8.8**	90.8
VE3EJ and VE7ZO	72.5	0:17	0:08	2:27	0:57	**0:48**	—	4:37	2 → 1	10.6	0.8	88.6
UT4UZ and UT5UGR	53.7	0:29	0:08	0:23	2:41	0:02	0:03	3:46	6 → 8	14.0	3.2	82.8
IK2QEI and IK2JUB	53.5	1:22	0:13	2:14	—	0:04	0:05	3:58	5 → 4	15.4	1.3	83.3
K1DG and N2NT	45.4	0:14	1:18	0:37	0:46	—	0:07	3:02	3 → 3	**32.9**	5.4	61.7
DL6FBL and DL2CC	49.9	0:56	0:33	1:38	1:02	0:18	—	4:27	7 → 6	5.1	2.8	**92.1**
9A8A and 9A5K	43.2	0:19	—	—	**3:23**	0:10	**0:38**	4:30	4 → 7	11.9	—	88.1
N6MJ and N2NL	41.3	—	**2:13**	1:05	—	0:16	0:08	3:42	1 → 2	15.0	2.3	83.7

ans interleave just four contacts, switching to S&P for 54 QSOs, and thus reducing their total run time. After getting burned with RF on 80 meters altering log data earlier in the evening, at 0555 UTC VE3EJ and VE7ZO reduce power and eek out one short run on that band.

Two other teams, despite spending about the same amount of running time as the Canadians, do not score nearly as well. 9A8A and 9A5K run mostly in the higher parts of the 40 meter CW and SSB bands, eschewing interleaving any contacts. Around 0500 UTC, static crashes begin annoying the operators. Within an hour, the crashes reach S9+20 dB. Another two noisy hours elapse before the rain begins. Once the wind hits at 0813 UTC, the 80 meter dipole stopped working. While 9A8A moves to run 40 meters, 9A5K tries not to think about the exposed lighthouse location — and dashes out into lightning and pouring rain to repair the broken leg of the antenna. A few minutes later he rushes back outside again to fix a fresh break in the other leg. Twenty five minutes later, the team is back on a very noisy 80 meters, picking up two more needed multipliers.

This behavior illustrates Chris, ZS6EZ's "Philosophy of Workload Management," as articulated back at WRTC2002 in Finland. Chris explained that errors (e.g., logging calls or exchanges incorrectly, or overlooking a declining rate) increase as the operator's workload goes up. Poor technology (awkward logging software, complicated band/antenna changes) increases the operator workload. Equipment or antenna failures increase workload. Most operators first attempting SO2R find a horrible increase in logging errors while they go through a process of training, station debugging and workload simplification. **Lesson**: *Good technology reduces operator workload, which leads to improved performance.*

For Chris, an aircraft pilot training exercise on simulators drove home this workload-management message in a second way. The simulator presented a two-person team (captain and copilot) with an escalating series of weather problems, engine failures, electrical faults and so on. In one team, the more experienced pilot, the captain, took the controls and attempted to deal with the mounting crisis; they narrowly averted a (simulated) disaster. In a second team, the captain immediately asked his copilot to fly the aircraft. By reducing his workload, the captain had opportunity to sit back, review options and determine the best course of action.

In their storm, 9A8A and 9A5K behave like the second captain and copilot. One operator immediately focuses solely on the task of flying the crippled station (keep filling the log with new contacts), while the other debugs and repairs the problems. Other good teams had thought about critical parts of their stations in advance and developed contingency plans for potential problems in these areas.

DL6FBL and DL2CC spend half of their 40 meter running time in the bottom and upper parts of the 40 meter CW band. As the two teams from the USA demonstrate, the bottom of the 40 meter CW band produces relatively slower rates than the middle. Occasionally the S9 noise on 80 meters disappears for 15 minutes or so, and the team hops down to run some stations. Unfortunately, these quiet periods did not occur early enough for the European opening on this band. On 40 meters, the band quiets in time for many juicy Pacific multipliers to call in.

UT4UZ and UT5UGR spends less time running than the Germans, but spend it in the rich middle of the 40 meter CW band and interleave other contacts. The longest run lasts 1.5 hours on 7039–40, yielding 196 stations after dupes and errors. Their rank improved by two positions as a result. Like the Canadians, RF in the shack causes some troubles. More significantly, Radio B fails completely during the night. The team, with permission, substitutes an Elecraft K2.

In contrast, N6MJ and N2NL never run longer than 47 minutes on a single frequency and did not run 80 meters at all. Dave, N2NL, will report: "Our station was good to Europe but only average to stateside… We simply weren't able to get anything going during this time on 40 meters or 80 meters, regardless of our location in the band. N6MJ was concerned during the S&P times that we should be CQing more, and I agreed, but our rate [was higher with S&P]. We truly struggled to work anything on 80 meters during this period, and as an afterthought, a higher SWR I noticed during this period may have been evidence that we had blown out one or both of the 80 meter loading coils since we were working stuff fine earlier in the evening."

K1DG and N2NT's log also shows many gaps between runs, and just one run spans 36 minutes; all other runs last 26 minutes or less. A plausible explanation may be the choice of frequencies low in the CW band. USA CW contesters with Amateur Extra class licenses and accustomed to keying domineering signals from the northeast states habitually crowd into the bottom of 40 meters for runs. That strategy works well from home (catching European operators as they first start to tune up the band). But in Brazil, sitting to the side of the North America-Europe path, with –3 dB lower power and lower antenna gain on 40 meters, a run frequency very low in the band appears statistically less productive. The competition for spectrum space from louder signals seems a plausible explanation. Later at night and after 40 meters closes to Europe, a low-in-the-band run frequency could experience less interference, but still exclude replies from USA contesters with license limitations.

Some of the operating patterns just described correlate with the differences in performance. While correlation does not prove cause, plausible explanations exist for these correlations. Yet most of these patterns have exceptions: teams who deviate from the implied "productive operating practice."

- Teams which call CQ continuously, with only brief interruptions (a minute or less) to work a station spotted elsewhere, perform significantly better. During very slow periods (such as the 0800 UTC hour in this WRTC), low-productivity CQing often feels like the wrong thing to do. When teams only S&P, they fall behind. Exception: the Canadian team spends the 0800 UTC hour S&Ping alternately on 40 and 80 meters, yet performs very well overall.

- Successful teams with faster runs spend more time running in the middle of the 40 meter CW band or even above 7025 kHz. Exceptions: Table 11 shows DL6FBL and DL2CC spend more time than the Italian team in these parts of the 40 meter CW band with inferior results. 9A8A and 9A5K fare even worse despite 3.5 hours running on 7034 and 7027. Note that the Germans suffer a problem with their 40 meter antennas, and thunderstorms with high static levels occur at the 9A site, probably bigger influences on results than choice of run frequency.
- Teams that spend significant run time below 7012.5 kHz on 40 meters CW experience shorter runs and poorer productivity. Exceptions: none!
- Split frequency 40 meters SSB run frequencies below 7100 kHz work better than calling CQ up above 7150 kHz. For example, VE3EJ and VE7ZO ran 32 minutes on 7070 kHz for 68 QSOs. As on other bands, SSB frequencies fizzle quickly, requiring operators to move often. Exception: none!
- Teams that interleave ordinary and new multiplier QSOs from other bands while running produce better results. Exceptions: VE3EJ and VE7ZO don't bother with much interleaving, and neither do IK2QEIM and IK2JUB. One wonders how these teams would have fared if they had included this tactic.

The VE and YT teams' locations may just work better on 40 meters for reasons that have nothing to do with the operators or the antennas. In the weeks following the WRTC, more information about local geography will become available. Dean Straw, N6BV, will circulate some interesting antenna pattern comparisons with his HFTA tools. While location and technology do not guarantee good results, excellent operators in excellent locations become formidable competitors.

Final sprint: 1000-1200 UTC

At 1000 UTC, N6MJ and N2NL lag a distant 146 equivalent QSOs behind the Canadians. Unless lightning, power or equipment failure take VE3EJ and VE7ZO off the air, the Canadians have locked up first place.

Similarly, N6MJ and N2NT lead K1DG and N2NT by 174 equivalent QSOs. Second place also seems locked up.

If the teams could see each other, K1DG and N2NT would need only to glance over their shoulder to see IK2QEI and IK2JUB 83 equivalent QSOs behind, a rather narrower margin. YT6A and YT6T pursue the Italians with a gap of 47 equivalent QSOs; DL6FBL and DL2CC follow closely, then 9A8A and 9A5K and UT4UZ and UT5UGR at 143 equivalent QSOs behind the Italian team. The sun pops above the eastern horizon. Every team faces the decision of when to move to 20 meters. Their choices yield important insights to the proper handling of the abrupt transition from nighttime to daylight propagation.

Table 12 summarizes how each team performed during the last four half-hour segments of the contest. The table lists teams in order of their final band change to 20 meters. 9A8A and 9A5K leave 40 meters for good at 0957 UTC. They move too early, logging 14.9 equivalent QSOs during the next 30 minutes, an inferior rate compared to teams still back on 40 meters. Unfortunately, they have just spent over an hour on 80 meters as that thunderstorm ended, working just one contact in the last 45 minutes. The slow rate on 20 meters probably felt exhilarating after all that static and dead time. It's not clear why this team didn't return to 40 meters around 0925 UTC, when 80 dried up. This tactical error drops them from #6 to #7 during the 0900 UTC hour. Their excellent 20 meters SSB run during the final hour allows them to hang on to seventh for the finish. **Lesson**: *When changing running bands, don't skip a band. Move to the next adjacent band for at least five minutes (long enough to get spotted) to get a feeling for the available rate.*

IK2QEI and IK2JUB make an even earlier attempt to run 20 meters, starting at 0943 UTC, in accordance with their strategy to be on the highest open band during daylight. An unproductive SSB running attempt precedes a CW rate that exceeds even earlier efforts on 80 meters. This team does stop for five minutes on 40 meters on their way to 20, but only for S&P. As discussed earlier, S&P does not reliably indicate running productivity on a band. Their SSB run on 14243 dries up after 15 minutes, so they try CW on 14019 for perhaps five minutes and then revert to 40 meters. Tasting 20 meters SSB and CW run frequencies, finding the rates slow, and continuing on to run 40 meters CW on 7016

Table 12

Team performance and run frequencies during 1000–1200 UTC. An "*" indicates the team checks 20 meters, making at least one QSO before returning to 40 meters. Bold highlights the time when the team makes its final switch to 20 meters. An equivalent QSO ("e-QSO") is one of average point value for the team; see Annex I for details.e-QSOs, mults and run frequencies for 30 minutes beginning:

Team	*1000 UTC*	*1030 UTC*	*1100 UTC*	*1130 UTC*	*1000-1200 UTC e-QSOs/mults*	*Change in rank*
9A8A and 9A5K	14.9/4 **0957 UTC** 14025	43.5/5 14025, 14203	61.2/5 14214	58.8/3 14214	178.4/17	7 → 7
UT4UZ and UT5UGR	35.5/6 7026	60.9/7 **1030 UTC** 14026	61.9/9 14162	53.1/2 14026	218.6/24	8 → 4
K1DG and N2NT	23.3/4 *7000	29.6/2 **1035 UTC** 14009	56.7/4 14009	65.1/4 14226, 14022	174.8/14	3 → 3
DL6FBL and DL2CC	39.6/4 7007	27.9/5 **1042 UTC** 14001	49.2/4 14001	48.9/3 14002	165.5/16	6 → 6
N6MJ and N2NL	55.4/3 7008	37.8/4 **1044 UTC** 14003	61.5/4 14002, 14243	70.0/2 14243, 14004	224.7/13	2 → 2
VE3EJ and VE7ZO	40.2/3 7016 *7022	36.9/3 **1053 UTC** 14186	49.0/4 14186, 14211	56.5/3 14221	182.6/13	1 → 1
YT6A and YT6T	41.2/3 7001	29.3/2 7024 **1059 UTC** 14251	44.3/4 14251	33.1/3 14251	147.9/14	5 → 11
IK2QEI and IK2JUB	11.8/5 (0943 UTC) 14243 14019, 7016	18.4/3 7016 **1058 UTC** 14234	63.4/6 14234	49.9/2 14234, 14015	145.3/16	4 → 5

are reasonable decisions. Once settled on 40 meters at 1020 UTC, however, the team doesn't pay attention to the decline in 40 meter rate 10 minutes later. It took a further 10 minutes of declining rates (now 1030 UTC) before the team switches to search and pounce — on 40 meters.

Stefano, IK2QEI, later explains their thinking: "During the morning we made a big mistake. We spent too much time to try with Japan on 40 meters but our signal was not strong (I think) and the pile up never started. We missed a lot." Eventually the team grabs a 20 meter run frequency at 1100 UTC, and the equivalent QSO rate jumps by a factor of six! The delay in returning to 20 meters costs this team one position in the final standings. **Lesson**: *If an anticipated band opening has not yet materialized to a productive level, and you revert to a back-up band, don't linger on the back-up band. At sunrise and sunset, and for a band expected to open only marginally (e.g., 10 meters at this time of the sunspot cycle), be absent for no more than 10–15 minutes.*

K1DG and N2NT run 80 meters CW but check 40 meters at 0940 UTC. Rates on 40 meters are about the same as 80. After 15 minutes on 7034, the team tries running 14009 but makes just three contacts in five minutes. As the final two hours of the contest begin, a dry spell on 20 meters pushes them back to 40 meters (7000 kHz) exactly at 1000 UTC for a better squirt, but rates fall off after 1015 UTC. One operator interleaves S&P contacts from 20 meters, but the run operator doesn't move to 14009 until 1035 UTC, whereupon a steady run materializes. Perhaps the team would experience a faster 20 meters run above 14025, where more USA contesters could call them. In any event, an earlier running attempt on 20 meters around 1020 UTC, after the 40 meters rate starts declining, would likely produce more contacts for the log.

A good decision by the Ukrainians vaults them from eighth to fourth place during the last two hours. The Ukrainians have spent the 0900 UTC hour searching and pouncing 80 and 40 meters simultaneously, but strangely not calling CQ. Performance by this team perks up substantially at 1000 UTC when one operator starts running 7006 kHz very effectively while the other pounces on occasional stations on 20 meters. The team makes the final jump to 20 meters at 1030 UTC; a good run on 14026 forces the rate meter even higher. Rather poor in multipliers, the team gathers some additional multipliers on both bands. This, together with good timing and frequency choices, leads to a strong finish. Well done!

By a slight margin N6MJ and N2NL make the most of the last two hours. The low end of 40 meters produces many JA and USA contacts during 1000–1030 UTC, but at 1025 UTC the rate starts to fade. The second operator had picked up a 20 meter multiplier a few minutes before, and the team contemplates a band change. At 1030 UTC, the 40 meter rate fades rapidly, and the second op scores two more multipliers on 20 meters SSB. The team moves to 14003 at 1044 UTC and the rate meter takes off. Shortly thereafter, the frequency becomes unproductive and, after five minutes fighting interference with only two contacts, the running op slides down 1 kHz. The rate triples. On the next rate meter fade the men jump to an SSB run frequency, returning back a half hour later to CW when SSB fades. Very well played, indeed. **Lesson**: *A sudden drop in rate suggests interference to your run frequency; check and take corrective action.*

VE3EJ and VE7ZO come off a ten minute S&P session on 80 meters (remember they use reduced power on this band to counteract RFI) at 0942 UTC to do further S&P on 40 meters. After five minutes, 7016 is established as a running frequency and the rate meter inflates. The meter crests at 0955 UTC as the final two hours begins and in the next 15 minutes declines to half of its peak value. Time to change bands? Five minutes on 14007 produces three contacts, so the running operator returns to 40 meters on a different frequency at 7022. Rich in JAs and far more productive than 20, this run's new multipliers and contacts push the equivalent QSO rate above 330 at 1030 UTC. Shortly thereafter the rate crashes. Although 20 minutes had elapsed since the end of the last visit to 20 meters, the run operator elects to move to 7002 instead of checking 20 meters again. Another string of JAs follow on 40 meters, but the operator misses the greater rates other teams enjoy on 20 meters during the remainder of the 1000 UTC hour. In no danger of losing first place, the team simply surrenders some of its lead to the second and third place finishers. However, in a tighter race (as seen at other WRTC events), this delay could have more serious consequences.

Every contest has great stories, and WRTC is no exception. Twelve minutes before the end of the contest Ben, DL6FBL, running 20 meters CW at 14002 kHz, says to Frank, DL2CC, "We're still missing zone 10 on this band." Frank replies, "Don't worry. XE1NW is always late." One minute later, XE1NW calls in for the last multiplier of the contest.

That's it: contest over. The teams have ten minutes to get those logs into Cabrillo format and into the hands of the referee. Then we'll head back to Florianopolis. The referees will turn in the logs to the judging committee, and we'll all gather around the beer kegs to swap stories and lessons. One common story: the difficulty of sustaining any kind of run on SSB. I've heard that story at every WRTC so far this century!

Lessons Learned

Before the contest

• At an unfamiliar location with limited remaining daylight hours, check and repair the antennas first!

• Unforeseen gremlins can undo complex equipment configurations. Make fallback and recovery plans in advance.

• Good technology reduced operator workload, which leads to improved performance. Bad technology increases workload, which increases operator errors. Choose only good technology.

Running

• If you are not running an existing pileup, call CQ with transmissions long enough to be noticed by almost every station tuning up the band, typically longer than the time spent listening for a reply.

• When replies dry up, try slowing down or sending longer CQ messages.

• Allow unanswered CQs for at least 2–3 times the interval between contacts at the hoped-for rate, before abandoning a frequency as too unresponsive.

• When the rate fades, take immediate action.

A sudden drop in rate suggests interference to your run frequency; check and take immediate corrective action.

Changing bands

• When changing running bands, don't skip a band. Move to the next adjacent band for at least five minutes to get a feeling for the available rate. This is especially important when propagation changes rapidly; e.g., at sunrise and sunset.

• You must call CQ to determine if a marginal band, or one expected to open very soon, is now open for you.

• If a marginal band, or one expected to open very soon, appears closed now, check again in 10–15 minutes.

• If an anticipated band opening has not yet materialized to a productive level, and you revert to a back-up band, don't linger on the back-up band. Be absent for no more than 10–15 minutes.

General

• Don't get fooled by simple rate meters. Measuring equivalent-QSOs per hour takes into account QSO point values and new multipliers.

• Log very carefully. Contacts deleted and penalties triggered by logging errors equate to switching off the radio before the end of the contest.

• When passing a multiplier, check log entries even more carefully.

• Never give up! What you do in the next few minutes may improve your finishing position.

• Every rule has its exceptions (including this one!). If you decide to break a rule, know why you are doing it. Watch closely for the impact of your decision, and switch strategies promptly if equivalent-rate declines.

Acknowledgments

Thanks to these people who were interviewed for this story, each of whom provided valuable insight to the events or reviewed the drafts: Chris Kovarik, 9A5K; Frank Grossman, DL2CC; Bernd Och, DL6FBL; Roger Weston, G3SXW; Don Field, G3XTT; Stefano Brioschi, IK2QEI; Doug Grant, K1DG; David Sumner, K1ZZ; Ward Silver, NØAX; Andy Blank, N2NT; David Mueller, N6MJ; Phil Goetz, N6ZZ; "Tree" Tyree, N7TR; Atilano Oms, PY5EG; Thomas Carlsson, SMØCXU; Yuri Onipko, UT4UZ; John Sluymer, VE3EJ, and Ranko Boca, YT6A.

I take responsibility for the opinions expressed here and for all errors. See you in the next contest!

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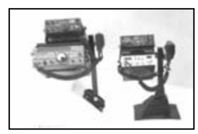

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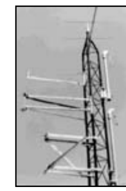
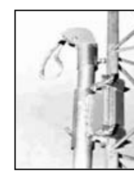


Standoffs and Gin Poles

Climbing Steps



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Some Reflections on WRTC 2006—Part 1

Dean Straw, N6BV, Team Leader at PT5J (with Mark Obermann, AG9A)

First, I want to thank the Northern California Contest Club for nominating me as Team Captain for one of the two US National WRTC teams. This type of team was designed to honor the host countries and organizing committees from previous WRTC events. For the US the first WRTC was held in Seattle in 1990, and the second WRTC was held in San Francisco in 1996. (There were also National WRTC Teams from Slovenia and Finland, where WRTCs were held in 2000 and 2002, respectively.)

Because of the way qualifications were ranked for selection to WRTC 2006, frankly I wouldn't have been able to qualify on my own. Most of the contests I have operated since I returned to the Bay Area in 1998 have been at multi-multi operations out at N6RO's place. Single-operator, all-band scores counted more for WRTC 2006 qualification.

Same Playing Field

WRTC has been billed as "the ham radio Olympic Games," a way of determining the best operators in the world, using a level playing field. From the official Web site for WRTC 2006:

"The World Radiosport Team Championship — WRTC in short — represents a large gathering of the world's best in radio traffic — as selected Regionally — coming from some 35 different countries and all continents in the spirit of competition, using the same playing field and allowing pure skills to determine world champions in two-man team, 24-hour nonstop competition in Florianopolis, the state of Santa Catarina, Brazil."

In my opinion, the organizers in Brazil did an absolutely amazing job trying to reach the goal of "same playing field." They set up 47 identical, brand-new antenna installations with towers, log-periodic 20/15/10 meter beams, 2 element 40 meter beams and 80 meter loaded dipoles at each of the stations. As best they could, the Brazilian organizers tried to ensure that the stations were located with clear shots to the major population areas for the contest — Europe, the USA and Japan.

The organizers put in a truly mind-boggling amount of time and effort. They placed many stations at existing ham locations, as might be expected. But they also negotiated with city and national authorities to put many other stations at completely new locations. For example, my partner Mark Obermann, AG9A, and I enjoyed the facilities at a research facility that studied aquatic life (shrimp, shellfish and fish). This site had never seen a ham radio installation before. But there we were, with a brand-new 50 foot high tower, loaded with shiny new antennas and rotator.

Other WRTC 2006 stations were located in city parks, and many stations were located at the houses of non-hams, somehow recruited to allow a large amount of antenna hardware to be placed at their residences. And each house was taken over by two "Type-A" contesters and a referee for 24 hours!

The Brazilian organizers also worked tirelessly with the local electrical power company in Florianopolis to minimize power-line noise at each location. Even so, some stations experienced very bad local power-line QRN during the actual competition. My understanding was that some of the noise came from defective streetlamps that started arcing when they turned on after nightfall. Arcing streetlamps would not have been noticed when the local electrical crew was out to replace defective insulators or pole hardware — during the daylight hours.

