NCJ

NATIONAL CONTEST JOURNAL

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July/August 2005

Volume 33 Number 4

- Antenna Interactions—Part 7
- Verticals by the Sea
- 2005 Dayton Contest Forum and Dinner
- February 2005 CW and phone Sprint Results
- February 2005 NAQP RTTY Results
- January 2005 NAQP CW Results

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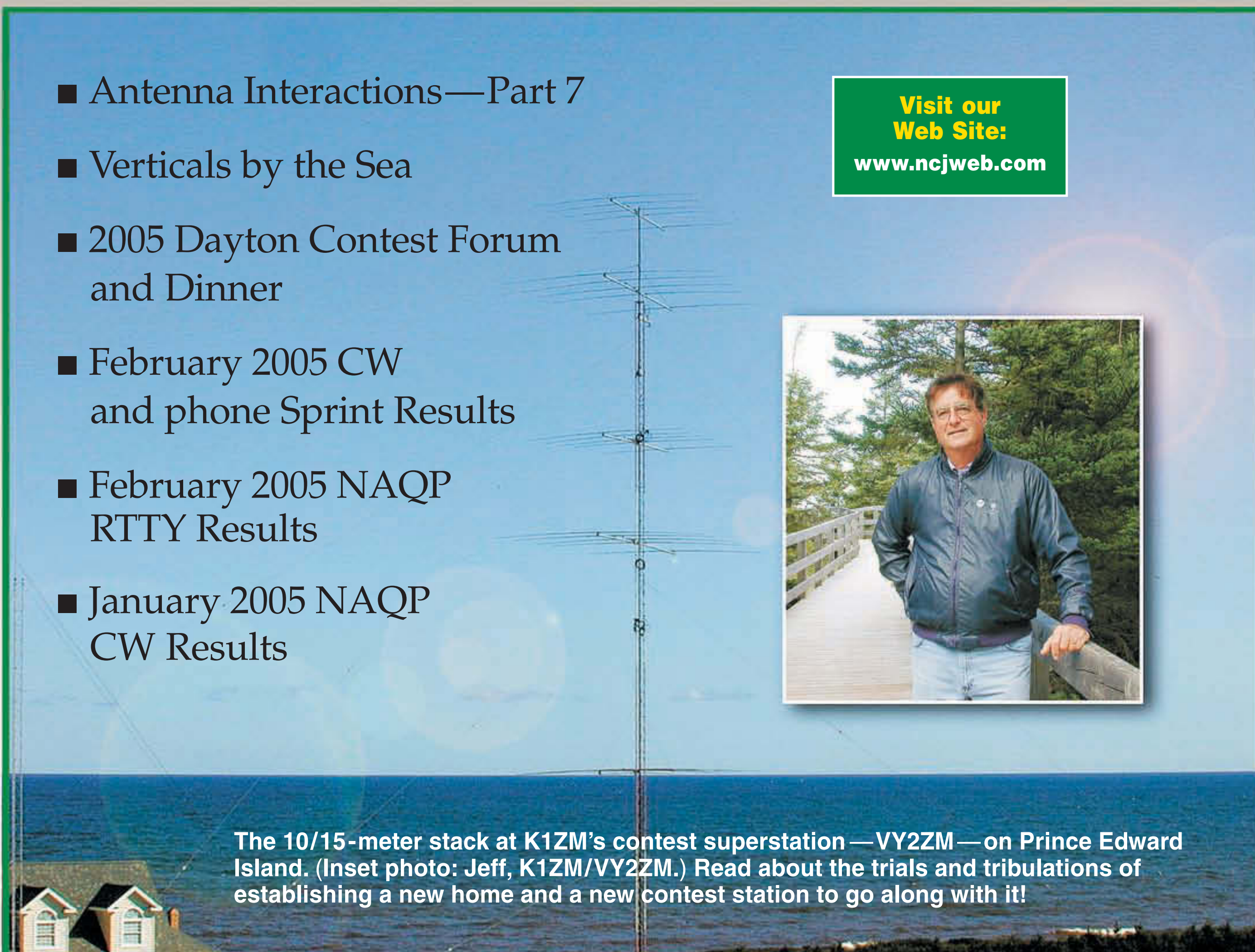

The 10/15-meter stack at K1ZM's contest superstation—VY2ZM—on Prince Edward Island. (Inset photo: Jeff, K1ZM/VY2ZM.) Read about the trials and tribulations of establishing a new home and a new contest station to go along with it!

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American Radio Relay League
225 Main Street, Newington, CT 06111
tel: 860-594-0200
fax: 860-594-0259 (24-hour direct line)
Electronic Mail: *hq@arrl.org*
World Wide Web: *www.arrl.org/*

Editor
Carl Luetzelschwab, K9LA
1227 Pion Rd, Fort Wayne, IN 46845
editor@ncjweb.com

Managing Editor
Joel R. Hallas, W1ZR
w1zr@arrl.org

NCJ WWW Page
Bruce Horn, WA7BNM, Webmaster
www.ncjweb.com

ARRL Officers
President: Jim Haynie, W5JBP
Executive Vice President:
David Sumner, K1ZZ

Contributing Editors
Gary Sutcliffe, W9XT—Contest Tips, Tricks & Techniques
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Bill Feidt, NG3K—DX Contest Activity Announcements
Bruce Horn, WA7BNM—Contest Calendar
Pete Smith, N4ZR—Software for Contesters
Don Daso, K4ZA—Workshop Chronicles

ARRL CAC Representative
Ned Stearns, AA7A
7038 E Aster Dr, Scottsdale, AZ 85254
aa7a@arrl.net

North American QSO Party, CW
Bob Selbrede, K6ZZ
6200 Natoma Ave, Mojave, CA 93501
cwnaqp@ncjweb.com

North American QSO Party, Phone
Bruce Horn, WA7BNM
4225 Farmdale Ave, Studio City, CA 91604
ssbnaqp@ncjweb.com

North American QSO Party, RTTY
Shelby Summerville, K4WW
6500 Lantana Ct, Louisville, KY 40229-1544
rttynaqp@ncjweb.com

North American Sprint, CW
Boring Amateur Radio Club
15125 Bartell Rd, Boring, OR 97009
cwsprint@ncjweb.com

North American Sprint, Phone
Jim Stevens, K4MA
6609 Vardon Ct, Fuquay-Varina, NC 27526
ssbsprint@ncjweb.com

North American Sprint, RTTY
Doug McDuff, W4OX
10380 SW 112th St, Miami, FL 33176
rttysprint@ncjweb.com

Advertising Information Contact:
Janet Rocco, tel 860-594-0203;
fax 860-594-0303; *jrocco@arrl.org*

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Editorial

By Carl Luetzelschwab, K9LA

Where Is *NCJ* Headed?

It's no secret that the Internet is affecting printed magazines (like *NCJ*). For example, the lead-time of *NCJ* has, for all intents and purposes, taken it out of the picture for discussions of contesting issues of the day. This is now aptly handled on the various contest reflectors (whether it is a worldwide reflector like cq-contest or a more "local" reflector sponsored by a contest club). This same lead-time also makes it pretty much impossible to address time-critical contest news, which NØAX's *Contest Rate Sheet* does exceptionally well with its every-other-week e-mail format.

Because of these issues, I have been trying to head *NCJ* toward more technical features that are relevant to contesters—the kind of material that fits best into a printed media. It's kind of like turning the main thrust of *NCJ* into "the journal for operating and technical information for contesters." So expect more technical articles in *NCJ* (which, I think you'll agree, is in fact already happening). This doesn't mean we're getting rid of everything else—we'll continue publishing the *NCJ*-sponsored contest results and our regular columns, and we sure won't forget the newcomers entering our aspect of the hobby.

Last October, with Al KØAD's help, I sent out snail-mail letters to 32 contest clubs discussing this vision. I encouraged the contest clubs to promote *NCJ*, as it is the only North American magazine for contesters and thus it is important to continue *NCJ*'s growth. As of the May/June 2005 issue, the number of *NCJ* subscriptions is up about 5% from a year ago, and I hope this was the result of the letters and several other initiatives to increase subscriptions (thanks to K3NA and G4BUO for these other initiatives). I hope to see this trend continue. There's a lot of opportunity out there for *NCJ*—we (I use "we" as we're all in this together) just have to figure out how to tap into those who do not subscribe.

Baltic Contest Results

In my editorial in the July/August 2004 *NCJ*, I mentioned receiving a little booklet from the Lithuanian Radio Sport Federation that listed the results of the 2003 Baltic Contest. My purpose in mentioning this was to plant a seed with contest sponsors who wanted to add a more personal touch to their results (and maybe even attract more participants as a result).

I recently received this year's booklet—the results of the 2004 Baltic Contest. If any club or contest sponsor would like to see this, drop me an e-mail and I'll send it to you. I'm sure we could also arrange for it to make the rounds if others are interested in taking a look at it.

WRTC2006

WRTC2006 is only one year away. (Wow—it's already been three years since Finland!). This issue has a short article by Martti, OH2BH, telling about Contest Club Finland's effort to select their national team for the competition.

NAQP CW and SSB Certificates

Thanks to Bruce, WA7BNM, certificates to the deserving for these two contests are now available on-line for printing beginning with the January 2005 events (the CW results are first, and are published in this issue, and the SSB results will follow). If you deserved a certificate per the NAQP rules, you'll receive an e-mail saying how to retrieve your certificate. This will also be automatic for the 2003 and 2004 events (i.e., you'll receive an e-mail). Certificates for earlier contests (2002 and prior) are available on request from the specific contest manager.

As a side note, I'd like to say "thanks" to Shelby, K4WW, for keeping up with all the NAQP plaques (CW, SSB and RTTY) and the NAQP RTTY certificates for the past 5 or 6 years.

NCJ Index

Terry, N4TZ/9, brought the *NCJ* index up-to-date through the November/December 2004 issue. The index is now available in pdf format on the NCJ Web site (**www.ncjweb.com**) under the **index** link at the top of the home page.

Taking Another Look at VY2ZM on Prince Edward Island, Atlantic Canada

Ari Korhonen, OH5DX

I interviewed Jeff, K1ZM/VY2ZM, for the March/April 2003 issue of the NCJ. *Jeff had just established an excellent contest station on Prince Edward Island. Since then, the station has improved considerably and many world-class scores have been made from there. Here's another look at the station*—Ari, OH5DX.

We last visited VY2ZM in 2002 shortly after K1ZM, Jeff Briggs, built a home on Prince Edward Island in Atlantic Canada and began initial operations. At that time, Jeff had constructed a 160-meter 4-element phased vertical array with the help of Peter Hutter, WW2Y and Rob Flory, K2WI, who did the modelling work underpinning the actual design of the array. Flushed with some initial success on Topband, Jeff then set about working on the other HF bands and we thought we might check in at this time to see what he has been doing.

During his second summer on the island (2002), Jeff's principal objective was to add an 80-meter system and, in this case, a classic 4-square array was erected right at the water. This antenna is Rohn tower on insulated bases with G-10 fiberglass rod inserted in the tower legs to insulate the radiators from ground. The system employs phillystran guys (two sets!) and 5000 feet of on-ground copper radials under each radiator. The antenna acquires Europe without obstruction and fires directly over salt water within 300 feet of the northeast leading tower.

A secondary objective as summer ensued was the erection of a 130 foot Rohn 45 tower for the HF bands and, initially, no plans were contemplated that summer for populating that tower with antennas. But, due to good weather, there was time at the end of the summer to hurriedly add an X7 tribander at 140 feet on this tower, coupled with an XM240 40-meter 2-element Yagi below it at 130 feet.

Needing a secondary antenna for SO2R on 20, 15 and 10 meters, Jeff put a very basic Cushcraft tribander driven element atop a 100-foot Rohn 25 tower and fixed it broadside northeast/southwest for multiplier chasing on the second radio on 20/15/10 while the X7 was engaged on the higher bands on the run radio.

This fairly modest station managed a top-10 world finish in CQWW SSB in 2002 and a very close second in Canada to VE3EJ, who edged Jeff by a small margin in that contest once UBNs were factored in, etc. In ARRL DX 2003, this same system managed a third-place finish for W/VE in ARRL DX CW and Jeff managed his first all-band win two weeks later in ARRL DX Phone—with a 15% margin over Bob Shohet, KQ2M.

Inside the shack, two Yaesu FT-1000D transceivers were employed driving two manually tuned amps (an AL1500 and an old Amp Supply model). Antenna switching was all manual initially using Daiwa two-fer and Daiwa four-fer switches to route the available antennas to both radios.

Jeff, K1ZM/VY2ZM.

During his third summer, Jeff, with alot of help from Andy Blank, N2NT, erected a slew of monoband Yagis—all of which employ remote switching through the coax feedline using Ameritron remote coax switching devices. At summer's end, the lineup consisted of these antennas:

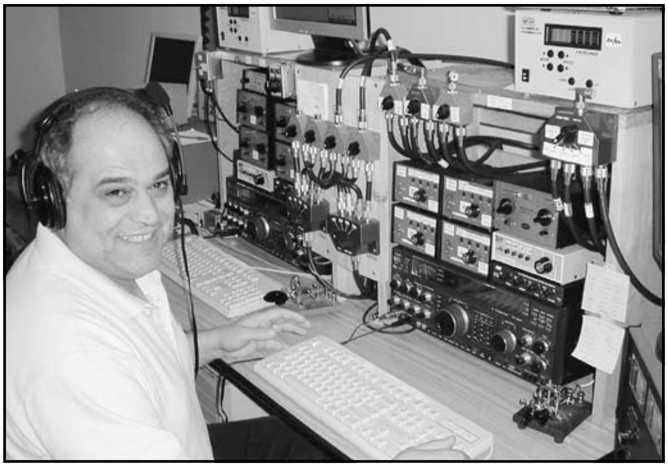
160 meters—4-elment phased array/ inverted Vee at 100 feet broadside NE/ SW
80 meters—Classic 4-square array
40 meters—Twin XM240s at 130/80 feet
20 meters—Twin 5-element Cushcraft Big Thunder Yagis at 140/100 feet
15 meters—Triple 5-element Cushcraft Big Thunder Yagis at 100/75/50 feet
10 meters—Twin 5-element Cushcraft Big Thunder Yagis at 110/85 feet

There are multiple Beverages at 880 and 1080 feet for backup receive work on the low bands, as Jeff swears he listens 99% of the time on his transmitting antennas.

The Rx Sixpack

As the summer ended in 2002 and

The 10 and 15-meter stack at VY2ZM.



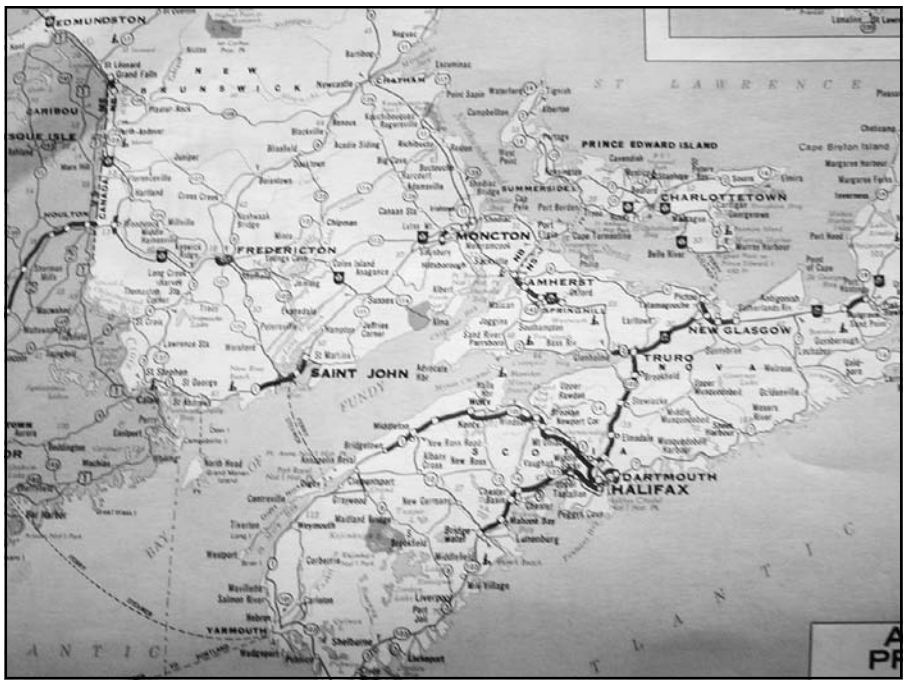
Krassy, K1LZ/VY2LZ, guest operting at VY2ZM.

Steve, VK6VZ/VY2LF, guest operating at VY2ZM.

again in 2003, Jeff arranged for 8 acres of his land to be cleared about 3000 feet from his main antenna field. On this land, a specialized receive antenna for 160 meters was installed with the real design work again being the braintrust of WW2Y and K2WI, without whose help the antenna never would have come into being. This antenna is similar in concept to a W8JI design as far as the radiators are concerned, but it differs from Tom Rauch's brainchild in one major respect. The antenna is really a miniature version of Jeff's transmitting array for 160 meters with two additional elements added at the rear. The on-ground footprint is 336 × 266 feet, meaning it is a $^{5}/_{8}$ wavelength spaced by a $^{1}/_{4}$ wavelength spaced array—6 active elements total.

The three pairs of radiators are fed with binomial feed, meaning the lead pair is fed at -90 degree phasing, the center pair is fed at 0 degree phasing and the rear pair is fed at +90 degree phasing. While the gain of the *Rx Sixpack*, as it is called, is only a bit more than Jeff's 160 meter transmitting array, it produces far more front to back—about 30 dB more in fact! In other words, the transmitting array was designed by WW2Y to maintain a presence off its back into the states during 160-meter European runs (in order to attract W1-W4 callers at the same time). The Rx Sixpack was designed to be a deathray into Europe with virtually nothing coming in off the back from the USA. This would allow, in theory, the very weakest European signals to be heard absent other North American QRM.

Does it work? Well, yes—most of the time! In normal temperatures down to about 20°F , W1AW on 1817.5kHz is virtually unreadable when beaming toward Europe on the Sixpack array. This means a front-to-back of at least 40 dB. But when the temperatures drop to -



VY2ZM is on the north shore of the eastern tip of Prince Edward Island. Next stop is Newfoundland 100 miles to the northeast—all over water.

35°C (about -30°F), the F/B deteriorates a bit to about 30 dB, which Jeff says puzzled him for a long time. Finally with the help of Eric Von Valtie, K8LV, one of the old K8LX crew, it was determined that the permeability of the toroidal cores used in the hybrid coupler was changing somewhat due to the extreme cold. This drift within the cores appears to be causing the phasing cancellation within the hybrid to change from its normal optimal values, thus lowering the perceived front to back under extreme cold! At some point this will have to be addressed to correct this issue but, for the moment, there are other things higher on the food-chain.

In 2003, Jeff had no choice but to put the entire 3500 feet of RG6 feedline for the Sixpack inside conduit as he learned that PEI red squirrels are ferocious and voracious little buggers. They ate his entire coax jacket on an initial feedline run out to the Sixpack site and, worse yet, they did the same on nearly all of Jeff's phasing lines on the 160-meter transmitting array. Talk about seeing a grown man cry! Jeff says he spent two weeks in October 2003 in the rain running a new feedline inside conduit all the way out to the Sixpack site. Then he spent a week during August 2004 replacing all four 160-meter feedlines with new RG213 and putting those systems in conduit as well. Phew! There is no rest for the weary!

More Contests, More Repairs

During the 2003/2004 contest season, Jeff did well in CQWW SSB, again making the top-10 world single-op all-band and set a new Canadian record in the process. Andy Blank, N2NT, guest-operated for CQWW CW, making a huge score with over 6000 QSOs and cracking the top-ten world. But, after all the log-checking was over, in a photo-finish with VE2IM (operating from Zone 2), Andy had to settle for second-place Canada. Andy swears to this day that he thinks he left something on the table in that contest, but one has to respect the fine effort Yuri made with a far lesser station from Sept-Iles in Northern Quebec.

Moving along now to the summer of 2004, this was the summer of repairs at VY2ZM. February 2004 was not kind, causing the outer ends of both 20-meter 5-element Yagi booms to snap during extreme cold and wind. One antenna broke on a Monday and the other one did the same in almost the same exact spot on the following Friday. This caused Jeff to climb the 20/40-meter tower at -30°C during the 160-meter CQ SSB test to cut away the second director elements on both antennas—and throw them off the tower into the ground. One director landed flat and was okay; the other one landed at 90 degrees vertical in a huge snowbank and, like, the *Titanic*, teetered there for a second or two and then bent over and sank like the *Titanic* into the snow.

Thus, about half of the summer of 2004 was spent taking down most of what was on the 20/40-meter tower, adding inserts into the booms to beef them up, and then tramming all of this stuff back up. Jeff recalls the antenna going from .065 wall to about .200 wall when retrofitting of the 20-meter antennas was completed. So far, these antennas are surviving the 2004/2005 winter, but on PEI, nothing can be certain given the harsh winds that literally scream inland from the northwest off the Gulf of St Lawrence.

After the repairs were done, there was time remaining in 2004 to literally manufacture three additional Big Thunder Yagis, one each for 20, 15 and 10 meters using two X7 tribanders. Jeff says hours of studying the parts lists for the X7 and the XM520/XM515/XM510 led him to believe there was just enough material to duplicate his existing antennas from scratch. This effort was made necessary because the Big Thunder line, introduced by Cushcraft in January 1999, had been summarily dropped less than 3 months later in a management rethinking of marketing priorities. Too bad, as these were some of the very finest and most rugged Yagis Cushcraft had ever made following a design by Danny, T93M and Art, K1ART.

Looking into 2004/2005 then, there were now triple stacks on 20, quad stacks on 15 and triple stacks on 10. Some new Beverages were also added to assist on the reception front during snowstorms and precipitation static.

A Work in Progress

For CQWW SSB, VY2LZ (Krassy Petkov) and Jeff did a multi-single, managing about 14.7M, which was right at the record score for Canada made by VE3EJ. UBNs will no doubt cause the score to drop, but the antennas seemed to work well. For CQWW CW, Andy, N2NT, came back vowing to avenge his loss in 2003, but 10 meters did him in. Jeff says he was impressed that even without 10 meters, Andy managed to come within 8 total multipliers of his 2003 WW CW score.

Along the way, there have been some inside-the-shack changes, mainly inplemented at the urging and under the guidance of Andy, N2NT. While the Daiwa switches are still there (Andy has been trying to sell them on eBay for 2 years now and Jeff won't let him), most switching is totally automated using N3RD controllers, ICE bandpass filters and a WXØB Sixpack. The amps are now auto-tuned (the old manually tuned ones are still available as backups) and most things are computer controlled. Rotators are the big Orion 2800 models, the only things that even stand a chance of surviving a PEI winter. So far, they are holding their own.

Jeff says he has been quietly soliciting guest-ops to give the station a whirl, as he says he did not build it for himself alone to enjoy. Most folks have politely demeurred, usually offering two lines of rationale—the snow in winter and/or a fear that if ever they operated from a place like PEI (especially on the lowbands), they would never want to turn on their radios again when they got back home! Those sound like plausible enough reasons and it is true that it is often necessary to walk in to VY2ZM in some very deep snow on snowshoes or via a snowmobile when the drifting snow depths allow it.

Jeff says he is still in a developmental mode with this new station of his, so stay tuned. He says there are still a few projects he dreams about at night, and if Mother Nature allows it, he will get to them at some point.

The 13th Annual Dayton Contest Dinner

By Tim Duffy, K3LR
www.k3lr.com

What an amazing run! Thirteen years and going strong! The North Coast Contesters hosted contesters from all over the world in Dayton, Ohio this past May 21, 2005. The Contest Super Suite and the Dayton Contest Dinner are the best ways to spend a radio weekend talking about our favorite hobby: radio contesting. This year almost 370 contesters (a new record!) enjoyed a prime rib dinner together at the Crowne Plaza Hotel in downtown Dayton. Every year this dinner gets bigger and better. Thanks to Paul, W0AIH, for giving an outstanding invocation to open the event this year.

The 13th annual event featured the return of long time dinner Master of Ceremonies, John, K1AR. John had been on Dayton sabbatical for 2 years and it was great to have him return.

The Dayton Contest dinner is home to the yearly induction of fellow contesters into the CQ Contest Hall of Fame. Since the award was created, 43 contesters have been inducted. We were honored to have Rusty, W6OAT, and Jeff, K1ZM, join the CQ Contest Hall of Fame this year (#44 and #45). The CQ Contest Hall of Fame is the top honor a contester can ever receive. To be recognized by your peers as standing apart from the rest as a top ambassador to our sport is the epitome of Radio Contesting. The award does not come about by winning contests; it happens because the CQ Contest Hall of Fame members have contributed to our hobby in many varied ways, specifically by giving back to our sport of amateur radio contesting. The first member into the hall was Buz Reeves, K2GL (SK).

Our dinner speaker this year was Ward Silver, NØAX. We were thrilled to have Ward accept our offer to speak. Ward has given so much of his time back to our hobby in the forum of mentoring and writing. Ward gave everyone a real treat by taking us deep into the future of radio contesting and providing many specific time line events for what will happen during the contest operations of the future. It was a very fun filled talk with lots of breaks when the audience laughing was 60 dB over S9!

One of the hilarious dinner moments occurred at the half waypoint when an errant pizza delivery girl opened the ballroom door looking for KQ2M. She had a large pepperoni pizza and was determined to deliver it! K1AR handled the mishap in stride, stating that the pizza needs to be delivered to Newtown, CT not Dayton, Ohio.

Hall of Fame (HOF) Inductees

Bob Cox, K3EST, who is the director of the CQ WorldWide Contest, chairman of the CQ Contest Hall of Fame and a member of the hall himself, gave out two HOF awards during the dinner this year.

New CQ Contest Hall of Fame inductees Jeff, K1ZM (left) and Rusty, W6OAT (right).

Rusty, W6OAT, is a world-class contester, co-creator of the North American CW Sprint Contest and active member of the WRTC steering committee. Rusty's efforts during the 1996 San Francisco WRTC event were substantial. He continues to support the WRTC efforts with his involvement in WRTC 2006. He has been a tremendous asset with his long time leadership in his local contest radio club, the Northern California Contest Club. Bob, K3EST, and Tim, K3LR, spoke on behalf of Rusty.

Jeff, K1ZM, has been active in contests for over 40 years. He has built tremendous stations and allowed many contest operators to use them. He has given back to our sport by giving countless hours of helpful advice and writing a book on 160-meter operations. Jeff has stepped up many times as an officer with the Yankee Clipper Contest Club, where he has been one of the major spark plugs since the club was formed. Jeff has steered substantial fund raising efforts in North America for both WRTC 2002 and WRTC 2006. Jeff also coordinated a drawing during the dinner where an Acom amplifier and a trip to WRTC 2006 were given away. Bob, K3EST, and Jim, K1IR, spoke on behalf of Jeff.