Now, let me emphasize that to the extent that everything wasn't perfect — that the playing field wasn't precisely level for everybody — is not a reflection of any lack of effort on the part of the Brazilian organizers. I can't even begin to imagine the amount of effort they put into making this WRTC 2006 successful. The amount of time spent negotiating — and implementing — such arrangements had to be incredible. Kudos to the PYs!

Summary of the Final Results

Table 1 summarizes the results for the Top Four WRTC 2006 stations, along with the 31st ranked station, operated by my partner AG9A and myself. More later on the results for this lower ranked station. Note also that I could not get exact latitude/longitude locations for many of the other WRTC 2006 stations.

The top-ranked station, PT5M, outdid the competition in terms of total QSOs, while still maintaining a competitive multiplier total. The second team, PW5C, apparently placed more emphasis on

Table 1

Rank	Station	Operators	Total QSOs	Total Mults
1	PT5M	VE3EJ, VE7ZO	2369	230
2	PW5C	N6ML, N2NL	2200	241
3	PT5Y	K1DG, N2NT	2124	230
4	PW5X	UT4UZ, UT5UGR	2304	204
31	PT5J	N6BV, AG9A	1736	181

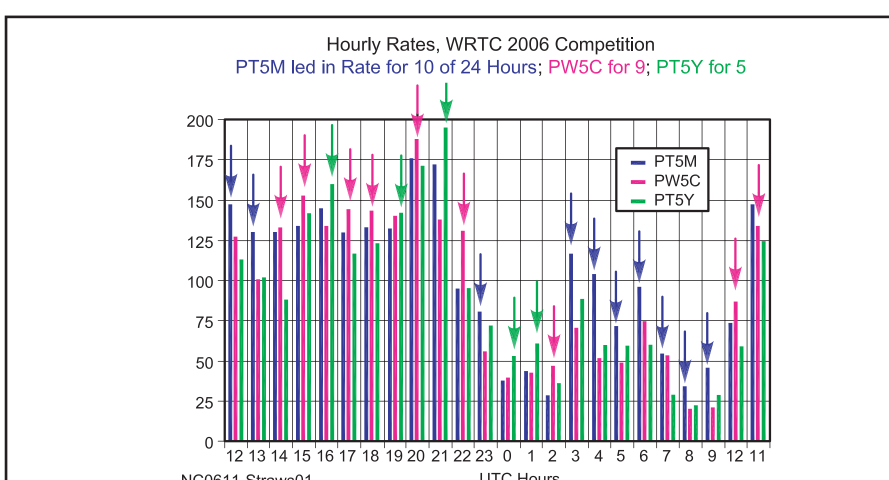


Figure 1—Hourly rates for Top Three stations in WRTC 2006. Note that PT5M led in rate for 10 hours out of the 24 hours in the contest; PW5C for nine hours; PT5Y for five hours. Obviously, rate rules!

multiplier hunting than raw QSO rate, although they also had a large QSO number. The challenge for any "morning-after" analyst is to try to separate the effects of:

- Operator skill
- Station design
- Station terrain
- Multiplier strategy
- Rate strategy
- Other problems (noise, perhaps)

For example, Figure 1 shows the hourly rates over the whole 24 hour WRTC 2006 contest for the Top Three stations. PT5M had the best rate for 10 out of those 24 hours. Second-ranked PW5C led for 9 hours, while third-ranked PT5Y led for 5 hours. Figure 1 would seem to indicate that a strategy of going primarily for rate was the winning approach. For example, you might expect that sitting on a frequency running rate calling CQ would bring in many multipliers, but not necessarily! More on this later.

Figure 2 is a bar graph showing the total QSOs on each band, separating the geographic targets of Europe and USA/Canada. Here it can be seen the PT5M team greatly dominated the other stations to the USA on both 40 and 15 meters while having a competitive QSO total to Europe on all the bands.

Many of you know that one of my favorite subjects in ham radio is trying to determine the effects of local terrain on the launch of HF signals. What I'd like to examine here is how the top results were related to having superior locations and how much were they related to strategy.

The Effects of Terrain: The Top Four Stations

When I discuss the following terrain analyses, I want to emphasize that I am not just sitting back, idly criticizing the hard work and the fantastic hospitality of our Brazilian hosts. But it is necessary to understand that the state of Santa Catarina, where Florianopolis is located, is a mountainous place.

Most of the stations used in WRTC 2006 were positioned on fairly narrow coastal plains, near the saltwater. Most QTHs that I examined were located at least some distance from the mountains, which were generally located inland from the coastal plains. (Yes, there were a few mountains right down at the seashore, but in general the mountains formed "backbones" inland.)

Figure 3 is a screen grab from *Google Earth* for a view of the PT5Y station and the area north of Florianopolis, viewed from the south. Here, the eye of the observer has been placed at 3000 feet above the ocean. This gives some 3D perspective to the terrain from PT5Y to Europe — a lovely downhill shot! In the direction of the USA there is a hill about 3000 feet from the tower.

With most of the stations I examined in this study, the most favored direction was toward Europe, although there were some notable exceptions where Europe was badly blocked (see later section on PT5G). Many of the shots toward the USA/Japan were at least partially blocked by inland hills. How badly those hills affected the antenna responses depended on the height of the hills and on how far they were away from the tower.

The rugged terrain and lush greenery in Florianopolis reminded me a lot of my own Hawaiian homeland. Setting up 47 exactly equal stations in KH6 would be a daunting task, let me assure you. In the following terrain analyses, particularly where a profile of a terrain is shown using HFTA (*HF Terrain Analysis*, the program included with the 20th edition of *The ARRL Antenna Book*), you should remember that the terrain profiles are purposely distorted to show as much terrain change as possible.

For example, Figure 4 overlays the terrain profiles from PT5M toward Europe (a heading of about 30° from southern Brazil) and also the terrain profile toward the East Coast of the US (a heading of about 340°). Each profile starts at the base of the PT5M tower, which was located at 3046 feet ASL (above sea level). The profile toward the USA drops down fairly uniformly (after the bump about 3000 feet from the tower base) to an altitude of 2750 feet at a distance of 12,891 feet from the tower. The terrain seems to fall off steeply in Figure 4, but in truth the slope is only –1.3°.

The slopes look steeper than what they really are because the x- and the y-axes for Figure 4 have different scales. The y-axis ranges from 3100 to 2730 feet, a change of only 630 feet, while the x-axis shows a change of 20,000 feet. This unequal scaling emphasizes the slope changes, and is a distortion that is purposely done in *HFTA*. Otherwise, graphing the terrain profile with equal x-axis and y-axis scaling would make the slopes look pretty much like almost horizontal lines,

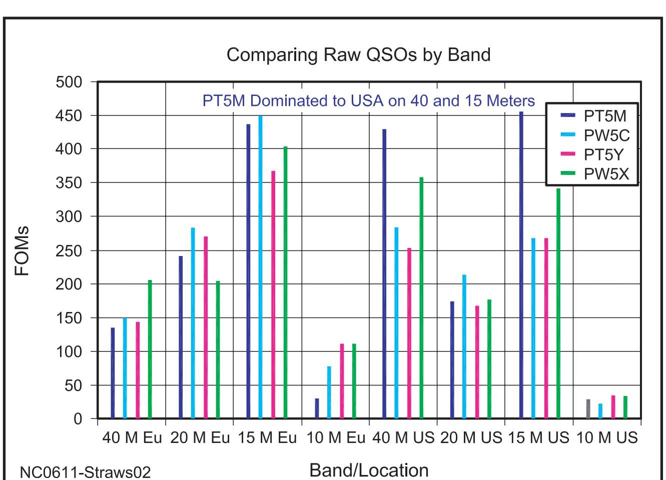


Figure 2—Comparing raw QSO totals by band for the Top Four stations in WRTC 2006. PT5M would appear to have had a significant competitive advantage toward the USA on both 40 and 15 meters, while remaining competitive into Europe on all the bands.

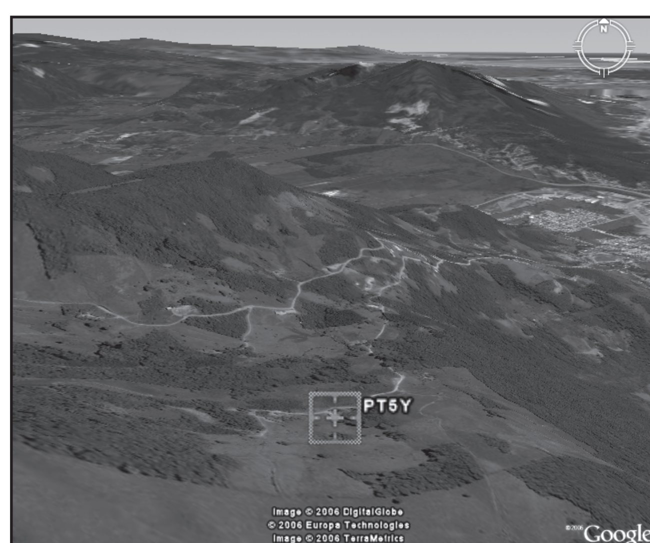


Figure 3—*Google Earth* view of the topography in the Florianopolis area. This 3D view is looking at the PT5Y QTH from the south. Note the lovely drop-off toward a heading of 30° toward Europe. There is a hill in the direction of the USA (340°), about 4000 feet from the tower base.

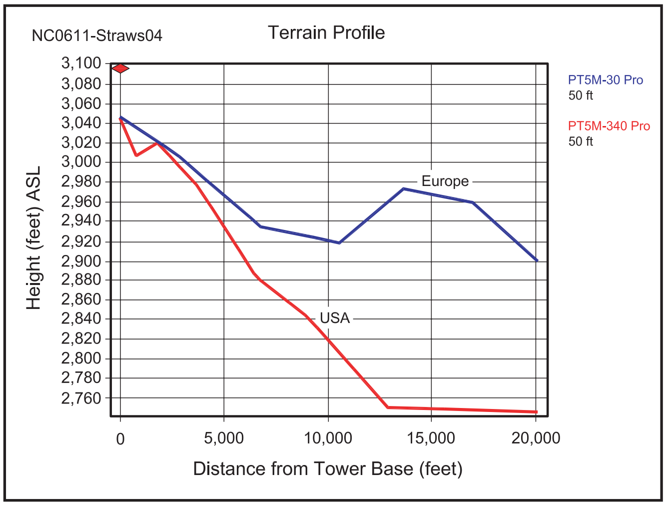


Figure 4—Terrain profiles toward Europe and toward the USA from PT5M. The ground slopes down in both directions but the slopes are only about 1° due to differences in the x- and y-axes in this *HFTA* graph.

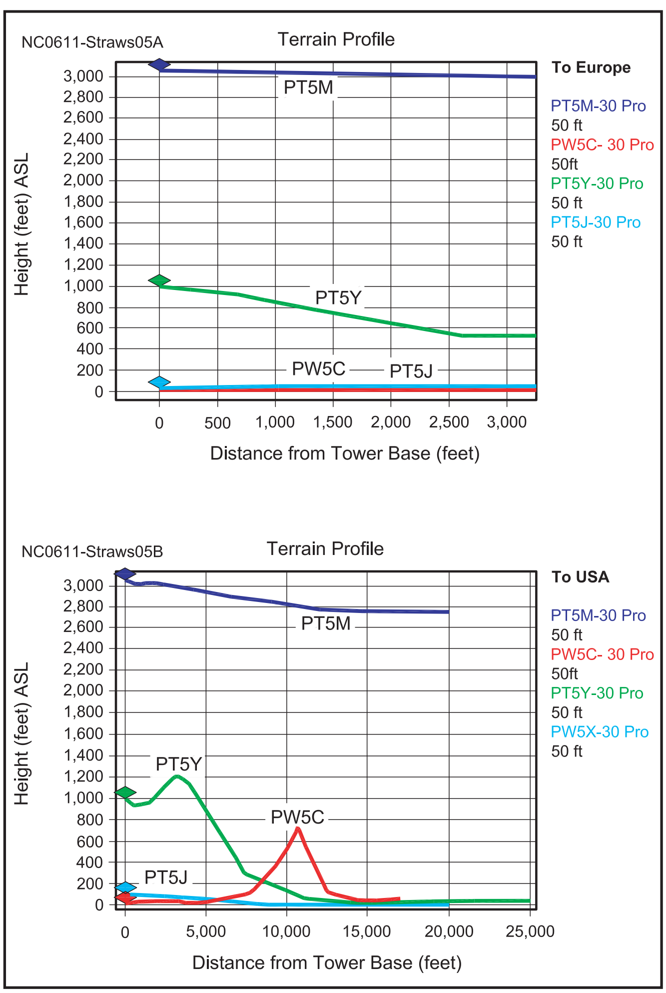


Figure 5—At A, a "true-perspective" view of the terrain profiles toward Europe from the Top Four WRTC 2006 stations, using equal scaling on both x- and y-axes. The PT5Y terrain slopes down such that the equivalent height of the tri-bander antenna on 15 meters was about 65 feet, compared to the actual physical height of 50 feet. At B, HFTA terrain profiles toward the USA.

with some very small squiggles in them.

See Figure 5A, which is a "true-perspective" view of the terrains toward Europe for the four top stations. The downward slope at PT5Y gave that station an "effective height" of 65 feet on 15 meters when the actual tri-bander was mounted at 50 feet (as were all the WRTC 2006 stations). Figure 5B shows a true-perspective view of the terrains toward the USA for the same stations.

Getting Terrain Data: *Google Earth*

For coverage of the USA, we Americans are blessed by having access to free digital terrain data on the Internet; this comes from the USGS (US Geological Survey). The theory is that in a democracy the data generated by the government should belong to the people in that democracy. Other countries look at things in a different manner, usually preferring to keep such data proprietary to their governments.

Thus, about the only source of reasonably accurate terrain data worldwide outside the USA is that captured by satellites (for example, LandSat or the Space Shuttle Radar Topography Mission). The data released to the public is less accurate, generally speaking, than the original survey data because of security concerns from other governments, and so as not to compete with paper topographic maps sold by these individual governments.

But the space-derived data will give you a reasonable idea of the layout of the terrain. Such data make it possible to read latitude/longitude and altitude at the crosshair of the mouse cursor using *Google Earth*. This is an incredible program with superb, and ever-expanding, capabilities. You'll need a fast Internet connection to use *Google Earth*, but you'll see the world in a different light once you start playing with this program. [Hint: Find and examine the pyramids at Giza, Egypt. You'll be amazed.]

And yes, you'll see altitudes in many areas of the world that don't look quite right — certain places near the shoreline around Florianopolis — places that are clearly in the Atlantic Ocean — can show altitudes as much as 20 feet high. This is obviously impossible — the only "hills" on the ocean are waves and these are, of course, transient. Figure 5B shows a conventional HFTA view of the terrains toward the USA for the same stations.

Generating Terrain Profiles Using *Google Earth*

Let's start by analyzing the terrains at the Top Four stations in WRTC 2006: PW5M, PW5C, PT5Y and PW5X. I used a utility program I wrote called *Range/Bearing* to compute range and bearing between two points entered manually from the

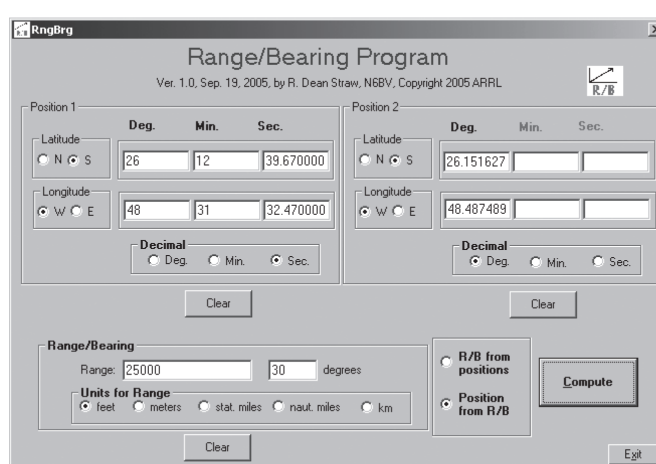


Figure 6—Screen shot of *Range-Bearing* program.

cursor positions using *Google Earth*. The first point was always the latitude/longitude of the tower for the station being analyzed, and the others were points along a radial line drawn from the tower base at the antenna heading of interest. From Florianopolis the heading toward most of Europe is 30° and toward the East Coast of the USA the heading is 340°.

The procedure was tedious, but it generated what I think are reasonable results. First, I computed the latitude and longitude for a point that was located 20,000 feet away from the tower base, at the desired heading. I used this as a target for the "Ruler, Line" function in *Google Earth*. See Figure 6, a screen grab of *Range/Bearing* for the location of the PT5Q station.

If there were tall mountains beyond a distance of 20,000 feet, I extended the evaluation distance to include them. The longest-distance line I used in all the WRTC 2006 analyses I did was 40,000 feet, and at that distance even 3000 foot hills had virtually no effect on the elevation-patterns computed by *HFTA*.

Once I generated a reference line at the desired heading from the tower base on the *Google Earth* display, I carefully moved the cursor along that line (pausing where significant changes in altitudes showed up) and wrote down the latitude/longitude and altitude for each such point. I used more points where the terrain changed rapidly, for example, in mountainous areas.

Finally, once I had a table of latitude-longitude-height data written down, I would type in the latitude/longitude information into *Range/Bearing*. I could thus compute the distances from the tower base for each altitude point. Then I used *Notepad* to enter the distance-altitude pairs beyond the tower base into an *ASCII *.PRO* file that *HFTA* could use. Whew… talk about labor intensive.

Each new station position required about 30 minutes to generate two *HFTA *.PRO* files, one toward Europe and one toward the USA. This was not a lot of fun, but I don't see many alternative methods to getting the data. So what kind of results came out of all this manual labor?

Results from HFTA

Figure 7 shows the 28 MHz computed elevation responses to Europe for the Top Four stations in WRTC 2006, along with an overlay of the range of elevation angles required from PY5 to all of Europe over the entire 11-year solar cycle. (The statistical elevation angle came from a special computation I ran for Florianopolis. Similar data for Rio de Janeiro is on the CD that accompanies the 20th edition of *The ARRL Antenna Book*.)

You'll note that the takeoff angles are generally quite low. This is due to the long distance to Europe from southern Brazil. Indeed, the statistical peak elevation angle is 1°, occurring some 16 percent of all the times when the 10 meter band is open between southern Brazil and Europe. The angles less than 5° account for 65 percent of the openings, statistically speaking.

Overlaid on Figure 7 is a table showing the number of 10 meter European QSOs made by each station during WRTC 2006. The number of QSOs is fairly small, so conclusions must necessarily be tentative — 10 meters wasn't open that much to Europe in July 2006, after all. But the calculated patterns suggest rather strongly that the PT5Y terrain should be superior to the other stations, as the terrain profile in Figure 5 suggests.

The computed "FOM" (Figure of Merit) for PT5Y is 12.5 dBi compared to PW5X at 9.9 dBi, a 2.6 dB difference. I use a rule-of-thumb that a new layer of weak signals is opened up for every 2 dB increase in signal strength. I'll deal more with FOM comparisons later.

By itself, the QSO data doesn't pinpoint the reason why PW5X had the same number of QSOs as PT5Y, while having what looks like a less potent signal into Europe on 10 meters at low takeoff angles; however, PW5X might have made a strategic decision to concentrate more heavily on 10 meter QSOs, knowing that the band wouldn't be open that much at this stage of the 11-year solar cycle.

Figure 8 shows the computed 10 meter responses toward the US East Coast from Florianopolis, Brazil. On this path the terrain at PT5M appears to offer a significant advantage, although the patterns for the other stations are not bad at all. Once again, the number of QSOs made is fairly small, making general conclusions difficult to support without more data.

Figure 9 compares the elevation responses for the Top Four stations into Europe on 15 meters. Again, low angles are dominant on this path, where elevation angles less than 9° account for about 67 percent of all openings. Once more, it appears that the PT5Y station has an edge, having access to perhaps another layer of weak signals compared to the others.

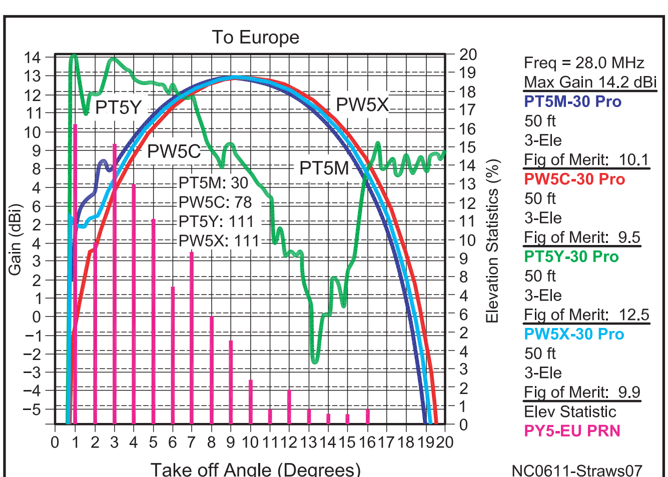


Figure 7—*HFTA* response for Top Four stations toward Europe on 10 meters. The table of numbers shows the QSOs into Europe for each station. PT5Y would appear to have an advantage by about 2.5 dB on average over all the statistically relevant elevation angles.

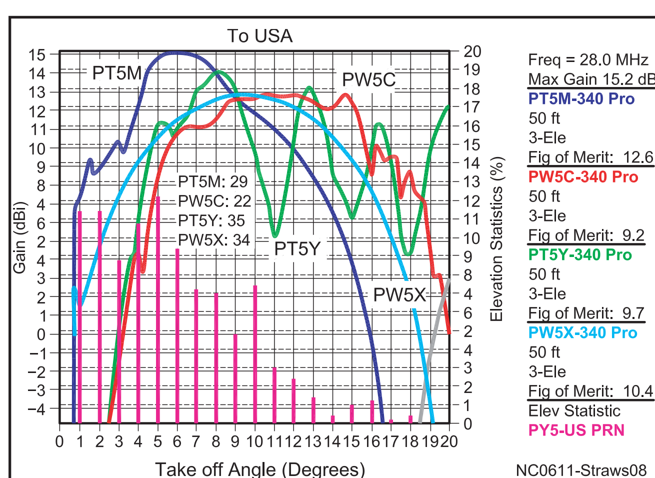


Figure 8—Responses for Top Four stations toward the East Coast of the USA on 10 meters. PT5M appears to be top dog in this direction.

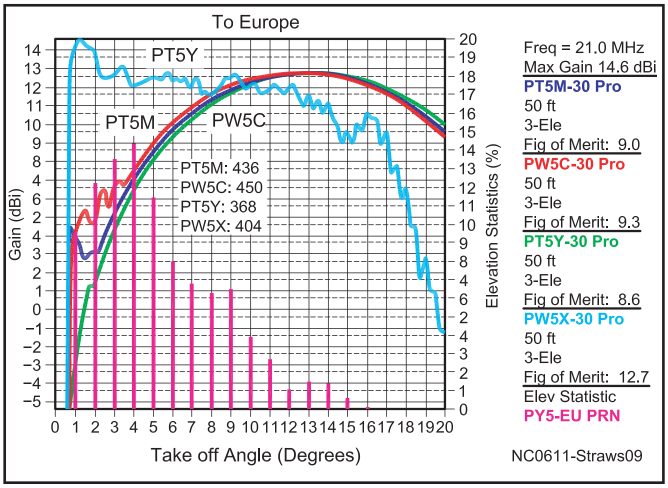


Figure 9—Responses for Top Four stations toward Europe on 15 meters. Again, PT5Y would appear to be stronger than the other three.

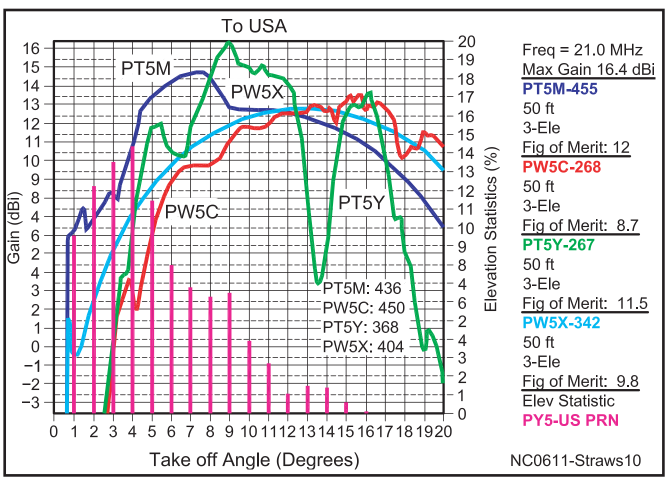


Figure 10—Responses for Top Four stations toward the USA on 15 meters. The nod goes to PT5M, and VE3EJ/VE7ZO appear to have taken advantage by racking up more than 100 QSOs over their nearest rivals.

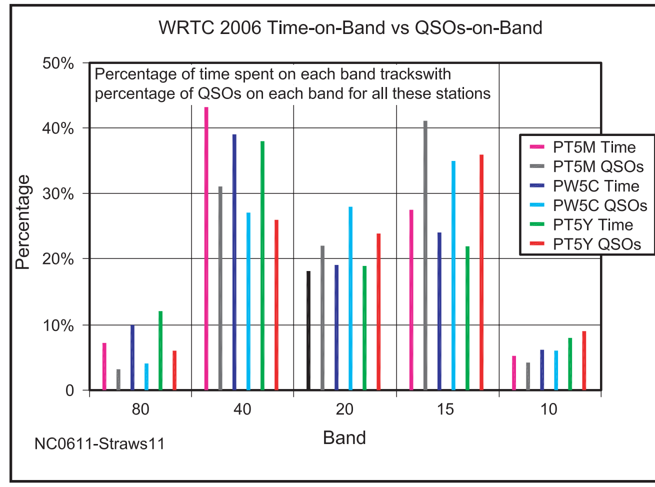


Figure 11—Comparison of the percentage of time spent on each band with the percentage of the QSOs netted on that band. There appears to be little disparity between effort expended and the resulting QSOs.

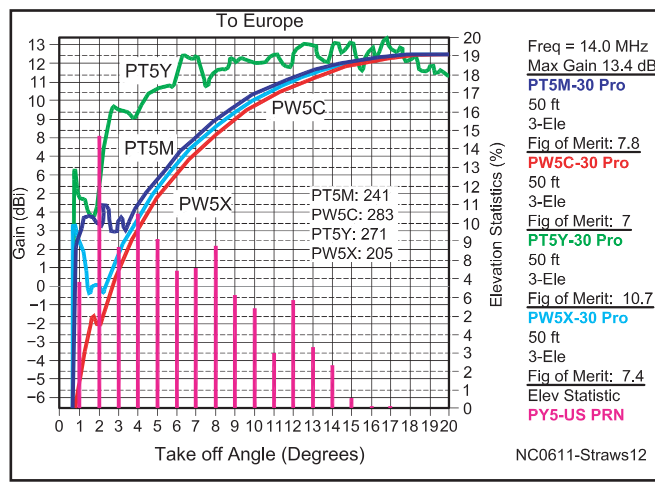


Figure 12—Responses for Top Four stations toward Europe on 20 meters. Although PT5Y is stronger than the others, the number of QSOs isn't remarkably different among the four stations. Maybe there is a "threshold effect" above which the signal strength isn't all that relevant.

Note that the number of QSOs made on 15 meters to Europe from PT5Y doesn't validate the terrain advantage. Again, a different operating strategy might be showing here, a factor unrelated to any terrain advantage or disadvantage. (For example, the PT5Y beam may have been pointed more often toward the USA than the other PT5/PW5 stations.)

Or it simply may be that beyond a certain threshold, signal strength doesn't mean that much. For example, Figure 9 shows about a 5 dB difference between the response for PT5M and PT5Y at a 4° takeoff angle. If the resulting signal in Europe is S9+20 for PT5Y, how disastrous is a signal level of "only" S9+15 for PT5M? In either case there would be sufficient signal strength in Europe to control a pileup, even an unruly one!

On the other hand, if the PT5Y signal is only S2 in Europe, a 5 dB difference puts PT5M at a significant disadvantage. The other three top stations all had very similar responses toward Europe on 15 meters, even if they were about 4 dB down from PT5Y in general. I'm sorry, Doug and Andy, but the question is hanging out there: Did you "leave something on the table" by not fully exploiting what seems like a superior location toward Europe from PT5Y?

Figure 10 shows elevation responses for 15 meters from southern Brazil to the US East Coast at a heading of 340°. Here, PT5M enjoyed an advantage at low takeoff angles, and it really did dominate in QSOs to the US, working 455 stations on 15 meters. PT5M's terrain gave it a significant advantage over the other Top Four stations, which was fully exploited. This is especially true during a low part of the solar cycle, where the elevation angles tend to be lower than the overall range shown in the elevation-angle statistics covering the entire 11-year solar cycle.

But what if one or more of the top stations purposely spent more time on a particular band? Wouldn't they have a higher QSO number there? Figure 11 graphs the percentage of time spent on each band by PT5M, PW5C and PT5Y, together with the percentages of total QSOs that each band represented. Each station has a pair of side-by-side bars on this graph for each band.

Figure 11 attempts to correlate effort (time) spent on each band with the resulting number of QSOs for that band. PT5Y spent 30 percent (7.2 hours) of its total operating time on 15

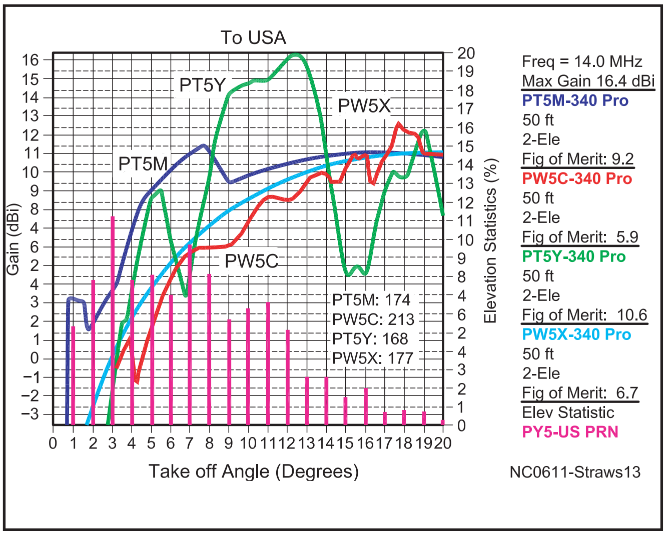


Figure 13—Responses for Top Four stations toward the USA on 20 meters. Again, PT5M looks like it is nominally stronger into the USA on 20 at low elevation angles.

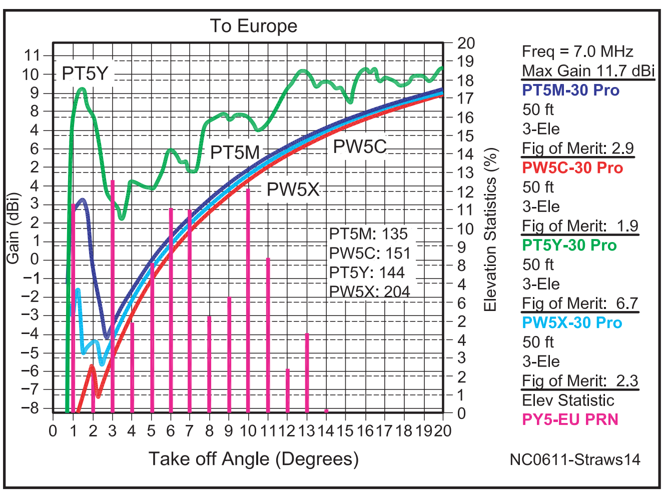


Figure 14—Responses for Top Four stations toward Europe on 40 meters. PT5Y doesn't appear to have made more QSOs because of a better terrain profile in that direction.

meters, with about 37 percent of the total QSOs (730) made there on 15 meters. This is an average rate of 101 QSOs per hour on 15 for PT5Y. By comparison, PT5M spent 38 percent (9.1 hours) of its time on 15, netting almost 41 percent of its QSOs (962) there, resulting in an average rate of 106 QSOs per hour.

Figure 12 shows the computed elevation responses for the Top Four stations into Europe on 20 meters. Again, PT5Y should have had a stronger signal at low elevation angles, with a Figure of Merit (FOM) some 3 dB stronger on average than the others. PT5Y had the second-highest QSO total on 20 into Europe, at 271 compared to PW5C at 283.

Figure 13 shows the computed responses for the Top Four stations on 20 meters to the USA. Again, PT5M should have enjoyed good signals in that direction, even though PW5C outdid PT5M in total QSOs by some 213 compared to 174 QSOs. PT5Y also had a good FOM on that path. The fact that 20 meters did not stay open overnight, as it had in the days prior to WRTC 2006, had a hand in the 20 meter QSO totals being lower than what I would have expected.

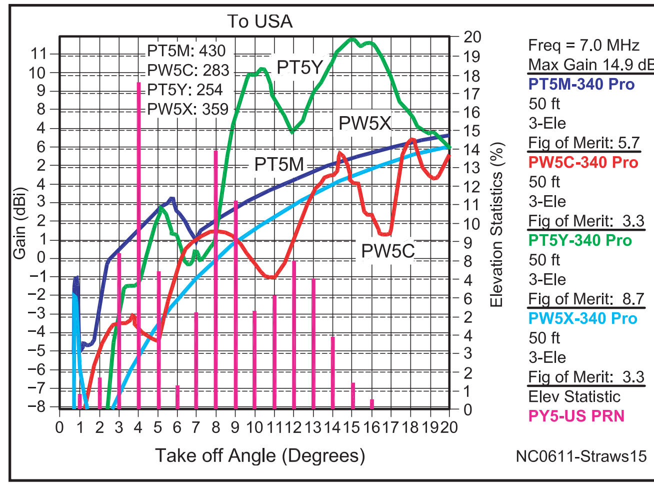


Figure 15—Responses for Top Four stations toward the USA on 40 meters. PT5M seems to have really exploited its advantageous terrain at low elevation angles toward the USA.

Figure 11 shows that PT5Y devoted 21 percent of its time on 20 meters, with 23 percent of its QSOs there. PW5C spent 23 percent of its time on 20, working 28 percent of its overall QSOs there. PT5M spent 20 percent of its time on 20, with 21 percent of its QSOs there. From these figures it's difficult to pinpoint effects of either terrain or strategy on the 20 meter results. All four top stations appeared to be equally effective on 20.

All in all, on 15 and 20 meters I don't see disproportionate amounts of time being spent on any one band by any of the top stations. When the bands were hot, the top stations were where the action was, moving down to lower bands as necessary to maintain rate when propagation changed. Not much of a surprise there.

Figure 14 shows the situation toward Europe on 40 meters. Once again, the terrain at PT5Y would seem to give that station a significant advantage at low angles, although once again the responses for the other stations are not all that bad, averaging about 4 dB less than PT5Y. Interestingly, PW5X had the most QSOs into Europe on 40 meters, indicating perhaps a strategic emphasis on Europe during the nighttime hours.

Figure 15 shows the 40 meter situation to the USA for the Top Four stations. PT5M had the highest predicted signal to the USA at low elevation angles and they took advantage of the terrain advantage by harvesting the highest number (430) of US QSOs on 40 meters. This was a rather wide margin over the others, since the second-highest 40 meter USA QSO total was only 83 percent, at 359 QSOs for PW5X.

To be continued...

The full article, in color, will be featured on the *NCJ* Website (**www.ncjweb.com**).

NCJ

To Win the World From Schenectady: The 25th Anniversary of the Last W2PV Contest Operation

Matt Power, KA1R, and Doug Grant, K1DG

"W2PV is considered to be a good brave fast-moving guy." — Martti Laine, OH2BH, 1976.

When you hear the call sign W2PV, what do you think of? Maybe it's the *Yagi Antenna Design* book. Maybe it's one of his designs in particular — the "PV4" 4 element Yagi design. Or perhaps a Multi-Multi from days gone by. It might be one of those call signs in the Contest Hall of Fame. In recognition of the 25th anniversary of the final contest operation from the Schenectady, New York home of Jim Lawson, W2PV, we'll look back at the W2PV era, discussing Jim's contributions to radio, the design and operation of his Multi-Multi station and some details of contesting in 1981.

Born in India to missionary parents, Jim had been deeply involved in radio for many years before beginning contest operations. On the ham radio side, he was licensed as W9SSP when in college in Kansas, and licensed as W8QUI when in graduate school in Michigan. Professionally, Jim was an expert on microwave communication. During World War II, he worked at the MIT Radiation Laboratory (Rad Labs) as one of the principal researchers on the development and application of radar. The laboratory employed several hundred people; Jim was one of the few dozen group leaders. He headed "Group 44," the Experimental Systems Group, which was part of Division 4 (Research).

After the war, Rad Labs made a public release of much of its scientific and engineering achievement in the form of a book series. Jim co-authored one of the books, *Threshold Signals* (New York, McGraw-Hill, 1950), a highly technical presentation of circuit and system theory. Ten years ago, *The Invention That Changed the World* by Robert Buderi (New York, Simon & Schuster, 1996) appeared in the popular press. It highlighted one of Jim's contributions to radar: the first successful TR (Transmit-Receive) switch. The book introduces the problem (pp 102-103) as, "In the Rad Lab's early days, project leaders would diagram the key radar components on a blackboard — antenna, receiver, pulser. When it came to the vital transmitter-receiver (switch), however, they simply drew an empty box labeled TR. No one knew what belonged inside." As a result, most early microwave radars used separate antennas for transmitting and receiving, which made the systems unwieldy. As the book notes, Jim had the skill and passion to complete the system:

> Jim Lawson, one of the few lab members with a strong background in Amateur Radio, jumped on the problem. "If we had been paid in proportion to our contributions to the success of the first microwave radar program, Jim Lawson would have earned more than half the monthly payroll," Luie Alvarez once asserted. Unusually gaunt, with a skull-like face marked by deep-set eyes and an extremely high forehead, the University of Michigan Ph.D. was a topflight experimentalist who burned like a fire to solve problems. And the duplexing question struck him as irresistible.
>
> Even before the lab's first rooftop success, Lawson gathered a small rooftop crew to address the issue. Within a few weeks, the team had managed to fashion a TR Box by using a klystron as a buffer between the crystal and the transmitter. On January 10 a slightly less cumbersome rooftop apparatus employing a single paraboloid sprang to life, once again detecting echoes from the Boston skyline. DuBridge, in Washington for a Microwave Committee meeting, happily received a cryptic telegram announcing the event: "HAVE SUCCEEDED WITH ONE EYE." ... The plumbing that ferried signals between the transmitter-receiver and the antenna amounted to little more than homemade beaded coaxial lines, albeit with a touch of Lawson elegance.

The book's last mention of Jim Lawson (p 117) refers back to both his appearance and his accomplishment, calling him "the cadaverous TR box architect."

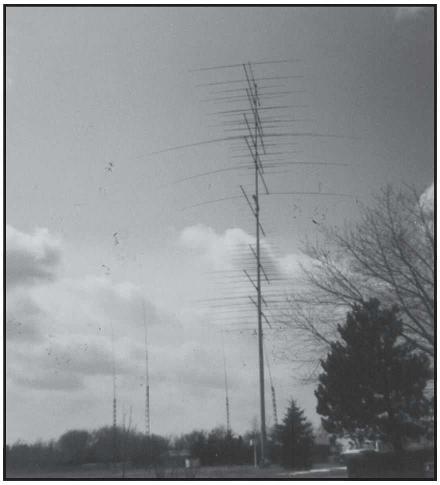
Jim remained interested in research throughout his life. After World War II, Jim became a career employee of General Electric, holding a series of research positions leading to Vice President for Research and Development Planning at the corporate headquarters in Schenectady, New York. He settled on three acres in suburban Schenectady County, New York (in the town of Niskayuna) with his first wife, Jane. In addition to his Amateur Radio hobby, he was an avid skier and hiker, and possessed an encyclopedic knowledge of classical music. He also owned a small boat named *L's Belle*, a play on his favorite exclamation "Hell's Bells!"

Jim's most widely known research topic relating to Amateur Radio was the Yagi antenna, which resulted in several 1979-1980 articles in *Ham Radio* magazine, as well as the book *Yagi Antenna Design* (Newington, CT, ARRL, 1986). One of his findings on Yagi design was the direct result of an antenna deployed for his Multi-Multi station. Specifically, he observed that the Wilson 3 element 40 meter Yagi had particularly poor performance. Jim decided to make substantial changes based on his calculations showing that element taper had a major effect on correct element length. Once the antenna was back up with its new dimensions, the W2PV signal on 40 meters was regularly the best on the band.

After Jim retired from GE and had completed the Yagi article series, he turned his attention to another challenging problem — phase noise in receivers. He began by placing a large order (about $50,000, which was approximately four times the average starting salary for an engineer at the time!) with Hewlett-Packard for spectrum analyzers and precision signal sources. This drew the attention of the local HP sales office, which was not accustomed to delivering such large orders to residential addresses. The local sales engineers dropped by to find out what Jim was doing, and his experimental setup led to several seminal application notes on phase-noise measurements published by HP.

By the early 1960s, Jim had become a highly competitive DXer. One of his contacts from this period (with one of his earlier call signs, WA2SFP) can currently be found in the JA1LZ online log for May 1, 1962. Jim soon became a perennial top entrant in single-operator all-band DX phone contests, possibly a surprise to those who remember only the Multi-Multi operations. The single-op efforts started in the mid-1960s and continued until the early 1970s. For example, Jim had a first-place USA finish in CQWW Phone 1971, edging out Chuck Cullian (now KØRF) 1.36 M to 1.33 M. In CQWW Phone 1972, Jim dropped to third, behind Gordon Marshall, W6RR, and Bob Ferrero, W6RJ.

RANDY SCHAAF, W9ZR



The antennas in 1972.

ERIC SMITT, K9ES

Jim Lawson, W2PV (standing), keeping and eye on John Dorr, K1AR (reaching for antenna switch), and another unidentified operator

The next year, W2PV switched to the Multi-Multi category for CQWW Phone, finishing first in the USA. The year 1973 also brought a W2PV Multi-Multi entry to CQWW CW, but one with only 70 percent of the point total of the winner (W3AU). By the next year, however, the Multi-Multi CW score was getting very close to the top (W2PV's 3.34 M versus W3AU's 3.62 M). Most of the operators from this 1974 CW contest are still active today, including John Dorr, K1AR; Ron Grzelak, K1BW; Doug Grant, K1DG; Richard Roth, K1OME; Mark Pride, K1RX; Jeff Briggs, K1ZM; Dave Sumner, K1ZZ; Fred Lass, K2TR, and Joe Krone, WA2SPL. Operators at the early Multi-Multis recall hearing Jane Lawson practicing complex piano pieces in the living room for hours at a time, and being a gracious host, cooking for the crew.

Although Jim's primary interests were the CQWW DX and ARRL DX contests, the station was also occasionally used for other contests, notably the single-op ARRL Sweepstakes entries by John Dorr, K1AR. Another aspect of Jim's ham career, one that differs from the great majority of owners of large contest stations, was the frequent non-contest activity. Jim was generally on the air every morning, working phone on the highest open band. A typical 10 meter QSO was sometimes roughly like:

ERIC SMITT, K9ES

Mark Pride, K1RX, on 10 meters. Mark is now President of Yankee Clipper Contest Club (YCCC). W2PV is held as a YCCC club call sign in memorial to Jim.

Table 1
Antenna Comparison circa 1981

Band	*W2PV*	*N2AA*
160	Inverted V at 170 feet	Sloper at 200 feet; Inverted V at 180 feet; Inverted V at 100 feet
80	2 el. delta loop at 160 foot; dipoles	3 element at 195 feet
40	3/3 at 180/90ft; 3 at 85ft	3 element at 120 feet; 3 element at 120 feet (South); 2 element at 90 feet
20	7/5/5 at 150/100/50 feet; 6/6 at 106/42 feet	6/6/6/6 at 200/150/100/50 feet (EU); 6/6 at 120/60 feet; 6 at 80 feet
15	8/8 at 99/49 feet; 4/4 (South)	8/8 at 90/45 feet (L-EU); 8/8 at 90/45 feet (JA); 5/5 at 90/45 feet (S); 5 at 70 feet; 6 at 80 feet (EU)
10	10/10 at 91/57ft; 6/6 at 70/40 feet	10/10 at 60/30 feet; 10 at 60 feet; 10 at 60 feet (EU)

PHOTO COURTESY PHIL KOCH, K3UA

Phil Koch, K3UA, and Dave Jordan, KC1Q (now K1NQ), on 10 meters.