Prizes and Pizza

The prize list was extensive this year. Almost 50 prizes were given to contest operators in attendance. These prizes came from companies who consider contesters to be a substantial part of their business. I'd like to thank the following companies who donated super prizes: Force12 antennas, American Radio Relay League, *WriteLog*, *CQ Magazine*, Comtek Systems, W4MPY QSL Man, *The DX Magazine*, Radio Bookstore, Radio Ware, Top Ten Devices, DX Engineering, *National Contest Journal*, *Daily DX*, *Weekly DX*, The Rotor Doctor, Tony Rogozinski, W4OI, *WinTest* and 9V1YC. If you won a prize, please write a thank you letter or e-mail to these companies. Their continued support is vital.

Special thanks to Jay Terleski and his companies from Array Solutions for stepping up and sponsoring The 2005 Contest Super Suite. OptiBeam, AY technologies, AN Wireless, Prosistel and Bushcomm all contributed funds. North Coast Contesters, Frankford Radio Club and The Mad River Radio Club hosted the suite.

Dave, K8CC, and Tim, K3LR, sponsored the Super Suite pizza party at midnight on Thursday night honoring Rush Drake, W7RM. During the party, contest operators enjoyed 25 delicious pizzas.

The Yankee Clipper Contest Club hosted the pizza party in the Super Suite at midnight on Friday night, where 35 pizzas went down fast.

The Potomac Valley Radio Club sponsored the midnight Saturday night pizza party, where 30 pizzas were consumed in 15 minutes! Wow!

The new venue for the Antenna forum and the Contest forum at the Crowne Plaza on Saturday afternoon was a major hit. K1DG and K3LR are not certain which location will be used next year (Hara or the hotel). The 5 hours of forum talks this year were well attended. Many of the talks can be downloaded at **www.k3lr.com**. Sincere thanks to Comtek Systems for helping with the expenses of the AV equipment.

Thanks to Jim Miller, K4SQR, for helping to coordinate the dinner. Also thanks to Tom Roscoe, K8CX, for taking the dinner pictures.

Make Plans for 2006

Preparations are already underway for the 14th Annual Dayton Contest Dinner. We expect ticket sales to start in February 2006.

Make your plans now to attend Dayton 2006 and enjoy the company of some of your best radio friends. Watch for announcements in this magazine, its Web site (**www.ncjweb.com**), the ARRL *Contest Rate Sheet*, **www.contesting.com** as well as the **cq-contest@contesting.com** reflector. Suggestions are always welcome. Send them to **k3lr@k3lr.com**. NCJ

Modifying the Top Ten DXDoubler for Enhanced Operation with N1MM Logger

By Pete Smith, N4ZR

Reprinted with permission from the PVRC Newsletter

For a week or so, Ted, W4NZ and I corresponded about the use of the unshifted tilde (~) key to switch audio for SO2R operation, a feature that *N1MM Logger* has implemented by toggling pin 5 of the parallel port. I think the idea originated with *NA*; *TR* may have it now also.

Ted had discovered that by moving Jumper 2 of the DXD to the "NA" position you could change the headphone audio from being always on the active radio to "stereo" (one radio in each ear), just by pressing that key. I wanted to go one better and mimic the "PTT" operation of the DXD. This puts both ears on the INactive radio for aggressive S&P, but still be able to put both ears on the Active (or Run) radio from the keyboard, to help pick up weak answers to my CQs while HC8N is blasting on the S&P radio at S9 +40.

You can do this manually by switching the DXD audio mode switch from PTT to Auto, but I'd rather keep my hands on the keyboard. After corresponding with George, W2VJN, and Dave, N3RD, of Top Ten, and entirely thanks to them, I have it working. I also owe a vote of thanks to Terry, N4TZ/9, whose article in the September/October 2004 *NCJ* ("A Simple Modification to the Top Ten DXDoubler," page 33) describes modifying the DXD to do the same trick, but with a foot switch, which got us all thinking.

First, put the DXD jumper in its *CT*/*Writelog*/*TR*/*MM* position. This has the effect of isolating pin 5 of the LPT port. Then, put a 2N2222 open collector switch between pin 5 and the Auto terminal of S3 on the DXD (that's the audio mode switch). Specifically, pin 5 drives the base of the transistor through a 1-kΩ resistor connected to the high side of R22, just like the basic CW keying interface (see Figure 1). The emitter is grounded to the ground side of R22, and the collector is wired to the switch side of R29. I mounted the transistor next to R22 with double-sided tape. It's ugly, but effective. That's all there is to it. NCJ

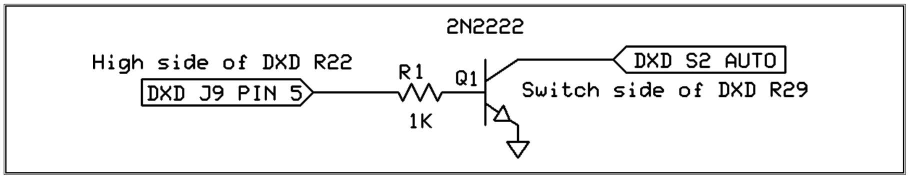


Figure 1—Pin 5 drives the base of the transistor through a 1-kΩ resistor.

Verticals by the Sea

Al Christman, K3LC
Grove City College
100 Campus Drive
Grove City, PA 16127-2104

This article analyzes the gain of vertical monopole antennas with two gull-wing elevated radials, when they are installed near the seacoast. The height of the radials is varied, along with the set-back distance between the antenna and the shoreline. Many of the amateur bands from 160 to 10 meters are reviewed.

Background

Contesters and DXers are well aware of the advantages that are inherent in the use of vertical antennas when they are placed near large bodies of salt water. Many years ago, Tom Erdmann, W7DND, had a rotatable 4-element 40-meter phased vertical array that was located at the edge of Puget Sound in Bremerton, Washington.[1] Well-known contester Rush Drake, W7RM (SK), used verticals mounted on a beach at the base of a cliff to work the world from his former QTH in Washington state.[2] More recently, "Team Vertical," composed of K2KW, N6BT and others, conducted several successful contest expeditions from the Caribbean using verticals.[3, 4] Their decision to employ bent or gull-wing elevated radials was based upon this author's earlier published work in an IEEE journal.[5]

A series of tests are described by K2KW, in which a vertical transmit antenna was erected on the beach and a receive antenna installed across the (saltwater) bay: "The team set the vertical on the land-water boundary (above) and moved the vertical away from the water in 3-foot steps. The land-water boundary was the reference point (0.0)...but when the antenna reached approximately 1/4 wavelength from the water, the signal level increased + 3 dB over the reference point! The zone of this enhancement was fairly small. As the antenna reached 1/2 wavelength from the water, the antenna was now -2 dB from the reference point! At the 3/4-wavelength point, the signal was now +2 dB. Obstacles prohibited us from going farther than 3/4 wavelength from the land-water boundary. But it was clear that the land-water boundary had a significant impact on the low-angle energy (in the pseudo-Brewster angle)."[4]

Kenny continues: "Unfortunately it appears that the gain enhancement is only in the immediate direction of the water. In directions other than the closest point of water, there is more land, thus impacting the pseudo-Brewster angle in those directions. While having 3 dB of gain is desirable, it is my conviction that the vertical should be placed as close to, or over, saltwater to ensure optimum performance in as many directions as possible."[4]

[1]Notes appear on page 12.

Computer Simulation

After considering the remarks above, it was decided to model several vertical monopole antennas, installed either at or near a land/sea boundary. Figure 1 shows a pictorial view of one antenna configuration, which is typical of those that were examined. The length of the vertical element and the two radials was fixed at exactly 0.25 wavelength at the operating frequency, while the base of the antenna was placed just one foot above the ground. The two gull-wing radials are oriented parallel to the shoreline, and they initially extend upward at a 45-degree angle from the bottom of the antenna, until reaching their final height H. This elevation height varies from 2.5 to 10 feet, depending upon the band of interest. The set-back distance from the water to the antenna is D, which ranges from 0 to 0.25 wavelengths in steps of 0.05 wavelength.

The antenna models were run using the new *EZNEC Pro* software, version 4.0,[6] with a double precision *NEC-4* calculating engine. For simplicity, it was assumed that all antennas were constructed entirely from #12 AWG copper wire. No attempt was made to prune either the vertical element or the radials to achieve resonance. The wire segment lengths for the vertical element and the radials were selected in accordance with the most conservative *NEC* guidelines. The seawater has an electrical conductivity of 5 Siemens per meter and a dielectric constant of 81. However, because the soil on most beaches is either sandy or rocky, its conductivity was set at 0.0015 Siemens/meter, with a dielectric constant of 4.

Results on 40 Meters

A frequency of 7.15 MHz was selected for the analysis on 40 meters, which corresponds to a length of about 34.39 feet for both the vertical element and the two gull-wing radials. Elevation heights

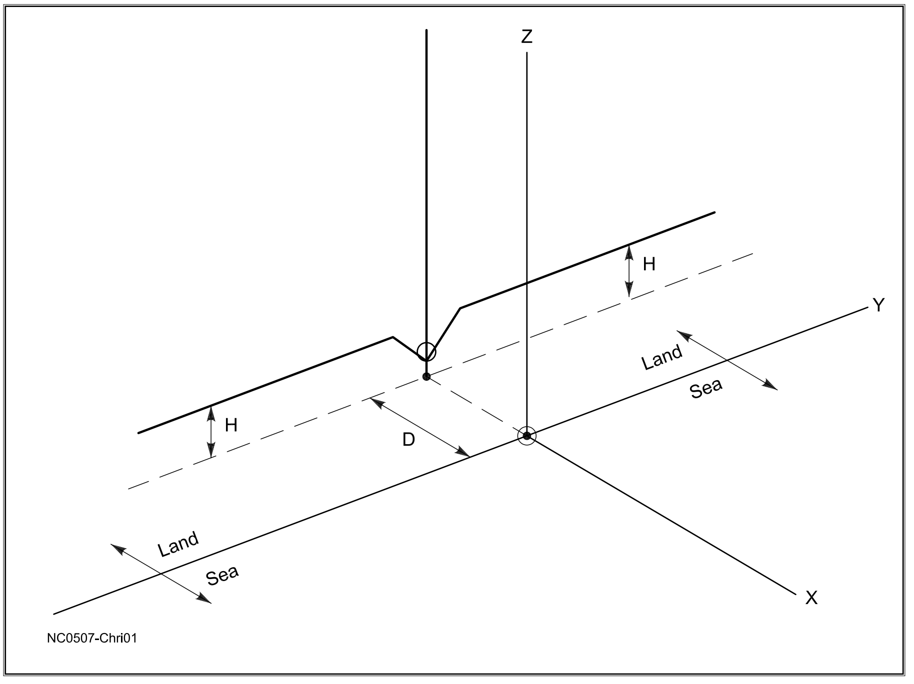


Figure 1—Drawing of an elevated vertical monopole antenna (base height = 1 foot) with two gull-wing radials. The length of both the vertical element and the radials is 0.25 wavelength (34.39 feet at 7.15 MHz). H represents the height of the horizontal portions of the radials, and D is the set-back distance from the shoreline.

of 2.5 and 5.0 feet were chosen for the horizontal portions of the radials.

Table 1 displays the resulting performance data for the gain and take-off angle, when looking either toward the front of the radiation pattern (seaward) or back toward land. Also shown are the front-to-back ratio (FBR) in the elevation plane, and the half power beamwidth (HPBW) in the azimuthal plane. We can see that increasing the height of the radials (H) always produced a small amount of extra gain and a slight improvement in the FBR, for any set-back distance (D). However, the changes were minor, with the gain remaining around 4 or 5 dBi and the FBR close to 7 dB. When the height of the radials (H) is held constant, the gain can be peaked (to a small degree) by varying the set-back distance. For either value of H, maximum gain and maximum FBR both occurred when the antenna was placed 0.1 wavelength from the edge of the water. When the height of the radials is fixed, the gain of the back lobe remains constant for any set-back distance, since the antenna always sees land in that direction.

The elevation and azimuthal plane radiation patterns for a set-back distance (D) of 0 wavelength and a radial height (H) of 2.5 feet are displayed in Figures 2 and 3, while those for D = 0.1 wavelength and H = 2.5 feet appear in Figures 4 and 5. For each plot, the sea is toward the right, and the land toward the left, as evidenced by the enhanced gain and lower take-off angles in the direction of the saltwater. Notice that the elevation plane pattern is very smooth when the antenna is mounted at the land-sea junction, but somewhat jagged and irregular when the set back distance increases. A similar effect is visible in the azimuthal plane patterns, along with a general decrease in the half power beamwidth when the antenna is moved away from the interface.

Why are some of the seawater portions of the pattern plots so odd looking? Roy Lewallen, W7EL, cautions us regarding the use of a second medium

Table 1

Antenna performance on 40 meters (f = 7.15 MHz) as a function of radial height and set-back distance. The base of the antenna is fixed at a height of one foot, and the radials are oriented parallel to the shoreline.

Radial Height H (ft)	*Set-back Distance D (WL)*	*Gain (dBi) and Take-off Angle (deg) front*		*back*		*FBR (dB)*	*Azimuthal Beamwidth (degrees)*
2.5	0.0	4.16	9	-2.65	29	6.81	179.6
	0.05	4.37	15	-2.65	28	7.02	162.4
	0.1	4.60	8	-2.65	29	7.25	157.0
	0.15	4.55	6	-2.65	28	7.20	152.6
	0.2	4.37	4	-2.65	28	7.02	156.2
	0.25	4.15	3	-2.65	28	6.80	158.0
5.0	0.0	4.52	9	-2.37	28	6.89	179.6
	0.05	4.77	17	-2.37	27	7.14	159.4
	0.1	5.17	9	-2.37	27	7.54	158.2
	0.15	5.15	6	-2.37	27	7.52	153.6
	0.2	5.01	9	-2.37	27	7.38	136.6
	0.25	5.01	7	-2.37	27	7.38	138.2

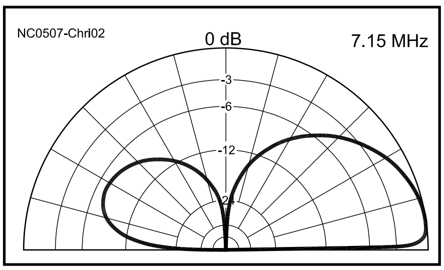


Figure 2—Elevation plane radiation pattern for the 40-meter vertical, where the set-back distance D = 0 and the height of the horizontal portion of the gull-wing radials is H = 2.5 feet. The sea is toward the right in the drawing. Gain = 4.16 dBi at 9 degrees take-off angle; front-to-back ratio = 6.81 dB.

Table 2

Antenna performance on 80 meters (f = 3.75 MHz) as a function of radial height and set-back distance. The base of the antenna is fixed at a height of one foot, and the radials are oriented parallel to the shoreline.

Radial Height H (ft)	*Set-back Distance D (WL)*	*Gain (dBi) and Take-off Angle (deg) front*		*back*		*FBR (dB)*	*Azimuthal Beamwidth (degrees)*
5.0	0.0	3.94	8	-2.49	28	6.43	179.6
	0.05	4.36	13	-2.49	28	6.85	164.2
	0.1	4.57	7	-2.49	28	7.06	159.0
	0.15	3.83	8	-2.49	28	6.32	150.8
	0.2	3.83	8	-2.49	28	6.32	140.8
	0.25	3.78	6	-2.49	28	6.27	142.2
7.5	0.0	4.20	8	-2.30	28	6.50	179.6
	0.05	4.60	12	-2.30	27	6.90	164.8
	0.1	4.75	7	-2.30	27	7.05	159.8
	0.15	4.64	4	-2.30	27	6.94	161.2
	0.2	4.49	3	-2.30	27	6.79	161.0
	0.25	4.48	6	-2.30	27	6.78	142.2
10.0	0.0	4.39	8	-2.18	28	6.57	179.6
	0.05	4.83	11	-2.18	27	7.01	167.4
	0.1	4.93	6	-2.18	27	7.11	164.4
	0.15	4.83	4	-2.18	27	7.01	164.0
	0.2	4.68	3	-2.18	27	6.86	161.8
	0.25	4.60	6	-2.18	27	6.78	143.0

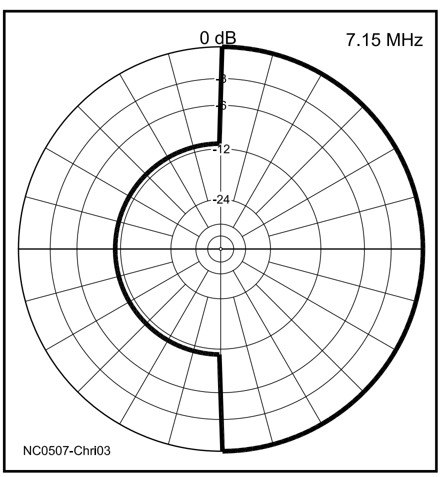


Figure 3—Azimuthal plane radiation pattern for the 40-meter vertical, where the set-back distance D= 0 and the height of the horizontal portion of the gull-wing radials is H = 2.5 feet. The sea is toward the right in the drawing. The half power beamwidth in the azimuthal plane is 179.6 degrees.

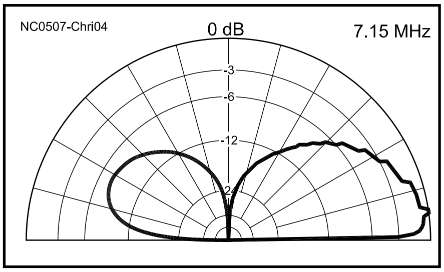


Figure 4—Elevation plane radiation pattern for the 40-meter vertical, where the set-back distance D = 0.1 wavelength and the height of the horizontal portion of the gull-wing radials is H = 2.5 feet. The sea is toward the right in the drawing. Gain = 4.60 dBi at 8 degrees take-off angle; front-to-back ratio = 7.25 dB.

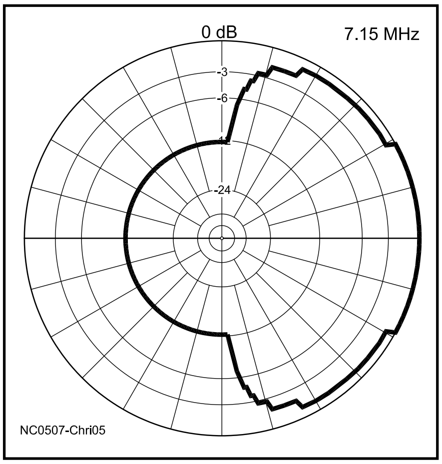


Figure 5— Figure 5. Azimuthal-plane radiation pattern for the 40m vertical, at a take-off angle of 8 degrees. The set-back distance D = 0.1 wavelength, and the height of the horizontal portion of the gull-wing radials is H = 2.5 feet. The sea is toward the right in the drawing. The half-power beamwidth in the azimuthal plane is 157.0 degrees.

Table 3

Antenna performance on 160 meters (f = 1.835 MHz) as a function of radial height and set-back distance. The base of the antenna is fixed at a height of one foot, and the radials are oriented parallel to the shoreline.

Radial Height H (ft)	*Set-back Distance D (WL)*	*Gain (dBi) and Take-off Angle (deg) front*		*back*		*FBR (dB)*	*Azimuthal Beamwidth (degrees)*
5.0	0.0	3.59	7	-1.76	26	5.35	179.6
	0.05	3.87	7	-1.76	26	5.63	170.4
	0.1	3.86	5	-1.76	26	5.62	164.0
	0.15	3.71	3	-1.76	26	5.47	165.2
	0.2	3.48	2	-1.76	26	5.24	164.8
	0.25	3.48	2	-1.76	26	5.24	162.8
7.5	0.0	3.77	7	-1.62	27	5.39	179.6
	0.05	4.14	10	-1.62	27	5.76	166.4
	0.1	4.25	6	-1.62	26	5.87	161.2
	0.15	4.21	4	-1.62	26	5.83	160.6
	0.2	4.12	3	-1.62	26	5.74	160.2
	0.25	3.89	2	-1.62	26	5.51	164.0
10.0	0.0	3.93	7	-1.49	26	5.42	179.6
	0.05	4.26	7	-1.49	26	5.75	170.6
	0.1	4.25	5	-1.49	26	5.74	166.2
	0.15	4.12	3	-1.49	26	5.61	165.4
	0.2	3.93	7	-1.49	26	5.42	143.6
	0.25	3.92	6	-1.49	26	5.41	141.2

(which in our case is seawater rather than a second type of soil) with *EZNEC*: "The effect of the second medium is taken into account only in a very simplified way. The vertical pattern is generated by tracing rays direct from the antenna and reflected from the ground. When a second medium is used, the ground reflection ray is determined by whichever medium it strikes the top of. The ray does not penetrate either medium, and diffraction or similar effects aren't considered."[7] All of the radiation patterns shown here were computed using one-degree increments in elevation angle, but the results were similar when the calculation interval was decreased to just 0.1 degree. Thus, it is likely that the information shown here is not as accurate as we would hope, although the general trends should be correct.

Results for 80 Meters

On 80 meters a frequency of 3.75 MHz was utilized, so the length of the vertical element (and the radials) is about 65.57 feet. Elevation heights of 5, 7.5, and 10 feet were chosen for the horizontal portions of the radials.

The results of the analysis are given in Table 2. As was true on 40 meters, raising the height of the radials (H) yielded a small amount of extra gain and (with two exceptions) a modest increase in the FBR, for any set back distance (D). Once again, the changes were small, with the gain staying between about 4 and 5 dBi, and the FBR close to 7 dB. When H is held constant, the gain (as before) can be peaked to a small extent by optimizing the set-back distance. For all three values of H, both maximum gain and maximum FBR occurred when the antenna was placed 0.1 wavelength from the edge of the water. And, if the height of the radials is fixed, the gain of the back lobe remains constant for any set-back distance.

The elevation and azimuthal plane radiation patterns are not shown for this band, but they closely resemble those presented for 40 meters.

Results on 160 Meters

A frequency of 1.835 MHz was selected for the computer simulation on top band, requiring a length of about 134 feet for the quarter wave vertical element and the radials. As on 80 meters, elevation heights of 5, 7.5, and 10 feet were utilized for the horizontal portions of the radials.

Table 3 lists the performance data for Top Band. We can see that increasing the height of the radials (H) usually generated a small amount of extra gain and a slight improvement in the FBR, although there were some exceptions when H = 10 feet. However, the variations are minor, with the gain remaining close to 4 dBi and the FBR between 5 and 6 dB. When the height of the radials (H) is held constant, the gain can be peaked a bit by varying the set-back distance. If H = 5 or 10 feet, maximum gain and maximum FBR both occurred when the antenna was placed 0.05 wavelength from the edge of the water, while D = 0.1 wavelength worked best at H = 7.5 feet. When the height of the radials is fixed, the gain of the back lobe remains constant for any set-back distance, since the soil characteristics are unchanged in that direction.

The elevation and azimuthal plane radiation patterns are omitted, but they are very similar to those given previously for 40-meter operation.

Results for the High Bands

After discussions with Carl, K9LA, it was decided to expand the coverage of this article to include the 20 and 10-meter bands as well. (*Results for 17, 15 and 12 meters can easily be interpolated from the*

20 and 10-meter results—Ed).

A frequency of 14.175 MHz was selected for the analysis on 20 meters, which corresponds to a length of about 17.35 feet for both the vertical element and the two-gull-wing radials. Elevation heights of 2.5 and 5.0 feet were chosen for the horizontal portions of the radials.

Table 4 displays the resulting performance data for this band. We can see that increasing the height of the radials (H) always produced a small amount of extra gain and a slight improvement in the FBR, for any set-back distance (D). However, the changes were minor, with the gain remaining around 5 dBi or so, and the FBR close to 7 dB. When the height of the radials (H) is kept fixed, the gain can be peaked (by a small amount) by varying the set back distance. For H = 2.5 feet, maximum gain and maximum FBR both occurred when the antenna was placed 0.15 wavelength from the edge of the water, while D = 0.1 wavelength worked best for H = 5 feet. Notice that, when H = 5 feet, both the gain and FBR oscillate up and down as D is made larger. If the height of the radials is held constant, the gain of the back lobe remains constant for any set-back distance, since the antenna always sees land in that direction.

The elevation and azimuthal plane radiation patterns are not shown for this band, but they closely resemble those presented for 40 meters.

On 10 meters a frequency of 28.3 MHz was utilized, so the length of the vertical element (and the radials) is about 8.69 feet. Elevation heights of 2.5 and 4 feet were chosen for the horizontal portions of the radials.

The results of the analysis on 10 meters are given in Table 5. As was true on 20 meters, raising the height of the radials (H) yielded a small amount of extra gain and (with some exceptions) a modest increase in the FBR, for any set back distance (D). Once again, the changes were small, with the gain staying between 5 and 6 dBi, and the FBR around 6 or 7 dB. When H is held constant, the gain (as before) can be peaked slightly by optimizing the set-back distance. When H = 2.5 feet, both maximum gain and maximum FBR occurred when the antenna was placed 0.15 wavelength from the shoreline, although D = 0.2 wavelength is optimal when H = 4 feet. Much as was seen on 20 meters, if H = 2.5 feet then both the gain and FBR oscillate up and down as D is made larger. On this band, the gain of the back lobe remained essentially the same for both heights, and at all set-back distances.

The elevation and azimuthal plane radiation patterns are omitted here, but they closely resemble those given previously for 40 meters.

Table 4

Antenna performance on 20 meters (f = 14.175 MHz) as a function of radial height and set-back distance. The base of the antenna is fixed at a height of one foot, and the radials are oriented parallel to the shoreline.

Radial Height H (ft)	*Set-back Distance D (WL)*	*Gain (dBi) and Take-off Angle (deg) front*		*back*		*FBR (dB)*	*Azimuthal Beamwidth (degrees)*
2.5	0.0	4.72	9	-1.97	29	6.69	179.6
	0.05	4.72	9	-1.97	28	6.69	170.0
	0.1	5.13	12	-1.97	28	7.10	154.6
	0.15	5.18	8	-1.97	28	7.15	149.8
	0.2	5.08	6	-1.97	28	7.05	149.4
	0.25	4.98	5	-1.97	28	6.95	147.2
5.0	0.0	5.00	9	-1.74	28	6.74	179.6
	0.05	5.00	9	-1.74	28	6.74	171.2
	0.1	5.68	13	-1.74	28	7.42	156.8
	0.15	5.43	14	-1.74	28	7.17	141.4
	0.2	5.56	11	-1.74	28	7.30	139.0
	0.25	5.66	5	-1.74	28	7.40	153.6

Table 5

Antenna performance on 10 meters (f = 28.3 MHz) as a function of radial height and set-back distance. The base of the antenna is fixed at a height of one foot, and the radials are oriented parallel to the shoreline.