> [Jim] G3ABC, thanks for the call. You're 59. Name is Jim; QTH New York. Running a hundred watts. How copy? W2 Papa Victor.
>
> [G3ABC] Jim, you're 40 over S9, peaking 50 over. You have the best signal on the band and I think the strongest stateside signal I've ever heard. When you said 100 watts, I was absolutely floored. You have an outstanding signal here!
>
> [Jim] The antenna is 10 over 10; go ahead.

Fred Hopengarten, K1VR, recalls hearing a station in the Pacific working by call areas one morning on 20 meters. While a pileup of W1s was calling, a loud burst of noise came on the frequency. The DX station stopped the pileup and asked "What was *that*?!? It was 30 over 9!" A somewhat embarrassed Lawson said "Oh, excuse me. I had to sneeze and forgot I had the VOX on. I'll wait my turn. W2PV."

Jim went through considerable effort to keep in touch with the operators of the Multi-Multi station. He joined the Murphy's Marauders contest club in 1974. Club meetings were typically on weekday evenings near Hartford, Connecticut, and Jim would regularly drive down from Schenectady to attend. In later years, Jim would rely on one of the station operators to be the primary coordinator of Multi-Multi operation planning and recruiting. At first, this was Fred Lass, K2TR. Fred, however, eventually built a Multi-Multi station of his own, so the coordinator role was passed along to others, including Andy Blank, N2NT.

The early 1980s were a time when several people operated at W2PV for the first time. This occurred, in part, because earlier W2PV operators either built large stations of their own, or became primarily interested in single-op entries. Jim was a member of the Yankee Clipper Contest Club (YCCC) from the very beginning of that club, and most operators were from YCCC. At present, W2PV is a YCCC club call sign, but is not frequently activated.

Martti Laine, OH2BH's, quote at the beginning of this article is a tribute to this approach for recruiting the operators. Jim knew the importance of having excellent operators at his station, and the PV operators' reputation spread quickly. In a September 1976 article in *CQ* magazine, Martti predicted the future of computer logging. He suggested entering a code to denote how the exchange should be sent for stations worked. He used the following illustration:

> So, when a station is calling you, just type in the call and an applicable command like 'W2PV 14Z'... that instruction means that W2PV is considered to be a good brave fast moving guy who will realize the quickest possible message at once. '1' stands for quick report, '4' for quick confirmation, and 'Z' means the highest speed.
>
> When you hear W2PV giving you 59905 you just type in 05 and start command for message number 4. That means that 05 goes only to the computer and confirms that complete QSO data can now be entered. The message number 4 confirms the same thing to Dr. Jim Lawson, W2PV. (From Laine, Martin, "How to Make a Contest More Fun," *CQ*, Sep 1976, p 21.)

Heading into the fall 1981 contest season, the premier station in the CQWW Multi-Multi category was N2AA, operated from the property of Buzz Reeves, K2GL, in Tuxedo Park, New York. N2AA had finished first on both modes in 1978, 1979 and 1980. W2PV was hardly a Multi-Multi underdog, though, having defeated the Tuxedo Park station and finished first in a few other recent contests: ARRL DX Phone 1979 and both modes of CQ WW 1977. W2PV also had other first-place finishes in contests where the Tuxedo Park station was inactive: ARRL DX Phone 1976, 1977, 1978 and 1981. Other N2AA victories included ARRL DX CW 1979 and ARRL DX Phone 1980. The only other stations with a CQWW or ARRL DX first-place Multi-Multi finish in the past five years had been N3RS (three times), W4BVV (twice), K2UA (once; licensee is now W5KU) and W7RM (once). Other frequently high scoring Multi-Multi stations of this era were K3WW, W3AU, W3FA, W3MM, K5RC, N5AU and K8LX.

See Table 1 for an antenna comparison between W2PV and N2AA circa 1981. There was sometimes a difference in which station had the advantage on a band (for example, N2AA on 80 meters and W2PV on 40 meters). For the most part, relative signal strengths had a strong dependency on propagation conditions, even varying from opening to opening within a weekend.

At the end of October 1981, based on claimed scores, it appeared that W2PV had narrowly defeated N2AA on phone, breaking AA's three-year CQWW winning streak (this was later confirmed in the final results: 10.6 M to 10.4 M). The challenge now was CW, traditionally the poorer mode for PV. By mid-November 1981, the W2PV CQWW CW operation had settled on this group of operators:

- 160 — Dave Jordan, KC1Q (now K1NQ)
- 80 — Dennis McAlpine, K2SX
- 40 — Clarke Greene, K1JX
- 20 — Paul Blumhardt, WA3ZAS (now K5RT); Saul Abrams, K2XA; Matt Power, KA1R
- 15 — Andy Blank, N2NT; Doug Grant, K1DG
- 10 — Joe Krone, WA2SPL; Phil Koch, K3UA

Also important to mention is the effort of Everett Hudson, AJ1I, (now a Silent Key) on 2 meters. Digital communication for spotting hadn't yet been developed, but Multi-op DX contesters were typically active on 2 meter FM repeaters that were reserved for spotting during the 48 hour period. Everett collected spots of new multipliers announced by members of the Schenectady Amateur Radio Club, and relayed them on the 11 meter CB "intercom" to the appropriate band.

Another secret weapon at the PV station was Jim's wife, Molly. A year or two after Jim's first wife passed away, Jim married Molly, who had worked in his department in GE, and had spent many hours typing contest logs from the handwritten originals. Molly made every operator feel welcome and always made sure the kettle of Contest Chili (or Stew or Curry) was full and fresh. One operator recalls arriving at the station for one contest suffering with a head cold. Molly provided him with orange juice and aspirin faithfully every four hours all weekend.

All of the stations, 160-10, plus 2 meters, were tested and ready at least an hour before the 7 PM contest start on November 27, 1981. The only substantial problem was fixed shortly before the contest began. Here's a description of what happened, written by Dennis McAlpine, K2SX:

> I was sitting down at the 80 meter station several hours before the start of the contest and tuning the band. The main antenna was a switchable 2-element wire quad with the apex at about 160'. After trying the antenna in several positions, I felt that it was not performing very well. I went over to Jim and told him my concerns. He listened to the receiver for a few minutes and then went to a large set of notebooks. After searching for a few minutes, he selected one of the notebooks and turned to a page in the middle of the book. He then took out a VOM and made several measurements somewhere on the antenna connection, checking them against the notebook. After a few minutes, he looked up and said, "Well, the problem is that the relay on the driven element is stuck in the SSB position and the antenna is out of tune in the CW band and is not performing like a gain antenna."
>
> By then, it was only about an hour before the start of the contest. It was dark out. It was snowing out. It was freezing out. But, never fear. Intrepid climber, Andy, N2NT, stuck a jumper cable in his mouth and climbed to the top of the 160' tower, reached out onto the quad and bypassed the relay. After he climbed down, I checked the antenna and, sure enough, that was the problem. The antenna was now performing like it was expected to. And, it did so for the entire contest.

As of 2006, we could not readily obtain the 1981 CQWW CW log, but Table 2 is an example of hourly rates at W2PV in another 1981 contest: ARRL DX Phone, operated by Jim, Lawson, W2PV; John Dorr, K1AR; Everett Hudson, AJ1I; Richard Roth, K1OME; Bill Gioia; K2EK, Noah Gottfried, K2NG; Andy Blank, N2NT; Bob Naumann, WA2OVE (now W5OV); Hope Smith, WB3ANE; Don Search, W3AZD; Leslie Richter, Jr, K3LR, and Phil Koch, K3UA.

Perhaps the clearest difference from current contests (or, specifically, ARRL DX phone contests) is in the QSO totals. In recent years on 10, 15 and 20 meters, it's been common to have 50 percent more contacts than were ever achieved in the early 1980s. The change on the low bands is even more pronounced: it's possible to work about three times as many stations on both 40 and 75 meters. In the early 1980s, 160 meters was not yet a very important band. Although the LORAN problem had mostly gone away, many fewer stations were active on 160 meters, and fewer countries allowed 160 meter operation. Countries worked on 160 meters would typically be less than 20 percent of the 75 meters total, whereas the percentage nowadays is often close to 50 percent. Going back to the high bands: peak rates from stateside have increased dramatically. Back then, a 125 hour on phone was very good; currently, the best stations see double that.

The operating environment in CQWW CW 1981 was similar to that in other years. The 160, 80, 20 and 10 meter stations were in the basement, and the 40 and 15 meter stations were in a small room upstairs, which also housed the huge W2PV logbook and QSL collection. The "In Memory of W2PV" article in the September/October 1983 issue of *NCJ* has additional details about the operating positions. The equipment on most bands was a Kenwood TS-830S and an Alpha 77 (1 kW input), and Clarke Greene, K1JX, brought his highly-modified Kenwood R-599 and T-599. For this operation, most of the state-of-the-art Signal/One transceivers normally used at W2PV were stacked neatly on the floor.

Jim was seldom around the stations

Table 2

Hourly rates at W2PV in the 1981 ARRL DX Phone contest

UTC	*160-Sa*	*75-Sa*	*40-Sa*	*20-Sa*	*15-Sa*	*10-Sa*	*160-Su*	*75-Su*	*40-Su*	*20-Su*	*15-Su*	*10-Su*
00	1	13	25	80	94	38	0	4	4	26	69	15
01	0	18	10	56	61	28	1	1	5	32	37	5
02	0	19	17	52	66	5	2	2	6	19	16	1
03	1	11	11	38	10	2	1	4	5	14	10	0
04	2	24	3	39	12	0	0	2	4	21	11	0
05	3	10	6	33	15	0	0	7	5	24	9	0
06	0	14	14	22	10	0	2	5	15	23	4	0
07	0	6	7	63	1	0	0	2	11	10	0	0
08	2	3	6	73	2	0	0	2	6	13	0	0
09	0	5	10	87	0	0	2	8	2	21	0	0
10	0	5	7	75	74	23	2	2	11	21	54	0
11	0	3	4	75	123	104	0	3	2	44	55	71
12	0	0	0	23	102	106	0	0	1	42	90	81
13	0	0	0	16	74	78	0	0	0	41	63	50
14	0	0	0	5	75	85	0	0	0	13	40	50
15	0	0	0	11	69	88	0	0	0	0	33	38
16	0	0	0	4	42	48	0	0	0	1	27	40
17	0	0	0	12	45	42	0	0	0	3	25	31
18	0	0	0	21	26	28	0	0	0	4	27	19
19	0	0	0	30	46	19	0	0	0	10	20	24
20	0	0	0	37	16	3	0	0	0	20	37	24
21	0	0	0	42	13	11	0	0	0	38	60	26
22	0	0	0	40	25	11	0	1	4	55	39	45
23	0	0	4	35	29	13	0	6	10	61	15	71
TOT	-	-	-	-	-	-	19	180	215	1525	1773	1323
DUP	-	-	-	-	-	-	0	13	0	132	47	53
NET	-	-	-	-	-	-	19	167	215	1393	1726	1270
MUL	-	-	-	-	-	-	14	72	74	138	142	126

Table 3

Top-Two USA Multi-Multi stations

Call	*160*	*80*	*40*	*20*	*15*	*10*	*Score*
W2PV	72/14/27	427/18/70	1101/30/103	1389/35/118	1228/35/103	1050/34/106	10,431,729
N2AA	49/12/15	461/21/70	803/26/85	1475/37/115	1314/35/113	1051/33/108	10,147,820

Table 4

Top-Six World Multi-Multi stations

Call	*Score*
W2PV	10,431,729
N2AA	10,147,820
W3LPL	9,628,026
OH3AA	9,301,635
K2UA	9,210,792
N9MM	8,884,400

that weekend. He was ill at the time and survived only a few months longer. One of the operators remembers hearing only three words from Jim during the contest. It followed a discussion of one station left unmanned when its band could conceivably have been open. Jim didn't offer an opinion on what should have happened. He simply said "Seize every opportunity."

By 7 PM local time Sunday, the outcome was essentially what is shown in the final scores (Oct 1982 *CQ* magazine) in Table 3, along with the unexpected list of the top-six world Multi-Multi stations in Table 4.

W2PV had won the world — at least in the claimed scores. Jim's health was failing (he died in the spring of 1982), and since the results weren't due to be published until October, an extraordinary gesture made it possible for Jim to know the official final outcome before his passing, as we'll see in the first of the following series of recollections. The stories here are from the perspectives of several people who knew Jim at different stages and who also operated at the station.

Randy Schaaf, W9ZR: I moved to Schenectady in January 1972 and called Jim on the phone and arranged to have lunch. Over lunch I told him about the great experience that I had operating from the W4BVV Multi-Multi in the CQWW CW the previous November. A few days later he called to see if I would be interested in doing a Multi-Multi in the CQ WPX. He rounded up a few guys, ordered some new equipment and we gave it a try. There were lots of gremlins that arose, but we had a ball and he was hooked.

Here are a few of my memories from those early years:

- The very first contest I was on 15 meters SSB at the start of the contest with the stack on JA and called CQ. Nothing could have prepared me for the wall of JAs that called at the same time.
- Jim used Alpha 70 water cooled amps mounted above the Signal One transceivers in the early years. In the middle of a run, the amp sprung a leak and the water started running into the Signal One below it. Not good.
- Dave Donnelly, K2SS, and Fred Lass, K2TR, spent many, many days there erecting additional large antennas and towers. They were simply amazing to watch and have to be among the best climbers around.
- Fantastic runs on 80 meters — with Europe and the Middle East calling us, it made the band feel like 20 meters. This is not so unusual now, but back then it did not happen very often.

W2PV was an extremely intelligent individual who used his skills to build a world-class station that influenced the development of many contesters who operated from it over the years. I am sure that he would have been very proud to see what "his guys" have accomplished since his passing.

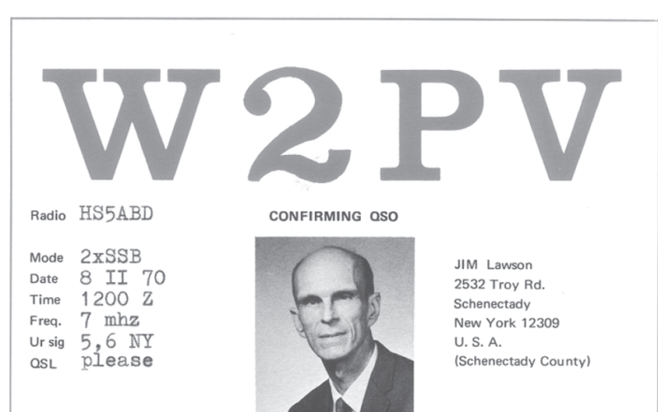
Joe Krone, WA2SPL: That last contest Jim's health was failing fast and he knew he didn't have much time left. Every hour we would bring our full log sheets to the kitchen where Jim was laying down. He would visually scan them and if you did well you got a smile — if you didn't, nothing was said, but you saw a wrinkled brow and knew you had to get back in there and do better for the next hour.

At the end of the contest, we gathered the scores from the other "Big Guns" and headed to the kitchen were Jim was now showing the strain the contest had had on him. Someone gave him the scores and a *huge* smile came across his face as he realized we had actually *won*! All he could manage was a weak "Thank you everyone."

Over the next few days, each of the other Multi-Multi stations agreed to concede the contest to W2PV. *CQ* agreed to have the winner's plaque made immediately and a group of the operators presented it to Jim a few weeks later. He passed away soon after. He was a good friend, a true mentor and a wonderful role model to all that knew him.

PHOTO COURTESY PHIL KOCH, K3UA

Phil Koch, K3UA, working 10 meters.



Saul Abrams, K2XA: I was sitting in the den with Jim during a break in operating and mentioned that I was going to build a 20 meter beam on a 40 foot boom using two 20 foot irrigation tubes. He asked how I was going to do it, and I responded that I was going to use the “traditional” even-spaced elements that many had used before. Jim said that there had to be a better design and asked me for my proposed element tapers. A week later Jim called me on the phone and told me that he had some “new” dimensions that he had had just calculated for me. Thus was born the now-famous four element “PV-4” 20 meter beam and its 15 and 10 meter counterparts.

Dave Jordan, K1NQ: I remember that last contest just like it was yesterday. I was on 160 meters, and we were just loud! I’m not sure anyone ever beat us in a pileup that weekend. I also spent time on the 20 meter station helping out on the mult radio and doing a few hours of afternoon running. What an amazing station. I will always remember that contest and talking to W2PV about antennas.

Dennis McAlpine, K2SX: I have a number of recollections from that weekend. The first was walking into the basement station and seeing five Signal One transceivers stacked up in a corner as back-ups. I remember thinking, “If that’s the back-up, what is the primary rig?” It turned out that most of the operators had chosen to bring their own TS-830s that weekend, and the Signal One rigs just sat in a pile on the floor.

The second immediate reaction was seeing a guy sitting at a card table listening to the 2 meter repeaters as spots came through. His job for the entire weekend was to copy the spots and then pass them on to the appropriate operator by using a CB radio (one channel for each band).

During one of the slow periods, I took a closer look at the library of notebooks and spent some time talking to Jim. He had made enough measurements when things were working correctly that he could pretty much find anything that went wrong with any of the antennas, rigs, amps and such without leaving the shack. It was a great example of the type of engineering that went into W2PV. It obviously left a lasting impression on me.

Clarke Greene, K1JX: I recall that John Dorr, K1AR, got the position of recruiting agent for W2PV that season. Some time around the beginning of September, John called me on the phone asking me what I had planned for CQWW, and then suggested that I think about operating at PV. Jim was quite ill and John wasn’t sure if the Lawsons were up for hosting a mob of operators. John discussed the topic with them, and they said they’d be happy to host a Multi operation.

I operated on 40 meters for the CW weekend. About midnight of the first night, Phil Koch, K3UA, asked if he could operate. He seemed anxious to get some operating in and hadn’t so far, as his band (10 meters) had been pretty much closed at the start of the contest. So Phil sat down for a couple hours and did really well, then decided that the band was closed to Europe, so he came out and said he’d had his quota. I sat back down, and a half hour later the JAs started coming through and the band got really good to Northern Europe. They kept calling until well after 1200 UTC. Phil stopped by on his way to the 10 meter position, and I think I may have worked another 200 stations since he had gotten out of the chair. His jaw visibly dropped.

I think that CW weekend was the first time a USA station had ever worked 100 countries and 30 zones on four bands in CQWW; W2PV did it on 40-10 meters. We may have also had 1000 or more contacts on those bands. We were all pretty thrilled. At the end of the CW contest, I stayed upstairs with Jim while the gang went downstairs to get the scores on 3830. I bet Jim that we had won, but he was really dubious. When we heard the yelling from downstairs, we knew I had won the bet. W2PV had the biggest smile on his face that I had ever seen.

Martti Laine, OH2BH: Jim visited Finland in the 60s and gave our group strong inspiration and guidance to get our then treasured OH2AM off the ground. We built to Jim’s specifications, and soon our efforts were up to world-level Multi-Multi winning at OH2AM. He was a genius on antennas, and also a strong supporter of young people toward serious contesting.

He designed and built antennas for contesting application! We often read his original book still, and his chapter on stacking distance vs F/B is rarely discussed in more recent books, but yet are correct and a most valuable finding.

Bill Poellmitz, K1MM: While attending Union College in Schenectady from 1970 to 1974, I participated in about half of the major contests from W2PV. My first job during contests was helping Jim update the band-by-band multiplier and QSO sheets that were taped to the walls. My first operating shifts consisted of listening on 10 meters when the band wasn’t open, and calling “CQ Canada” on 80 and 40 meters during the day. By 1971, I had earned the right to share responsibilities with the more experienced operators, and I shared 15 meters with Dave Donnelly, K2SS, and 10 meters with John Yodis, K2VV. Since I spoke fluent Spanish, I was also the one called upon when we needed to explain to some South American operator what the contest was all about, and convince him to give us the right exchange for our first Bolivia or Zone 12, and maybe move to another band!

In 1972, I was President of the Schenectady Amateur Radio Association (SARA). I was always impressed when I saw Jim Lawson and the crowds he attracted as he “held court” before and after the meetings. As soon as Jim started speaking about any subject, people were magnetically drawn to him, and patiently listened to his stories about everything from how the manufacturers should improve the efficiency of an 8877, to the physics behind calculating the effective height above ground for stacked Yagis. Jim always stayed and patiently answered questions until the last of the audience went home.

Mark Pride, K1RX: Some of my fondest recollections of Jim and Molly were the friendliness and the warmth this ham couple offered to each and every person that entered the house. I remember spending a lot of time on the big tower with Fred Lass, K2TR, modifying those 40 meter beams when Jim determined the lengths needed adjustment to compensate for the severe element taper.

Jim’s engineering and bookkeeping were masterful. This set the vision of my own plan that would not unfold for another 15 years, building my own Multi-Multi station. He was truly an inspiring human being and he brought a level of professionalism to this hobby I had never experienced. He was my best mentor!

Tim Duffy, K3LR: I visited W2PV twice. The first time was when I was 18. I drove my father's station wagon to visit Dan Street, K1TO. Along the way, Joe Scelsi, WB3EUB, and I stopped in to visit Jim and Molly. He was an incredible host and gave this young ham quite a tour. This left an impression on me that has driven me in my career and in my hobby ever since.

When I operated ARRL DX Phone at W2PV in 1981, it was a dream come true. It was an incredible operation. I remember making pages of notes after the contest, all of which were used when I started construction of my own Multi-Multi in 1987. All about details, all about the "Quality Operator Experience." I was fortunate to have Fred Lass, K2TR, purchase the W2PV receiver band-pass filters from Jim's estate for my station. We still use them today!

Arranging to have Molly come to Dayton to receive Jim's Contest Hall of Fame award at the Contest dinner in 1993 was another important PV high point for me!

Andy Blank, N2NT: My first 48 hour single-op was at W2PV. I only remember two things from that contest: first was being amazed at how many stations I could work barefoot on 160 meters (amplifiers were not permitted on the band at that time), and second was being so exhausted that after the contest I slept for 15 hours. There were lots of other memories from the Multi-Multi operations. I remember sitting at the 15 meter station, which was upstairs, and seeing numerous pictures on the wall of mountain peaks. Then I noticed that the guy standing on those peaks in the photos was Jim! He had been a fairly serious hiker and climbed some big mountains, including Kilimanjaro and the Matterhorn. Another time, Doug Grant, K1DG, brought a book from Jim's library over to show me, and opened it to page after page of very complex-looking calculus and schematics. Then he pointed to the author of the book — Jim Lawson! It was frankly a little intimidating to be around Jim in those days, since he was so accomplished both professionally and in his hobbies, especially since I had not yet decided on a career. But I guess I redeemed myself by climbing the tower to fix the 80 meter quad at that last operation.