Radial Height H (ft)	*Set-back Distance D (WL)*	*Gain (dBi) and Take-off Angle (deg) front*		*back*		*FBR (dB)*	*Azimuthal Beamwidth (degrees)*
2.5	0.0	5.01	10	-1.33	28	6.34	179.6
	0.05	5.01	10	-1.33	27	6.34	171.0
	0.1	5.14	20	-1.33	27	6.47	148.2
	0.15	5.59	14	-1.33	27	6.92	143.4
	0.2	5.30	15	-1.33	27	6.63	132.0
	0.25	5.43	12	-1.33	27	6.76	125.6
4.0	0.0	5.02	10	-1.32	27	6.34	179.6
	0.05	5.02	10	-1.32	26	6.34	172.8
	0.1	5.18	20	-1.32	26	6.50	151.8
	0.15	5.71	14	-1.32	26	7.03	151.2
	0.2	5.88	10	-1.32	26	7.20	150.6
	0.25	5.87	8	-1.32	26	7.19	150.2

Conclusions

An elevated vertical monopole with two gull-wing radials makes an effective DX antenna when installed at or near a large body of salt water. Compared to land, the high conductivity of this liquid medium yields enhanced signal strength at low take-off angles, with a resulting forward lobe that is broad in both the elevation and azimuthal planes. The height of the horizontal portions of the radials need not be great (typically on the order of a few feet), and the set-back distance from shoreline to antenna can range from zero to 0.25 wavelength, with little change in performance. This is good news for those who operate in locations with significant tidal action.

Notes

[1]Jerrold Swank, W8HXR, "The S-Meter Bender: W7DND's magic antenna," *73* magazine, June 1978.

[2]Information on the W7RM and W7DND antennas was obtained from private communications with Chip Margelli, K7JA, Ward Silver, NØAX, and Paul Kiesel, K7CW.

[3]Kenny Silverman, K2KW, and Tom Schiller, N6BT, "Verticals for Contest Expeditions: Learnings from the 6Y4A CQ WW CW Contest," *CQ Contest*, March 1998. This article can also be found on the Web at **www.k2kw.com/verticals/learning.html**.

[4]Kenny Silverman, K2KW, data posted on the Web at **www.k2kw.com/verticals/tests.html**.

[5]Al Christman and R. Paul Zeineddin, with Roger Radcliff and Jim Breakall, "Using Elevated Radials in Conjunction with Deteriorated Buried-Radial Ground Systems," *IEEE Transactions on Broadcasting*, Volume 39, Number 2, June 1993.

[6]Several versions of the *EZNEC* antenna modeling software are available from Roy Lewallen, W7EL, PO Box 6658, Beaverton, OR 97007.

[7]Roy Lewallen, W7EL, *EZNEC Pro* V.4.0 User's Manual, page 68.

NCJ

The Finnish Way To WRTC2006

Martti Laine, OH2BH

On the recent Contest Club Finland (CCF) 10th Anniversary Cruise, it was announced that Finnish contesters can apply for the Finnish team captain position during Spring 2005 and get involved with a variety of pre-qualifying activities. The target was set for the Finnish captain to lead a Finnish team to take WRTC honors for the first time outside of the United States. Not a modest target but a reasonable one, coming from a previous WRTC hosting country.

The first qualifying run was set to take place during IARU Radiosport in July with all captain candidates participating, using a 100 W WRTC-like station. Indeed, there are still dozens of those up on the WRTC2002 battlefield. This will be followed by the Scandinavian Activity Contest (SAC) in September with full-board stations highlighting multiplier search and pounce and correct logging. Running best with the 100-W station, being effective in multipliers and correct logging, will set the stage for final selection at the end of 2005. Their past performance added to an overall ability to represent the Republic of Finland will count. The selected captain will be given total freedom to select his partner, the established specifications of which the selected captain will know best.

But what seems an interesting approach is the fact that the racing stations will appear in front of the Finnish public on 80-meter CW and 75-meter SSB for a quick 30-minute show during the IARU contest. Not only for an on-the-air presentation, but an immediate SMS (Short Message Service) vote for operating style and efficiency, and involving the entire Finnish population to compete in capturing a roster of six (6) qualifying candidates in the shortest possible time. Obviously the "drivers" will gather on 80-meters for a public press conference on 3666 kHz, following the true racing spirit.

As indicated, there are six (6) competing captain candidates representing three different contest generations: Olli Rissanen, OHØXX; Juha Tuovinen, OH1JT; Timo Klimoff, OH1NOA; Toni Linden, OH2UA; Marko Holmavuo, OH4JFN and Jussi-Pekka Sampola, OH6RX. These six competing captains are joined by one dark horse, giving the competitors valuable reference points.

It's Marko, OH4JFN, shaping up his strategy for the fast lane ahead of a pre-qualifying run for WRTC2006. In the back, Veijo, OH6KN, is trying to capture the holy moment.

The station locations and call signs will be issued randomly prior to the actual race in true WRTC spirit. The stations can be identified by their special W suffix (**OH2W, OH4W, OH5W, OH6W, OH7W, OH8W** and **OH9W**) so that you can find them during the IARU competition. Those working these 7 stations in the IARU Radiosport will be presented with a WRTC2002 video donated by James Brooks, 9V1YC. More than 100 PAL/NTSC videos are reserved. Just keep watching the news about these qualifying WRTC stations from Finland.

A Contest Club Finland (CCF) special task force, headed by Veijo Kontas, OH6KN and Risto Lund, OH3UU, will provide the WRTC2002 scoreboard concept and basic technology to be used as the basis for the WRTC2006 Web scoreboard project led by Eric de Castro, PY2EMC.

The drawings for station locations were done May, 26 2005 at the famous Black Horse restaurant in Helsinki, Finland. The proceedings were handled by secretary of the Finnish WRTC Committee Risto Lund, OH3UU with lady Foruna.

Young contesters were highly visible at the CCF 10th anniversary gathering. Patrick, OH6GDX, Lee, GØMTN (two on left), with Thomas, OZ1AA, and Timo, OH1NOA (two on right), all of World Young Contester Club (WYCC) fame. Standing in the middle is an experienced OT–Oms, PY5EG–looking forward to WRTC2006.

A 35-year difference in age would not bother Toni, OH2UA, or Olli, OHØXX, in running against each other in a big way in the WRTC2006 pre-qualifying run. Do you want to put your money on young enthusiasm or old wisdom? Toni, age 25, and Olli, age 59, are ready to race—big time!

Antenna Interactions—Part 7
Antennas Pointing in Opposite Directions

Eric L. Scace, K3NA
k3na@arrl.net

Part 1 of our series introduced meta-tools that give more comprehensive maps and statistics about antenna radiation patterns.[1]

Part 2 applied those meta-tools to twisted stacked Yagis where the antennas point in different directions, identifying some problem situations that contesters may encounter.[2]

Part 3 examined self-interactions of unused antennas within a stack, applying a new meta-tool to compare complete sky-hemisphere patterns. This part gave examples of siting problems in the design of a contesting station antenna farm, but did not fully explore siting issues.[3]

Part 4 introduced current tapering to clean up stack patterns.[4]

Part 5 identified impairments by identical antennas in the near field located on the same tower, or turned 90° on a separate tower.[5]

Part 6 described impairments by identical antennas in the near field on separate towers, when both antenna systems point in the same direction.[6]

In this part we look at identical antennas in the near field pointing in opposite directions.

Opposite Azimuths, Separate Towers

We continue to examine scenarios involving a short stack of 6-element 20m OWA Yagis, mounted at heights of ½ and 1λ. A third, identical Yagi stands ¾ λ above ground on a separate tower; we will refer to this as the "multiplier Yagi."

Part 5 of this series examined the scenario when the multiplier Yagi pointed to an azimuth at right angles to the stack's azimuth. Part 6 examined the case when both the stack and the multiplier Yagi point to the same azimuth. Today we look at the situation where the multiplier Yagi points in the opposite direction.

Having examined these three scenarios, we can make some recommendations about locating and using two towers with rotating Yagi systems on the same band.

Multiplier Yagi fed

We start by examining impairments to the pattern of the multiplier Yagi caused by the unused stack. The feedpoints of the stack's Yagis are short-circuited.

By itself, this multiplier Yagi's peak gain of 14.6dBi occurs at 17° elevation. The main beam's –3dB points stand ±28° to the left and right, and at 8 and 28° elevation. These –3dB points form the target zone for this analysis.

To identify the minor lobes, a range of ±51° in azimuth and 3 to 36° in elevation (representing the –11dB points on the main beam) was excluded from the non-target zone statistics. This exclusion prevented the sides of the main beam from obscuring information about the behavior of the pattern outside the main beam.

Table 1 summarizes pattern parameters and impairments as a function of relative location between these two antenna systems. The first row gives performance parameters for an isolated multiplier Yagi (i.e., no stack present) for comparison. The columns in this table represent, from left to right:

- Location of the multiplier antenna relative to the stack; e.g., 1 at 0° means the multiplier antenna stands one wavelength in front of the stack. The stack Yagis always point to 0° azimuth. The multiplier Yagi always points to 180°.
- Peak gain of the multiplier antenna, its azimuth and elevation, and the impairment to peak gain (change in peak gain caused by the presence of the unused stack).
- Median gain over the target zone, and the impairment to median gain.
- Minimum gain within the target zone, and the impairment to that minimum gain. Since no antenna fills a target zone uniformly, we want to know if impairments exist to the least well-served part of the target.
- Largest spot increase in gain, and largest spot decrease in gain, within the target zone. "Spot gain" refers to the gain in a specific direction (azimuth and elevation). A significant change in the gain in any one direction would be an undesirable interaction, even if the overall pattern averaged out to the same level of gain.
- Median gain outside of the main beam, and impairment to that median gain. A well-designed antenna has little sensitivity outside of its main beam; any increase in median gain indicates impaired performance. An entry of "floor" here means the median gain is less than the floor threshold of –15dBi.
- Worst (highest gain) minor lobe outside the main beam, its location, and the impairment (increase in gain of the worst minor lobe).
- Largest spot increase in gain, and largest spot decrease in gain, outside the main beam.
- Portion of the sky hemisphere with gain of <–15dBi (quiet regions of reduced QRM and QRN), and impairment to that portion.
- Feedpoint impedance.

Multiplier Yagi Impairment Overview

In the previous parts of this series, we examined three different, increasingly strict, thresholds for tolerable impairments between a stack and a multiplier antenna:

- No impairment within the target zone exceeding 1dB, but accept any degree of impairment outside the main beam.
- No impairment to the median gain outside the mean beam exceeding 1dB, and no variation in spot gain by more than 6dB (an S unit).
- No variation in spot gain at any point in the pattern exceeding 1dB.

As in other configurations, study of Table 1 reveals that all impairments vary

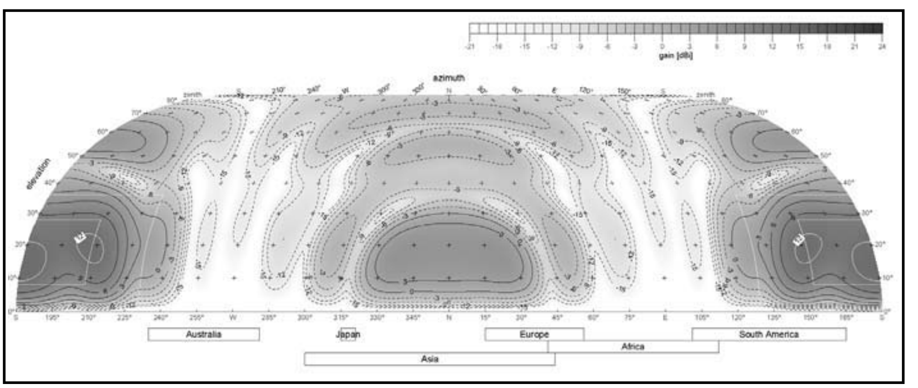


Figure 1—Gain pattern of the multiplier Yagi when it stands 4λ directly in front of the stack. The stack's Yagis point to 0° azimuth; the multiplier Yagi points to 180°. Parasitic re-radiation by the stack modulates the Yagi's pattern with a rippled pattern of constructive and destructive interference, and adds a substantial rear lobe.

Table 1
Performance parameters for the multiplier Yagi and impairments caused by a nearby 2-Yagi stack. The multiplier Yagi points toward 0° azimuth. The stack points 180°.

Yagi loc		target #1									non-target									feedpoint
dist	dir	peak gain			median gain		minimum gain		largest		median gain		worst minor lobe			largest		%sky <-15 dBi		feedpoint
λ	°	dBi	location	delta	dBi	delta	dBi	delta	decr	incr	dBi	delta	dBi	location	delta	decr	incr		change	impedance
no stack		14.60	az 180° el 17°		12.66		8.84				-9.78		3.49	az 180° el 54°				25.0%		30.0 -j10.4
0.0	0°	10.26	az 180° el 21°	-4.34	8.53	-4.13	2.79	-6.05	-6.55	-1.47	-5.18	4.60	9.25	az 0° el 13°	5.76	-7.14	21.27	10.3%	-14.7%	63.4 +j42.3
0.5	0°	12.33	az 179° el 13°	-2.27	8.21	-4.45	2.46	-6.38	-8.04	-1.06	-7.57	2.21	12.33	az 0° el 13°	8.84	-13.39	19.81	17.4%	-7.6%	234 -j157
1.0	0°	13.05	az 179° el 13°	-1.55	8.14	-4.52	1.58	-7.26	-7.91	-0.11	-4.46	5.32	11.72	az 0° el 12°	8.23	-10.91	19.60	11.7%	-13.3%	119 -j107
2.0	0°	11.90	az 179° el 13°	-2.70	8.21	-4.45	3.86	-4.98	-5.57	-1.38	-5.24	4.54	7.79	az 0° el 12°	4.30	-8.96	17.42	19.8%	-5.2%	36.2 -j10.0
4.0	0°	13.18	az 179° el 13°	-1.42	11.43	-1.23	7.14	-1.70	-2.97	1.37	-7.51	2.27	5.75	az 342° el 17°	2.26	-8.54	11.51	19.3%	-5.7%	27.4 -j 6.2
8.0	0°	13.95	az 195° el 19°	-0.65	12.83	0.17	8.72	-0.12	-0.92	0.78	-9.85	-0.07	3.73	az 180° el 51°	0.24	-10.49	7.10	23.6%	-1.4%	29.3 -j10.5
16.0	0°	14.72	az 181° el 18°	0.12	12.70	0.04	8.79	-0.05	-0.24	0.23	-9.73	0.05	3.58	az 181° el 55°	0.09	-3.74	2.83	24.6%	-0.4%	29.9 -j10.5
28.0	0°	14.60	az 179° el 16°	0.00	12.68	0.02	8.78	-0.06	-0.09	0.08	-9.72	0.06	3.50	az 180° el 55°	0.01	-1.16	1.07	24.7%	-0.3%	30.0 -j10.4
32.0	0°	14.55	az 179° el 16°	-0.05	12.67	0.01	8.83	-0.01	-0.06	0.07	-9.74	0.04	3.49	az 180° el 53°	0.00	-0.89	0.84	24.8%	-0.2%	30.0 -j10.4
0.5	30°	11.73	az 159° el 15°	-2.87	7.90	-4.76	-2.13	-10.97	-13.30	0.36	-6.55	3.23	9.86	az 30° el 15°	6.37	-14.67	16.76	17.8%	-7.2%	55.5 +j55.6
1.0	30°	13.43	az 207° el 17°	-1.17	9.97	-2.69	5.64	-3.20	-6.01	1.96	-7.10	2.68	9.60	az 23° el 16°	6.11	-6.80	15.57	14.0%	-11.0%	37.6 +j 3.8
2.0	30°	15.78	az 194° el 17°	1.18	11.68	-0.98	6.17	-2.67	-3.08	2.24	-8.65	1.13	6.20	az 7° el 17°	2.71	-9.48	11.67	21.9%	-3.1%	30.0 -j 6.9
4.0	30°	15.73	az 183° el 16°	1.13	12.32	-0.34	7.78	-1.06	-1.55	1.30	-9.47	0.31	4.49	az 178° el 52°	1.00	-10.63	8.13	24.1%	-0.9%	29.5 -j 9.7
8.0	30°	14.85	az 186° el 17°	0.25	12.58	-0.08	8.91	0.07	-0.50	0.47	-9.72	0.06	3.85	az 180° el 54°	0.36	-7.20	3.94	24.5%	-0.5%	29.9 -j10.4
16.0	30°	14.71	az 181° el 17°	0.11	12.68	0.02	8.72	-0.12	-0.14	0.14	-9.72	0.06	3.59	az 180° el 54°	0.10	-1.55	1.32	24.7%	-0.3%	30.0 -j10.4
24.0	30°	14.65	az 178° el 17°	0.05	12.67	0.01	8.62	-0.22	-0.06	0.06	-9.75	0.03	3.53	az 180° el 54°	0.04	-0.69	0.64	24.7%	-0.3%	30.0 -j10.4
0.5	60°	12.50	az 206° el 17°	-2.10	9.94	-2.72	5.77	-3.07	-5.94	0.86	-6.93	2.85	8.68	az 5° el 15°	5.19	-9.00	14.99	11.5%	-13.5%	19.8 -j 9.2
1.0	60°	15.03	az 192° el 17°	0.43	12.43	-0.23	7.56	-1.28	-1.74	1.42	-10.21	-0.43	4.14	az 128° el 17°	0.65	-10.53	7.38	25.3%	0.3%	29.2 -j11.0
2.0	60°	14.99	az 175° el 17°	0.39	12.70	0.04	8.29	-0.55	-0.58	0.57	-9.76	0.02	3.53	az 128° el 17°	0.04	-2.82	2.32	24.4%	-0.6%	30.0 -j10.5
4.0	60°	14.74	az 177° el 17°	0.14	12.67	0.01	8.86	0.02	-0.20	0.19	-9.73	0.05	3.67	az 181° el 54°	0.18	-0.74	0.79	25.0%	0.0%	30.0 -j10.4
8.0	60°	14.63	az 178° el 17°	0.03	12.68	0.02	8.81	-0.03	-0.06	0.06	-9.77	0.01	3.51	az 183° el 54°	0.02	-0.26	0.24	24.9%	-0.1%	30.0 -j10.4
16.0	60°	14.60	az 182° el 17°	0.00	12.66	0.00	8.85	0.01	-0.02	0.02	-9.76	0.02	3.49	az 178° el 54°	0.00	-0.06	0.07	25.0%	0.0%	30.0 -j10.4
0.5	90°	12.79	az 196° el 17°	-1.81	11.86	-0.80	8.98	0.14	-2.23	0.69	-8.78	1.00	6.00	az 231° el 17°	2.51	-6.56	10.75	24.4%	-0.6%	36.2 -j 9.7
1.0	90°	14.77	az 176° el 17°	0.17	12.66	0.00	8.54	-0.30	-0.40	0.35	-9.77	0.01	3.73	az 231° el 17°	0.24	-4.32	2.92	24.1%	-0.9%	30.0 -j10.4
1.5	90°	14.62	az 182° el 17°	0.02	12.65	-0.01	8.75	-0.09	-0.12	0.12	-9.76	0.02	3.47	az 178° el 54°	-0.02	-1.52	1.53	24.5%	-0.5%	30.0 -j10.4
2.0	90°	14.60	az 178° el 17°	0.00	12.67	0.01	8.76	-0.08	-0.08	0.08	-9.74	0.04	3.56	az 180° el 54°	0.07	-0.85	0.79	24.8%	-0.2%	30.0 -j10.4
2.5	90°	14.62	az 181° el 17°	0.02	12.66	0.00	8.85	0.01	-0.04	0.05	-9.73	0.05	3.46	az 181° el 54°	-0.03	-0.52	0.52	24.7%	-0.3%	30.0 -j10.4
0.5	120°	12.50	az 154° el 17°	-2.10	9.94	-2.72	5.77	-3.07	-5.94	0.86	-6.93	2.85	8.68	az 355° el 15°	5.19	-9.00	14.99	11.5%	-13.5%	19.8 -j 9.2
1.0	120°	15.03	az 168° el 17°	0.43	12.43	-0.23	7.56	-1.28	-1.73	1.42	-10.21	-0.43	4.14	az 231° el 17°	0.65	-10.53	7.38	25.3%	0.3%	29.2 -j11.0
2.0	120°	14.99	az 184° el 17°	0.39	12.70	0.04	8.29	-0.55	-0.58	0.57	-9.76	0.02	3.53	az 231° el 17°	0.04	-2.82	2.32	24.4%	-0.6%	30.0 -j10.5
4.0	120°	14.74	az 182° el 17°	0.14	12.67	0.01	8.86	0.02	-0.19	0.19	-8.73	1.05	3.67	az 178° el 54°	0.18	-0.72	0.79	25.0%	0.0%	30.0 -j10.4
8.0	120°	14.63	az 182° el 17°	0.03	12.67	0.01	8.81	-0.03	-0.06	0.05	-9.77	0.01	3.51	az 178° el 54°	0.02	-0.24	0.24	24.9%	-0.1%	30.0 -j10.4
16.0	120°	14.60	az 182° el 17°	0.00	12.66	0.00	8.82	-0.02	-0.02	0.02	-9.76	0.02	3.49	az 181° el 54°	0.00	-0.07	0.07	25.0%	0.0%	30.0 -j10.4
0.5	150°	14.52	az 184° el 17°	-0.08	12.62	-0.04	8.11	-0.73	-0.75	0.56	-11.68	-1.90	4.43	az 231° el 17°	0.94	-10.63	7.88	31.5%	6.5%	31.9 -j10.4
1.0	150°	14.51	az 183° el 17°	-0.09	12.59	-0.07	8.62	-0.22	-0.42	0.33	-10.53	-0.75	4.22	az 128° el 17°	0.73	-5.92	5.35	23.4%	-1.6%	30.0 -j10.6
2.0	150°	15.78	az 165° el 17°	1.18	11.68	-0.98	6.17	-2.67	-3.08	2.24	-8.64	1.14	6.20	az 352° el 17°	2.71	-9.48	11.67	21.9%	-3.1%	30.0 -j 6.9
4.0	150°	15.73	az 176° el 16°	1.13	12.32	-0.34	7.78	-1.06	-1.55	1.30	-9.47	0.31	4.49	az 183° el 52°	1.00	-10.63	8.13	24.1%	-0.9%	29.5 -j 9.7
8.0	150°	14.85	az 173° el 17°	0.25	12.58	-0.08	8.91	0.07	-0.50	0.47	-9.72	0.06	3.85	az 180° el 54°	0.36	-7.19	3.94	24.5%	-0.5%	29.9 -j10.4
16.0	150°	14.71	az 178° el 17°	0.11	12.68	0.02	8.73	-0.11	-0.14	0.14	-9.73	0.05	3.59	az 180° el 54°	0.10	-1.55	1.32	24.7%	-0.3%	30.0 -j10.4
24.0	150°	14.65	az 181° el 17°	0.05	12.67	0.01	8.82	-0.02	-0.07	0.07	-9.75	0.03	3.53	az 180° el 54°	0.04	-0.69	0.64	24.7%	-0.3%	30.0 -j10.4
0.5	180°	14.77	az 181° el 17°	0.17	12.80	0.14	8.94	0.10	0.07	0.21	-12.21	-2.43	3.18	az 180° el 55°	-0.31	-10.43	5.52	30.5%	5.5%	31.0 -j11.1
1.0	180°	14.82	az 181° el 17°	0.22	12.78	0.12	8.63	-0.21	-0.21	0.27	-10.07	-0.29	3.82	az 180° el 54°	0.33	-7.05	5.47	24.0%	-1.0%	29.9 -j10.7
2.0	180°	14.63	az 181° el 17°	0.03	12.56	-0.10	8.62	-0.22	-0.28	0.16	-10.23	-0.45	4.12	az 231° el 17°	0.63	-4.98	4.89	23.5%	-1.5%	30.1 -j10.5
4.0	180°	14.48	az 181° el 17°	-0.12	12.64	-0.02	8.88	0.04	-0.14	0.22	-9.69	0.09	3.67	az 180° el 55°	0.18	-2.57	2.34	23.8%	-1.2%	30.0 -j10.4
8.0	180°	14.59	az 181° el 17°	-0.01	12.68	0.02	8.84	0.00	-0.06	0.06	-9.74	0.04	3.47	az 180° el 55°	-0.02	-0.85	0.97	24.7%	-0.3%	30.0 -j10.4

in a coordinated fashion, rising and falling together. While impairments to the main beam rapidly dwindle in significance as spacing between the antenna systems increases, the antenna pattern outside the main beam can remain impaired at greater distances.

The extreme example occurs when the multiplier Yagi stands in front of, and therefore points towards, the stack. The stack, illuminated by radiation from the multiplier Yagi, re-radiates parasitically, producing a classic interference pattern. In this alignment one must separate these systems by about 6λ before impairments to the main beam fall below 1dB, our first design threshold.

Figure 1 shows the pattern impairments in this alignment at a separation of 4λ. Note the substantial rear lobe (+5.8dBi) caused by re-radiation off the stack. To meet our second design criterion requires about 12λ separation. The most stringent design goal requires 31 λ separation, the largest identified to date in this series.

In contrast, when the multiplier Yagi stands off to the side of the stack, at right angles to the stack's azimuth, just over 2λ separation achieves our most stringent third design criterion.

Figure 2 maps contours of this spot variation in the pattern as the site of the multiplier Yagi moves around the center of the stack. Three zones allow significantly closer spacing with no pattern impairment: off to the left or right of the stack, and behind the stack.

Beam Shifts In Azimuth

The stack, when standing ½ to 1 λ away from the multiplier Yagi and 30-60° to the left or right of it, sucks the multiplier Yagi's main beam away from its intended direction. This shift is toward the stack, and can exceed 25° in azimuth. The multiplier Yagi's signal in the intended direction (along the axis of the boom) drops about –4dB. See Figure 3.