Paul Blumhardt, K5RT: Jim's wife Molly was wonderful. She picked me up at the airport that cold November afternoon. Twenty meters was amazing. Weak Europeans never stopped calling. In the middle of the night Saturday, I remember Andy, N2NT and Phil, K3UA coming downstairs and the three of us getting a little silly. FRØGGL was active that weekend, and we nicknamed him "Frog Legs." Sadly, Jim couldn't eat by then and spent most of the weekend sipping on distilled water. I recall talking to him about water skiing in his younger days. It was a wonderful experience with some of my closest friends that weekend, and I'll never forget it. NCJ

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NCJ Reviews:

Carl Luetzelschwab, K9LA

The AIM4160 Antenna Analyzer

This review focuses on the AIM4160 Antenna Analyzer, designed by Bob Clunn, W5BIG. The AIM4160 does a lot in a small package, and it may be just what you're looking for to help with your contest antenna efforts.

If you've been a contester for many years, it is likely that you've followed a similar path to mine with respect to measuring the very basic performance of contest antennas. I started out in the early years with a simple SWR meter. It allowed me to adjust the antenna for a low SWR reading — but I didn't know anything more than the SWR, which represents an infinite number of impedances. My next step was the acquisition of a Palomar antenna noise bridge. Compared to today's standards, the Palomar bridge was crude — but it did give reactance, in addition to resistance, of the antenna under measurement. One of the limitations of these two earlier measurement systems was that a source was needed — a transmitter for the SWR meter and a receiver for the Palomar bridge.

My current antenna analyzer is an MFJ-259B. It's similar to several other antenna analyzers that are on the Amateur Radio market.[1] These antenna analyzers contain a source, and thus are very portable for in-field use. Some can even resolve the sign of the reactance, which is handy if you're familiar with a Smith chart and have a desire to go through antenna matching exercises. Although the MFJ-259B has helped tremendously with my antenna projects, it does not resolve the sign of the reactance, nor does not have the ability to generate a hard copy of the data for subsequent analysis or comparison to new data. That's where the AIM4160 comes in.

Introduction to the AIM4160

The AIM4160 measures the complex impedance at each frequency of interest in the range of 0.1 to 160 MHz, thus covering from below 160 meters to just above 2 meters. The test frequency is generated digitally and band-pass filters are used to reject stray signals (like broadcast stations). A 12-bit analog to digital converter digitizes the raw data, which includes the true phase to resolve the sign of the reactance.

The digitized data is sent to your PC (or laptop) via the RS232 port (or via a USB port with a user-obtained adapter cable). Some of the parameters calculated by the PC include: SWR referenced to any impedance; resistance and reactance at the cable input; resistance and reactance at the antenna terminal; resistance and reactance of discrete components; return loss; reflection coefficient; cable length; cable impedance; cables loss; distance to fault (open or short); Smith chart display, and quartz crystal parameters (for those designing filters). The scanned data can be saved or printed. In essence, the AIM4160 is a poor man's network analyzer.

To learn more about the AIM4160, visit **www.w5big.com**. You can download the most recent version of the informative (and substantial) manual. And W5BIG compared the accuracy of the AIM4160 to the antenna analyzers reviewed in the May 2005 issue of *QST* — this is at **www.w5big.com/TestResults.htm**.

Some Unique Features of the AIM4160

The AIM4160 does a lot of unique things compared to my MFJ-259B. Here's a short, but not all inclusive, list of the ones that really stand out:

- Reports SWR in Morse code for remote tuning (within earshot) of antenna.
- Easily 'backs out' the effect of a length of cable to get the true antenna terminal impedance.
- Measures crystal parameters for the design of filters.
- Easily saves a hard copy of results for subsequent analysis or for A-B comparisons.
- Scalable parameters to allow broad look or close-in look of an antenna's parameters.

Inside Evaluation

To gain familiarity with the AIM4160, I put it through its paces on the kitchen table with my laptop running under *Windows Me*. Since this laptop does not have an RS232 port, I had to buy an RS232-to-USB adaptor cable. How to make this work is nicely covered in the manual.

I measured various loads for my in-house evaluation, both real and complex. My results were on par with the above referenced accuracy comparison.

I also used the AIM4160 to measure a crystal (one of my old 40 meter Novice crystals). The results were as expected with respect to the series resonant frequency, the parallel resonant frequency and the crystal parameters. I did a normal frequency scan, and I also used the *Measure Crystal* command to get a tabular output of the crystal's parameters. Measuring crystals is a very handy option if you're into filter design. And if you're going to measure a lot of crystals, I would make a small fixture to better accept the crystal (my measurement was done by holding the pins of the crystal to the inner pin and the outer shell of the BNC connector on the AIM4160).

In summary, my inside evaluation of the AIM4160 showed it was very easy to use and quickly gave extremely useful results. When I felt comfortable with using it, I anxiously took it outside to measure my 80 meter/160 meter inverted-L.

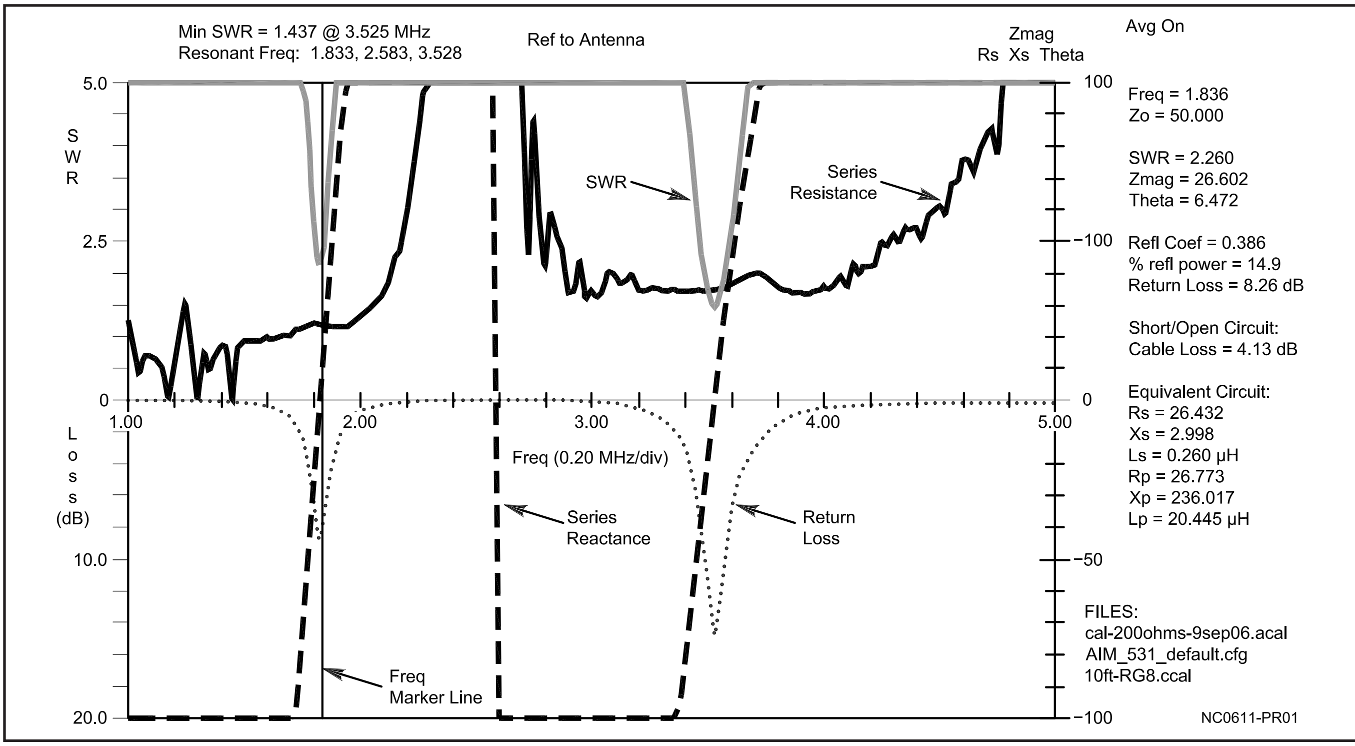
Out in the Field

My antenna for 80 meters and 160 meters is a quarter-wave wire vertical for 80 meters, with a homebrew 80 meter trap at the top. Above the trap, a wire slants back to the house to make it an inverted-L on 160 meters. For ground, I use three 60 foot long elevated radials on 80 meters, and three 120 foot long elevated radials on 160 meters. The top of the vertical wire (including the 80 meter trap) is supported from a convenient limb of an 80 foot tree on the east side of our property. I have a small B&W coil at the bottom of the wire to allow tuning the system to the CW or Phone portion of either band (by using a short jumper wire with alligator clips to short out turns on the coil).

My previous efforts at characterizing this antenna have been to carefully tune my MFJ-259B in 25 kHz increments across both bands, and write down the resulting R (resistance) and X (absolute value of the reactance). With a little playing around and some mental gymnastics, I could guess the sign of the reactance.

The AIM4160 made very short work of that manually-intensive effort. Not only do I have more accurate data now, I have a nice hard copy. See Figure 1 for the normal display generated from the AIM4160. The display on the laptop is in color, but Figure 1 is in gray scale due to publication in *NCJ*. Thus I have added additional annotation to point out which curves are

[1]In the May 2005 issue of *QST*, Joel Hallas, W1ZR, reviewed the Autek VA1, the Kuranishi BR-210, the MFJ-269 (similar to the MFJ-259, but also covers UHF) and the Palstar ZM-30.



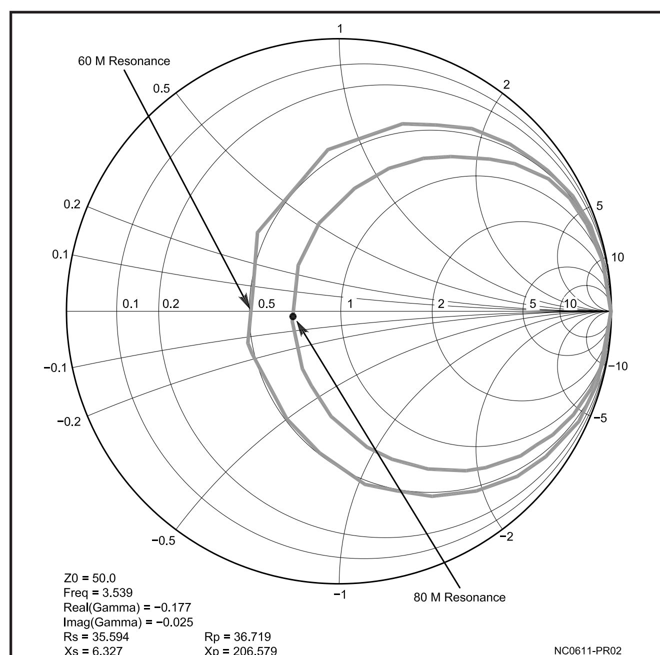
SWR, return loss, series resistance and series reactance. The data on the right side of the plot is for the frequency of the vertical marker line.

Note from the text in the upper left hand corner that this antenna, over the evaluated 1 to 5 MHz frequency range, exhibits three resonant frequencies: 1.833 MHz, 3.528 MHz and 2.583 MHz. The first two resonant frequencies are low resistance (about 26 Ω and 36 Ω, respectively), and of course are the desired ones. The last resonance is high resistance (way off the plot, with the upper scale at 100 Ω).

Also note that the files used for this run are given in the lower right hand corner. The calibration file used was the one I ran on September 9 using the furnished short, open and 200 Ω terminations. I also chose to reference the results to the antenna terminal, which means I used the AIM4160 to calibrate the 10 foot length of coax that went from the AIM4160 to the connector at the bottom of my antenna. If I wanted to, I could have re-run the data with an expanded scale to get better resolution in each band.

I used the *Averaging* function to smooth out the plot in Figure 1. This is noted in the top right hand corner with the annotation AVG ON.

Figure 2 shows the Smith chart version of the impedances in Figure 1. The dot just to the left of the center of the plot (the center is 1.0, which is 50 + j0 Ω) is a marker at 3.539 MHz. The impedance also crosses the real axis near the 0.5 point (25 + j0 Ω), which is 1.833 MHz. This indeed indicates that the 160 meter SWR is worse than the 80 meter SWR.



Summary

I found the AIM4160 very easy to use. It may not be as portable as my MFJ-259B, since I have to drag my laptop around with the AIM4160, but in my mind, the extra capabilities (better accuracy, better resolution, ability to save scanned files, ability to print hard copies and such) more than make up for that minor issue.

If you're looking for a new antenna analyzer to do some in-depth antenna work, check out this product. It may be exactly what you need.

Price, Availability, and Contact Information

W5BIG advises that the antenna analyzer to be put on the market will be the AIM4170, which has improvements over the AIM4160. The 4170 will go to 170 MHz, it will be in an aluminum box (the 4160 that I evaluated is in a plastic box) and the 4170 will have a few more tweaks to the software.

The AIM4170 will be manufactured and distributed by Array Solutions. Jay Terleski, WXØB, of Array Solutions, expects to offer the AIM4170 at $395. For availability and firm price of the AIM4170, contact Jay at 972-203-2008 or via e-mail at **jayt@arraysolutions.com**. You can also visit the Array Solutions website at **www.arraysolutions.com** NCJ

NCJ Profiles

Scott Robbins W4PA

In this issue "NCJ *Profiles" takes a look at PVRC member Ken Claerbout, K4ZW, of Stafford, Virginia. Ken is one of those contesters that has been slowly and steadily climbing up the contest results ladder, putting together a number of top-5 finishes in ARRL DX SSB, WPX SSB and CQ WW SSB over the past few years, peaking with winning CQ WW SSB USA SOAB HP in 2004. No slouch on CW either, Ken has been holding down the 40 meter chair at W3LPL for ARRL DX CW from Frank Donovan's Maryland location with #1 M/M scores posted from there in both 2004 and 2005. I would have picked this fellow to be a sure-fire bet for WRTC-2006!*

I got my start in Amateur Radio in 1977 while a freshman in high school. I was one of those that got swept up in the CB radio craze. I managed to work Mexico and Argentina on SSB, but if memory serves me, working DX on the CB bands was illegal at the time. Either way, the mold was cast!

One evening my dad took me to visit a friend of his, Rich Dykstra, WA9LEK. Not that I needed the additional motivation, but I was hooked at that point. Shortly afterwards, I ran into Lyle Ten Pas, WB9QCY (now WE9R). Lyle helped me get started in a Novice class taught by the Sheboygan County (Wisconsin) Amateur Radio Club. Months later I was licensed as WD9DEE. It wasn't long before I upgraded and became actively involved in chasing DX and contesting from the black hole. Once I got my Extra ticket, I applied for a new call and received KE9A.

In August of 1984 I accepted a position with the Diplomatic Telecommunications Service and moved to Virginia. Three months after coming on board, I was offered the chance to go on a six week trip to Africa. I spent the first four weeks in Liberia and obtained the call EL2CD. During that time, I put up a 160 meter antenna, one of my other loves, and managed to work a grand total of three people. The first contact was with John Rogers, G3PQA. Four days later I managed to work CT1AOZ and VE1YX. My travels during that time also took me to Ivory Coast, Zaire, Cameroon and Kenya, but I did not operate from any of those locations. I did operate from Ivory Coast on another trip in 1998 (TU/K4ZW). As that trip was concluding, the US Embassies in Kenya and Tanzania were blown up. That was enough to convince me it was time to head home.

In 1988 I applied for an overseas assignment and was given the choice of Liberia or the Philippines (Clark Air Base). Liberia would have been a good contest location, but Clark was a plum assignment and a little more family friendly, so the choice was pretty easy. I spent the next three years operating as KE9A/DU3 and working on telecommunications projects at our facility on Clark and at US embassies in the Far East. Life was good! Well, for the most part it was. The Philippines has a lot to offer, but unfortunately we missed out on much of it during the last two years due to the deteriorating security situation. There's nothing like wearing flak jackets and traveling to Manila in armored vehicles to play the Marines in softball! Our tour concluded a week and a half before the eruption of Mount Pinatubo. During our tour we also experienced a coup attempt and a 7.2 magnitude earthquake.

Ken Claerbout, K4ZW

In 1998 I was ready for a change, so I went back into the private sector working for Global One (a joint venture of Sprint, Deutsche Telecom and France Telecom). Eventually the venture dissolved. France Telecom took over whole ownership and merged us with another telecom firm, Equant. While I had a great career going there, the new company culture became something I could no longer stomach, and by late 2003 it was time to move on. After a short stint with a government-contracting firm, I jumped at an opportunity to move back into government service.

Today I work as an electrical engineer managing projects for the International Broadcasting Bureau (**www.ibb.gov**). IBB provides the administrative and engineering support for US government-funded non-military international broadcast services. The most well known is Voice of America (**www.voa.gov**). Our division is responsible for the overseas broadcast infrastructure. My office is located at the Cohen Building in downtown Washington DC, two blocks from the US Capital. If you're ever visiting Washington, drop me an e-mail (**kclaerbo@ibb.gov**).

I visited Mongolia in 2001 and 2002. The JT trips were for radio only and not work related. I met Chak Chadraawal, JT1CO, during a party at Karl Renz, K4YT's, house. Chak was in Washington on business. Being a low-band aficionado and needing zone 23 on 80 meters for one of my last zones toward 5BWAZ, I stopped at Ham Radio Outlet and picked up a copy of John Devoldere, ON4UN's, book *Low Band DXing* as a gift.

Later in the week Chak stopped at my place to see my station and 80 meter 4-Square. He said he was building a new home outside of Ulaanbaatar and suggested I should come to Mongolia to help him with antennas. Chak came back to the States later that spring for the Dayton Hamvention and the subject came up again. It was apparent he was serious so I took him up on the offer. We didn't put up a 4-Square, but instead a Titanex V160HD to also cover 160 meters. My first trip was scheduled for September 14, 2001. For obvious reasons, that didn't happen. I eventually made it to Mongolia in November. Along with playing around on the low bands, Chak let me use his station for CQWW CW 2001.

It was an experience to say the least. Being in such a rare zone was fun, but at times the pileups just got out of hand. It's very difficult to hold any rate with so many calling. On the flip side, there are times when rate is non-existent. Mongolia is too far from the big ham population centers. You really are out in the middle of nowhere. It was kind of cool to work so many UA9s and UAØs. I am hopeful to make a return trip to JT this winter.

I've never been real captivated by domestic contests with the exception of some serious efforts in single band contests like ARRL 10 Meter and ARRL CW 160 Meter. I'm trying to change that a little bit because I think some of them, like the Sprints, are good skill builders. CQWW contests are the premier events in my book, especially CW. That weekend (CW) tends to bring out some of the best SOAB ops in the USA.

Presently, I'm running a Yaesu FT-1000MP and a Kenwood TS-940S in SO2R configuration, with an Alpha 87A and a Commander HF-2500 providing the power. The antennas are on two towers of 90 feet each. I have 7/7 on 10 meters, 6/6 on 15 meters, 4/4 on 20 meters, 2 el on 40 meters, a 80 meter 4-Square and a T-top wire vertical for 160 meters. Beverages run out into the woods for receive antennas. I use *WriteLog* and an SO2R controller for logging in the shack.

Here's a statistic for you: In 2004 and 2005, Ken had eight — count 'em, eight — top 5 finishes as a single op out of 12 possible DX contest entries (both modes of ARRL DX, CQWW and CQ WPX), including winning CQ WW SSB in 2004. Two of the remaining four were spent in the 40 meter chair at W3LPL. That's quite an impressive achievement, to say the least. I don't think it's going to be anytime soon that this will be changing. Ken has not only stated he's going to continue going for the top spot at his present location, he's thinking about taller, higher, better in years to come.

In the January/February 2007 issue of NCJ*, "*NCJ *Station Profiles" travels "across the pond" for a close-up look at a high performance German contest station. 'Til next time — 73.* NCJ

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Contest Tips, Tricks & Techniques:

Gary Sutcliffe, W9XT

Filters, Part II

The last installment of CTT&T examined some of the filter combinations that contesters are using, including roofing filters and DSP filtering. In this final part of this series we will look at how some contesters use the filters in their radio, the filters between their ears and a brief look at future receivers.

How Narrow?

Mark Aaker, K6UFO, prefers 400-500 Hz filters for CW operation, as do others. Some, like Jim Callow, K8IR, and Pete Chamalian, W1RM, split between the 250 and 500 Hz filters. The narrow filter is used during S&P and the wider one is used for CQing.

The danger of using a filter that is too narrow is that you will not hear someone answering a bit off-frequency. Even with the 500 Hz filter on, I will give the receiver incremental tuning (RIT) a workout to make sure I don't miss a caller who is not zero beat. Jim George, N3BB, even uses his 1.8 kHz SSB filter on CW when the band is not well populated.

Phil Rice, WX9U, likes a very wide filter when the band is not very crowded. He can CQ and still hear stations 3 kHz or more away, some of which might be new multipliers.

Although the general consensus is to use a narrow filter in CW S&Ping, Mel Crichton, KJ9C, uses a 1 kHz filter with the variable width adjusted to bring it down to about 800 Hz. This lets him hear the next couple of stations up the band at the same time.

Gary Breed, K9AY, uses IF shift more often than narrow filters to deal with strong signals just outside the pass band.

There are different preferences with filters for SSB, as well. A 2.4 kHz filter is the favorite of Mark, K6UFO, while Chuck Schneebeli, KI9A, prefers narrower filters in the 1.8 to 2.0 kHz range. I personally operate SSB almost exclusively with the stock 2.4 kHz filter, followed by a 1.8 kHz filter in the 455 kHz IF with my FT-1000MP. In between those extremes, Hal Kennedy, N4GG, prefers 2.1 kHz INRAD filters.

Paul Chapman, W6PDC, feels that a pair of 1.8 kHz filters in his FT-1000 field provides the best value in filter investment. He puts them ahead of a roofing filter in priority, but feels that the 1.8 KHz filters, plus a roofing filter, is a sensible option.

Meat Filters

A lot of operators believe the most important filter is the one between your ears. That was echoed by Jim, N3BB, George Wagner, K5KG, and Cort Judd, K4WI.

A lot of great operators learned their trade before highly selective receivers became available. The great operators who operate from rare locations have learned to pick out calls from mass pileups. Their brains are the super filters.

Jim, K8IR, says he depends more on the filters in the radio on CW, and more on mental filtering for phone. Ken Fatchett, WØMU, relies heavily on mechanical filters, but feels sometimes that the mental filters are best. In tough conditions, Mike likes having a lot of options.

Antonio Galiana, EA5BY, likes to use the filter contour controls and pitch control to aid in copying signals on a noisy low frequency band. Tony says this adapts the signal so the mental filters can be most effective.

Basic communications theory tells us that the noise power is inversely proportional to the bandwidth. That would suggest that you use very narrow filters under noisy conditions. That seems pretty obvious, except a number of low-band experts suggest using a wider filter under conditions of heavy interference.

Apparently it is an effect of *stochastic resonance*, a phenomenon where addition of a certain amount of random noise can actually improve the detection of weak signals. Only a narrow noise level range will have this effect: too little noise will not have any effect, while too much will swamp the signal.

I have noticed low-band situations were the 250 Hz filter made copy of weak CW signals more difficult than a 500 Hz filter. I have been told that sometimes SSB-width filters work best, but I have never noticed it myself. Perhaps there is something else going on and it takes some time to train the brain to do this effectively.

Pete, W1RM, feels the filter between the ears is key, but the goodies in the radio sure help. He goes on to say "The best way to train that mental filter is to use it often! Contesting, like any sport, requires practice and that especially goes for the mental filters!"

Mike Wetzel, W9RE, does not spend a lot time switching between filters. He notes that you don't have a lot of time to twiddle with things during a contest. He does not change his operating style much during casual operating.

Pete Smith, N4ZR, says he could not get by with both the mechanical and mental filters. Hal, N4GG, feels the same way. He has high frequency hearing loss, so he adds a stage of audio shaping to compensate.

The Future

DSP technology promises filter characteristics beyond anything that can be built with traditional crystal or mechanical filters. An almost infinite number of poles can be put into a DSP filter design that would not be possible with traditional filters because of cost, component tolerance and other reasons.

The limitations on DSP are the speed of the processors and the conversion speed and resolution of the analog-to-digital (A/D) converters — major advances have been made in both. For a number of years I have felt that it is only a matter of time before a receiver consisted of only an A/D converter, a DSP processor, an audio amp and maybe an RF amplifier thrown in on the front end.

After attending a couple of talks on SDR (software defined radios) at Dayton this year, I feel that this time is approaching quickly. One representative from a major radio manufacturer told me he thought we had one more generation of the super-het type designs before all radios were of the SDR type.

Yaesu's newly announced FT-2000 is a step in that direction. The main receiver has a pair of roofing filters; all the other filtering is done with DSP. It will be interesting to hear the reviews of the first contesters to use them.

That wraps up this installment of CTT&T. Thanks as usual go out to our readers who passed along their experiences and thoughts on filters. This time there were comments from EA5BY, K2ONP, K4WI, K5KG, K6UFO, K8IR, K9AY, K9KM, KI9A, KJ9C, LU5DX, N2WN, N3BB, N4GG, N4ZR, NF8R, PY2NY, W1RM, W6PDC, W9RE and WX9U. Thanks guys!

Also thanks to Editor Carl Luetzelschwab, K9LA, for suggesting this great topic. This is CTT&T installment number #117, and I am running out of ideas for topics! Please send me suggestions for topics that you would like to see covered.

The deadline for the January/February 2007 issue of *NCJ* is November 15, 2006.

Small Contests

Nearly every weekend has 3 or 4 smaller contests like state QSO parties, mode or other specialty contests, as well as national DX contests. Which of those do you operate? What tips to you have for operating such contests? Do you ever operate several contests simultaneously? How do you do that? What tricks do you use to get non-contesting stations to call you and give you a contact? How does operating in a small contest improve your skills for bigger contests?

Send in your ideas on these subjects or suggestions for future topics either at Gary Sutcliffe, W9XT, 3310 Bonnie Ln, Slinger, WI 53086, or via e-mail at **w9xt@qth.com**. Be sure to get them to me by the deadline.

NCJ

RTTY Contesting

Don Hill, AA5AU

All the best to Bill Turner, W6WRT, on his retirement as the RTTY contesting columnist for *NCJ*. We will miss Bill's informative columns. The experience and knowledge Bill brought to his articles were beneficial to all of us.

When *NCJ* Editor Carl Luetzelschwab, K9LA, came to me this past summer, inquiring if I wanted to write this column, I was hesitant to accept at first. I was still in the process of remodeling my home after completing repairs from hurricane Katrina and I couldn't imagine having the time to dedicate to writing. But the invitation to contribute to such an excellent publication was too good to pass up.

As your new RTTY contesting columnist, I'm looking forward to bringing nearly 25 years of RTTY experience to this column, which I hope will benefit both newcomer and experienced RTTY contesters. RTTY contesting has exploded in the 21st century as Amateur Radio operators all around the world have flocked to this fun and easy contest mode. Statistics compiled by Sigi Sembra, DJ3NG, using actual contest results data, show that in the years 2000 through 2005, the amount of RTTY contest logs submitted to contest sponsors has increased by an average of 18 percent each year (see Figure 1). The number of logs submitted in 2005 was more than double what was submitted in 2000. Even more interesting is that the biggest increases have come in the last three years, which have been in the low part of the sunspot cycle.

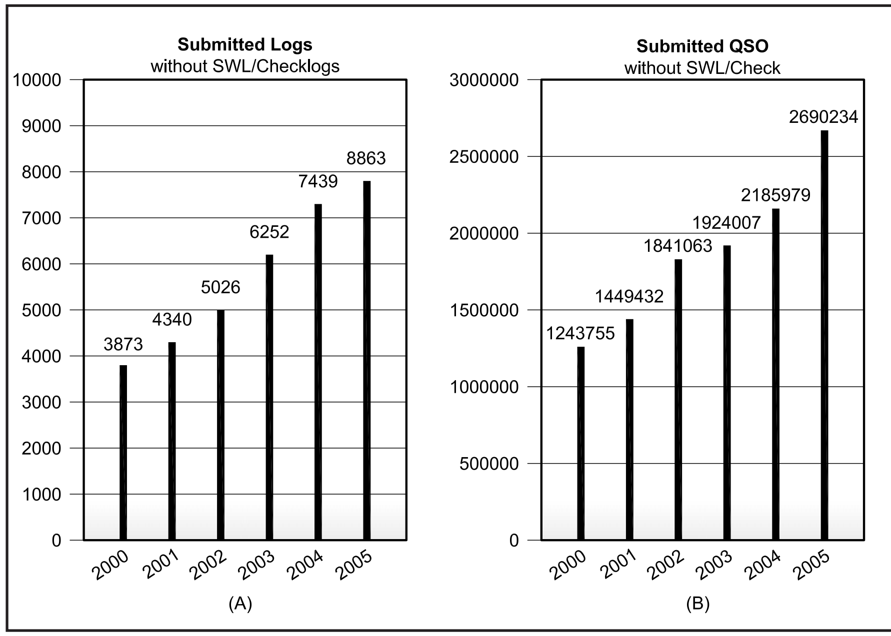

Figure 1— (A) Submitted RTTY logs by year (B) Submitted RTTY QSOs by year Sigi Sembra, DJ3NG

If You Build It, They Will Come

Additional statistics by Sigi show a similar increase in the number of RTTY contest QSOs in the past five years (see Figure 2). But these numbers tell a different story from the log submission data. The number of RTTY contest QSOs jumped a dramatic 23 percent in 2005 as compared to 2004. It's difficult to explain the reason for this other than to guess that RTTY contesters are getting better at their sport. Another reason for this could be the increasing number of operators going SO2R.

It's hard to know exactly where all the new RTTY contesters are coming from. Some come from the CW/SSB contesting ranks, and that's an obvious path to RTTY contesting. I hope more CW and SSB contesters give RTTY a shot. If you are looking for a new challenge, RTTY contesting is worth a try. If you already contest on the other modes, it doesn't take much to get up and running on RTTY. In his first all-out effort in RTTY contesting, Randy Thompson, K5ZD, took first place High Power and set a new class record in the 2001 ARRL RTTY Roundup. This may not be surprising to some considering Randy's overall contesting expertise, but it was a remarkable performance nonetheless.

Another contester with CW/SSB roots is Dave Ranney, KTØR. Dave is an avid CW and SSB contester and got his feet wet in RTTY contesting for the first time in the 2005 CQWW RTTY contest. After limited efforts in the 2006 CQ WPX RTTY and February NAQP RTTY contests, his first full-scale effort came in the 2006 July NAQP RTTY contest. His claimed score placed him third behind two well-known experienced operators – Charlie Morrison, KI5XP, and Nick Smith, W4GKM. His claimed QSO total of more than 600 QSOs is quite impressive. This represents an average of one QSO a minute for the 10 hour period. This is the kind of rate that RTTY contesters strive for. It's elusive and normally reserved for the more experienced operators. For Dave to achieve this in his first serious effort shows the crossover into RTTY from the other modes can be easily realized with successful results in a short time.

There are lots of success stories when it comes to CW and SSB contesters jumping into the RTTY fun. For those CW and SSB contesters wanting to try RTTY, there is now enough information available on the Internet to get you going without a lot of cost or effort. Just do an Internet search on "RTTY contesting" and you'll find what you are looking for. If not, send an e-mail to **aa5au@bellsouth.net** and I'd be happy to answer any questions you might have.

November/December RTTY Contests

Contest season is in full swing, but the only major RTTY contest in November is the Work All Europe DX Contest (WAEDC). The RTTY segment, which takes place on the second full weekend in November (November 11-12 in 2006), has different rules than its CW and SSB counterparts.

What makes the WAEDC interesting is QTC traffic (one point for working someone and another point for telling a second station that you worked the first staion). For the beginner RTTY contester, this can be a bit confusing but it is really quite simple. A QTC is simply passing information of a previous QSO from one station to another. In the CW and SSB portions of WAEDC, stations outside of Europe can only work and send QTCs to stations in Europe. In the WAEDC RTTY contest, QSOs with stations within the same continent are permitted (you can work anyone) and QTCs can be passed (sent and received) between any two stations that are not in the same continent.

WAEDC is special to me because I won my first ever contest trophy in the 1975 CW contest for first place W9 land (10th USA) as WB9IVC. In the early years of WAEDC there were separate High Band and All Band categories for both EU and non-EU. I won the non-EU

RTTY All Band titles in 1986, 1988 and 1989. The real reason I was able to win these contests was because I became proficient at sending and receiving QTCs. This was before there were contestlogging programs with WAEDC QTC traffic handling capabilities.

I was using two Heathkit H-89 computers and a home-brew RTTY program (not designed for contesting). One computer was for RTTY and the other was for logging in a text-editing program in CP/M. Between contacts, I would create text files of QTCs and save them to a floppy disk and transfer the disk from one computer to the other to send the QTCs. To receive QTCs, I would open a receive text file and capture the incoming QTCs. I would then copy these received QTCs into my text log file on the other computer. Back then, nearly all QTCs were sent by hand "live at the keyboard" and it was a slow process. So with a little ingenuity I was able come out on top despite not having a big contest station.

Most of today's RTTY contest programs, including *WriteLog*, *N1MM Logger*, *MixW* and *RCKRtty* have built-in QTC traffic handling capabilities. The most important thing you can do if you plan on passing QTCs is to practice with your software. Don't be afraid to try. Once you get the hang of it, you'll end up having a lot of fun. I've missed several recent WAE RTTY contests because it fell on opening weekend of duck season in Louisiana; however, it looks like my duck hunting days are behind me now and I'm looking forward to WAE RTTY this year.

In December, there are two RTTY contests to note. On the first Saturday of the month is the TARA RTTY Melee (formerly called the TARA RTTY Sprint), and two weeks later is the OK DX RTTY Contest. Although neither is considered a major RTTY contest, they are important because they come in the month before the ARRL RTTY Roundup and can be used to test your set-up going into the Roundup. The rules for the TARA RTTY Melee are the same as the Roundup, so it's perfect for pre-Roundup preparation. If you find you need to make some kind of change or improvement to your contest set-up after TARA, you can then use the OK DX RTTY Contest to test these changes. Both contests are fun and offer good activity to keep you busy. The ARRL RTTY Roundup falls on the first full weekend of January (excluding January 1). Whatever you do, don't miss the Roundup! NCJ

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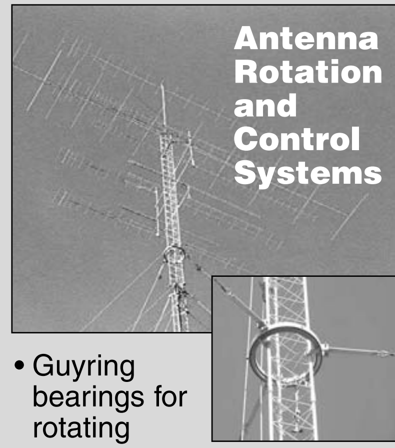

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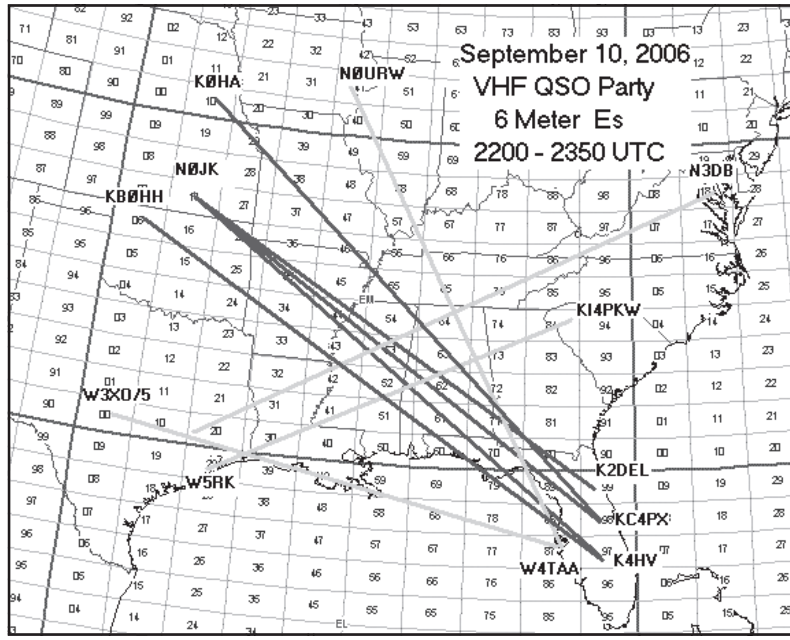
Jon K. Jones, NØJK

The CQ 2006 WPX VHF Contest

"In eight seasons, I have never heard the 6 meter band so good." — Jim Reisert, AD1C

Jim's comment pretty well sums it up. The 2006 CQ VHF WPX contest rocked on 6 meters. It may be the best VHF WPX Contest ever.

Of the major VHF Contests, the CQ VHF WPX has lived in the shadow of the ARRL contests. The VHF WPX is scheduled in late July, well after the normal peak of the summer E_s season, yet it is usually "too early" and "too hot" for tropospheric openings. The VHF WPX is shorter than the ARRL contests by several hours, and it covers only the 6 and 2 meter bands. Most of the time conditions are mediocre and participation sparse — this year was different. The VHF WPX hit the jackpot for E_s in 2006.



E_s Not So Sporadic

The summer 2006 E_s season may go down as one of the best ever recorded. The "World Above 50 MHz" columns in *QST* by Gene Zimmerman, W3ZZ, document the great European and Japanese 6 meter E_s openings in May, June and July. On July 12 (three days before the VHF WPX), there was a huge 6 meter E_s opening to much of Europe from the United States and Canada. Bob Yates, W4GCB, said, "The floodgates opened to Europe!" From Kansas I worked EA5HT (IM98) and EH8BPX (IL18) while running 50 W and a 2 element Yagi! Gene, W3ZZ, worked the Netherlands from his mobile in Maryland. The big gun stations on the East Coast and in the Midwest ran Europeans on 6 meters E_s like a HF contester would on 10M CW during WW meters CW during the solar cycle peak.

On Friday July 14, W4GCB again had 6 meters E_s to Europe — working, G3FPQ, IT9EJW, EI7IX, MMØAMW, GDØTEP and GØJHC. Would the E_s continue for the VHF WPX contest?

Saturday July 15 found a good 6 meter E_s opening from much of North America to Europe. Joe Kraft, CT1HZE worked as far west as KØGU (DN70) in Colorado, and also worked N7KA (DM65) in New Mexico at 1745 UTC — just 15 minutes before the start of the contest!

The VHF WPX started at 1800 UTC July 15, and the 6 meter band was wide open. Ed Kelly, VP9GE, reported 267 QSOs and 107 grids on 6 meters from Bermuda during the 2331-0200 UTC period. He worked into the Pacific Northwest — three E_s hops. He finished the contest with 461 QSOs and 135 grids on 6 meters. Bob Striegl, K2DRH, in Illinois reported 6 meters stayed open all afternoon Saturday to the Northeast states. He worked K1TEO, on 2 meter E_s. Bob also reported decent tropo on 2 meters out to 500 miles or so. His biggest thrill of the contest was when Jose Hierro, EA7KW, called him on 6 meters Sunday in a pileup! He claimed 1428 QSOs and 288 grids on 6 meters. This may be an all time top 6 meter band score in any VHF contest. Bob notes, "This is the most QSOs I have ever made in any VHF contest… definitely one for the record books!"

Bill Hohnstein, KØHA EN10 in Nebraska, made 1378 QSOs in 274 grids on 6 meters in the VHF WPX. He worked many KP4s, TI8CBT, HI3TEJ, HI8ROX, FG5FR, FG1GW, VY2SS and other DX. Almost all of his 6 meter QSOs were via E_s, with very few QSOs with close-by stations via ground wave. This is typical of the heartland — if E_s or tropo occurs, you can work many stations. Otherwise it's very few local QSOs and a slow contest.

Gerard Jendraszkiewicz, KE9I, operated the RTTY contest Saturday, and "was just going to fool around on 6 meters Sunday, but the band was so good I decided to have a bit of fun! I worked a couple of Europeans, some Caribbean and South America. This is the best I have ever heard the band [6 meters] with multi-E_s ever!"

Climb Every Mountain

A category unique to the CQ VHF WPX contest is the "Hill Topper QRP Category." In this category, you operate for 6 hours QRP, battery portable. I entered in this category and managed to work Lefty, K1TOL (FN44) in Maine on 6 meters Saturday afternoon using 10 W and a whip antenna. Good ears, Lefty! K1TOL is claiming 1319 QSOs in 274 grids on 6 meters. I heard a very loud FM5JC on Sunday morning, but could not work him for contest credit, as my 6 hours were used up! FM5JC worked all the way to the Pacific Northwest — this is as far from Martinique as Western Europe! The Hill Topper QRP category is great for those who don't have time to operate the full contest period, live where they can not put up outside antennas or don't have the resources for a high power big antenna station. You do, however, have to be selective when you pick your 6 hour period to operate!

Another feature of the VHF WPX is that DX stations can work each other, as well as W/VE stations — unlike the ARRL VHF Contests where DX can only work W/VE. This encourages more DX activity and with the great 50 MHz E_s this year, it made the CQ VHF WPX a truly "international" VHF contest. Steve Hodgson, ZC4LI, of Cyprus reported he "even managed a few stateside Qs."

Phil Krichbaum, NØKE, from Colorado observed "great conditions for July. I've never worked this much DX in a VHF contest before!" He worked many rovers and noted this may be "because it is a lot easier to do 2 bands." Fellow Rocky Mountain op Ken Anderson, WØETT, found "fantastic conditions on 6 meters." And a VHF contest tip: W0ETT said his IC-756 PROII worked like a champ on 6 meters. He felt it was much more sensitive and selective than the IC-756 for 6 meters.

So, two days of fantastic E_s on 50 MHz and even 144 MHz, good regional tropo and many record scores posted. Looks like the 2006 CQ VHF WPX Contest will be one for the record books!

What about 2007? Some experts feel E_s is best at the solar cycle minimum. The quiet geomagnetic activity may let E_s clouds last longer before fading. So 2007 could be another great year for the summer VHF contests. Hope you check them out.

The 2006 September VHF QSO Party — Surprise 6 Meter E_s Opening and Coastal Tropo on 432 MHz.

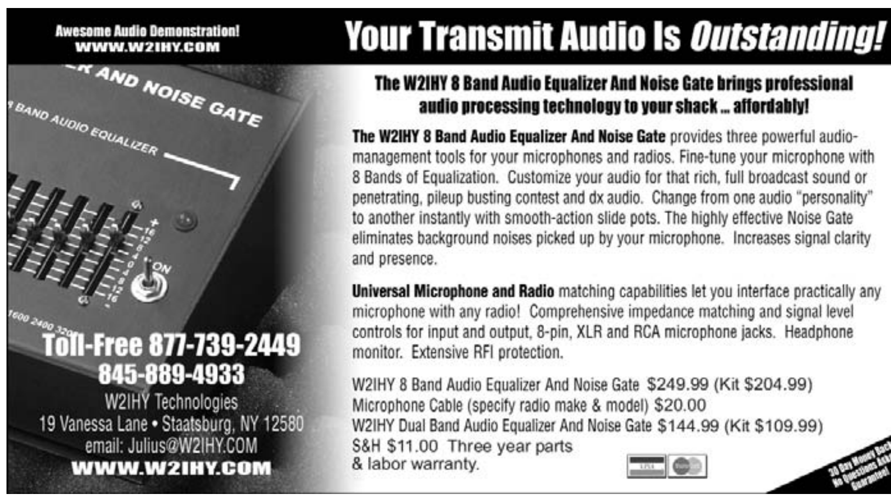
After a very slow Saturday and Sunday morning, a nice 50 MHz E_s opening popped up Sunday afternoon across the Southeastern states. This opening caught many ops by surprise, as Sunday afternoon in the September VHF contest is usually a slow period and a good time to watch some football or do chores around the house.

Stations in Oklahoma began hearing Florida stations around 2100 UTC. Gary Gerber, KBØHH (EM06), tipped me off that he was working Florida at 2155 UTC. I did not hear any Florida stations in EM17. The opening became more widespread with time, and by 2215 UTC, I started to hear K4HV CQing on 50.130 MHz. From home using only a stealth attic dipole and 100 W on 6 meters, I worked: K4HV (EL97), KC4PX (EL98) and K2DEL (EL99).