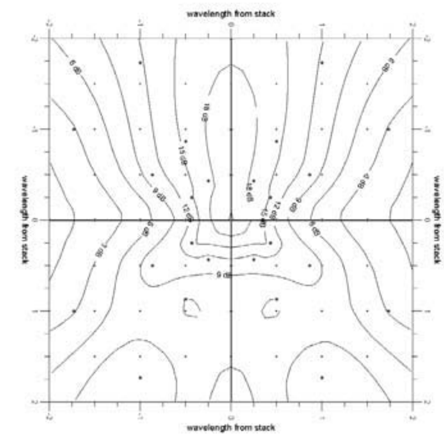
Improvement To The Multiplier Yagi

Table 1 shows something else unique to antennas pointing in opposite directions. When the multiplier Yagi stands ½λ behind the stack, the multiplier Yagi's pattern improves! Main beam gain increases by a fraction of a dB, which is not operationally significant. The rear lobes decline by over –10dB.

Further iterations indicate the pattern improvements hold over a range of locations for these OWA antennas. The tiny boost to the multiplier Yagi's main beam peaks when the reflector lies in the same vertical plane as the reflectors for the stack.

The best rear lobe reductions occur when the multiplier Yagi's reflector lies in the same vertical plane as the stack's driven elements; however, this location seems a bit too sensitive as any further displacement of the multiplier Yagi underneath the stack triggers a rapid growth in the rear lobe and reduced forward gain. Placing the multiplier Yagi's reflector midway between the vertical planes containing the stack's reflectors and driven elements represents a good compromise, with rear lobes reduced by over –12dB. The entire sky outside of the main beam becomes more than –3 dB quieter.

While intriguing, such an improvement is difficult to exploit. If these Yagis cantilever fore and aft from a single tower, guy wires probably would restrict the system from rotation. For stations



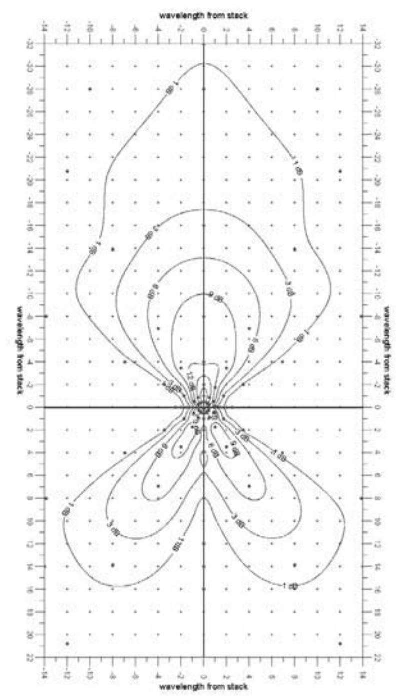
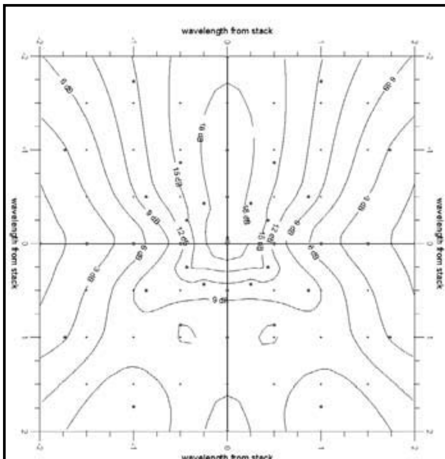


Figure 2—Maximum absolute variations in spot gain in any direction for the multiplier Yagi due to the presence of the stack. The stack stands at the origin of the coordinate system. Dots indicate calculated locations for the multiplier Yagi relative to the stack. The stack points up (0° azimuth); the multiplier antenna points down (180° azimuth).



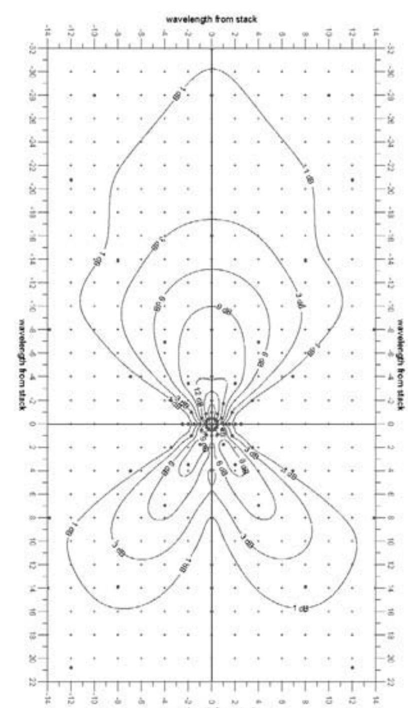


Figure 3—Gain pattern of the multiplier Yagi when it stands 1λ in front of, and 30° left or right of, the stack. The stack sucks the point of peak gain to shift 27° in azimuth off the intended direction (south) to 207°. The stack adds a large rear lobe, also shifted in azimuth by an equal amount.

Table 2

Performance parameters for the stack and impairments caused by a near-by multiplier Yagi. The stack's antennas point toward 0° azimuth. The multiplier Yagi points 180°. See text for explanation of column entries.

Yagi loc		target #1									non-target							% sky <-15dBi		feedpoint impedance	
dist	dir	peak gain			median gain		minimum gain		largest		median gain		worst minor lobe			largest					
λ	°	dBi	location	delta	dBi	delta	dBi	delta	decr	incr	dBi	delta	dBi	location	delta	decr	incr		delta	top	bottom
no mult		15.76	az 0° el 15°		13.87		10.09				floor		-4.88	az 0° el 48°				47.2%		26.7 -*j* 7.8	27.7 -*j* 8.1
0.0	0°	12.94	az 0° el 14°	-2.82	11.04	-2.83	6.25	-3.84	-4.20	-2.00	-5.72	9.28	6.60	az 181° el 65°	11.48	-8.96	21.60	8.3%	-38.9%	50.9 +*j*38.9	52.9 +*j*42.6
0.5	0°	13.23	az 0° el 13°	-2.53	10.29	-3.58	3.04	-7.05	-7.15	-1.65	-7.20	7.80	11.12	az 179° el 13°	16.00	-8.99	25.89	12.3%	-34.9%	226 -*j*137	232 -*j*125
1.0	0°	13.00	az 0° el 12°	-2.76	8.18	-5.69	-1.76	-11.85	-13.20	-1.50	-4.72	10.28	11.68	az 179° el 13°	16.56	-5.80	26.41	12.2%	-35.0%	108 -*j*96.4	99.5 -*j*91.0
2.0	0°	13.92	az 0° el 12°	-1.84	10.03	-3.84	6.30	-3.79	-5.57	-0.71	-6.21	8.79	7.75	az 180° el 14°	12.63	-5.86	22.52	16.2%	-31.0%	29.8 +*j*16.1	38.8 +*j* 7.9
4.0	0°	14.88	az 0° el 12°	-0.88	12.40	-1.47	8.76	-1.33	-2.53	1.69	-11.36	3.64	3.95	az 180° el 12°	8.83	-6.38	18.67	23.6%	-23.6%	23.1 -*j* 6.0	25.1 -*j* 2.4
8.0	0°	15.25	az 0° el 14°	-0.51	14.01	0.14	9.37	-0.72	-0.75	0.71	-14.66	0.34	-3.80	az 0° el 50°	1.08	-5.15	11.15	38.6%	-8.6%	26.4 -*j* 8.0	26.9 -*j* 8.1
16.0	0°	15.71	az 0° el 16°	-0.05	13.79	-0.08	10.07	-0.02	-0.20	0.19	floor	—	-4.73	az 59° el 15°	0.15	-2.81	5.18	44.9%	-2.3%	26.7 -*j* 7.9	27.6 -*j* 8.1
28.0	0°	15.81	az 0° el 15°	0.05	13.86	-0.01	10.14	0.05	-0.07	0.07	floor	—	-4.85	az 0° el 49°	0.03	-1.16	2.02	46.8%	-0.4%	26.7 -*j* 7.8	27.7 -*j* 8.1
32.0	0°	15.76	az 0° el 14°	0.00	13.86	-0.01	10.07	-0.02	-0.05	0.05	floor	—	-4.83	az 0° el 48°	0.05	-1.08	1.55	47.0%	-0.2%	26.7 -*j* 7.8	27.7 -*j* 8.1
0.5	30°	12.66	az 345° el 14°	-3.10	10.11	-3.76	5.45	-4.64	-7.28	-0.71	-8.08	6.92	10.36	az 160° el 15°	15.24	-8.96	25.36	17.2%	-30.0%	48.3 +*j*54.1	46.3 +*j*55.2
1.0	30°	14.41	az 24° el 16°	-1.35	11.54	-2.33	6.87	-3.22	-5.27	2.20	-8.61	6.39	7.43	az 210° el 17°	12.31	-7.93	22.43	13.5%	-33.7%	33.2 +*j* 6.7	33.6 +*j* 4.5
2.0	30°	16.54	az 13° el 16°	0.78	13.26	-0.61	7.34	-2.75	-2.86	2.11	-11.76	3.24	4.00	az 196° el 18°	8.88	-7.59	19.00	22.7%	-24.5%	26.0 -*j* 4.0	28.5 -*j* 5.2
4.0	30°	16.65	az 3° el 15°	0.89	13.57	-0.30	8.84	-1.25	-1.32	1.16	-14.15	0.85	-0.80	az 185° el 16°	4.08	-6.58	14.20	36.0%	-11.2%	26.1 -*j* 7.6	27.2 -*j* 7.1
8.0	30°	15.88	az 6° el 15°	0.12	13.80	-0.07	9.84	-0.25	-0.40	0.40	floor	—	-4.29	az 7° el 49°	0.59	-4.34	7.03	44.0%	-3.2%	26.6 -*j* 7.9	27.6 -*j* 8.1
16.0	30°	15.83	az 2° el 15°	0.07	13.88	0.01	10.02	-0.07	-0.11	0.11	floor	—	-4.65	az 1° el 48°	0.23	-1.64	2.52	46.6%	-0.6%	26.7 -*j* 7.8	27.7 -*j* 8.1
24.0	30°	15.80	az 0° el 15°	0.04	13.88	0.01	10.06	-0.03	-0.05	0.05	floor	—	-4.79	az 358° el 48°	0.09	-0.86	1.23	47.2%	0.0%	26.7 -*j* 7.8	27.7 -*j* 8.1
0.5	60°	13.31	az 20° el 15°	-2.45	12.23	-1.64	9.19	-0.90	-3.70	0.35	-9.40	5.60	6.97	az 209° el 17°	11.85	-9.87	21.97	12.4%	-34.8%	15.6 -*j* 6.9	16.5 -*j* 7.2
1.0	60°	15.87	az 10° el 15°	0.11	13.69	-0.18	9.05	-1.04	-1.39	1.18	floor	—	-0.65	az 192° el 16°	4.23	-7.39	14.35	41.7%	-5.5%	25.9 -*j* 8.5	27.1 -*j* 8.7
2.0	60°	15.99	az 356° el 15°	0.23	13.83	-0.04	9.78	-0.31	-0.39	0.41	floor	—	-4.28	az 59° el 15°	0.60	-3.29	4.89	44.4%	-2.8%	26.7 -*j* 7.9	27.7 -*j* 8.1
4.0	60°	15.83	az 357° el 15°	0.07	13.84	-0.03	10.10	0.01	-0.12	0.12	floor	—	-4.68	az 4° el 48°	0.20	-1.19	1.35	47.1%	-0.1%	26.7 -*j* 7.8	27.7 -*j* 8.1
8.0	60°	15.77	az 358° el 15°	0.01	13.87	0.00	10.07	-0.02	-0.03	0.03	floor	—	-4.87	az 356° el 48°	0.01	-0.33	0.35	47.2%	0.0%	26.7 -*j* 7.8	27.7 -*j* 8.1
16.0	60°	15.76	az 358° el 15°	0.00	13.87	0.00	10.09	0.00	-0.01	0.01	floor	—	-4.87	az 1° el 48°	0.01	-0.09	0.10	47.3%	0.1%	26.7 -*j* 7.8	27.7 -*j* 8.1
0.5	90°	14.37	az 0° el 15°	-1.39	13.20	-0.67	10.03	-0.06	-1.77	0.40	-13.28	1.72	2.69	az 201° el 18°	7.57	-9.18	17.69	31.7%	-15.5%	31.6 -*j* 6.8	32.9 -*j* 6.6
1.0	90°	15.88	az 357° el 15°	0.12	13.85	-0.02	9.80	-0.29	-0.37	0.31	floor	—	-4.28	az 59° el 15°	0.60	-3.86	4.51	44.7%	-2.5%	26.7 -*j* 7.8	27.6 -*j* 8.0
1.5	90°	15.76	az 2° el 15°	0.00	13.86	-0.01	10.04	-0.05	-0.11	0.10	floor	—	-4.60	az 59° el 15°	0.28	-1.75	1.92	45.8%	-1.4%	26.7 -*j* 7.8	27.7 -*j* 8.1
2.0	90°	15.76	az 358° el 15°	0.00	13.87	0.00	10.05	-0.04	-0.07	0.07	floor	—	-4.71	az 59° el 15°	0.17	-1.45	1.50	46.9%	-0.3%	26.7 -*j* 7.8	27.7 -*j* 8.1
2.5	90°	15.77	az 0° el 15°	0.01	13.86	-0.01	10.09	0.00	-0.04	0.05	floor	—	-4.78	az 59° el 15°	0.10	-0.42	0.49	47.5%	0.3%	26.7 -*j* 7.8	27.7 -*j* 8.1
0.5	120°	13.31	az 340° el 15°	-2.45	12.23	-1.64	9.19	-0.90	-3.70	0.35	-9.40	5.60	6.97	az 152° el 17°	11.85	-9.87	21.97	12.4%	-34.8%	15.6 -*j* 6.9	16.5 -*j* 7.2
1.0	120°	15.87	az 350° el 15°	0.11	13.69	-0.18	9.05	-1.04	-1.38	1.18	floor	—	-0.65	az 168° el 16°	4.23	-7.39	14.35	41.7%	-5.5%	25.9 -*j* 8.5	27.1 -*j* 8.7
2.0	120°	15.99	az 3° el 15°	0.23	13.83	-0.04	9.78	-0.31	-0.40	0.41	floor	—	-4.30	az 300° el 15°	0.58	-3.29	4.89	44.4%	-2.8%	26.7 -*j* 7.9	27.7 -*j* 8.1
4.0	120°	15.83	az 2° el 15°	0.07	13.84	-0.03	10.10	0.01	-0.12	0.12	floor	—	-4.68	az 355° el 48°	0.20	-1.19	1.36	47.1%	-0.1%	26.7 -*j* 7.8	27.7 -*j* 8.1
8.0	120°	15.77	az 1° el 15°	0.01	13.87	0.00	10.07	-0.02	-0.03	0.03	floor	—	-0.05	az 3° el 48°	4.83	-0.33	0.35	47.2%	0.0%	26.7 -*j* 7.8	27.7 -*j* 8.1
16.0	120°	15.76	az 1° el 15°	0.00	13.87	0.00	10.09	0.00	-0.01	0.01	floor	—	-4.87	az 358° el 48°	0.01	-0.09	0.10	47.3%	0.1%	26.7 -*j* 7.8	27.7 -*j* 8.1
0.5	150°	15.56	az 2° el 15°	-0.20	13.70	-0.17	9.81	-0.28	-0.43	0.24	-12.90	2.10	-2.14	az 350° el 15°	2.74	-6.61	10.25	30.1%	-17.1%	27.3 -*j* 6.3	28.7 -*j* 6.2
0.75	150°	15.78	az 0° el 15°	0.02	13.87	0.00	9.97	-0.12	-0.15	0.12	floor	—	-4.43	az 59° el 15°	0.45	-2.07	2.06	51.2%	4.0%	26.7 -*j* 7.8	27.8 -*j* 8.0
1.0	150°	15.75	az 0° el 15°	-0.01	13.87	0.00	10.06	-0.03	-0.05	0.07	floor	—	-4.72	az 0° el 48°	0.16	-1.48	2.16	47.6%	0.4%	26.7 -*j* 7.8	27.7 -*j* 8.1
1.5	150°	15.75	az 0° el 15°	-0.01	13.87	0.00	10.08	-0.01	-0.04	0.06	floor	—	-4.76	az 0° el 48°	0.12	-1.52	1.97	46.0%	-1.2%	26.7 -*j* 7.8	27.7 -*j* 8.1
2.0	150°	15.64	az 346° el 16°	-0.12	13.24	-0.63	7.35	-2.74	-2.87	2.11	-11.76	3.24	4.00	az 163° el 18°	8.88	-7.59	19.00	22.6%	-24.6%	26.0 -*j* 4.0	28.5 -*j* 5.2
4.0	150°	16.65	az 356° el 15°	0.89	13.57	-0.30	8.85	-1.24	-1.31	1.15	-14.15	0.85	-0.80	az 174° el 16°	4.08	-6.58	14.20	36.0%	-11.2%	26.1 -*j* 7.6	27.2 -*j* 7.1
8.0	150°	15.88	az 353° el 15°	0.12	13.80	-0.07	9.84	-0.25	-0.40	0.40	floor	—	-4.29	az 352° el 49°	0.59	-4.34	7.03	44.0%	-3.2%	26.6 -*j* 7.9	27.6 -*j* 8.1
16.0	150°	15.83	az 357° el 15°	0.07	13.88	0.01	10.02	-0.07	-0.11	0.11	floor	—	-4.65	az 358° el 48°	0.23	-1.64	2.52	46.6%	-0.6%	26.7 -*j* 7.8	27.7 -*j* 8.1
24.0	150°	15.80	az 0° el 15°	0.04	13.88	0.01	10.06	-0.03	-0.05	0.50	floor	—	-4.79	az 1° el 48°	0.09	-0.86	1.23	47.2%	0.0%	26.7 -*j* 7.8	27.7 -*j* 8.1
0.5	180°	15.77	az 0° el 15°	0.01	13.86	-0.01	10.05	-0.04	-0.08	0.04	-14.74	0.26	-4.23	az 59° el 15°	0.65	-4.76	4.95	39.1%	-8.1%	27.6 -*j* 6.7	29.0 -*j* 6.8
1.0	180°	15.68	az 0° el 15°	-0.08	13.82	-0.05	10.05	-0.04	-0.08	0.03	floor	—	-4.20	az 0° el 49°	0.68	-5.49	4.03	43.9%	-3.3%	26.7 -*j* 7.9	27.7 -*j* 8.2
2.0	180°	15.73	az 0° el 15°	-0.03	13.87	0.00	10.11	0.02	-0.04	0.07	floor	—	-4.83	az 0° el 48°	0.05	-3.40	2.91	47.8%	0.6%	26.7 -*j* 7.8	27.7 -*j* 8.1
4.0	180°	15.77	az 0° el 15°	0.01	13.89	0.02	10.07	-0.02	-0.05	0.03	floor	—	-4.80	az 0° el 48°	0.08	-1.21	1.47	47.3%	0.1%	26.7 -*j* 7.8	27.7 -*j* 8.1
8.0	180°	15.76	az 0° el 15°	0.00	13.87	0.00	10.09	0.00	-0.01	0.02	floor	—	-4.93	az 0° el 48°	-0.05	-0.59	0.50	47.9%	0.7%	26.7 -*j* 7.8	27.7 -*j* 8.1

in northeast USA, a tower containing a stack fixed on Europe could add this rear-facing Yagi for domestic contesting or as a QRM-chaser.

Stack fed

Having examined impairments when feeding the multiplier Yagi, now reverse the roles and feed the stack. The multiplier Yagi's feedpoint is short-circuited.

In isolation the stack's peak gain of +15.76dBi occurs at 15° elevation. The main beam's –3dB points stand ±26° to the left and right, and at 7 and 25° elevation. These –3dB points form the target zone for this analysis.

To identify the minor lobes, a range of ±59° in azimuth and 1 to 38° in elevation (representing the –20dB points on the main beam) was excluded from the non-target zone statistics. This exclusion prevented the sides of the main beam from obscuring information about the behavior of the pattern outside the main beam.

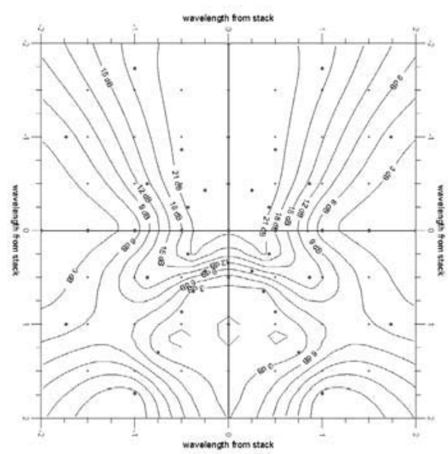
Table 2 itemizes pattern impairments to the stack. The stack's pattern displays slightly less sensitivity to the presence of the multiplier Yagi in this orientation than vice versa. We find again that, when the antenna systems point towards each other, the most stringent impairment demand requires tremendous separation (over 32 λ). Little disruption to drivepoint impedance exists except for the closer spacings with the multiplier Yagi in front of the stack. An examination of the table also reveals a poorly sited, unused multiplier antenna can deviate the stack's main lobe as much as 24° off the intended azimuth.

Figure 4 maps out the worst impairment to the pattern of the stack as a function of the location of the multiplier antenna. The antennas show little interaction when placed off to the left or right. Another sweet spot exists where close spacing exhibits little pattern disruption: at around 1 λ and 150° behind and to the right (or, similarly, at 210° behind and to the left), the multiplier antenna barely disturbs the stack. These areas of minimum interaction are similar to those of Figure 2, allowing use of either antenna system.

Practical Applications

Let's now illustrate how the techniques illustrated in Parts 5–7 can be applied to typical station design problems, following these steps:

- Determine relative orientation(s) of the two antenna systems.
- Determine available separation space.
- Consult the tables and maps for the most similar orientation to identify likely regions of minimum interaction within the available separation space. Be sure to examine the interactions when each of the two antenna systems transmits.
- Run models to verify the expected level of interaction for the specific an-



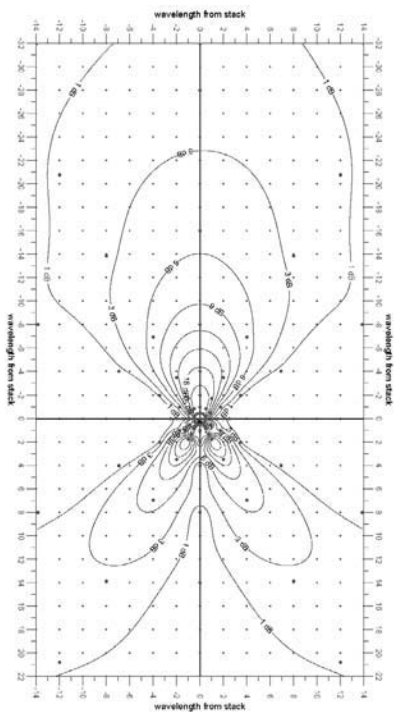


Figure 4—Maximum absolute variations in spot gain in any direction for the stack due to the presence of the multiplier Yagi. The stack stands at the origin of the coordinate system. Dots indicate calculated locations for the multiplier Yagi relative to the stack. The stack points up (0° azimuth); the multiplier antenna points down (180° azimuth).

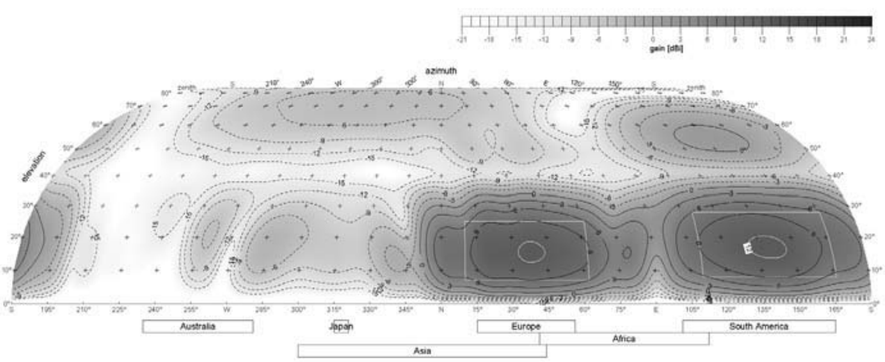


Figure 5—Austin, Texas station with 2-Yagi fixed stack on Europe and a fixed Yagi on South America. The feed system delivers specific current ratios to equalize the beams into both continents.

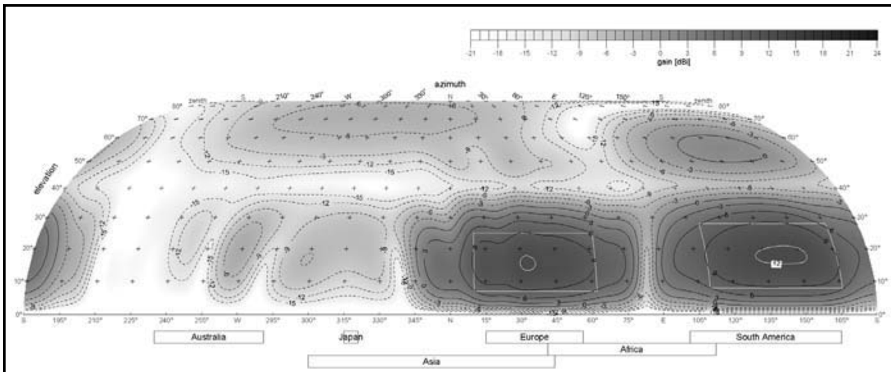


Figure 6—Same systems as Figure 5, with phase and current levels adjusted for cleanest patterns.

tennas, orientations, and spacing, iterating around the proposed location to check for sensitivity in position.

The last step is very important! The near field geometry can vary considerably from antenna to antenna; a 3-element Yagi, for example, likely will exhibit a different level of interactions than the 6-element owa designs used in this series. Real world orientations may be different from the general cases examined here. The charts and tables in these articles can point you in the general direction of candidate locations for reduced interaction—but you need to run some models with your specific locations and antennas to verify the candidate locations could provide reasonable results.

Fixed Stack And Fixed Single Yagi

Problem: A station in Austin, Texas includes a 20meter stack (6-element OWA Yagis at ½ and 1 λ height) fixed on Europe and a single 20 meter Yagi (6-element OWA at ¾ λ height) fixed on South America/Caribbean to minimize interactions. The site requires the two antenna systems to be within 200 feet (60 meters, or about 3 λ). Where should these antenna systems stand to minimize impairments?

An equidistant-azimuthal chart centered on Austin shows Europe to span 15–57° azimuth (centered on 36°). South America and the Caribbean cover 110–166° azimuth (centered on 138°). The two main beam bearings are 102° apart, so the antenna systems will point nearly at right angles. We should therefore use the data for antennas pointed at right angles.

Part 5 Figure 1 and the underlying model results show little effect on the single Yagi's pattern when it stands 3 λ away and 90° off to the side of the stack, and facing away from it. Calculations of the stack's pattern (not published in the paper edition of *NCJ*) also show a minimum in level of interaction at these locations. Let's adopt the convention of measuring distances relative to the stack. Since the stack points 36° toward Europe, our tentative location for the South American Yagi stands 200 feet away in the direction 126°, at 162 feet East, 118 feet South; this antenna points to 138° azimuth.

Model runs with this specific geometry confirm the lack of interaction between these systems. When feeding the South America/Caribbean Yagi, no part of the pattern deviates by more than ¼ dB due to the presence of the stack. When feeding the Europe stack, no part of the pattern deviates more than 0.9dB. The models confirm the suitability of the candidate sites.

Table 3

Summary of impairments for a rotating Yagi located within 3 behind and to the side of a fixed 2-Yagi stack pointing to 36° azimuth. See text for detailed description of the table entries. Italicized entries represent interpolations between calculated figures. Spot checks indicate that, generally, the impairments to the rotating Yagi's pattern caused by the fixed stack are less when the rotating Yagi's beam is perpendicular to that of the stack.

		largest change in spot gain to stack's pattern				largest change in spot gain to rotatable Yagi's pattern				
rotat'g Yagi az:		126°	216°	306°	36°	126°	216°	306°	36°	worst
λ	direction	right	opposite	left	parallel	right	opposite	left	parallel	change
0.00	180°	14.03	n/a	14.03	n/a	n/a	n/a	n/a	n/a	14.03
0.50	180°	5.22	4.95	5.22	21.65	n/a	10.43	n/a	19.78	21.65
0.75	180°	1.03	*4.49*	1.03	*19.68*	n/a	*8.74*	n/a	*11.16*	19.68
1.00	180°	0.97	4.03	0.97	17.70	n/a	7.05	n/a	2.54	17.70
1.50	180°	0.94	*3.47*	0.94	*15.73*	n/a	*6.02*	n/a	*2.16*	15.73
2.00	180°	0.66	2.91	0.66	13.75	n/a	4.98	n/a	1.78	13.75
3.00	180°	*0.50*	*2.19*	*0.50*	*11.66*	n/a	*2.98*	n/a	*1.42*	11.66
0.50	150°	*9.89*	10.25	*9.91*	17.65	n/a	10.63	n/a	13.61	17.65
0.75	150°	*7.35*	2.06	*7.76*	*15.44*	n/a	*8.28*	n/a	*7.56*	15.44
1.00	150°	*4.81*	2.16	*5.60*	13.23	n/a	5.92	n/a	1.51	13.23
1.50	150°	*4.11*	1.97	*4.68*	*13.34*	n/a	*8.80*	n/a	*1.80*	13.34
2.00	150°	*3.41*	19.00	*3.77*	13.45	n/a	11.67	n/a	2.08	19.00
3.00	150°	*2.71*	*16.60*	*3.51*	*11.99*	n/a	*11.15*	n/a	*1.67*	16.60
4.00	150°	n/a	14.20	n/a	10.53	n/a	10.63	n/a	1.25	14.20
0.50	135°	8.72	*18.06*	8.74	*14.94*	n/a	*13.54*	n/a	*12.58*	18.06
1.00	135°	3.85	*10.29*	4.44	*8.91*	n/a	*8.99*	n/a	*2.91*	10.29
2.00	135°	2.72	*9.59*	2.99	*6.82*	n/a	*5.77*	n/a	*2.29*	9.59
3.00	135°	*2.16*	*7.62*	2.76	*5.64*	n/a	*4.92*	n/a	*1.79*	7.62
0.50	120°	*9.63*	21.97	*10.29*	13.59	n/a	14.99	n/a	12.07	21.97
1.00	120°	*3.85*	14.35	*4.66*	6.75	n/a	10.53	n/a	3.61	14.35
2.00	120°	*2.27*	4.89	*2.63*	3.50	n/a	2.82	n/a	2.39	4.89
3.00	120°	*1.71*	*3.13*	*2.01*	*2.46*	n/a	*1.81*	n/a	*1.85*	3.13
0.50	90°	11.46	17.69	13.39	10.57	n/a	10.75	n/a	13.77	17.69
0.75	90°	5.96	*11.10*	9.53	*6.81*	n/a	*7.54*	n/a	*9.49*	11.10
1.00	90°	3.85	4.51	5.11	3.04	n/a	4.32	n/a	5.21	5.11
1.50	90°	*2.61*	1.92	*3.51*	*2.12*	n/a	1.53	n/a	2.27	3.51
2.00	90°	1.36	1.50	1.90	1.19	n/a	0.85	n/a	1.40	1.90
2.50	90°	*1.08*	0.49	*1.20*	0.68	n/a	0.52	n/a	1.11	1.20
3.00	90°	0.80	n/a	*0.50*	*0.50*	n/a	n/a	n/a	0.42	0.80

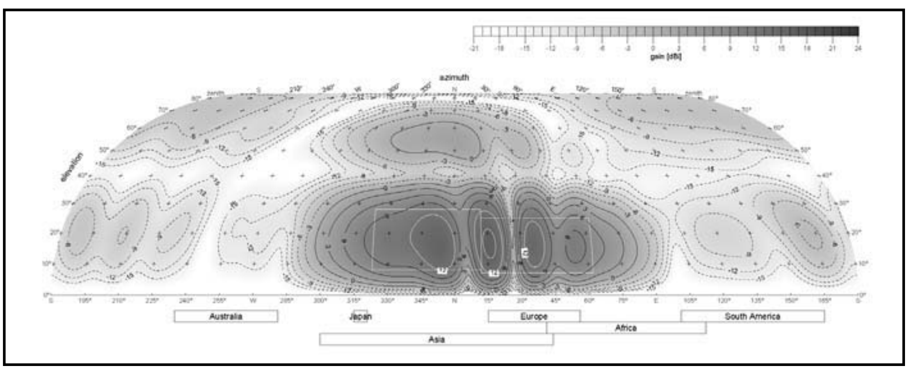


Figure 7—Pattern when driving the fixed 2-Yagi stack on Europe and the rotating single Yagi pointed at 351° azimuth. The beams of these two antenna systems overlap, creating destructive interference at key locations in the target zone.

Driving Both Systems Together

With little interaction between the systems individually, can we drive both together? Yes, with some minor interference between the patterns. One must divide the power carefully, however. Simply splitting currents equally between the two systems results in unequal beams; the South America beam peaks at 2½ dB more than the European beam. Applying equal currents to each of the three Yagis reverses the imbalance, with Europe peaking 3.3dB louder. The ratio 1.5:1:1 (South America to Europe-top to Europe-bottom) provides beams with equal peak gain. See Figure 5 for the resultant pattern.

We can reduce the interference between the two beams and reduce minor lobes by altering the phase relationship between the drive currents for the South America Yagi and the Europe stack. Feeding the South America system +135° in phase with a current ratio of 1.6:1:1 delivers a slightly cleaner pattern, with two clearly separated main beams as shown in Figure 6, but probably is not worth the extra effort to include the phase shifter.

Fixed Stack And Rotating Yagi

Problem: The same station in Austin, Texas uses a rotating Yagi to work all directions except for Europe; the fixed stack covers Europe. The two antenna systems must stand within 200 feet (3λ). Where should the rotating Yagi stand to minimize impairments?

We begin by assuming the operator never needs to point the rotating Yagi toward Europe, as the stack has superior performance in that direction. Let's examine the charts and tables of Parts 5 and 7 for hints as to good locations when the rotating Yagi points to the side or in the opposite direction as the stack.

Table 3 extracts data calculated in Parts 5 and 7 for all available positions (within 3 λ) of the rotating Yagi from off the side of the stack's boresight around to behind the stack. Beginning from the left, the first column is the distance between the antenna systems.

The second column is the relative direction from the stack's boresight to the rotating Yagi; i.e., 90° means the Yagi stands to the right of the stack (south and east) and 180° means the Yagi stands directly behind the stack (south and west).

The next three columns show the largest absolute change in any single spot of the pattern of the stack when the Yagi points to the four azimuths listed at the top of the column. These four azimuths represent directions at right angles, opposite, and parallel to the stack's main beam. A similar set of columns shows the largest absolute spot change to the Yagi's pattern due to the stack.

The rightmost column simply highlights the worst value across the row. For the four azimuths tested, the least impairments occur when the rotating Yagi is off to the side of the stack's main beam—even for separations down to less than 2 λ.

The listed azimuths, however, do not cover the entire range over which the operator needs the rotating Yagi. Let's do one more spot check by placing the rotating Yagi 3λ to the south and east of the European stack, and check impairments when the rotating Yagi points just 45° off the European stack's boresight, at 81° and 351° (the later somewhat overlooking the stack). A few model runs later, the stack emerges relatively unscathed, with no spot in its pattern deviating more than 1.8dB. The rotating Yagi's pattern also holds up, degrading no more than 1.5dB at any single spot. All of these pattern degradations are outside the main beams of these antennas, affecting only minor lobes and have no operational significance. Even at 2λ spacing with 351° azimuth, the worst impairment is a +4.6dB spot increase on a minor sidelobe.

Driving Both Systems Together

Earlier I showed a fixed stack and a separate fixed Yagi could be driven together to yield two beams of equal power to two targets, as long as due attention was paid to the driving currents.

Can one drive the fixed stack together with a rotating Yagi? Figure 7 shows the pattern when the rotating Yagi of our example Austin station points to 351°, and equal currents drive the two systems. The result is horrible: an enormous –20 dB hole right in the middle of the European beam!

Unfortunately, once the main beams of two antenna systems *in different locations* begin to overlap, a zone of destructive interference (cancellation) occurs between them. Adjusting the phase between the systems shifts the location of, but does not remove, this cancellation.

For typical Yagi systems employed by contesters, one may successfully drive two systems on different towers only if the main beams point in directions separated by at least 90°.

Conclusions

By applying the tools developed over this series, we have shown that one can successfully place a rotating Yagi surprisingly close to another fixed system, with insignificant interaction between the antennas when each is driven independently—as long as one chooses the correct locations!

As shown here as well as in earlier parts to this series, an unfortunate choice of locations can cause very serious impairments, including large holes in the main beam, a main beam pointing in the wrong direction, and large minor lobes that increase received QRM/QRN.

For the situation of a fixed stack and a rotatable Yagi on a second tower, we analyzed a short 2-Yagi stack at ½ and 1λ height, and a single rotating Yagi at ¾ λ, all using the 6-element OWA design:

Minimal interaction occurs when the rotating Yagi stands at right angles to the stack's main beam.

Interactions were minimal (<2dB) for separations of at least 2 λ, regardless of the direction of the rotating Yagi. Interactions essentially disappeared at 3 separation.

When the rotating Yagi points at least 90° off from the stack, one may feed both antenna systems simultaneously without destructive interference between the beams.

To equalize the gain in both beams, choose a proper ratio of drive currents. For the example analyzed, the best ratio was about 1.5 or 1.6 (single Yagi) to 1 (top of stack) to 1 (bottom of stack).

Next time we will look at interactions between 40 and 15meter Yagi systems.

Notes

[1]Scace, Eric K3NA; "Antenna Interactions—Part 1: Stop Squinting! Get the Big Picture", *National Contest Journal*, 2003 Jul/Aug; ARRL, Newington CT USA.

[2]Scace, Eric K3NA; "Antenna Interactions—Part 2: Twisting Stacks", *National Contest Journal*, 2003 Sep/Oct; ARRL, Newington CT USA.

[3]Scace, Eric K3NA; "Antenna Interactions—Part 3: When Good Aluminum Goes Bad", *National Contest Journal*, 2003 Nov/Dec; ARRL, Newington CT USA.

[4]Scace, Eric K3NA; "Antenna Interactions—Part 4: Cleaning Up Stacked Yagis with Current Tapers", *National Contest Journal,* 2004 Jan/Feb; ARRL, Newington CT USA.

[5]Scace, Eric K3NA; "Antenna Interactions—Part 5: How Close is Too Close?" *National Contest Journal,* 2004 Mar/Apr; ARRL, Newington CT USA.

[6]Scace, Eric K3NA; "Antenna Interactions—Part 6: Antennas Pointing in the Same Direction", *National Contest Journal,* 2004 Jul/Aug; ARRL, Newington CT USA. NCJ

The 2005 Dayton Contest Forum

Doug Grant, K1DG

The Dayton Contest Forum was held in a new location this year. The event was held for many years in a makeshift space partitioned by curtains at Hara Arena. It then moved to the nearby high school for a few years, was assigned to a much-too-small room in 2004, and had been scheduled for the same room in 2005. After the complaints I received in 2004 from the 300 or so people who tried to fit in the room with 120 chairs, I knew we had to do something different. Some discussions to find an alternate location with the Hamvention Committee and K3LR (moderator of the Antenna Technology Forum, who was in a similar situation) resulted in these two forums moving to the Crowne Plaza hotel in the same room as the Contest Dinner on Saturday afternoon of the Hamvention.

Results of a survey of attendees showed an overwhelming majority preferring the Crowne Plaza to any of the old locations.

An Excellent Program

With the venue issue resolved, we had an excellent program. The first speaker was Mike Sims, K4GMH, an active RTTY contester, with some tips on how to get started in RTTY contesting. In the past few years, it has become very easy to get on RTTY, with an abundance of PC programs that use the sound card as an analog front end for software-based demodulation. About a third of the people in the room had some experience in RTTY contesting, and the remaining two-thirds were observed taking copious notes. With top single-ops routinely making over 1000 QSOs in a RTTY contest, this mode is getting interesting.

Second speaker was Saty "Bob" Nakamura, JE1JKL/JH6J/9M6NA, describing his quest for the Oceania CQWW CW record, including both failed and successful attempts from various exotic locales in the Pacific. One of his goals now is to beat the current record held by Mike Gibson, KH6ND, who happened to be in the audience. One of the great moments in the forum was the photo opportunity with these two outstanding competitors shaking hands. Later in the evening, Saty was involved in a four-way tie for first place in the KCDXC annual CW Pileup contest (with N9RV, N2NT, and N2NC).

Next up was Dayton regular Roger Western, G3SXW, with the story of the "Voo-Dudes," the CQWW CW multi-multi team that has put many an African multiplier in our logs over the past 10+ years. Roger, who has chronicled the group's exploits in a book recently published by Idiom Press, entertained and informed us all with recommendations on licensing, lodging, customs, equipment and antennas for would-be contest DXpeditioners. And he showed us a sign in a hotel in one country advising that "...the bar is not open because it is closed." Things are different in Africa.

Do you really need sunspots to operate a contest? How about a rig or antenna? Not necessarily. Uli Ann, DL2HBX/KK8I, took a break from his US work assignment to describe the many new CW contest simulation programs available. Uli, a member of both the High-Speed CW club and the Very High Speed CW club, has some of the highest scores on these programs, though he notes that some of the Eastern European operators have even higher scores—up to 100+ WPM copying call signs. His talk included both screen shots and audio clips from many of the latest programs.

The final presentation was by Bill Coleman, N4ES, who for many years wondered if it would someday be possible to record a whole band during a contest and play it back later. His "Eureka!" moment came a few years ago, resulting in the development of a box he calls the Time Machine. This box, which connects to an antenna and a low-cost stereo VCR, allows you to record an 80 kHz wide chunk of spectrum (the 40-meter CW subband, for example), so you can later play back the whole band into a receiver and hear what you missed—and what your competition didn't. If the contest sponsors put this technology in place, it would allow log-checkers to verify suspected infractions, such as transmitting two signals simultaneously, copying errors, illegal band-changes and various other practices. Demonstrations at the forum included playback of signals on the 40-meter band during the September 2002 Sprint and a comparison on 20 meter SSB between NX5M and N2IC 2005 WPX (neither station could hear the other, but both were 59+ as recorded in NH and less than 1 kHz apart).

The presentations are all available on the Web at **www.kkn.net/dayton2005** (thanks to George, K5TR). NCJ

Bill Turner, W6WRT

The Care and Feeding of RTTY Amplifiers

Thinking of getting an amplifier for RTTY contesting? Personally, I wouldn't contest without one, but that's just me—I don't have the patience to work low power during a contest. When I call someone, I want them to come back *now!* If you feel the same way, a good amplifier may be just what you need.

Things To Consider

There is good news and bad news about amplifiers for RTTY. The good news is they are probably the least critical when it comes to design, tune up and drive level. You do not need a linear amplifier because RTTY is a constant-amplitude mode, just like FM. In fact, RTTY is a type of FM in a sense, and any amplifier that works on FM will work on RTTY. Even a Class-C amplifier from the old days will work fine for RTTY, and would actually be a bit more efficient than a "linear" amp. Nowadays, though, nearly all HF amplifiers on the market are designed to be linear because they are meant to be used for SSB. Don't fret over it, though. The difference is only a few percentage points and all it means is that your shack will be a little warmer for the same power output.

The bad news is that a RTTY amplifier is greatly stressed because of the high duty cycle during a contest, especially during a string of unanswered CQs. What is duty cycle? It is simply the ratio of ON time to OFF time. If you put a brick on the key and let it run (into a dummy load of course), that's 100% duty cycle. CW, for example, is at full power during a dit or dah and at zero power in between. If you average out the dits, dahs and spaces, it will probably be around 50% duty cycle, depending on the operator's fist, of course. RTTY, however, is continuously at 100% while transmitting and only goes to zero on receive. Short of brick-on-the-key, I would guess that RTTY or FM contesting has the highest duty cycle of any Amateur Radio mode. Ignoring this fact while shopping for a RTTY amplifier can easily lead to a smoke-filled shack!

Buying A RTTY Amplifier

Check the specification sheet from the manufacturer. Watch for phrases like "no time limit", "continuous power", "100% duty cycle" or "brick-on-the-key." If none of those are present, steer clear, or at least make a phone call to the manufacturer's tech support to get a firm, iron clad commitment. If they say something like "Well, it should be ok for RTTY," run, don't walk, to the next manufacturer. When an amplifier really is rated at 100% duty cycle, the manufacturer will undoubtedly advertise it. A 100% duty cycle amplifier costs more to make, carries a higher price tag and is intended for customers who demand that level of performance. If the rating is missing, there's a reason why. Keep looking. You can also do some evaluating on your own by following the suggestions in the next paragraph.

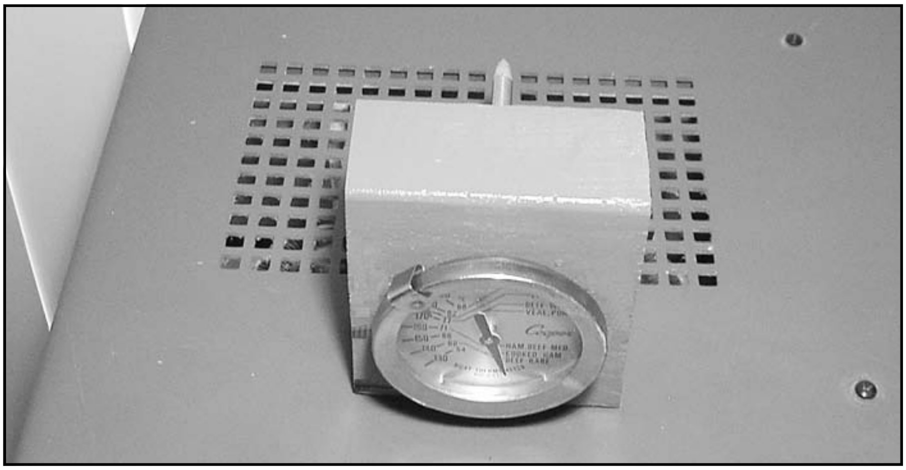


Figure 1—Using a meat thermometer to monitor amplifier temperature.

Homebrewing Your Own Amplifier

Take a look inside an amplifier rated at 100% duty cycle and note the size of the components compared to other amps of the same power rating, but at a lower duty cycle. Pay close attention to four areas in particular:

1. Tubes. To put out 1500 W (the legal limit in the USA) while running at 60% efficiency (typical), the tube or tubes must have a total dc plate input of 2500 W. The tube(s) will be dissipating the difference, or 1000 W of pure heat. That means the plate dissipation rating must be 1000 watts or more. More is better. A pair of 3-500Zs will be running right on the edge, and frankly, I wouldn't recommend them. Much better would be a pair of 3CX800s, 4CX800s or a single 3CX1500A/8877. A lot of homebrewers go overboard with their tubes, using ones with dissipation ratings in the multiple kilowatts. Their tubes last a long time, I might add.

2. Power transformer. Surprisingly, the limiting factor in many commercial amplifiers isn't the tubes, but rather the power transformer. A 2500-W, 100% duty cycle power transformer is a serious piece of iron and should be chosen carefully. Many smaller power transformers will deliver 2500 W for a while, but heat builds up deep inside and eventually will reach the danger point. Those transformers are fine for 1500 W of SSB, but not RTTY. Your best guide is the manufacturer's rating. Be cautious and conservative, just as you would when purchasing a complete amp.

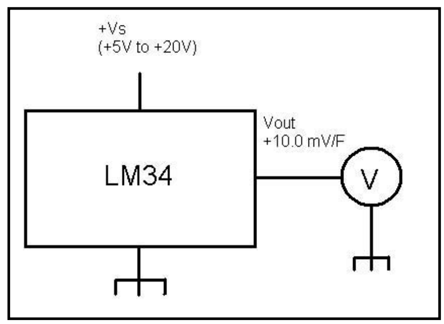


Figure 2—Schematic for the temperature transducer. In this diagram, a voltmeter is shown between the LM34 Vout terminal and ground.

3. Bandswitch. The bandswitch should have very heavy contacts. The amount of circulating current in a 1500-W tank circuit can reach astonishing levels, especially if the loading is a little light and the drive a little high. Again, the manufacturer's rating should be your guide. A good bandswitch could easily cost two to three hundred dollars or more depending on the number of contacts and the number of decks. Do not scrimp here.

4. Wire. The wire used for the plate tank coils should be only one thing: big. Nobody was ever sorry for using wire with a too-large diameter, but the opposite has been true many times. Diameter is especially important at the higher frequencies due to skin effect. The 10 and 15-meter coils should be at least ¼-inch diameter copper tubing; 3/8 inch would be even better. Lay out the amplifier so that cooling air flows over the tank circuit. I once owned a legal-limit amplifier that did not cool the tank circuit, and during one contest the 80-meter coil got so hot it broke free from it's solder connections and ended up looking like spaghetti. The resulting arc lit up the room, too.

Temperature Management

That's a fancy way of saying "Be aware of how hot it's running." For some reason, no Amateur Radio amplifier maker that I know puts a temperature gauge in his amps. Personally, I like to be able to observe the temperature of the air being exhausted from the tubes. A quick glance can be quite reassuring, confirming that all is well down in the boiler room.

Here are two suggestions for temperature monitoring, one very low-tech and one a little bit higher, but not much. Either one will ease your mind greatly during a run of CQs into a dead band, and either one costs very little compared to the damage it could forestall.

1. Simple and cheap. Your local grocery store will no doubt have meat thermometers. The kind with a probe several inches long should be perfect. They are normally calibrated for temperatures up to about 190 degrees F, just right for an amplifier. My amplifier maxs out at around 200 degrees F under heavy contest conditions. Unfortunately, they are round and will roll around, so I drilled a piece of wood to make a tight fit for the probe and it sits on the amp, right where the probe can extend into the air flow without blocking it. See Figure 1. Just paint it to match the amplifier and it's ready to go. No batteries required!

While that method worked fine, I wanted something a little more convenient, and that led to this:

2. Temperature transducer. National Semiconductor makes a marvelous little device that looks like a transistor but is actually a temperature transducer. What is neat about it is the output. It puts out a voltage that is equal to 0.01 V/degree F. In other words, if it is sitting in a 150-degree environment, it puts out 1.50 volts (150 x 0.01). No calibration required, just measure the voltage and you know the temperature. The basic device number is LM34, and there are several versions available, depending on temperature range and accuracy. There is a Celsius version, too—the LM35. The one I chose was the LM34CZ, which has a range of -40 to + 230 degrees F, with an accuracy of +/- 1.6 degrees. This version sells in the $6 range and there are other versions selling between about $2 and $16, depending on temperature range and accuracy. They are available from Digi-Key Corporation, **www.digikey.com**. Digi-Key has links on their Web site to the manufacturer's data sheets if you want more information.

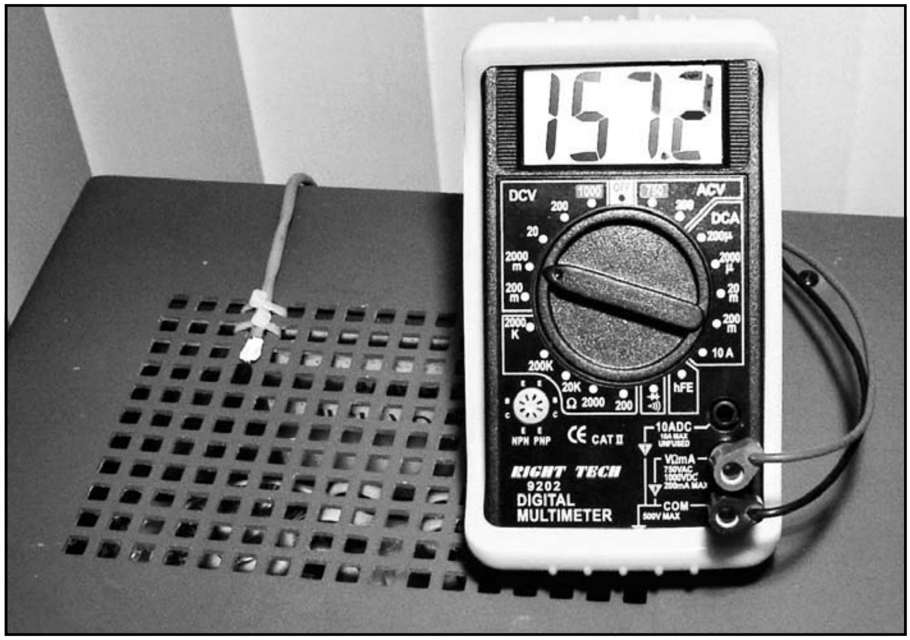


Figure 3—Transducer and digital multimeter.

In my case, I use an inexpensive digital multimeter to monitor the temperature, but you could use a dedicated digital panel meter, or even an analog meter. Either way, I would put the meter close to the rig or computer monitor so you don't have to glance away to see it. Figure 2 shows the hookup for the transducer. It's about as simple as it could be. In a strong RF environment, you might need to put some bypass capacitors from each active terminal to ground, and possibly add some shielding, too.