Ivars Lauzums, KC4PX, was quite loud here in Kansas and ran quite a few stations on 50.132 MHz. He made 115 QSOs in 67 grids on 6 meters. The E_s opening lasted until 0045 UTC Sept. 11 —almost 4 hours! The accompanying map shows the extent of the opening, and also other contacts crossing the E_s cloud. While not as widespread or intense as the Sunday afternoon E_s opening in the 2005 September VHF QSO Party, this year's opening was a nice treat. Alert ops who watched the band picked up some new grids and QSOs on 6 meters via E_s.

Ken Neubeck, WB2AMU, operating single op QRP Portable from FN30 made a nice 432 MHz tropo contact with AA3ID (FM25), located on the outer banks off North Carolina, a 650 kilometer distance. Ken said AA3ID's signal was so strong on 432 MHz that he was able to work him using his 3 element 2 meter Yagi!

NCJ



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Contest Calendar

Compiled by Bruce Horn, WA7BNM

Here's the list of major contests of possible interest to North American contesters to help you plan your contesting activity through January 2007. The Web version of this calendar is updated more frequently and lists contests for a 12 month period. It can be found at **www.hornucopia.com/contestcal/**.

As usual, please notify me of any corrections or additions to this calendar. I can be contacted via e-mail at **bhorn@hornucopia.com**. Good luck and have fun!

November 2006

IPARC Contest, CW — 0600 UTC-1000 UTC, Nov 4 and 1400 UTC-1800 UTC, Nov 4
Ukrainian DX Contest — 1200 UTC, Nov 4 to 1200 UTC, Nov 5
ARRL Sweepstakes Contest, CW — 2100 UTC, Nov 4 to 0300 UTC, Nov 6
NA Collegiate ARC Championship, CW — 2100 UTC, Nov 4 to 0300 UTC, Nov 6
IPARC Contest, SSB — 0600 UTC-1000 UTC, Nov 5 and 1400 UTC-1800 UTC, Nov 5
High Speed Club CW Contest — 0900 UTC-1100 UTC, Nov 5 and 1500 UTC-1700 UTC, Nov 5
DARC 10 Meter Digital Contest — 1100 UTC-1700 UTC, Nov 5
ARS Spartan Sprint — 0200 UTC-0400 UTC, Nov 7
WAE DX Contest, RTTY — 0000 UTC, Nov 11 to 2359 UTC, Nov 12
ARRL EME 50-1296 MHz — 0000 UTC, Nov 11 to 2359 UTC, Nov 12
JIDX Phone Contest — 0700 UTC, Nov 11 to 1300 UTC, Nov 12
OK/OM DX Contest, CW — 1200 UTC, Nov 11 to 1200 UTC, Nov 12
Kentucky QSO Party — 1400 UTC, Nov 11 to 0600 UTC, Nov 12
CQ-WE Contest — 1900 UTC, Nov 11 to 0500 UTC, Nov 13
NAQCC Straight Key/Bug Sprint — 0130 UTC-0330 UTC, Nov 16
YO International PSK31 Contest — 1600 UTC-2200 UTC, Nov 17
LZ DX Contest — 1200 UTC, Nov 18 to 1200 UTC, Nov 19
All Austrian 160 Meter Contest — 1600 UTC, Nov 18 to 0700 UTC, Nov 19
ARRL Sweepstakes Contest, SSB — 2100 UTC, Nov 18 to 0300 UTC, Nov 20
NA Collegiate ARC Championship, SSB — 2100 UTC, Nov 18 to 0300 UTC, Nov 20
RSGB 2nd 1.8 MHz Contest, CW — 2100 UTC, Nov 18 to 0100 UTC, Nov 19
Run for the Bacon QRP Contest — 0200 UTC-0400 UTC, Nov 20
CQ Worldwide DX Contest, CW — 0000 UTC, Nov 25 to 2400 UTC, Nov 26
ARCI Topband Sprint — 0000 UTC-0600 UTC, Nov 30

December 2006

ARRL 160 Meter Contest — 2200 UTC, Dec 1 to 1600 UTC, Dec 3
TARA RTTY Melee — 0000 UTC-2400 UTC, Dec 2
Wake-Up! QRP Sprint — 0400 UTC-0600 UTC, Dec 2
ARS Spartan Sprint — 0200 UTC-0400 UTC, Dec 5
ARRL 10 Meter Contest — 0000 UTC, Dec 9 to 2400 UTC, Dec 10
NA High Speed Meteor Scatter Rally — 0000 UTC, Dec 10 to 0700 UTC, Dec 18
CQC Great Colorado Snowshoe Run — 0200 UTC-0359 UTC, Dec 10
NAQCC Straight Key/Bug Sprint — 0130 UTC-0330 UTC, Dec 13
Russian 160 Meter Contest — 2100 UTC-2300 UTC, Dec 15
MDXA PSK DeathMatch — 0000 UTC, Dec 16 to 2400 UTC, Dec 17
OK DX RTTY Contest — 0000 UTC-2400 UTC, Dec 16
Croatian CW Contest — 1400 UTC, Dec 16 to 1400 UTC, Dec 17
ARCI Holiday Spirits Homebrew Sprint — 2000 UTC-2400 UTC, Dec 17
Run for the Bacon QRP Contest — 0200 UTC-0400 UTC, Dec 18
DARC Christmas Contest — 0830 UTC-1059 UTC, Dec 26
RAC Winter Contest — 0000 UTC-2359 UTC, Dec 30
Stew Perry Topband Challenge — 1500 UTC, Dec 30 to 1500 UTC, Dec 31

January 2007

SARTG New Year RTTY Contest — 0800 UTC-1100 UTC, Jan 1
AGCW Happy New Year Contest — 0900 UTC-1200 UTC, Jan 1
ARRL RTTY Roundup — 1800 UTC, Jan 6 to 2400 UTC, Jan 7
EUCW 160 Meter Contest — 2000 UTC-2300 UTC, Jan 6 and 0400 UTC-0700 UTC, Jan 7
Kids Day Contest — 1800 UTC-2400 UTC, Jan 7
Hunting Lions in the Air Contest — 0000 UTC, Jan 13 to 2400 UTC, Jan 14
070 Club PSKFest — 0000 UTC-2400 UTC, Jan 13
MI QRP January CW Contest — 1200 UTC, Jan 13 to 2359 UTC, Jan 14
Midwinter Contest, CW — 1400 UTC-2000 UTC, Jan 13
North American QSO Party, CW — 1800 UTC, Jan 13 to 0600 UTC, Jan 14
NRAU-Baltic Contest, CW — 0530 UTC-0730 UTC, Jan 14
Midwinter Contest, Phone — 0800 UTC-1400 UTC, Jan 14
NRAU-Baltic Contest, SSB — 0800 UTC-1000 UTC, Jan 14
DARC 10 Meter Contest — 0900 UTC-1059 UTC, Jan 14
LZ Open Contest — 1200 UTC-2000 UTC, Jan 20
UK DX Contest, RTTY — 1200 UTC, Jan 20 to 1200 UTC, Jan 21
Hungarian DX Contest — 1200 UTC, Jan 20 to 1200 UTC, Jan 21
North American QSO Party, SSB — 1800 UTC, Jan 20 to 0600 UTC, Jan 21
ARRL January VHF Sweepstakes — 1900 UTC, Jan 20 to 0400 UTC, Jan 22
CQ 160 Meter Contest, CW — 0000 UTC, Jan 27 to 2359 UTC, Jan 28
REF Contest, CW — 0600 UTC, Jan 27 to 1800 UTC, Jan 28
BARTG RTTY Sprint — 1200 UTC, Jan 27 to 1200 UTC, Jan 28
UBA DX Contest, SSB — 1300 UTC, Jan 27 to 1300 UTC, Jan 28

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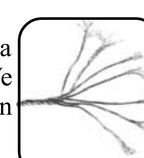

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July 2006 NAQP RTTY Results

Shelby Summerville, K4WW

There were a lot of pre-contest suggestions about checking 10 meters "on the hour" and 15 meters "on the half hour". Post-contest comments indicate that once either band was "checked," conditions made it difficult to leave. It's almost difficult to explain how much more fun having favorable conditions on 10 and 15 meters adds to the contest.

Once again Charlie Morrison, KI5XP, operated — without peer — the W5WMU superstation to another winning score of 146,306. Dave Ranney, KTØR, although finishing with one more multiplier than KI5XP, could not overcome the 137 QSO deficit, finishing second with 120,768 points. Multipliers were the difference between KTØR and Nick Smith, W4GKM, as Nick had eight more QSOs, but fell 10 short on multipliers. Steve Franzen, N9CK, at 114,390 and Jeff Rymer, KE9S, at 113,094 round out the top five.

Sixteen State/Province records were established: Tom Homewood, W8BAR (operated by W1TO), Massachusetts; Paul Whitman, KC2NMZ, New Jersey; Robert Johnson, K3MQ, Delaware; Joe Trench, AA3B, Pennsylvania; Shelby Summerville, K4WW, Kentucky; Joe Wheeler, Jr, K4HMB, North Carolina; Nick Smith, W4GKM, Tennessee; Jose Castillo, N4BAA, Virginia; Earl Smith, N5ZM, Arkansas; Charlie Morrison, KI5XP, Louisiana; Jim Callow, K8IR, Michigan; Steve Franzen, N9CK, Wisconsin; Steve Sawyer, KTØDX, Colorado; Dave Ranney, KTØR, Minnesota; Jim Wennblom, KØHW, South Dakota, and Bud Mortenson, VA7ST, British Columbia.

The Stanford Amateur Radio Club team, W6YX (Mark Aaker, K6UFO; Everett Palmer III, KG6RYB; Dean Wood, N6DE; Michael Heideman, N7MH; Tom Berson, ND2T, and Risto Kotalampi, W6RK), again established themselves as the "one to beat" in M/2 with a score of 166,460. The W6YX QSO and multiplier totals (812/205) easily outdistanced the KB1JZU team (Bob Montemerlo, KB1JZU; Charlie Cayen, KT1I; Gordon LaPoint, N1MGO, and Bill Leger, N1UZ).

The TCG Diddles team (Nick Smith, W4GKM; Don Binkley. N4ZZ; Jim Hall, AD4EB; Kenny Young, AB4GG, and Howard Wright, WA4OSD) broke the "stranglehold" that the Southwest Arizona Contest Club (SWACC) team (Charlie Morrison, KI5XP; Mark Mandelkern, K5AM; Dave Hachadorian, K6LL; Micheal Matlock, K7WM, and Charles Anderson, KK5OQ) has had on the team competition.

DX scoring was led by Mohamed Kharbouche, CN8KD, operating as 5F5ØKD, with a score of 13,065 points.

Beginning with the February 2007

Soapbox

AA9DY — I operated much more than I thought I was going to get a chance to.
AA3B — First time in this contest.
AA5AU — It was great to contest again.
AD4EB — This contest was a blast.
AD6WL — Great conditions on 10 and 15 meters.
KØHW — I wish more stations had been on 10 meters.
KØPC — How did I miss 10 meters?
K2PAL — Thanks to all who made 10 meters fun.
K3MQ — My first RTTY NAQP. Had a great time!
K4GMH — Nice 10 meter opening.
K4RO — Ten meters was open for HOURS — much fun!
K7SV — I had a blast using a very simple station with a wire antenna in the trees!
K8AJS — Interesting to work DX in the NAQP.
K8IR — 10 and 15 meters exceeded expectations.
K9SEX — Found a bone to chew on and quit early.
KE5OG — Great fun, but man, the bands were tough in West Texas.
KE7AJ — Great fun — nice to hear 10 and 15 meters open for a change.
KI5XP — I set out to beat my last years July score — never thought I'd beat my Feb 2006 score.
KK5LO — My first RTTY contest.
KSØM — My first time in this contest.
KTØR — Wow! What fun.
N2WK — Murphy was present from the start.
N4BAA — Weather forced some untimely breaks
N4ZZ — Almost double my score from last year!
N5RN — This was my first solo effort on RTTY.
N7MQ — Love this contest
VA1CHP — Prop was okay, I even worked some DX.
VA7ST — Ten meters was open all afternoon.
VE3NZ — GREAT contest
W1BYH — Great contest for bottom of cycle
W4GAC — We use this contest to introduce new members to RTTY.
W4UK — Wire dipoles only.
W6YX — This is the best we have ever done in a July NAQP RTTY.
WA7SLD — Best NAQP result for me
WM3T — Boy that was fun.
WN1G — The wife and I operated as a multi-op.
WO4O — Part-time diddling, in between piddling. Running barefoot RULES!
WX4TM — The gremlins were sure with me in this one.

Team Scores

1. TCG Diddles		*2. SWACC #1*		*3. SO1R*	
W4GKM	115,934	KI5XP	146,306	K4WW	88,375
N4ZZ	109,114	K5AM	62,500	N5ZM	80,410
AD4EB	104,286	K6LL	61,686	K9MUG	59,885
AB4GG	52,959	K7WM	58,904	W6WRT	40,320
WA4OSD	29,120	KK5OQ	54,316	WX4TM	36,406
Total	**411,413**	**Total**	**383,712**	**Total**	**305,396**

MWA Baudots (KTØR,KØRC,NØAT,KEØL)	281,750
SWACC #2 (AD6WL,K8IR,KE5OG,N7UVH,WA6BOB)	268,916
NCCC Rabid Mallards (WK6I,N6OJ,WØYK,K6DGW,KJ6RA)	244,079
YCCC (W8BAR,NP3D,AD1C,WA1Z)	195,306
Pikes Peak DX Group (PPDXG) (KTØDX,KØRFD,WØRAA,K8FC)	178,683
Team PVRC (W3LL,WM3T,W2YE,N2WK)	175,815
SMC Blue (N9CK,N2BJ)	168,410
MWA Chads (WA2MNO,KØJJR,KØPC,KSØT)	121,114
SMC Red (K9WX,AA9DY,N9LF,K9MI)	107,729
TCG Line Feeds (WO4O,NY4N,K4RO,W4BCG,NA4C)	105,595
NCCC Dockers (NF6A,K6EU,WB6S,K6UM,W6ZZZ)	82,165
Metro Muttz (W9ILY,N9LAH,K9PY,N9AKR)	66,013
TCG Space Tones (K4KO,K1GU,W9WI,KA4OTB)	59,560
SMC Green (AK9F,AI9L)	14,607
NCCC Polos (N6CK,W6RKC,KO6LU,K6OWL,W6RK)	10,431

Single Op Top Ten Breakdowns

Call	Score	QSOs	Mults	80	40	20	15	10	Team
KI5XP	146,306	766	191	97/37	199/44	287/52	154/40	29/18	SWACC #1
KTØR	120,768	629	192	41/27	121/43	182/45	165/40	120/37	MWA Baudots
W4GKM	115,934	637	182	94/36	189/49	208/42	120/38	26/17	TCG Diddles
N9CK	114,390	615	186	67/25	173/44	189/47	126/41	60/29	SMC Blue
KE9S	113,094	618	183	33/20	143/43	246/51	125/37	71/32	
N4ZZ	109,114	613	178	70/32	188/48	192/41	103/33	60/24	TCG Diddles
AD4EB	104,286	573	182	96/36	157/47	185/47	78/30	57/22	TCG Diddles
WK6I	102,138	587	174	58/19	154/43	211/48	76/31	88/33	NCCC Rabid Mallards
KTØDX	93,019	557	167	38/19	145/42	204/46	114/35	56/25	Pikes Peak DX Group (PPDXG)
K4WW	88,375	505	175	82/33	134/42	155/44	80/32	54/24	SO1R

NAQP RTTY, there will be a "recognition" list of Single Operator, Single Radio. This information will be taken from the 3830 score-posting site, which can be found at **www.hornucopia.com/3830score/**.

I encourage all participants to post their score there, and also at **www.ncjweb.com/naqplogsubmit.php**.

Using this log submission utility will give you instant confirmation that your log has been received, and will lessen the workload of Bruce Horn, WA7BNM, the NAQP log checker.

Many thanks to all the participants, to Bruce for the log checking and to ICOM America for so graciously sponsoring the plaque program.

Single Op QRP Top Five Breakdowns

Call	Score	QSOs	Mults	80	40	20	15	10
WA4PGM	21,306	201	106	46/22	48/22	48/28	39/22	20/12
KU5B	20,520	190	108	27/15	67/32	64/34	20/16	12/11
K9VIC	11,242	146	77	21/10	46/28	63/28	11/6	5/5
K4AQ	3,612	86	42	0/0	45/21	37/18	4/3	0/0
NØQJS	81	9	9	0/0	0/0	9/9	0/0	0/0

Multi-Two Breakdowns

Call	Score	QSOs	Mults	80	40	20	15	10
W6YX	166,460	812	205	83/32	200/49	255/49	168/41	106/34
KB1JZU	95,485	565	169	60/26	150/46	226/46	103/34	26/17
W4GAC	72,450	483	150	47/24	125/37	235/50	67/31	9/8

Single Operator Scores

Call	Score	QSOs	Mults	QTH	Team
W8BAR (W1TO)	84,660	510	166	MA	YCCC
W1BYH	50,274	342	147	MA	
AD1C	31,320	261	120	MA	YCCC
WB8IMY/1	5,194	98	53	CT	
WN1X	5,073	89	57	RI	
W1LZ	3,139	73	43	NH	
WA1Z	3,066	73	42	NH	YCCC
N1MD	2,220	60	37	CT	
NP3D (EW1AR)	76,260	465	164	NY	YCCC
W2RTY	65,700	438	150	NY	
KC2NMZ	44,880	330	136	NJ	
K2PAL	26,112	256	102	NY	
N2WK	25,134	213	118	NY	Team PVRC
N2UM	5,445	99	55	NY	
N2KX	2,924	68	43	NY	
N2JSO	1,092	39	28	NJ	
W2PWE	1,080	40	27	NJ	
KC2NFI	308	22	14	NY	
K3HR	99	11	9	NJ	
AA3B	76,160	448	170	PA	
W3LL	65,100	465	140	MD	Team PVRC
WØBR	54,937	401	137	PA	
K3MQ	53,721	381	141	DE	
W3KB	51,198	371	138	PA	
WA3AAN	35,250	282	125	PA	
W3PT	35,164	298	118	PA	
W3WKR	34,770	305	114	PA	
N3XLS	33,600	320	105	PA	
W3DQN	20,256	211	96	MD	
W3OFD	8,120	116	70	PA	
KE3T	6,466	106	61	DE	
W3BUI	5,355	85	63	MD	
W3DSX	3,784	86	44	PA	
K3OK	3,195	71	45	PA	
N3NZ	858	39	22	PA	
K3YJP	180	15	12	MD	
N3RDV	56	8	7	PA	
W4GKM	115,934	637	182	TN	TCG Diddles
N4ZZ	109,114	613	178	TN	TCG Diddles
AD4EB	104,286	573	182	TN	TCG Diddles
K4WW	88,375	505	175	KY	SO1R
N4BAA	84,480	528	160	VA	
K4FJ	70,807	451	157	VA	
W4LC	60,648	456	133	KY	

Call	Score	QSOs	Mults	QTH	Team
K9MUG	59,885	413	145	AL	SO1R
K7SV	59,348	401	148	VA	
WM3T	53,640	447	120	VA	Team PVRC
K4HMB	53,053	371	143	NC	
AB4GG	52,959	381	139	TN	TCG Diddles
W4UK	47,286	333	142	SC	
WB2RHM	39,732	301	132	NC	
WO4O	37,406	317	118	TN	TCG Line Feeds
WX4TM	36,406	334	109	AL	SO1R
K4IQJ	33,630	285	118	AL	
K4KO	32,148	282	114	TN	TCG Space Tones
W2YE	31,941	273	117	VA	Team PVRC
NT4D	30,381	247	123	NC	
NY4N	30,371	251	121	TN	TCG Line Feeds
WA4OSD	29,120	260	112	TN	TCG Diddles
K4RO	26,606	251	106	TN	TCG Line Feeds
KN6RO	24,856	239	104	GA	
AA4LR	22,119	219	101	GA	
*WA4PGM	21,306	201	106	VA	
K1GU	20,685	197	105	TN	TCG Space Tones
K4CZ	19,950	210	95	NC	
W2TGP	12,699	153	83	GA	
K4HAL	10,281	149	69	AL	
WD4DDU	9,417	129	73	VA	
K3NC	9,179	137	67	VA	
NJ4F	8,349	121	69	SC	
W4BCG	6,844	116	59	AL	TCG Line Feeds
WG4M	6,630	102	65	VA	
KV4CN	5,712	102	56	NC	
W9WI	4,929	93	53	TN	TCG Space Tones
NA4C	4,368	78	56	TN	TCG Line Feeds
AI4ME	4,056	78	52	VA	
*K4AQ	3,612	86	42	GA	
KE1F	3,496	76	46	FL	
W4KTF	2,583	63	41	VA	
KA4OTB	1,798	58	31	TN	TCG Space Tones
K4DJ	1,612	52	31	NC	
WB5NMZ	825	33	25	AL	
AD4YQ	375	25	15	FL	
KR4FM	216	18	12	NC	
WA4GLH	130	13	10	TN	
NQ4K	21	7	3	VA	
KI5XP	146,306	766	191	LA	SWACC #1
N5ZM	80,410	473	170	AR	SO1R
NA5Q	73,350	450	163	LA	
K5AM	62,500	500	125	NM	SWACC #1