Figure 3 shows the installation in my shack. After wiring the transducer, I covered the connections with silicone RTV. My amplifier's cabinet is aluminum, so I used nylon cable ties to hold the transducer in place. If yours is steel, a small magnet glued to the transducer would do. Figure 3 shows the transducer and the digital multimeter. Observant readers will notice that I used a magic marker to place a decimal point at the correct point on the display. This meter is only used for this purpose, but if I ever want to remove the decimal point, rubbing alcohol will take it off.

So now you have some things to think about. If you have a few low-power contests under your belt, perhaps now is the time to give high power a try. Just use some caution and common sense with your amplifier and watch your score go up!

NCJ

Contest Tips, Tricks & Techniques

By Gary Sutcliffe, W9XT

Stealth Contesting—Part 1

It is becoming more difficult for the contester to find a place to put up the types of antennas we all dream of. New housing developments usually have restrictions on what "improvements" can be added to the property. More established areas often have town or city laws restricting towers.

Rather than staying off the air, some contesters are resorting to stealth contesting. They are hiding or otherwise disguising their antenna systems to prevent a visit from the development's enforcement bureau.

A number of contesters responding to this issue's topic requested that their identity be kept secret to avoid unpleasant encounters with their Home Owner's Association. In keeping with the stealth theme, the call signs of the readers sharing their tips will not be disclosed for this issue.

Meet Ed, Paul, Ray, Mel and Scott

Ed lives in a heavily wooded one-acre lot. He operates on SSB and the digital modes on 160 through 2 meters running 100 W.

Ed strives to make his antennas difficult to see. For the lowest two bands Ed starts out with a 75-meter dipole made from wire with black insulation. When he wants to go down to 80, he clips on extensions. A second set of extensions is used to make it resonant on the 160 meter band. Ed likes green parachute cord for supporting wire antennas.

On 40 through 10 meters, Ed uses a ground mounted SteppIR BiggIR. He has installed 16 radials, each about 35 feet long. The chrome parts of the antenna are covered with black tape to make it harder to see.

For 6 and 2 meters, Ed home brewed his own copper loop antennas using the KØFF design. He also has a J-pole for 2 meters. He uses PVC pipe for support for both types. The J-pole is actually inside the PVC pipe. The pipe is painted black with random blotches of brown and green paint to make it difficult to see.

Paul has been very successful operating contests from his stealthy station. He prefers simple dipoles fed with twin lead. Paul likes black, gray or brown wire, which is hard to see. On the other hand, the feed line is more visible, and Paul usually tries to run them up the trunks and branches of trees to make them less obvious. The matching system uses a pre-set L/C network with automatic band switching.

Paul considers each new antenna as temporary. He realizes that if the neighbors are unhappy with his antennas they can probably shut him down. Paul does not ask for permission to put up new antennas, but does not try to push the envelope, either. He once installed a 36-foot push up mast to support an end fed wire. A neighbor commented that it looked ugly, and Paul quickly switched to a something less obtrusive.

If you know Ray, stealth antennas are not the first thing you associate with him. It has not always been that way. After getting out of college he lived in a third-floor apartment with a large tree conveniently located about 100 feet away. Ray drilled a small hole in the aluminum frame of a bedroom window. He ran a length of gray stranded wire through the hole out to the tree. He put a piece of plastic tubing in the hole in the frame for insulation. A simple knot at the feed end of the wire acted as a strain relief to keep the wire from being pulled out of the apartment.

To feed the antenna, Ray used an L network consisting of a large coil and a 500 pF variable capacitor. He could clip in fixed capacitors in parallel with the variable cap to increase the total capacitance as needed for the lower bands. He tied everything he could reach together, including the heating pipes, window frame and balcony railing to act as the ground. Ray used this with good results from 160 through 10 meters.

When he moved out of the apartment, Ray put a small self-tapping screw in the hole, and doubts anyone ever noticed it. Ray may have a chance to give this a try once again. He is moving to another state, and will be spending a few months in an apartment while his new house is being completed.

Although Mel does not live in a neighborhood with restrictions regarding antennas, they are considering revising the restrictions. Mel does not want to give anyone ideas to add antennas to the list of forbidden structures, so he keeps his antennas low key. That means he avoids shiny aluminum.

Mel has a 9 foot tower mounted on his rooftop. It is painted tree bark brown and supports a quad with wire elements. The quad's spreaders are also painted tree bark brown. Mel has a 6 meter Yagi that is painted—you guessed it—tree bark brown. He also uses wire antennas and likes to use black or olive colored rope for supports. To keep the rope even harder to see, Mel tries to run them along branches and tree trunks wherever possible.

Mel also operates some contests mobile. He usually does not do the major contests mobile except when he is on vacation. He does like the QSO parties of nearby states.

Scott likes to use trees to hide his antennas wherever possible. Although he has used verticals, Scott likes wire horizontal loops the best. The loops are inexpensive, says Scott. Twenty to twenty-five dollars will buy you 500 feet of 12 or 14 gauge electrician wire at the local home emporium. He prefers wire with gray-black insulation for low visibility. Scott has also found them to be rugged, having survived 3 winters, several tropical storms and a weak hurricane with only 1 wire break.

According to Scott, the horizontal loops have low angles of radiation on the higher bands, but act as cloud warmers on the lower bands. This makes them useful for both DX and domestic contesting. He also finds they are quieter than the verticals.

We are nearly out of space and still have comments from a number of clandestine contesters. We will pick up next time with their comments. If you are forced to use low profile antennas at your station, please pass your best ideas for the next issue. Please get them to me by July 12.

Send in your ideas on these subjects, or suggestions for future topics. Postal mail: 3310 Bonnie Lane, Slinger, WI 53086. E-mail: w9xt@qth.com.

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 October 2005. 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!

July 2005

RAC Canada Day Contest	0000Z-2359Z, Jul 1
NCCC Thursday Sprint	0230Z-0300Z, Jul 1
Venezuelan Ind. Day Contest	0000Z, Jul 2 to 2359Z, Jul 3
WLOTA Contest	0600Z, Jul 2 to 1200Z, Jul 3
Original QRP Contest	1500Z, Jul 2 to 1500Z, Jul 3
DARC 10-Meter Digital Contest	1100Z-1700Z, Jul 3
MI QRP July 4th CW Sprint	2300Z, Jul 4 to 0300Z, Jul 5
NCCC Thursday Sprint	0230Z-0300Z, Jul 8
VK/Trans-Tasman 160m Contest, Phone	0800Z-1400Z, Jul 9
IARU HF World Championship	1200Z, Jul 9 to 1200Z, Jul 10
FISTS Summer Sprint	1700Z-2100Z, Jul 9
ARCI Summer Homebrew Sprint	2000Z-2400Z, Jul 10
NCCC Thursday Sprint	0230Z-0300Z, Jul 15
CQ Worldwide VHF Contest	1800Z, Jul 16 to 2100Z, Jul 17
North American QSO Party, RTTY	1800Z, Jul 16 to 0600Z, Jul 17
RSGB Low Power Field Day	0900Z-1600Z, Jul 17
NCCC Thursday Sprint	0230Z-0300Z, Jul 22
Great Lakes Sweepstakes	0000Z, Jul 23 to 2359Z, Jul 24
VK/Trans-Tasman 160m Contest, CW	0800Z-1400Z, Jul 23
NCCC Thursday Sprint	0230Z-0300Z, Jul 29
RSGB IOTA Contest	1200Z, Jul 30 to 1200Z, Jul 31
ARS Flight of the Bumblebees	1700Z-2100Z, Jul 31

August 2005

TARA Grid Dip Shindig	0000Z-2400Z, Aug 6
10-10 Int. Summer Contest, SSB	0001Z, Aug 6 to 2359Z, Aug 7
National Lighthouse Weekend QSO Contest	0001Z, Aug 6 to 2359Z, Aug 7
European HF Championship	1200Z-2359Z, Aug 6
ARRL UHF Contest	1800Z, Aug 6 to 1800Z, Aug 7
North America QSO Party, CW	1800Z, Aug 6 to 0600Z, Aug 7
SARL HF Phone Contest	1230Z-1630Z, Aug 7
NCCC Thursday Sprint	0230Z-0300Z, Aug 12
WAE DX Contest, CW	0000Z, Aug 13 to 2359Z, Aug 14
Maryland-DC QSO Party	1600Z, Aug 13 to 0400Z, Aug 14 and 1600Z-2359Z, Aug 14
NCCC Thursday Sprint	0230Z-0300Z, Aug 19
SARTG WW RTTY Contest	0000Z-0800Z, Aug 20 and 1600Z-2400Z, Aug 20 and 0800Z-1600Z, Aug 21
ARRL 10 GHZ and Up Contest	0600 local, Aug 20 to 2400 local, Aug 21
Keyman's Club of Japan Contest	1200Z, Aug 20 to 1200Z, Aug 21
North American QSO Party, SSB	1800Z, Aug 20 to 0600Z, Aug 21
New Jersey QSO Party	2000Z, Aug 20 to 0700Z, Aug 21 and 1300Z, Aug 21 to 0200Z, Aug 22
NCCC Thursday Sprint	0230Z-0300Z, Aug 26
ALARA Contest	0600Z, Aug 27 to 1159Z, Aug 28
Hawaii QSO Party	0700Z, Aug 27 to 2200Z, Aug 28
SCC RTTY Championship	1200Z, Aug 27 to 1159Z, Aug 28
YO DX HF Contest	1200Z, Aug 27 to 1200Z, Aug 28
Ohio QSO Party	1600Z, Aug 27 to 0400Z, Aug 28
SARL HF CW Contest	1230Z-1630Z, Aug 28
Kentucky QSO Party	1600Z, Aug 28 to 0400Z, Aug 29

September 2005

NCCC Thursday Sprint	0230Z-0300Z, Sep 2
All Asian DX Contest, Phone	0000Z, Sep 3 to 2400Z, Sep 4
Wake-Up! QRP Sprint	0400Z-0600Z, Sep 3
AGCW Straight Key Party	1300Z-1600Z, Sep 3
IARU Region 1 Field Day, SSB	1300Z, Sep 3 to 1259Z, Sep 4
RSGB SSB Field Day	1300Z, Sep 3 to 1300Z, Sep 4
DARC 10-Meter Digital Contest	1100Z-1700Z, Sep 4
MI QRP Labor Day CW Sprint	2300Z, Sep 5 to 0300Z, Sep 6
WAE DX Contest, SSB	0000Z, Sep 10 to 2359Z, Sep 11
Swiss HTC QRP Sprint	1300Z-1900Z, Sep 10
Arkansas QSO Party	1400Z, Sep 10 to 0600Z, Sep 11 and 1800Z, Sep 11 to 0200Z, Sep 12
ARRL September VHF QSO Party	1800Z, Sep 10 to 0200Z, Sep 12
North American Sprint, CW	0000Z-0400Z, Sep 11
Tennessee QSO Party	1800Z, Sep 11 to 0100Z, Sep 12
ARCI End of Summer PSK31 Sprint	2000Z-2400Z, Sep 11
YLRL Howdy Days	1400Z, Sep 14 to 0200Z, Sep 16
ARRL 10 GHz and Up Contest	0600 local, Sep 17 to 2400 local, Sep 18
Scandinavian Activity Contest, CW	1200Z, Sep 17 to 1200Z, Sep 18
Washington State Salmon Run	1600Z, Sep 17 to 0700Z, Sep 18 and 1600Z-2400Z, Sep 18
QCWA Fall QSO Party	1800Z, Sep 17 to 1800Z, Sep 18
North American Sprint, SSB	0000Z-0400Z, Sep 18
CQ Worldwide DX Contest, RTTY	0000Z, Sep 24 to 2400Z, Sep 25
Tesla Cup	0000Z-2400Z, Sep 24 (Phone) and 0000Z-2400Z, Sep 25 (CW)
Scandinavian Activity Contest, SSB	1200Z, Sep 24 to 1200Z, Sep 25
Texas QSO Party	1400Z, Sep 24 to 0200Z, Sep 25 and 1400Z-2000Z, Sep 25
Fall QRP Homebrewer Sprint	0000Z-0400Z, Sep 26

October 2005

TARA PSK Rumble Contest	0000Z-2400Z, Oct 1
Oceania DX Contest, Phone	0800Z, Oct 1 to 0800Z, Oct 2
International HELL-Contest	1400Z-1600Z, Oct 1 (80m) and 0900Z-1100Z, Oct 2 (40m)
EU Autumn Sprint, SSB	1500Z-1859Z, Oct 1
California QSO Party	1600Z, Oct 1 to 2200Z, Oct 2
UBA ON Contest, SSB	0600Z-1000Z, Oct 2
RSGB 21/28 MHz Contest, SSB	0700Z-1900Z, Oct 2
German Telegraphy Contest	0700Z-0959Z, Oct 3
YLRL Anniversary Party, CW	1400Z, Oct 5 to 0200Z, Oct 7
Makrothen RTTY Contest	0000Z-0759Z, Oct 8 and 1600Z-2359Z, Oct 8 and 0800Z-1559Z, Oct 9
Oceania DX Contest, CW	0800Z, Oct 8 to 0800Z, Oct 9
EU Autumn Sprint, CW	1500Z-1859Z, Oct 8
Pennsylvania QSO Party	1600Z, Oct 8 to 0500Z, Oct 9 and 1300Z-2200Z, Oct 9
FISTS Fall Sprint	1700Z-2100Z, Oct 8
North American Sprint, RTTY	0000Z-0400Z, Oct 9
UBA ON Contest, CW	0600Z-1000Z, Oct 9
10-10 Int. 10-10 Day Sprint	0001Z-2359Z, Oct 10
YLRL Anniversary Party, SSB	1400Z, Oct 14 to 0200Z, Oct 16
JARTS WW RTTY Contest	0000Z, Oct 15 to 2400Z, Oct 16
Worked All Germany Contest	1500Z, Oct 15 to 1459Z, Oct 16
Asia-Pacific Fall Sprint, CW	0000Z-0200Z, Oct 16
RSGB 21/28 MHz Contest, CW	0700Z-1900Z, Oct 16
Illinois QSO Party	1800Z, Oct 16 to 0200Z, Oct 17
ARCI Fall QSO Party	1200Z, Oct 22 to 2400Z, Oct 23
CQ Worldwide DX Contest, SSB	0000Z, Oct 29 to 2400Z, Oct 30
10-10 Int. Fall Contest, CW	0001Z, Oct 29 to 2359Z, Oct 30
FISTS Coast to Coast Contest	0000Z-2400Z, Oct 30

DX Contest Activity Announcements

Bill Feidt, NG3K

RSGB IOTA Contest (Jul 30-31, 2005)

Call	*Entity*	*IOTA*	*Operators*
3V8SM	Tunisia	AF-083	EC8ADU, EC4DX, EC8AUA + 3V8 ops
9K2F	Kuwait	AS-118	9K Team
CYØAA	Sable	NA-064	W8GEX, K8LEE, W9IXX
DH6GD/p	Germany	EU-128	DH6GD
DLØKWH/p	Germany	EU-129	DL2SWW, DF9TM, DH7NO, DL2RTK, DL2VFR + others
FP	St Pierre Miq	NA-032	K9OT, KB9LIE, as FP/homecall
GB5MOB	Isle of Man	EU-116	Scarlett Point Radio Group
IMØ/IZ0EJQ	Sardinia	EU-165	IZØEJQ
J48KW	Greece	EU-052	HA8KW
K1VSJ	USA	NA-046	K1VSJ
K5M	USA	NA-092	K5OLE, KS5V, KC5YKX, W5DK, W5QZT, AC5YK, KB5WT, N5VYS
M8C	England	EU-011	GØVJG, GØFDZ, G4BUO, G7GLW, 2EØATY, M3CVN
MMØECG	Scotland	EU-012	DL1ECG
MMØLON	Scotland	EU-012	DF1LON
MMØQ	Scotland	EU-092	MM0BQI
OZ8MW/P	Denmark	EU-008	OZ2TF, OZ7KDJ, OZ9V
TF	Iceland	EU-071	G3ZAY, MØBLF, MØTDG, MØTJH
TM4Z	France	EU-065	multi-national team
TMØEME	France	EU-074	ON4CJK, ON4DPX, ON5FP
W4YO	USA	NA-110	W4YO

Thanks to: 425DXN, DF1LON, DL2VFR, EC8AUA, F5NQL, HA8KW, IZØEJQ, K1VSJ, K5OLE, K9OT, M3CVN, ON5FP. See **www.ng3k.com/Misc/iota2005.html** for further details.

CQ World Wide DX SSB Contest (October 29-30, 2005)

Call	*Entity*	*Class*	*Operators*
3Z3Z	Poland	SOSB 10M	SQ3ET
6W1RY	Senegal	SOAB HP	F5VHJ
8Q	Maldives	M/M	EA1DGZ, EA1DBC, EA1AAW, EA1CNF
8R1EA	Guyana	SOAB HP	AH8DX
EA8/F6GOE	Canary Is	SOSB 20M	F6GOE
FS/KR7X	St Martin	SOAB HP	KR7X
KG4	Guantanamo Bay	???	N4BAA KG4WW
IG9R	African Italy	M/S	IK8HCG, IZ8DFO, IZ8FBU, IZ8EFD
J3A	Grenada	M/?	AC8G + others
LZ9W	Bulgaria	M/M	LZ Contest Team
P4ØW	Aruba	SOAB	W2GD
PJ7/K7ZUM	Sint Maarten	SOAB HP	K7ZUM
VK9XD	Christmas	SOAB	VK2CZ
ZD8Z	Ascension	SOAB HP	N6TJ
ZPØR	Paraguay	SOAB	ZP5AZL

Thanks to: AC8G, AH8DX, EA1CNF, F5VHJ, F6GOE, IK8HCG, LZ2CJ, N4BAA, N6TJ, SQ3ET, VK2CZ, W2GD, ZP5AZL. See **www.ng3k.com/Misc/cqs2005.html** for further details.

CQ World Wide DX CW Contest (November 26-27, 2005)

Call	*Entity*	*Class*	*Operators*
9Y4AA	Trinidad Tobago	SOAB HP	N6TJ
E21IZC	Thailand	SOAB LP	E21IZC
FS/K7ZUM	St Martin	SOAB	K7ZUM
LZ9W	Bulgaria	M/M	LZ Contest Team
VK9AA	Cocos (Keeling)	SOAB	VK2IA

Thanks to: E21IZC, K7ZUM, LZ2CJ, N6TJ, VK2IA. See **www.ng3k.com/Misc/cqc2005.html** for further details.

Workshop Chronicles

Don Daso, K4ZA
k4za@juno.com

Recently, a client asked me to help rebuild some beams, prior to putting them back up on his tower. The work required making new elements, new beam-to-mast clamps, as well as a general “clean up” or replacement of old, rusted hardware. During this work, the client raised several good points, starting with the remark, “I didn’t think drilling holes was such a big deal. It’s easy. Well…most of the time....”

That’s because, not so surprisingly, drilled holes do not always come out nice and round, or in the right place. So, since more than skill is involved, right then and there I knew that a new “Workshop Chronicles” column was in the works!

What do you need? An electric drill (nobody drills holes by hand anymore) and the right size drill bit(s), right? At this point, a few minutes reflection may convince you there may just be more than one way to drill a good hole—exactly where you want it and of the exact size and depth. So, what are the tricks or secrets to drilling success?

As Usual, the Right Equipment Helps

If you already have a drill, fine. If you have to buy one, choose a $^{3}/_{8}$-inch variable-speed drill. A cordless drill is well worth having, along with a spare battery and charger. However, there are times when an ac-powered drill (with higher torque) is worthwhile. While chuckless drills now seem to be everywhere, sometimes you will benefit from being able to tighten the chuck by hand. In any case, buy the best drill you can afford. Look for one with bearings, not bushings, as you shop. Usually, the more expensive the drill, the better it will serve you.

Obviously, the variety of choices is huge. You could even opt for a drill press, or a pneumatic drill, or an angle drill, or a hammer drill, or…well, you get the idea. Each version has a different purpose. For now, stick with a basic $^{3}/_{8}$-inch variable speed model.

One of your next realizations will be that you seem to be changing bits a lot. Having multiple drills can save you a lot of time. For example, you can put a small bit in one drill, then the finish bit in another, and a countersink bit in still another. But we’re getting ahead of the process.

Before Starting to Drill

Here’s the first rule: measure twice, cut/drill once. And always make a punch mark at the exact point where you wish to drill. In other words, use a center punch. This is vitally important, especially when the hole must be exact.

“But Don,” you say, “I don’t have a center punch!” Here’s a simple way to ensure starting a hole exactly where you want it. Press the point of the drill bit on the mark and slowly turn the chuck clockwise by hand once or twice before squeezing the trigger. This works fine for smaller bits—anything under about $^{1}/_{8}$-inch.

What about larger holes? Always drill a pilot hole first (I usually use $^{1}/_{8}$-inch, mainly because I once bought 50 of them literally for pennies). Even though you think this will slow you down, the operation will go faster. Trust me. Even though instinct may say the best way to enlarge a hole is by progressively using a larger and larger drill, this is wrong. It’s much safer to start with a pilot hole, and then complete the hole with the correct finish-size drill bit. Trying to enlarge a drilled hole by running a slightly larger drill bit into the undersized hole is just asking for trouble since the pressure of the cutting action will only be on the outside edges of the drill’s flutes. This action can cause the drill bit to bind and can ruin its cutting edges.

Drilling Speeds

It’s possible to make this so complicated that you spend all your time studying charts and graphs instead of working on your project. Most of the time, an exact drill speed isn’t critical. Simply remember that:

1. Small drill bits up to $^{1}/_{8}$-inch diameter or smaller works best at high speed.
2. Larger drill bits, $^{1}/_{4}$-inch diameter or larger, should be turned at lower speeds (especially in hard steels), with sufficient pressure applied to ensure the drill is always cutting.

If you let the drill spin very fast without cutting, the metal will get extremely hot and possibly harden to the point where it dulls and no longer cuts (a blue tip is one telltale sign of such damage). When this happens, switch to a smaller bit, drilling through before you switch back to a larger bit.

When bits get too hot, we need to consider using lubrication, or cutting oil, which will help prevent burning (kerosene or turpentine also work well). Only a few drops are needed. One clue you’re running too fast for the material is bit chatter; sometimes you may even see smoke. If the bit turns faster than the speed allowed by that bit’s geometry, it will heat up and dull. If the bit goes too slow, it will overload and bind. Again, experience will have to be your best teacher.

Softer metals, like aluminum (say 6061-T6, which is a tougher aluminum alloy) still tend to clog drill bit flutes. Clamp your work. Drill slowly, and remove the bit frequently to free the flutes of chips. If you don’t, you may find the drill jammed tight in the hole.

Holes in steel are best made with a drill press. Use a slow speed, along with plenty of lubricant, and remember to keep pressure on the drill to keep it cutting.

This brief overview should give you some cause for pause as you haul out that drill for your next project. Usually, on the typical ham project, time takes precedence over materials and tools. Toss in some variables, typical of most any repair job, and suddenly you’ll realize that drilling a hole is indeed a complicated one-shot effort. Make it worth your time.

Jon K. Jones, NØJK
n0jk@hotmail.com

Stealth VHF Contesting

Taking the lead from Gary, W9XT's column topic "Stealth Contesting" in his "*Contest Tips, Tricks & Techniques"* in this issue of the *NCJ*, here are some ideas for Stealth VHF Contesting.

Outside antenna restrictions from local zoning boards and homeowner association CC&Rs are becoming more common in many parts of the United States. In my hometown of Wichita, almost all housing developments built in the last 15 years strictly prohibit outside antennas (with the exception of the small dishes for satellite TV). Many hams are frustrated by these obstacles and just give up. There are ways to contest competitively on VHF despite outside antenna restrictions.

Probably the best way to operate a VHF Contest from an outside antenna restricted QTH is *not to.* That is**,** *don't operate from your restricted location***,** but rather away from your home. There are a number of ways to do this. In the VHF contests there are the Rover, Single Operator Portable and multi-operator categories. As a Rover or Single op/portable, you compete only against stations in the your category. A single op QRP portable station located on a hill can often put out a signal comparable with high-power big-antenna stations located in a valley or a city. The antennas can be home made and radios economical for the single op portable category. This is VHF Contesting "on a budget!" I often operate the VHF contests QRP portable from a high point in the Flint Hills about a one-hour drive from my home. Ken, WB2AMU, relates his adventures operating the January 2005 VHF Sweepstakes single op QRP portable in the Spring 2005 issue of *CQ VHF Quarterly*.

Multi-Oping from a rural location or mountaintop is still another way to contest. For years I operated with the WBØDRL group from Salina, Kansas. Pete lived west of Salina in the countryside and was able to build a great VHF contest station—no TVI, no antenna restrictions, etc. Other groups operate portable from the same locations each year. They usually pick a mountaintop. Examples are W2SZ/1, K8GP, etc. You may be able to join a group like this to operate a VHF contest. Or you may "guest operate" from a home station that does not have antenna restrictions. If you belong to a VHF club, often there are members who may allow other club members to "guest operate" their stations. There are stations advertised in *QST* and *DX Holiday* that are available to rent for a contest. Finally, if you have the means, you can buy land in the country and build yourself the VHF contest station of your dreams.

Operating from Home

If none of the "away" options work for you, and you plan to contest from your outside-antenna-restricted home, you'll obviously be limited in the antennas you can use. Nonetheless, you can still make contacts and submit an entry in the VHF contests. Starting with 6 meters, a potential attic antenna farm for a VHF contest may consist of a dipole, a loop or a 2-element Yagi. At one of the homes I lived in, the attic had few obstructions and a solid floor. I set up a tripod with rotor and had a 3-element Yagi for 6 meters and a 7 element for 2 meters. On 6 meters during Solar Cycle 22, I logged all continents and many countries with the attic Yagi. The Moxon antenna is another candidate for attic or concealed outdoor use. The Par Electronics SM-50 6 Meter Moxon is advertised as "ideal for stealth operation." Visit **www.parelectronics.com/** for more info.

At our current home, there is no floor in the upper attic and many vertical wood supports. Thus, a rotatable 6-meter Yagi won't work for me. I use a dipole for 6 meters and a loop for 2 meters. I have found the dipole to be an effective antenna for 6 meter E_s openings and capable of real DX. I contacted ZP6CW in Paraguay with it on March 12, 2005 on 6 meters during an "E_s to TEP" opening to South America. A 6-meter "stealth" dipole can be hung discreetly outside from a porch to a tree just for the contest. The lowly dipole can be a hot performer on 6 meters during E_s openings, as Bryan W5KFT reported on the "3830 Internet reflector" for the June 2003 VHF QSO Party (see sidebar).

The June VHF QSO Party often has many hours of E_s openings on 6 meters, so it is the best VHF contest to enter with simple indoor or stealth outdoor antennas. Kim Stenson, W4KVS, in South Carolina has "done quite a bit with modest equipment and indoor antennas on VHF" during last summer's 6 meter E_s openings.

"*My first introduction to ham radio came in the 60s when I was a young boy growing up in Vermont. I was probably about 10 and when watching TV one summer evening heard, "CQ 6, CQ 6, CQ 6" come over the TV. I had no idea what it was but my father knew right away that it was our neighbor up the street, Leo Berry, W1OSU. For me, much of the allure of 6 meters is that it brings me back to that time.*

My 6-meter station consists of an ICOM 551-D and have used indoor antennas only – a dipole, loop, and 3-element beam. The dipole worked, but soon graduated to the loop, which worked much better, and then finally to the beam. Much of my station information is included in an article on indoor antennas in the March 2004 QST.

With the beam I have been able to get into Europe and Africa via E_s and last summer was able to work and confirm the following during the period 3-4 July 2004 on 6 meters:

G8BCG/P	*CN8LI*
CT1HZE	*CT1EAT*
EH7RM	CT1APE

These contacts were a mixture of SSB and CW. All except England were worked on July 4. As a bonus, I also worked FP/K9OT on CW the same day. A good day for me on 6 meters."

Kim's, Bryan's and my own contacts show that simple antennas can work on 6 meters. No one is claiming these antennas will outperform a big Yagi on a tall tower. If you can put a M^2 6M9KHW up at 100 feet, for example, by all means do so. You will have a commanding 50 MHz signal in the contest. But if you are unable, and the choice is to use a simple antenna or not enter the contest at all, try a simple antenna. You may be pleasantly surprised at what you work.

E_s has made appearances in the September and January VHF contests. In VHF contests without E_s openings, one may still make 6-meter DX contacts using indoor antennas via meteor scatter using WSJT digital modes.

On 2 meters and 70 cm, stealth attic antennas like loops, Yagis or quads can "put you in the game" during a VHF contest weekend. In the April 2005 issue of *QST* Steve Ford, WB8IMY, reviewed KU4AB's 2-Meter and 70-cm antennas. These are basic loop designs. Steve put them in his "cramped attic antenna farm"

W5KFT—June 2003 VHF QSO Party

In about 10 minutes I had built a 6-meter dipole and it took about another 10 minutes to hang it about 10 feet off the ground from one end of the porch to a tree in the side yard. I hooked it up to the IC-746 transceiver and I was ready to go, complete with hand mike and paper log. As soon as I turned the rig on, it was gangbusters for the next five hours. I would never have dreamed that I could establish and hold a run frequency, working stations at over 100 per hour with about as basic a station as you can put together. The weekend was a blast. Thanks guys for all the contacts and the fun. Thanks to Ken, WM5R, for bringing basics back into perspective. VHF contesting is just plain fun!

—Bryan, W5KFT

Summary:

Band	*QSOs*	*Mults*	*Score*
6	283	126	35,658

and operated during the January 2005 VHF Sweepstakes, making numerous contest contacts. Steve notes, "I couldn't hear most of what the guys with the big beams were working, but with my 50 W of RF, I was making contacts out to about 90 miles (and I am *not* on a hilltop). The KU4AB loops are reasonably priced. See **www.ku4ab.com/index.html**.

You can make your own loop antennas, small quads or Yagis. I have made VHF contest DX contacts even on 1296 MHz with indoor antennas. In the September 1986 VHF QSO party I worked WS4F (EM85) on Mt Toxaway, North Carolina from Kansas on 1296 MHz tropo using a 45-element indoor loop Yagi placed on two chairs pointing out the window of my apartment!

VHF Contesting—The Basics

In the March 2005 "The World Above 50 MHz" column written by Gene Zimmerman, W3ZZ, in *QST*, Gene describes basic VHF contest station design. This article has good information about the basics of VHF contesting, including station location, antennas, radios, transverters, station layout, feedlines and more. One idea for building a high-quality VHF contest station is to use the Elecraft K2 transceiver with the Elecraft VHF transverters. Elecraft transverters are currently available from 50 to 222 MHz with a 432 MHz model to be released sometime in 2005. See **www.elecraft.com** for more info.

All-Time June VHF QSO Party 6- Meter QSO Totals

There are some additions to the table of all time high 50 MHz QSO totals in the June VHF QSO Party that appeared in last month's column.

NW5E had 993 QSOs on 50 MHz in the June 2003 VHF QSO Party. N4IS reported 955, with KC4PX posting 949 QSOs on 6 meters. These are among the highest QSO totals reported on 6 meters outside of the W5 and WØ call areas for the June VHF QSO Party. Who will be the first station outside of W5/WØ to make over 1000 QSOs on 6 meters in the June VHF QSO Party?

May 6-Meter E_s Bring June VHF Contest Records?

In the previous column, we discussed whether a good February/March 6-meter E_s season predicted a great June VHF Contest E_s opening. As I write this column in mid May, there have been several extensive 50 MHz E_s openings. On May 12, stations in W1 and VE1 worked into Europe on 6 meters, and on May 13, N3DB reported hearing the 9Y4AT/b and FY7THF/b 6-meter beacons. On both days there were hours of coast-to-coast double-hop E_s. If the June VHF QSO Party had been held on May 12-13, it would have been an awesome contest. NCJ

Results, February 2005 Phone Sprint

Jim Stevens, K4MA
ssbsprint@ncjweb.com

The decline of Sunspot Cycle 23 was felt in this Phone Sprint with 20-meters closing early and the resulting 20-meter QSO totals down from what they were a year ago. However, 40 and 80 meters did a good job in making up the difference, so overall scores weren't down too much. One certainly would not have been able to tell that conditions were worse from the number of logs submitted. One hundred and forty-six logs were received, which is only 10 less than the record number from last February. This continues a trend in the last few Phone Sprints of receiving more logs with a relatively small number of QSOs. It is great that more contesters are participating, even if they only make a few QSOs, and it is awesome that they are sending in their logs. There was also good participation from rare areas with several KL7s, a VE8, a VO1 and a VE9 on the air. No DX logs were received, but one or more participants logged the following DX multipliers: C6, HR, J3, KP2, KP4, V4 and XE. Yours truly didn't operate, but in looking at the band breakdowns, I would say 80 meters was long and quiet. Look at the 6s and 7s; there are some impressive 80 meters QSOs totals there.

As a reminder, I am continuing the changes made in February 2004 to the HP and LP Top Ten listings by adding you-and-them error percentages, and adding QSOs Lost and hour-by-hour QSO totals for the LP Top Ten. I have also newly added to the HP Top Ten a +/- rating of claimed vs actual scores. I will talk more about this later.

QRP

Jeff, NX9T, decided to turn down the power this time and picked up the QRP win from North Carolina. W8LBO and K6UFO (Mr "That Is Mork Not Mark") took QRP second and third respectively. I'm sure QRP was tough sledding with the conditions. Good job guys!

Low Power

Dan, N6MJ, continued his winning ways in the LP category. He finished just out of the Top Ten QSOs and multipliers with only 100W in poor conditions. In fact, Dan's 291 QSOs represented the second highest LP QSO total ever. N5DO, Dave, also turned in a very good LP performance topping 10K points and taking second from Texas. Coming in third with another fine performance from his new home in Georgia was Jeff, KU8E. Perennial LP Top Ten finishers VE5SF and K7SV took fourth and fifth. Nobody has finished in the LP Top Ten more than Sam and Larry. Rounding out the Top Ten were N6ZFO, NA4K, WØETT, NA4BW and ACØW.

High Power

Winning the HP category for the third time was Bill, K4XS. He led in QSOs and was one short of the top number of multipliers. Congrats, Bill!

After his record shattering number of QSOs in CW Sprint the week before, I guess N6TR thought he would try to get the Sprint Clean Sweep, and he almost did. Tree only finished 5 QSOs behind Bill to take second. In addition, Tree had a Golden Log that is no easy feat with 300+ QSOs.

Rounding out the Top Ten were many

Top 10 QSOS

K4XS	337
K9PG (at WB9Z)	335
W7WA	333
N6TR	332
K6LL	325
K6LA	317
K7RI (K7SS)	311
W6YX (N6DE)	308
W5KFT (K5OT)	300
N6RO	299

Top 10 Multipliers

K6LL	49
KA9FOX (at W9RPM)	49
K4XS	48
N6TR	48
K7RI (K7SS)	48
W6YX (N6DE)	48
W7RN (KL2A)	48
KW8N	48
W7EJ	48
K9PG (at WB9Z)	46
K7RL	46
K7ZSD	46

Top 10 QRP

NX9T	2449
W8LBO	336
K6UFO	224

Top 10 Low Power

	Score	QSOs Lost	Error Rates YOU	Error Rates THEM	00Z	01Z	02Z	03Z
N6MJ	13095	6	1.7%	2.1%	76	82	69	65
N5DO	11352	6	1.9%	2.3%	88	68	57	52
KU8E	9855	4	1.3%	3.6%	68	60	59	33
VE5SF	9592	11	4.4%	1.8%	82	61	38	38
K7SV	9270	4	1.9%	3.9%	75	49	44	38
N6ZFO	8610	0	0.0%	2.4%	72	50	48	35
NA4K	8316	2	1.0%	0.5%	55	44	63	36
WØETT	7440	7	3.6%	0.5%	54	53	38	41
NA4BW	7059	7	3.7%	5.0%	41	50	46	44
ACØW	6764	1	0.6%	3.4%	38	47	54	39

Top 10

	Score	Band Changes	QSOs Lost	Error Rates YOU	Error Rates THEM	Change +/-	00Z	01Z	02Z	03Z
K4XS	16176	78	4	0.9%	2.7%	0	94	88	87	69
N6TR	15936	16	0	0.0%	3.9%	+2	106	76	86	64
K6LL	15925	2	1	0.3%	1.5%	0	98	70	65	92
K9PG (at WB9Z)	15410	83	3	0.9%	1.8%	+1	106	80	98	51
K7RI (K7SS)	14928	2	15	3.4%	4.8%	-3	98	87	63	67
W6YX (N6DE)	14784	24	13	3.1%	2.3%	0	92	89	42	88
W7WA	14652	4	7	2.1%	1.8%	+2	95	94	82	62
KW8N	14304	81	4	1.0%	3.7%	0	96	68	73	62
K6LA	14265	12	1	0.3%	1.6%	+2	94	75	79	69
W7RN (KL2A)	14160	49	14	3.9%	4.4%	-3	96	68	78	55

Top 10 Golden

N6TR	332
N6ZFO	205
K9PW	133
WA7BNM	100
K1HT	93
K4HA	77
N8AA	75
VE3RCN	20
N6AN	18
K4BEV	5

Top Reserve Golden

K4HA	31

Top 10 Band Changes

K9PG (at WB9Z)	83
KW8N	81
K4XS	78
W9RE	66
W7RN (KL2A)	49
AE6Y	38
NA4BW	34
ACØW	29
W6YX	24
N6ZFO	24

Team Scores

Only One Radio

N6TR	15936
K7RI (K7SS)	14928
W7WA	14652
W7EJ	13680
K7RL	13294
K7ZS	11745
K7ZSD	11684
N7LOX	10879
KI7Y	4795
	111593

SMC #1

K4XS	16176
K9PG (at WB9Z)	15410
KW8N	14304
KA9FOX (at W9RPM)	13377
W9RE	12980
K9ZO	10692
K0OU	9408
K9PW	5187
K9NW (at K9UWA)	2670
	100204

NCCC #1

W6YX (N6DE)	14784
W7RN (KL2A)	14160
N6RO	13156
AE6Y	11802
K6IF	9660
WX5S	9408
N6ZFO	8610
K6LRN	8282
W6YL	6549
KE6ZSN	3080
	99491

SCCC #1

K6LL	15925
K6LA	14265
N6MJ	13095
W6TK	9618
W7WW	8736
K6NA	2816
	64455

5. TCG #1 (N4ZZ, W4NZ, KU8E, NA4K, K1GU, KE4OAR, WA4VJC, K4BEV) 46666
6. SMC #2 (WT9U, N2BJ, K9JS, WI9WI, AA9RT, KG9N) 32331
7. Big Bend Rowdies (N5DO, KE5OG) 18832
8. NCCC #2 (K6III, AE7DX, W6FB, W6EB, NO6X, K6UFO) 18483
9. PVRC (K7SV, K3DNE) 14835
10. Rocky Mtns (W0ETT, KU7Z) 8171
11. NCCC #3 (NT6K, K6OWL, KJ6RA) 4403
12. W3LRC (K3HDM, N3XL) 43

of the usual suspects with K6LL, K9PG, K7RI (K7SS), W6YX (N6DE), W7WA, KW8N, K6LA, and W7RN (KL2A) placing third through tenth. It was N6DE's and KL2A's first time in the Top Ten.

As I stated earlier, I have added a new column to the Top Ten box. It shows whether a participant moved up, down, or stayed the same when comparing claimed position to actual position. The + means they moved up from their claimed position, - means they moved down, and 0 means they stayed in the same position. I have stated several times in the past that logging accuracy makes a big difference, especially in the HP Top Ten where the scores tend to be bunched close together. For example, good logging accuracy by Ken, K6LA, in conjunction with some not-so-good logging accuracy by competitors above him, allowed Ken to move into the final Top Ten when his claimed score was 11th place.

Golden Logs

The Top Ten Golden Logs were N6TR, N6ZFO, K9PW, WA7BNM, K1HT, K4HA, N8AA, VE3RCN, N6AN and K4BEV. The Top Reverse Golden Log (meaning there were no busts of that station's sent info in the receiving station's log) was my good friend just up the road from me—K4HA. Bob had the "double-double" of having a golden log both ways. Congratulations to all on the accuracy! If you want a copy of your log checking report, please send an e-mail to **ssbsprint@ncjweb.com**.

Records

Despite the poor conditions, there were a few records broken or established. In QRP, NX9T established the mark for North Carolina, and W8LBO extended his record for Michigan. New low power area records are K2PS in New Jersey, KU8E in Georgia, AE7DX in Nevada (the old record dated back to 1997) and KL1V in Alaska. Even one high power record was eclipsed by VE3KZ in Ontario. You can view the SSB Sprint records at **www.ncjweb.com/ssbsprintrecords.php**.

Teams

A new team named Only One Radio took top team honors with a score of 111,593. Second was the always-strong SMC #1, and right on their heels was NCCC #1. The difference between second and third was only 713 points. Rounding out the top five teams were SCCC #1 and TCG #1.

Notes

There were some reports of contestants forgetting the rules about giving both calls in the exchange and not obeying the QSY rule (so called "round robin" QSOs). This is just a friendly reminder to re-check the rules and make sure you are in compliance with all of them.

The September 2005 Phone Sprint will be held at 0000Z on September 18 (September 17 local time). Get on and join us in the fun!

Finally, I am writing this as I have just heard of the passing of W7RM. I never met Rush Drake, but I have heard some great stories about him from K7SS and NØAX. He was truly a legend and innovator in our sport. We should all strive to carry on a bit of the contesting flame that he and other early contesting giants have left to us.

Soapbox

Terrible conditions here. Looking forward to doing this from my new home station in September.—KA9FOX. You know things are bad when you start working West Coast on 80 meters at 0158Z.—K9PG. Interesting conditions. Too bad it wasn't a DX contest.—K7SV. Couple hours of fun and frustration.—K6OWL. A lot of fun! Dismal numbers, but my first-ever contest.—KL7RY. Low antennas and QRP make for a slow Sprint. QRP to keep the neighbors happy.—K6UFO. Someday I will get the hang of this.—K1GU. Finally, I think I am back in the contesting saddle again. Keep an eye out for me.—N5SMQ. Jukka enjoyed trying the Sprint during his visit to the station. He's hooked.—OH6LI at K6NA. It was a treat to work the mighty N6TR on SSB.—N6AN. The 40-meter antenna was soldered to radials last week for the 160-Meter Contest. Guess we don't get points for soldering mid-contest?—WØZP (N6TR and I will have to take the mid-contest soldering bonus under advisement for the future—*Ed*). Poorest performance in years. Did work KL1V and VE8NSD.—KØOU.

Scores

Call	Name	QTH	20	40	80	QSOs	MLT	Score	Team
KK1L	RON	VT	63	102	73	238	40	9520	
WB1GQR	MITCH	VT	54	72	72	198	40	7920	
K1HT	*DAVE	MA	33	16	44	93	31	2883	
W1CRK	*CAL	MA	0	3	0	3	4	12	
W2LC	SCOTT	NY	64	89	71	224	41	9184	
K2PS	*PETE	NJ	42	31	52	125	32	4000	
WA2RY	*RON	NJ	19	45	36	100	33	3300	
W2RDS	*RICK	NJ	14	36	4	54	22	1188	
N2QOR	*JUSTIN	NJ	2	47	5	54	20	1080	
KC2LYQ	*MIKE	NY	2	7	1	10	8	80	
K3DNE	ED	MD	51	49	59	159	35	5565	PVRC
AJ3M	MASA	MD	49	38	35	122	34	4148	
N3SD	*GREG	PA	10	29	55	94	33	3102	
W3DOS (K9GY)	*CONDI	MD	0	1	11	12	9	108	
KB3KAQ	*STEVE	MD	7	3	0	10	8	80	
K3HDM	*HD	MD	6	0	0	6	7	42	W3LRC
N3XL	*BILL	MD	0	0	1	1	1	1	W3LRC
K4XS	BILL	FL	101	141	95	337	48	16176	SMC #1
N4ZZ	DON	TN	60	101	97	258	44	11352	TCG #1
W4NZ	TED	TN	46	98	84	228	45	10260	TCG #1
KU8E	*JEFF	GA	42	99	78	219	45	9855	TCG #1
K7SV	*LARRY	VA	47	91	68	206	45	9270	PVRC
NA4K	*STEVE	TN	36	71	91	198	42	8316	TCG #1
NA4BW	*BRIAN	GA	46	64	71	181	39	7059	
K1GU	*NED	TN	48	47	46	141	36	5076	TCG #1
W4EEH	*BOB	TN	31	47	57	135	35	4725	
W9WI	DOUG	TN	26	46	54	126	37	4662	
N4CW	BERT	NC	47	43	26	116	37	4292	
NX9T	**JEFF	NC	3	34	42	79	31	2449	
K4HA	*BOB	NC	24	36	17	77	31	2387	
NF4A	CHARLIE	FL	30	20	9	59	25	1475	
N4HLR	*PAUL	GA	34	16	9	59	23	1357	
KE4OAR	CHUCK	TN	29	20	0	49	22	1078	TCG #1
W4OGG	DAVE	TN	19	0	18	37	25	925	
N5SMQ	*BUTCH	VA	0	33	10	43	21	903	
N1WI	*TERI	TN	1	17	22	40	18	720	
WA4VJC	*BOB	GA	11	4	19	34	21	714	TCG #1
KT4AC	*JOHN	TN	5	26	0	31	17	527	
K4RO	KIRK	TN	21	0	0	21	10	210	
WA4JA	*JOHN	TN	8	0	0	8	4	32	
K4BEV	*DON	TN	1	4	0	5	3	15	TCG #1
W5KFT (K5OT)	LARRY	TX	90	108	102	300	44	13200	
N5DO	*DAVE	TX	88	91	85	264	43	11352	Big Bend
N5AN	PAT	LA	75	88	94	257	43	11051	
KE5OG	BILL	TX	66	74	47	187	40	7480	Big Bend
W5GN	BARRY	TX	42	57	13	112	35	3920	
N5RZ	*GATOR	TX	61	40	1	102	28	2856	
K5KA	*KEN	OK	22	57	20	99	24	2376	
K5AM	MARK	NM	5	26	34	65	26	1690	
AD5SR	*LES	OK	7	9	0	16	10	160	
W6YX (N6DE)	BILL	CA	94	136	78	308	48	14784	NCCC #1
K6LA	KEN	CA	111	109	97	317	45	14265	SCCC #1
N6RO	KEN	CA	89	104	106	299	44	13156	NCCC #1
N6MJ	*DAN	CA	114	120	57	291	45	13095	SCCC #1
AE6Y	ANDY	CA	76	106	99	281	42	11802	NCCC #1
K6IF (at N6NF)	DAN	CA	65	76	89	230	42	9660	NCCC #1
W6TK	DICK	CA	81	70	78	229	42	9618	SCCC #1
WX5S (at AD6E)	MATT	CA	78	73	73	224	42	9408	NCCC #1
N6ZFO	*BILL	CA	75	73	57	205	42	8610	NCCC #1
K6LRN	DICK	CA	61	83	58	202	41	8282	NCCC #1
W6YL	SCOTT	CA	64	72	41	177	37	6549	NCCC #1
W6KK	CHAS	CA	71	51	49	171	37	6327	
K6III	JERRY	CA	71	34	23	128	40	5120	NCCC #2
WA7BNM	*BRUCE	CA	0	100	0	100	36	3600	
W6FB	*JACK	CA	36	41	35	112	31	3472	NCCC #2
W6EB	JIM	CA	17	56	33	106	31	3286	NCCC #2
KE6ZSN	JOHN	CA	49	39	0	88	35	3080	NCCC #1
K6NA (OH6LI)	JUKKA	CA	7	81	0	88	32	2816	SCCC #1
NT6K	DAVE	CA	23	7	55	85	28	2380	NCCC #3
NO6X	KEN	CA	30	25	0	55	27	1485	NCCC #2
K6OWL	MARK	CA	11	34	16	61	23	1403	NCCC #3
N6QQ	*JOHN	CA	39	0	0	39	23	897	
KD6PQF	*TERRY	CA	13	17	16	46	16	736	
KJ6RA	RICH	CA	14	17	0	31	20	620	NCCC #3
K6CSL	BERT	CA	15	6	8	29	19	551	
N6AN	*REX	CA	0	18	0	18	15	270	
K6UFO	**MORK	CA	9	10	9	28	8	224	NCCC #2
N6TR	TREE	OR	105	127	100	332	48	15936	Only One
K6LL	DAVE	AZ	131	114	80	325	49	15925	SCCC #1
K7RI (K7SS)	DAN	WA	124	122	65	311	48	14928	Only One
W7WA	DAN	WA	120	110	103	333	44	14652	Only One
W7RN (KL2A)	JON	NV	83	122	90	295	48	14160	NCCC #1
W7EJ	JIM	OR	97	124	64	285	48	13680	Only One
K7RL	MITCH	WA	61	120	108	289	46	13294	Only One
K7ZS	KEVIN	OR	112	93	56	261	45	11745	Only One
K7ZSD	BRAD	OR	80	115	59	254	46	11684	Only One
N5LZ	DON	UT	65	87	92	244	45	10980	
N7LOX	BRIAN	WA	85	108	60	253	43	10879	Only One
W7WW	DAVE	AZ	85	73	50	208	42	8736	SCCC #1
AE7DX	*JACK	NV	25	53	58	136	36	4896	NCCC #2
KI7Y	*JIM	OR	48	47	42	137	35	4795	Only One
K7ZO	SCOTT	ID	31	51	24	106	30	3180	
N7WA	*MIKE	WA	41	42	18	101	27	2727	
W7IJ	BILL	WA	20	31	17	68	30	2040	
AL1G	CAT	AK	43	28	0	71	26	1846	
KL1V	KENT	AK	63	0	1	64	27	1728	
KU7Z	*MARK	UT	0	31	12	43	17	731	Rocky Mtns
N7VS	*STEVE	OR	12	0	0	12	10	120	
KL7RY	*LUKE	AK	2	1	3	6	5	30	
KW8N	BOB	OH	64	125	109	298	48	14304	SMC #1
K8MR	JIM	OH	20	49	69	138	38	5244	
K8BB	DON	MI	0	10	81	91	34	3094	
N8AA	*JOHN	OH	35	40	0	75	25	1875	
AJ1M	JAY	WV	0	2	34	36	17	612	
W8LBO	**TIM	MI	0	21	0	21	16	336	
K9PG (at WB9Z)	PAUL	IL	63	147	125	335	46	15410	SMC #1
KA9FOX (at W9RPM)	SCOTT	WI	49	112	112	273	49	13377	SMC #1
W9RE	MIKE	IN	67	104	124	295	44	12980	SMC #1
K9ZO	RALPH	IL	60	87	96	243	44	10692	SMC #1
WT9U	JIM	IN	51	77	90	218	43	9374	SMC #2
N2BJ	BARRY	IL	47	82	72	201	40	8040	SMC #2
K9JS (at AI9U)	JON	IL	24	89	51	164	39	6396	SMC #2
K9PW	*PETE	IL	42	69	22	133	39	5187	SMC #1
WI9WI	JIM	WI	24	61	36	121	33	3993	SMC #2
WW9R	*PAT	WI	23	65	29	117	31	3627	
AA9RT	*LOU	IL	16	37	43	96	32	3072	SMC #2
K9NW (at K9UWA)	MIKE	IN	32	57	0	89	30	2670	SMC #1
KG9N	*CHUCK	IL	0	50	6	56	26	1456	SMC #2
WØBH	BOB	KS	35	82	103	220	43	9460	
KØOU	STEVE	MO	53	96	75	224	42	9408	SMC #1
KØRI	LOU	CO	47	76	76	199	40	7960	
WØETT	*KEN	CO	51	88	47	186	40	7440	Rocky Mtns
KTØR	DAVE	MN	24	82	68	174	39	6786	
ACØW	*BILL	MN	38	69	71	178	38	6764	
KØHW	*JIM	SD	42	45	56	143	37	5291	
NØAG	*TOM	KS	26	61	47	134	35	4690	
WØZP	WAYNE	CO	46	67	31	144	30	4320	
WBØNNI	*BOB	SD	28	70	29	127	34	4318	
NTØF	*DON	IA	20	52	38	110	32	3520	
WØUY	TOM	KS	31	33	35	99	30	2970	
NØAC	*BILL	IA	25	30	0	55	24	1320	
KCØQXE	*MARK	CO	0	38	6	44	22	968	
KØKX	*MARK	MN	0	2	15	17	9	153	
VE5SF	*SAM	VE5	63	103	52	218	44	9592	
VE3KZ	BOB	VE3	27	83	74	184	40	7360	
VE6JO	WILLY	VE6	72	52	60	184	35	6440	
VA3NR	CHRIS	VE3	0	87	63	150	38	5700	
VE7IN	*EARL	VE7	57	46	37	140	37	5180	
VE7FO	*JIM	VE7	41	20	31	92	32	2944	
VE3TW	*STAN	VE3	12	29	19	60	22	1320	
VE3WG	*BOB	VE3	18	33	0	51	25	1275	
VE3ESH	*IAN	VE3	9	8	19	36	18	648	
VO1MX	*DAN	VE1	0	23	0	23	14	322	
VE3RCN	*KEVIN	VE3	7	11	2	20	12	240	
VE7TLH	*LOGAN	VE7	3	0	0	3	2	6	

Check Log: K7NV
* denotes Low Power
** denotes QRPCall

February 2005 CW Sprint Results

Boring Amateur Radio Club

Chaos: [kâ'äs'] ***n*** [< Gr, space] **1** extreme confusion or disorder **2** state of amateur radio bands during sprint contest—**cha-ot?ic** [kâ ät'ik'] ***adj.***

The 56th CW Sprint was held on February 14 2005 UTC. Conditions seemed to be good for most everyone, at least on two of the three bands. A total of 49 stations made at least 100 QSOs on 20 meters and another 19 stations made at least 100 QSOs on 80 meters. Stations in the Northeast or black hole (W9/W8 area) probably had some justification for complaining however, as scores from those areas were somewhat depressed.