Call	Score	QSOs	Mults	QTH	Team
KE5OG	62,376	452	138	TX	SWACC #2
KK5OQ	54,316	367	148	MS	SWACC #1
K9SEX	29,640	260	114	TX	
KC5LK	21,590	254	85	MS	
*KU5B	20,520	190	108	TX	
AA5CH	19,885	205	97	AR	
KG5VK	19,513	247	79	LA	
N5II	14,240	178	80	LA	
AC5AA	14,094	174	81	TX	
N5VYS	13,926	211	66	TX	
W5MEJ	13,674	159	86	TX	
KK5LO	12,900	150	86	TX	
W5ROS	10,050	150	67	TX	
NA4M	9,591	139	69	TX	
K5WW	8,850	150	59	TX	
N5YE	5,610	102	55	LA	
KK5CA	5,568	96	58	TX	
W5IBM (K5PI)	3,920	80	49	TX	
KA5EYH	3,311	77	43	TX	
W5JAY	3,080	70	44	AR	
KU5Z	960	40	24	TX	
N5RN	513	27	19	AR	
WK6I	102,138	587	174	CA	NCCC Rabid Mallards
AD6WL	80,791	467	173	CA	SWACC #2
N6OJ	55,080	408	135	CA	NCCC Rabid Mallards
WØYK	47,343	367	129	CA	NCCC Rabid Mallards
W6WRT	40,320	315	128	CA	SO1R
K6HGF	39,990	310	129	CA	
NF6A (K6XX)	35,568	304	117	CA	NCCC Dockers
K6RIM	32,205	285	113	CA	
KM6Z	27,000	270	100	CA	
K6DGW	24,926	242	103	CA	NCCC Rabid Mallards
K6EU	22,601	233	97	CA	NCCC Dockers
N6QQ	17,004	218	78	CA	
KJ6RA	14,592	192	76	CA	NCCC Rabid Mallards
N6QEK	13,125	175	75	CA	
WB6S	11,900	175	68	CA	NCCC Dockers
NN6NN (W6XK)	11,360	160	71	CA	
WB6JJJ	7,840	112	70	CA	
KG6ZHC	6,386	103	62	CA	
W6KY	6,360	106	60	CA	
N6CK	5,454	101	54	CA	NCCC Polos
K6GFJ	3,108	74	42	CA	
W6LPW (K5EJL)	2,448	72	34	CA	
W6RKC	2,448	68	36	CA	NCCC Polos
W6ZZZ	2,394	63	38	CA	NCCC Dockers
NA6G	1,813	49	37	CA	
N6VH	1,782	54	33	CA	
KO6LU	1,664	52	32	CA	NCCC Polos
WA6BOB	1,598	47	34	CA	SWACC #2
N1ILZ	1,590	53	30	CA	
KH6GMP	1,458	54	27	KH6	
WB6KDH	945	35	27	CA	
NC6P	882	42	21	CA	
K6GEP	858	39	22	CA	
K6OWL	735	35	21	CA	NCCC Polos
KK6TV	140	14	10	CA	
W6RK	130	13	10	CA	NCCC Polos
KA6GDT	48	8	6	CA	
KE7AJ	62,878	422	149	WA	
K6LL	61,686	414	149	AZ	SWACC #1
K7WM	58,904	398	148	AZ	SWACC #1
N7UVH	49,911	381	131	ID	SWACC #2
W7KB	34,008	312	109	UT	
KJ7NO	26,751	241	111	UT	
K7GS	20,196	204	99	WA	
WA7SLD	17,748	204	87	AZ	
W7NNN	16,849	203	83	WA	
W7WHY	15,022	203	74	OR	
KW7N	12,580	170	74	WA	
K7KAR	12,090	155	78	AZ	
NK7Z	11,899	163	73	OR	
K6UM	9,702	147	66	OR	NCCC Dockers
KG9JP	8,385	129	65	AZ	
N6MA	3,510	78	45	AZ	
W6SA	3,080	70	44	NV	
WG7X	2,772	66	42	WA	
W7DPW	2,695	77	35	WA	
W7MRC (NG7Z)	2,336	73	32	WA	
N7ON	1,458	54	27	NV	
KL8DX	693	33	21	KL7	
K8IR	74,240	464	160	MI	SWACC #2
K3GP	41,985	311	135	OH	
WF5X	31,694	299	106	MI	
KI8U	29,415	265	111	OH	
W8WEJ	18,032	184	98	WV	
N8BJQ	13,288	151	88	OH	
WB8MKH	11,492	169	68	MI	
WA8SDA	10,138	137	74	WV	
KN8J	9,860	170	58	WV	
W8WT	8,050	115	70	OH	
N8XI	1,512	54	28	MI	
N9CK	114,390	615	186	WI	SMC Blue

Call	Score	QSOs	Mults	QTH	Team
KE9S	113,094	618	183	WI	
K9WX	60,894	398	153	IN	SMC Red
N2BJ	54,020	370	146	IL	SMC Blue
W9HLY	51,750	345	150	IN	
W9ILY	49,136	332	148	IL	Metro Muttz
AA9DY	36,533	307	119	IL	SMC Red
N7GVV	28,044	228	123	IN	
N9SV	19,656	216	91	IN	
AK9F	13,284	162	82	IL	SMC Green
N9LAH	11,704	152	77	IL	Metro Muttz
*K9VIC	11,242	146	77	IL	
W9VQ	8,732	118	74	IL	
KB9DVC	7,548	111	68	IL	
K9EMG	6,076	98	62	WI	
KC9GGV	6,048	112	54	IN	
N9LF	5,978	98	61	IN	SMC Red
K9PY	4,345	79	55	IL	Metro Muttz
K9MI	4,324	92	47	IN	SMC Red
AI9T	3,053	71	43	IL	
AI9L	1,323	49	27	IL	SMC Green
N9AKR	828	36	23	IL	Metro Muttz
KTØR	120,768	629	192	MN	MWA Baudots
KTØDX	93,019	557	167	CO	Pikes Peak DX Group (PPDXG)
KØRC	86,020	506	170	MN	MWA Baudots
KØHW	79,218	489	162	SD	
NØAT	51,375	375	137	MN	MWA Baudots
KØRFD	48,444	367	132	CO	Pikes Peak DX Group (PPDXG)
WA2MNO	45,314	326	139	MN	MWA Chads
WNØL	35,462	298	119	NE	
KØJJR	35,052	276	127	MN	MWA Chads
K6XT	27,664	247	112	CO	
KØXU	27,084	244	111	NE	
WØRAA	25,864	244	106	CO	Pikes Peak DX Group (PPDXG)
KEØL	23,587	229	103	MN	MWA Baudots
KØPC	22,072	248	89	MN	MWA Chads
KSØT	18,676	203	92	MN	MWA Chads
KØBX	18,000	200	90	MO	
KØCF	17,613	171	103	IA	
K8FC	11,356	167	68	CO	Pikes Peak DX Group (PPDXG)
KAØEIC	6,996	106	66	KS	
KSØM	4,368	84	52	MO	
KCØRET	3,185	65	49	MN	
NRØL	2,088	58	36	MN	
*NØQJS	81	9	9	CO	
VE3ESH	74,214	434	171	ON	
VA7ST	63,036	412	153	BC	
VE3XD	62,328	424	147	ON	
VA1CHP	53,721	381	141	NS	
VE3NZ	47,190	330	143	ON	
VE3NE	34,584	262	132	ON	
VE3IAY	25,440	240	106	ON	
VE7KET	19,380	204	95	BC	
VE6AX	18,430	190	97	AB	
VE6YR	17,952	187	96	AB	
VE3WDM	16,744	182	92	ON	
W1AJT/VE3	16,296	168	97	ON	
VE3FJ	13,288	151	88	ON	
VA7ALK	3,362	82	41	BC	
VE3NWA	3,266	71	46	ON	
VA7KOJ	3,080	77	40	BC	
VE7HBS	2,015	65	31	BC	
VE4LR	775	31	25	MB	
NP4BM	2,460	60	41	KP4	
5F5ØKD (CN8KD)	13,065	201	65	DX	
S51MA	7,865	143	55	DX	
DM9CM	228	19	12	DX	
VR2XLN	2	2	1	DX	

*QRP

Multi-Two Scores

Call	Score	QSOs	Mults	QTH
W6YX	166,460	812	205	CA
(K6UFO, KG6RYB, N6DE, N7MH, ND2T, W6RK)				
KB1JZU	95,485	565	169	MA
(KB1JZU, KT1I, N1MGO, N1UZ)				
W4GAC	72,450	483	150	FL
(AA1IK, KP2N, KR4U, N2ESP, N4RI, W4CU, WA4EEZ)				
W4MLB	66,120	435	152	FL
(AF4Z, AK4R, K4PX, K4QD, KD4DJT, KD4DPN, KF4MIN, KI4OAZ, KI4OBC, KI4OBD, KI4QBR, N8KH, W4KS, W4LVA,WB4SRR, WF3C)				
VE7FO (VE7FO)	34,749	297	117	BC
KS5V	25,300	253	100	TX
(KJ5ZO, KS5V)				
WN1G	17,575	185	95	KY
(NX1T, WN1G)				
WB1EDI (WB1EDI)	6,426	102	63	NH
VE3AA	3,192	84	38	ON
(VE3BFE, VE3XLG)				

Check Logs: CU2JT, F5IHP, KC5YSM, KP4JRS, N3ZK, N7MQ, OK1VRF

RT-20 UNIVERSAL DIGITAL ROTOR CONTROLLER

Don't you wish . . .

Your rotor had Point-and-Shoot?

Your rotor had a large, accurate, bright LCD display?

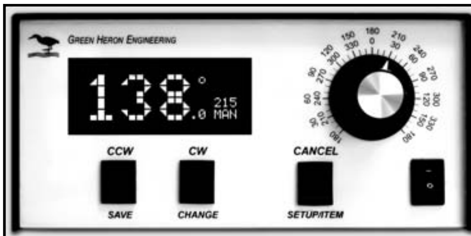
Your rotors could be slaved together for the ultimate in stacked array versatility?

Your rotor had PWM speed control and would ramp up/down when turning large arrays?

The RT-20 gives you all of this and it works with your existing rotors*.

*See web site for more information.

AMATEUR NET - $549.00



The RT-20 Rotor Controller

Intuitive and simple user interface

Updates your rotor to digital performance and computer control (EIA-232 included)

Manages stacked arrays, side mounts and counter rotation schemes (rotor above rotor)

Fully programmable for speed, delays, limits and more

GREEN HERON ENGINEERING LLC (585) 217-9093

www.greenheronengineering.com info@greenheronengineering.com

DX Contest Activity Announcements

Bill Feidt, NG3K

CQ World Wide DX CW Contest (November 25-26, 2006)

Call	*Entity*	*Class*	*Operators*
3B8/OMØC	Mauritius	M/S	Slovak contest team
5A7A	Libya	M/M	DJ7IK + international team
5Z4LS	Kenya	???	G3RWF
6V7D	Senegal	SOAB LP	K1XM
9Y4AA	Trinidad Tobago	M/2	W6NV W2VJN OH2MM N6TJ
C6	Bahamas	SOSB	K2KW N6V KE7X
C6	Bahamas	SOAB	N3DXX
CN2R	Morocco	SOSB 40M	W7EJ
CT3NT	Madeira	SOAB	CT1BOH
CU2A	Azores	SOAB HP	OH2UA
EY8MM	Tajikistan	SOSB 160M	EY8MM
GD6IA	Isle of Man	SOAB HP	GM3WOJ
HC8N	Galapagos	M/M	N5KO + others
HI3K	Dominican Rep	???	HI3K
IH9P	African Italy	M/M	IT9BLB + international team
LZ9W	Bulgaria	M/M	LZ contest team
P4ØA	Aruba	SOAB	KK9A
P4ØW	Aruba	SOAB	W2GD
TM4Q	France	M/S	F6FYA F6EKS F6EMT F5CWU F5MYT F5SQM F5CQ F5MOO F4EGD
TZ5A	Mali	M/M	AA7A G3SXW G4BWP G4IRN GM3YTS K5VT KC7V KY7M
V26K	Antigua	SOAB LP	AA3B
VK9AA	Cocos (Keeling)	SOAB	VK2IA
VP5W	Turks Caicos	M/2	W7VV VE7XF K7BTW, perhaps others
VP9I	Bermuda	SO	WA4PGM
WP3C	Puerto Rico	SOAB LP	WP3C
ZK1	South Cook Is	???	N7OU W7YAQ
ZPØR	Paraguay	SOAB HP	CX6VM

Thanks to: AA3B, CT1BOH, DJ7IK, EY8MM, F6FYA, G3SXW, GM3WOJ, HI3K, IT9BLB, K1XM, K2KW, KK9A, KN5H, LZ2CJ, N5KO, N6TJ, OH2UA, OM2TW, OPDX, VK2IA, W2GD, W7EJ, W7VV, WA4PGM, WP3C, ZP5AZL.

See **www.ng3k.com/Misc/cqc2006.html** for further details.

Serious Products for Serious Hams

SCAF-1 Audio Filter

Make your receiver listener friendly! Variable cut-off audio low-pass filter, 96 db rolloff per octave! Cut-off range frequency 450 Hertz to 3.5 kHz. Absolutely real time, NO delay—perfect for QRQ CW and no monitor problems. Use for CW, Digital modes, and SSB, with headphones or speakers. Super-simple operation, yet wonderfully effective. Sample audio files on our web site. Available as a kit or preassembled.

Keyers: Logikey K5, Super CMOS-3, CMOS-4

Our keyers simply are the best keyers available — Period. More user friendly by far, more features. Extremely powerful memory functions, yet easy to learn. Extended paddle input timing reduces errors and increases your speed. Can emulate many earlier designs for timing feel, but with full feature set. Use with both positive and negative keyed rigs. Built-in monitor included. Full beacon capability.

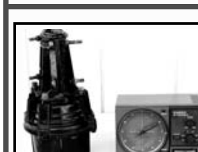
For full details see our web site. Forget that built-in keyer in your transceiver. You deserve far better. We have one waiting for you.

Antenna Rotor Enhancements:

TailTwister & Ham-M

Do you own one of these fine rotors? Bring it into the 21st Century! Rotor-EZ adds a unique "Auto-Point" capability plus brake delay, end-point protection, optional complete computer-control capability for logging and contesting programs, and more!

See our web site for full details of this "must have" enhancement.



Yaesu DXA and SDX series rotors

Add affordable plug-in computer-control capability for far less. See our web site for full details!

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LP-100 Digital Vector HF Wattmeter

The perfect accessory for the "well-dressed" station...

Vector Impedance display: R+jX and Z/phase
Like an inline Antenna Analyzer

Bright, fast, state-of-the-art PLED display

Accurate power and SWR from 50 mW to 2500W

SWR alarm with PTT loop-thru, user adjustable

Remote coupler for uncluttered desktop

Simultaneous display of power and SWR with fast dual bargraphs and numerical displays with peak-hold and/or fast display

160-6m, with automatic band-by-band power and impedance correction using built-in frequency counter, user adjustable in 0.1% increments

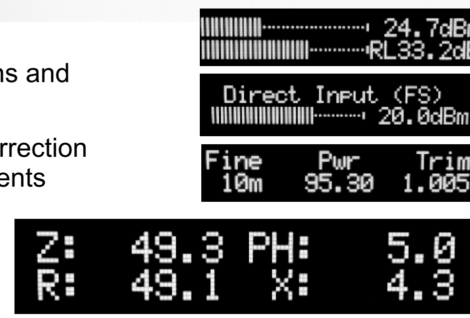
Displays dBm & Return Loss in 0.1 dB steps

Direct input for Field Strength / bench work, -15 to +33 dBm

Included Windows® remote control and graphing software

Upgradable firmware via download and "flash" programming

Available as a kit or assembled/calibrated - NIST traceable



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K2 Transceiver Now with DSP!

- New KDSP2 internal DSP unit for the K2
- New XV Series transverters for **50**, **144**, **222**, and **432** MHz
- New KRC2 Programmable Band Decoder

K2 Transceiver

KAT100 ATU

Elecraft K2 and K2/100 Transceivers. Our 160-10 m, SSB/CW transceiver kit is available in 10 and 100-watt models, which share the same chart-topping receiver performance. Add the new KDSP2 option for versatile notch and bandpass filtering, plus noise reduction. K2 pricing starts at $629.

Our KX1 4-watt, 3-band CW transceiver is the new featherweight champ!

Pocket-size and with controls on top, it's ideal for trail-side, beach chair, sleeping bag, or picnic table operation. DDS VFO covers both ham and SWL bands; the receiver handles CW, SSB, and AM. Features memory keyer, RIT, logbook lamp, and internal battery. Optional internal ATU and attached paddle. Basic KX1 kit covers 20 & 40m ($299). KXB3080 option adds 20 and 80m ($65).

Visit our web site for details on the K1, XV Series, KRC2, and mini-module kits.

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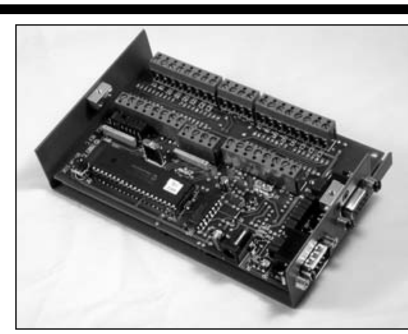

NEW KRC2 Universal Band Decoder

Our new KRC2 universal Band Decoder can automatically switch any combination of antenna relays, filters, amplifiers, or other equipment as your rig changes bands. It supports analog, digital, and RS232 band control inputs.

- Decodes band data from our K2, Icom, Yaesu and Kenwood rigs
- Microprocessor control / Software reconfigurable
- Rugged source & sink relay drivers for all HF bands
- Also has BCD HF band and transverter band outputs
- Price: $159

SAVE BIG ON ANTENNAS, TOWERS & CABLE

TELESCOPING ALUMINUM TUBING

DRAWN 6063-T832

.375"	$.80/ft
.500"	$.90/ft
.625"	$1.00/ft
.750"	$1.10/ft
.875"	$1.20/ft
1.000	$1.30/ft
1.125	$1.45/ft
1.250"	$1.65/ft
1.375"	$1.85/ft
1.500"	$2.05/ft
1.625"	$2.35/ft
1.750"	$2.60/ft
1.875"	$2.85/ft
2.000"	$3.10/ft
2.125"	$3.60/ft

EXTRUDED 6061-T6

.250" rod	$.50/ft
2"x.125"	$4.50/ft
.188" rod	$.35/ft
4"x.375" bar	$6.50/ft
2"x.250"	$8.00/ft

6' OR 12' LENGTHS. 6' LENGTHS SHIP UPS.

ANTENNA ROTATORS

M2 OR-2800PDX	$1379
Hygain HAM IV	$499
Hygain T2X Tailtwister	$569
Yaesu G-450A	$249
Yaesu G-800SA/G-800DXA	$329/409
G-1000DXA	$499
Yaesu G-2800SDX	$1089
Yaesu G-550	$299
Yaesu G-5500	$599

ROTATOR CABLE

R62 (#18), HD 6 conductor	$.49/ft.
R81/82/84, 8 cond.	$.49/ft./.69/ft./1.19/ft.

ROHN TOWER

25G/45G/55G	$99/209/259
25AG2/25AG3/25AG4	$149/199/139
45AG2/45AG4	$289/289
AS25G/AS455G	$55/115
BPC25G/BPC45G/BPC55G	$89/129/149
BPL25G/BPL45G/BPL55G	$109/189/399
GA25GD/GA45GD/GA55GD	$109/149/179
GAR30/GAS604	$39/49
SB25G/45/55	$65/119/169
SB25G5/SBH25G	$85/219
TB3/TB4	$149/169

PLEASE CALL FOR MORE ROHN ITEMS.

COMET ANTENNAS

GP3, 2m/70cm Vertical	$99
GP6, 2m/70cm Vertical	$159
GP9 2m/70cm Vertical	$199
GP15, 6m/2m/70cm Vertical	$159
GP98, 2m/70cm/23cm Vertical	$169

DIAMOND ANTENNAS

X50A, 2m/70cm Vertical	$109
X200A, 2m/70cm Vertical	$149
X510MA 2m/70cm Vertical	$195
X500HNA 2m/70cm Vertical	$259
X700HNA 2m/70cm Vertical	$399
V2000A 6m/2m/70cm Vertical	$172

COAX CABLE

RG-213/U, (#8267 Equiv.)	$.69/ft
RG-8X, Mini RG-8 Foam	$.35/ft
RG-213/U Jumpers	Please Call
RG-8X Jumpers	Please Call

CALL FOR MORE COAX/CONNECTORS.

TIMES MICROWAVE LMR® COAX

LMR-400	$.69/ft
LMR-400DB Direct Bury	$.99/ft
LMR-400 Ultraflex	$.99/ft
LMR-600	$1.39/ft
LMR600 Ultraflex	$2.19/ft

CALL FOR MORE SIZES & CONNECTORS.

TRYLON "TITAN" TOWERS

SELF-SUPPORTING STEEL TOWERS

T200-64	64', 15 square feet	$1489
T200-72	72', 15 square feet	$1819
T200-80	80', 15 square feet	$2169
T200-88	88', 15 square feet	$2529
T200-96	96', 15 square feet	$2969
T300-88	88', 22 square feet	$2869
T400-80	80', 34 square feet	$2759
T500-72	72', 45 square feet	$2629
T600-64	64', 60 square feet	$2499
T700-56	56', 80 square feet	$2349

MORE TRYLON TOWERS AVAILABLE.

M2 VHF/UHF ANTENNAS

6M5X/6M7JHV	$259/319
6M2WLC/6M9KHW	$549/589
2M4/2M7/2M9SSBFM	$119/129/149
2M12/2M5WL	$209/249
2M5-440XP, 2m/70cm	$219
440-470-5HD/420-50-11	$169/119
432-9WL/432-13WLA	$219/299
440-18/440-21ATV	$159/179

M2 SATELLITE ANTENNAS

2MCP14/2MCP22	$209/299
436CP30/436CP42UG	$299/349

CALL FOR MORE IN-STOCK M2 ITEMS.

TOWER HARDWARE

3/8"EE/EJ Turnbuckle	$15/16
1/2"x9"EE/EJ Turnbuckle	$21/23
1/2"x12"EE/EJ Turnbuckle	$24/26
3/16"/1/4" Big Grips	$5/6
3/16"EHS-500'/1/4"EHS-500'	$119/149

PLEASE CALL FOR MORE HARDWARE.

HIGH CARBON STEEL MASTS

5 FT x .12" / 5 FT x .18"	$45/59
11 FT x .12" / 11 FT x .25"	$80/199
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TH7DX/TH11DX	$749/995

MFJ

259B/269, Analyzers	$259/339
948/949E, Tuners	$139/159
969, HF–6m Tuner	$189
986, 3kW Tuner	$319
989D, Deluxe 3kW Tuner	$339
991/993 Autotuners	$169/229

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HPTG1200I	$.45/ft
1200 END KIT	$3.60
HPTG2100I	$.59/ft
PLP2738 Big Grip (2100)	$7.00
HPTG4000I	$.89/ft
PLP2739 Big Grip (4000)	$9.50
HPTG6700I	$1.29/ft
PLP2755 Big Grip (6700)	$13.50
HPTG11200	$1.89/ft
PLP2758 Big Grip (11200)	$16.00

PLEASE CALL FOR HELP SELECTING THE PHILLYSTRAN SIZE FOR YOUR PROJECT.

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TX472, 72' Crankup Tower	$3689
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