Activity continues to be very strong—and the chaos factor was indeed high. A factoid that demonstrates this is K1HT logging 255 QSOs, but never working the station who won the contest.

For those of you who have not operated this contest and are wondering why the chaos is so high, you will need to understand the "sprint QSY rule." I once gave a talk at the local radio club about the sprint, and after I was done explaining it, I gave everyone a log sheet and we operated a sprint with the 40 or so people in the room. If you called CQ and someone answered you, you had to take at least 5 steps before you could CQ again, or at least one step if you wanted to answer someone else CQing. Imagine a bunch of grown men tripping over chairs to answer someone CQing before someone else did. Of course, this wasn't everyone's cup of tea, and there were four gentlemen watching this from the back of the room. One of the high points for me was walking up to them and calling CQ with "you don't have to be in the contest to give me a point" added. One of them finally gave me a QSO, probably just to get rid of me shouting in front of them.

Now, imagine doing this on the radio, except instead of taking 5 steps, you have to QSY 5 kHz.

This unique contest rule totally changes the way you operate the contest. No longer do you just get on one frequency and press F1 over and over to work guys. Your best rates occur when you can quickly find someone CQing that you haven't worked, have him come back to you, and then have someone else call you when the QSO is over. Having a perfect "doublet" QSO like this is what sprint operators dream of. It balances operator ability and station capability better than any other contesting format.

Because of the chaos created by this mode of operation, the rules require that both call signs be sent during the exchange. This helps remove any confusion about who is working whom. It is important to make sure you hear your call sign, as it is very possible the station you think you are working is actually working someone else. Again, it isn't like everyone owns a frequency, so the situation is very dynamic.

QRP Top Ten

Only three logs using less than 5 W were received this time. Long time QRP Sprint veteran Dale, KG5U, posted another win in this category that he helped pioneer. Dale's 6992 points was well ahead of NØSXX and N6WG, but NØSXX set a new QRP Colorado record. Now that we have the records shown for QRP and low power broken out by QTH, you might see some of the big guns entering this category to establish records in their respective state or Canadian call area. Making 184 QSOs, or even 100 QSOs with 5 W is a very brave act indeed during this contest. Rumor even has it that some of the big guns might take 5 minutes off at the end of the contest, switch off the amplifier and make a QRP entry with the club call sign.

Low Power Top Ten

The low power category continues to

Top 10—QSOs

N6TR	427
N2IC	387
W6YI	374
K3LR	371
K5GN	371
K5TR	371
NK7U	363
N2NT	361
N6ZZ	358
N9RV	357

Top 10—Multipliers

N2IC	46
N2NL	46
N6ZZ	46
K3LR	45
K5GN	45
K5KA	45
K5ZD	45
K6XX	45
N6TR	45
Many	44

Top 10—Low Power

W4OC	11088
K7SV	10988
NAØN	10865
NØAX	10725
NØAT	10480
N5DO	10440
K3MM	10179
K1HT	10160
WQ5L	10120
KA9FOX	10040

Top 10 QRP

KG5U	6992
NØSXX	3224
N6WG	2688

Top 10 Golden Logs

K4RO	307
NØAX	275
K1HT	254
KA9FOX	251
N2GC	243
KV8Q	211
W6YL	195
K7WA	168
NN1N	64
WB2ABD	61

Top 10 Band Changes

N6TR	171
K5TR	168
N9RV	162
K5GN	154
N2NT	150
W4PA	147
N2IC	118
KU8E	97
NK7U	96
AA3B	93

Top 10 Scores

	Score	*Band Changes*	*QSOs Lost*	*00Z*	*01Z*	*02Z*	*03Z*
N6TR	19215	171	1	123	117	97	90
N2IC	17802	118	2	112	94	81	100
K3LR	16695	2	3	100	89	91	92
K5GN	16695	154	3	105	99	84	84
N6ZZ	16468	24	1	108	87	73	90
W6YI	16456	92	9	103	98	91	84
K5TR	15953	168	6	115	90	88	78
N2NT	15884	150	4	108	85	88	81
N9RV	15708	162	2	112	91	82	72
NK7U	15609	96	1	104	86	84	89

Top 10 Less Than 10 Band Changes

	Score	*Band Changes*	*QSOs Lost*	*00Z*	*01Z*	*02Z*	*03Z*
K3LR	16695	2	3	100	89	91	92
K5KA	14940	2	5	92	76	81	84
K1KI	14872	7	1	94	86	85	73
N6AA	14740	2	2	95	72	86	82
N5OT	14706	2	2	84	91	87	80
K6LL	14238	2	1	95	84	77	83
K6XX	13635	2	3	95	75	69	65
W6YX	13545	2	3	93	72	76	75
K9NW	13440	9	1	84	78	77	81
K6NA	13398	6	2	90	80	78	71

see stiff competition among those trying to make the top ten box, which is much stiffer than the span in the other categories. The difference between the top score and the 10th score was less than 10 percent. Don, W4OC, who was probably your South Carolina multiplier, edged out Larry, K7SV, by a couple of QSOs to take first place. Pat, NA0N, edged out NØAX and NØAT to grab 3rd place. N5DO, K3MM, K1HT, WQ5L and KA9FOX filled out the bottom half of the box.

High Power Top Ten

Last September, it took N6TR a whole hour to make just one QSO from Alaska using a portable setup. This time, things were a little better for Tree as he made 123 of them in the same period of time. This was one better than the 122 Bill Fisher had during his initial 400+ QSO effort. After a second hour of 119, Tree was well on his way to his second 400 QSO finish. Typically, things really slow down in the 3rd hour, but Tree leveraged his new four-square on 80 meters and managed to work 97 more guys. He cruised past 400 QSOs with 22 minutes left in the contest and finished with 427 QSOs. This was indeed an untouchable effort by Tree, who easily won his 10th CW Sprint.

Steve, N2IC, took second place honors with a comfortable margin above the rest of the pack. This was Steve's 31st top ten showing and he seems to be well established at his new QTH in New Mexico. Steve also moved ahead of N5TJ in the top ten-appearance list. Tim, K3LR, and Dave, K5GN, tied for the third place score—followed closely by Phil, N6ZZ, from New Mexico. Dan, N6MJ, piloted W6YI to a sixth place finish, with N5RZ operating K5TR's station coming in 7th place. N2NT, N9RV and NK7U filled out the rest of the box. Chris, KL9A, who appears in the top ten for the first time, manned NK7U. Congrats, Chris! Since only a very few number of QSOs were made from Idaho, I am sure many people hope you will go back to Idaho next time.

If you look at the next five scores after the top ten, you find W4PA, K5ZD, K5KA, K1KI and N6AA. These five gentlemen have a combined total of 110 top ten finishes. Randy, K5ZD, doesn't miss the top ten very often, having 33 showings by himself. This is another indication of the strong activity, and how tough it is to make the top ten.

We included a new box, showing the top ten with stations that had fewer than 10 band changes. K3LR shows up in both boxes, along with three of the 11th-15th scores previously mentioned.

Team Competition

The Southern California Contest Club edged out Texas Radio and The Big Bert for top team honors.

This is the 22nd victory for the well-tanned team, which also set the highest team score last year. The old Independent Contests team that started out with victories in the first nine sprints has the second best total, followed by the Winning Alliance of Sprint People (WASP), which has won eight. The Blues Brothers have won four, and the NCCC and SCC twice each.

Third place went to the Northern California Contest Club, followed by the PVRC/FRC team, SMC #1 and SSC #1, who all had scores over 100K points. One new team we saw this time around was called "Coathanger." No wonder WØRTT and WØZP were so weak.

History has shown that the most successful way to increase participation in this event is to sponsor a team. The process is easy to do on the Web (**www.ncjweb.com**) and can be done up to the start of the contest.

Golden Logs

The automated checking process was unable to remove any QSOs from 12 logs. Congrats to K4RO for the only golden log with over 300 QSOs. Considering the level of checking possible in this contest, this is quite the achievement. A few people had problems with the logging of a station who sent "DC" as his QTH. We tried our best not to ding anyone for this. In the future, it might be worth adding DC to your contest program, so that it counts the same as MD. DC is not a separate multiplier in the sprint and if the name is Rice, it might get confused as Rhode Island by your logging software.

Records

With the help of Ken "shoeless" Adams, K5KA, N2IC and a few others, we now have the CW Sprint records broken up by power level for each QTH. You will notice that there are many opportunities to establish the first record in many of the QRP categories and even some in the Low Power one. These are best viewed at the *NCJ* Web page **www.ncjweb.com**.

Congratulations to Ray, WQ5L, who set a new low power record for Mississippi and Gary, NØSXX, who established the QRP record for Colorado. The only other record set was for the total number of QSOs—427 by N6TR. This was a jump of 22 QSOs over the previous record. You would have to go back to 1979 to see a bigger jump in the QSO record, when N2NT pushed his Febru-

Team Scores

Southern California Contest Club #1		Texas Radio and the Big Bert		Northern California Contest Club #1		PVRC & FRC #1	
W6YI	16456	N6TR	19215	N6RO	14706	N2NT	15884
N6AA	14740	K5GN	16695	K6XX	13635	K3NM	13588
K6LL	14238	K5TR	15953	W6YX	13545	N4AF	13115
AC6T	13760	K5ZD	15075	W6EU	12810	K3WW	11970
N6AN	13608	K5GA	14658	N6XI	12505	W2RQ	11856
K6LA	13588	K5NZ	12986	AE6Y	12382	AA3B	11800
K6NA	13398	KM3T	12558	W6RGG	12212	K7SV	10988
W4EF	12852	K2UA	11911	K7NV	11275	K3MM	10179
K6NR	10416	N5PO	11130	AJ6V	10998	W4AU	8320
W6TK	10209	KB5NJD	405	NI6T	10218		107700
	133265		130586		124286		

5. SMC #1 (N9RV, W9RE, KØOU, N9CK, K9ZO, WT9U, KA9FOX, WI9WI, K9AY, K9KM) 105805
6. SSC #1 (W4PA, K4RO, W4NZ, W4OC, NA4K, N2NL, N4ZZ, K4FXN, KU8E) 102178
7. Azenmokers (N2IC, N6ZZ, K5KA, N5OT, K5YAA) 76916
8. Austin Powers (K5OT, N3BB, W5KFT, N5DO, KZ5D, W5JAW, KG5U, AC5AA) 75609
9. NCCC #2 (K6AW, N6PN, AD6E, N6ZFO, W6YL, K6SRZ, K6DGW, N6WG) 63021
10. CPC (NK7U, NØAX, KI7Y, N7LOX, N7WA, K7WA) 60416
11. YCCC #1 (K1KI, W1WEF, K1HT, N2GC, W1EBI, W1JQ) 58945
12. MRRC (K9NW, KW8N, W1NN, K8BB, K8MR) 50834
13. PVRC & FRC #2 (N4ZR, N8NA, K4QPL, K3MD, W3YY, W7YS, K3STX, W3DOS) 49596
14. MWA (NAØN, NØAT, KØAD, KTØR, ACØW, WGØM) 45692
15. CCO#1 (VE3DZ, VE3KZ, VA3NR, VE3FU, VE3IAY, VE3KP, VE3RZ, VE3RCN) 45470
16. NCC (K3LR, K8AZ, KL7WV, K3UA, K8NZ) 40060
17. SSC #2 (K4NO, WQ5L, AD4EB, K4BAI, AA4LR) 27312
18. SCCC #2 (W6SJ, W6KY, NE6I, K6EY) 20643
19. NCCC #3 (K6VVA, K6LRN) 20538
20. Coathanger (WØZP, WØRTT) 18258
21. GMC (WØETT, NØSXX, KØUK) 11539
22. YCCC #2 (NN1N, K1AR) 2020

ary mark of 304 QSOs up to 327 in September. One wonders if the confluence of factors will ever occur again to enable someone to break this new record.

Next Time

The next *NCJ* CW Sprint will be held on September 11 UTC. Will N9RV be able to repeat his victory from last September after having most of his antennas destroyed by an ice storm? Will N6TR once again be in KL7, using a wire hung out of the 3rd floor window of KL7RA's "shack"? Will N5RZ drive to K5TR's house, or operate at home with a hamstick? Will anyone ever be on from North Dakota again in this contest? Will W4OC, K4NO and K4FXN all show up to give us those rare W4 mults? Will anyone new join the 400+ QSO club? Will someone put together a team score to beat the SCCC? Tune in next time.

For team registration, use the *NCJ* Web page at **www.ncjweb.com**. Logs are submitted via e-mail to **cwsprint@kkn.net** and are due seven days after the contest. We do try to accept any logs that are late for a good reason, but once we have turned the crank on the results, having to add another log requires a lot more work. There were several logs that came in more than two weeks after the contest and were not included in the results. At least one of these would have been a new state record.

If you are encouraging someone to operate the sprint for the first time, remember to pass along the Spring Survival Web page URL at **n6tr.jzap.com/sprint.html**. This page has detailed examples of actual sprint QSOs, including sound files.

Soapbox

—Only about 10 minutes of operating. I had a back injury that hasn't fully healed. After 10 minutes in the chair, I'd had enough. It was a fun 10 minutes, though. Next time.—*AA4LR*

—Twenty meters completely dead here. Forty meters wasn't in great shape, but I scratched around for 30 minutes working the louder stations but decided it wasn't a good year for an entry from Europe! Kudos to N9RV W2MUM N2NT AA4GA who came back to my CQs—*G4BUO*

—Heard but did not work UT. Never heard close mults like IA, NE, AR. Best 4 hours in radio.—*KØOU*

—Nice little contest you fellows run.—*K1AR*

—Challenging propagation from New England. I don't recall ever arriving so often at the wrong time in QSOs in progress. I must have been one of the few stations that N6TR did *not* work.—*K1HT*

—This was my first serious attempt at competing in the NA Sprint on CW. My hat goes off to all the FB ops out there with such impressive CW skills!—*K1KD*

—Lost around 10 QSOs when the cat unplugged the linear and computer, which are temporarily set-up upstairs.—*K3MD*

—Missed KY! Didn't do as well as I planned due to: a: antennas; b: propagation; c: operator; d: all of the above. Answer d.—*K4FXN*

—Congrats to Tree on an amazing QSO total!—*K4RO*

—Always a great contest. Well worth the 5.5 hour drive to operate at Geo's. Congrats to the great ops and thanks to all for the QSOs.—*K5TR*

—I was stuck in alternate universe where no one would answer my CQs and I was beat out almost every time! —*K5ZD*

—TS-870S, AL-80B at 800W, A3 at 30 feet, 40-meter loop at 35 feet/80-meter Windom at 42 feet. I really wanted to haul my stuff down to N6IJ and use the antennas there but didn't have time. Another Little Pistol Contest Station effort here. Developed a splitting headache after the first hour, which was the pits, but still had fun. Sure are a lot of sharp operators in the CW Sprint! Had a side-contest with K7NV for beers in Visalia over who would find who first S&Ping. I won first on 20 meters, but Kurt socked it to me on 40 and 80 meters.—*K6VVA*

—Suffering from a bout of the flu. Started great, but tired very quickly.—*K6XX*

—Let's do it again real soon!—*K7SV*

—This one will get your blood pressure up! Didn't get to op much due to Valentine's Day festivities.—*KB5NJD*

—Could have used SO2R capability this time.—*KM3T*

—Great ops. Thanks again. See you all next time.—*KTØR*

—Whew! What a hoot! See you all in the next one.—*KV8Q*

—The collision with the RTTY WPX on 40 was pretty massive! Pretty good activity this time—lots of new calls. Now to just get 'em in the log! Didn't hear a couple of the usual mults. The 300 barrier will eventually fall.—*NØAX*

—Congratulations to Tree on yet another outstanding performance. "Even on my favorite table he can beat my best." Ward, can you help me out here? Thanks to all of you for another 4 hours of the highest octane radio fun available. It is great to have broken through the 300 QSO barrier again. My first two hours were OK with 180 Qs in the log. Then things really slowed down. Somehow I cannot sustain the rate going into the third hour and if the pace doesn't pick up on 80 during the last 60 minutes, my second half falls short. One of these days I'll crack 350! One radio, 3 antennas, one amplifier, and about 10 band changes made manually. How do you guys manage two radios at this frenetic pace? I know, I know. The same way you get to Carnegie Hall.—*N6AN*

—This was my best Sprint by a long stretch. I had 55% more QSOs, finally breaking through the 100 QSO barrier and 77% more score points. Tonight I'm enjoying the ol' Happy Dance. I was surprised how well my short 40-meter dipole did on 80 meters. That's not a lot of wire for this band. Eighty meters was noisy here, so I used my 160-meter flag loop for receiving and had no problem hearing anyone I worked. As always, CQing wasn't the best use of my time. I did better when I did the S&P thing, once I caught the rhythm of the game. I also tried to get repeats on numbers and names I wasn't sure of. We'll see if that helps when my log gets into the hands of the Scoring Gods. Anyway, it was fun, it was intense, and it's over. See you all in the ARRL DX contest.—*N6WG*

—New excuse: Lack of sleep! I blew off four QSOs by doing silly things like pushing the wrong button or QSYing before logging the contact.—*N6XI*

—Bands were reasonably good, but very long skip. It sure got rough in spots; had a 5-minute gap with no QSOs! I sure missed my 40-meter Yagi.—*N9RV*

—Chased K6LL around 80 for the AZ mult. No joy. Got KC7V instead with 5 mins to go! Low power and wet noodle antennas suck in Sprint, but they are better than nothing at all!—*NE6I*

—Wow, what a circus! Can't wait till next one.—*WØZP*

—Some day I'll get the hang of this one.—*W1JQ*

—Thanks to N2BA for use of his station.—*W1NN*

—This contest rocks!—*W2RQ*

—Hardly a brilliant showing, but still a lot of fun, made all the more interesting that my day began in Switzerland at 0300 EST.—*W3EF*

—My second Sprint. What a hoot!—*W6SJ*

Scores

(* indicates low power **indicates QRP)

Call	Name	QTH	20	40	80	QSO	Mlt	Score	Team
K5ZD	RANDY	MA	108	113	114	335	45	15075	TR and Bert
K1KI	TOM	CT	114	105	119	338	44	14872	YCCC #1
W1WEF	JACK	CT	108	109	96	313	41	12833	YCCC #1
KM3T	OJ	NH	88	114	97	299	42	12558	TR and Bert
K1HT	*DAVE	MA	80	100	74	254	40	10160	YCCC #1
W1EBI	GEO	MA	56	69	73	198	39	7722	YCCC #1
NY1S	*JOE	ME	50	61	56	167	37	6179	
K1KD	GRANT	VT	53	68	56	177	34	6018	
W1JQ	*MIKE	CT	32	35	30	97	35	3395	YCCC #1
NN1N	DAVE	CT	26	16	22	64	22	1408	YCCC #2
K1AR	JOHN	NH	0	0	34	34	18	612	YCCC #2
W2JU	*ALEC	CT	0	0	17	17	13	221	
N2NT	ANDY	NJ	101	155	105	361	44	15884	PVRC & FRC #1
K2UA	RUS	NY	61	98	118	277	43	11911	TR and Bert
W2RQ	BILL	NJ	72	111	121	304	39	11856	PVRC & FRC #1
W1NN	HAL	NY	95	101	82	278	42	11676	MRRC
W2LC	SCOTT	NY	81	115	69	265	40	10600	
N2GC	MIKE	NY	62	81	100	243	41	9963	YCCC #1
K2QMF	TED	NY	54	61	57	172	38	6536	
WB2ABD	*PAUL	NY	0	61	0	61	30	1830	
K3NM	JOHN	PA	103	120	93	316	43	13588	PVRC & FRC #1
K3WW	CHAS	PA	85	112	88	285	42	11970	PVRC & FRC #1
AA3B	BUD	PA	84	121	90	295	40	11800	PVRC & FRC #1
K3MM	*TY	MD	82	91	88	261	39	10179	PVRC & FRC #1
N8NA	*KARL	DE	65	77	88	230	37	8510	PVRC & FRC #2
K3MD	JOHN	PA	68	69	74	211	37	7807	PVRC & FRC #2
W3EF	*AL	MD	39	76	58	173	37	6401	
N3GJ	GEO	PA	21	54	92	167	38	6346	
K3STX	*PAUL	MD	24	18	40	82	30	2460	PVRC & FRC #2
K3UA	*PHIL	PA	0	35	36	71	30	2130	NCC
W3DOS	RICE	MD	35	15	0	50	15	750	PVRC & FRC #2
W4PA	SCOTT	TN	103	152	99	354	44	15576	SSC #1
N4AF	AL	NC	72	129	104	305	43	13115	PVRC & FRC #1
K4RO	KIRK	TN	79	123	105	307	42	12894	SSC #1
K4NO	GREG	AL	99	102	85	286	41	11726	SSC #2
W4NZ	TED	TN	77	93	91	261	44	11484	SSC #1
W4OC	*DON	SC	88	92	84	264	42	11088	SSC #1
K7SV	*LARRY	VA	61	121	86	268	41	10988	PVRC & FRC #1
NA4K	STEVE	TN	85	106	95	286	38	10868	SSC #1
N2NL	DAVE	FL	95	138	0	233	46	10718	SSC #1
N4ZZ	DON	TN	68	108	91	267	39	10413	SSC #1
K4FXN	DAN	KY	62	101	88	251	39	9789	SSC #1
KU8E	*JEFF	GA	77	118	51	246	38	9348	SSC #1
K4QPL	JIM	NC	58	74	90	222	38	8436	PVRC & FRC #2
W4AU	JOHN	VA	74	69	65	208	40	8320	PVRC & FRC #1
W3YY	BOB	VA	64	60	39	163	41	6683	PVRC & FRC #2
N5VI	*VAN	GA	61	48	40	149	35	5215	
K1GU	*NED	TN	45	43	38	126	36	4536	
AA4GA	*LEE	GA	55	44	0	99	33	3267	
N4CW	*BERT	NC	0	43	49	92	35	3220	
AD4EB	*JIM	TN	23	20	45	88	31	2728	SSC #2
K4BAI	JOHN	GA	0	9	76	85	32	2720	SSC #2
N4BCB	*BRUCE	AL	26	29	24	79	29	2291	
K8NZ	*RON	FL	44	13	0	57	20	1140	NCC
AA4LR	*BILL	GA	6	0	0	6	3	18	SSC #2
N2IC	STEVE	NM	149	143	95	387	46	17802	Azenmokers
K3LR	TIM	OK	127	129	115	371	45	16695	NCC
K5GN	DAVE	TX	132	143	96	371	45	16695	TR and Bert
N6ZZ	PHIL	NM	132	150	76	358	46	16468	Azenmokers
K5TR	GEO	TX	130	153	88	371	43	15953	TR and Bert
K5KA	KEN	OK	118	119	95	332	45	14940	Azenmokers
N5OT	MARK	OK	126	116	100	342	43	14706	Azenmokers
K5GA	BILL	TX	116	131	102	349	42	14658	TR and Bert
K5OT	LARRY	TX	118	104	94	316	42	13272	Austin Powers
N3BB	JIM	TX	105	109	98	312	42	13104	Austin Powers
W5KFT	ROB	TX	114	119	93	326	40	13040	Austin Powers
K5YAA	JERRY	OK	106	119	100	325	40	13000	Azenmokers
K5NZ	MIKE	TX	120	99	83	302	43	12986	TR and Bert
N5PO	LEE	TX	86	106	73	265	42	11130	TR and Bert
N5DO	*DAVE	TX	88	108	65	261	40	10440	Austin Powers
WQ5L	*RAY	MS	95	101	57	253	40	10120	SSC #2
KZ5D	ART	LA	90	98	57	245	38	9310	Austin Powers
W5JAW	*JIM	TX	58	104	47	209	39	8151	Austin Powers
N5ZK	JOE	TX	85	71	34	190	41	7790	
KG5U	**DALE	TX	80	70	34	184	38	6992	Austin Powers
AC5AA	*DUANE	TX	22	28	2	52	25	1300	Austin Powers
W5GN	BARRY	TX	0	11	15	26	18	468	
KB5NJD	*JOHN	TX	25	2	0	27	15	405	TR and Bert
W6YI	JIM	CA	123	151	100	374	44	16456	SCCC #1
N6AA	DICK	CA	143	121	71	335	44	14740	SCCC #1
N6RO	KEN	CA	129	127	86	342	43	14706	NCCC #1
AC6T	STEVE	CA	124	127	69	320	43	13760	SCCC #1
K6XX	BOB	CA	123	115	65	303	45	13635	NCCC #1
N6AN	REX	CA	117	126	81	324	42	13608	SCCC #1
K6LA	KEN	CA	117	130	69	316	43	13588	SCCC #1
W6YX	MIKE	CA	116	127	72	315	43	13545	NCCC #1
K6NA	GLEN	CA	129	123	67	319	42	13398	SCCC #1
W4EF	MIKE	CA	133	106	67	306	42	12852	SCCC #1
W6EU	JIM	CA	125	119	61	305	42	12810	NCCC #1
N6XI	RICK	CA	94	129	82	305	41	12505	NCCC #1
AE6Y	ANDY	CA	130	120	52	302	41	12382	NCCC #1
W6RGG	BOB	CA	94	100	90	284	43	12212	NCCC #1
K6AW	STEVE	CA	85	121	75	281	41	11521	NCCC #2

Call	Name	QTH	20	40	80	QSO	Mlt	Score	Team
K6VVA	RICK	CA	124	105	37	266	42	11172	NCCC #3
AJ6V	ED	CA	118	108	56	282	39	10998	NCCC #1
N6PN	MATT	CA	85	121	60	266	40	10640	NCCC #2
K6NR	DANA	CA	102	98	48	248	42	10416	SCCC #1
AD6E	AL	CA	113	93	41	247	42	10374	NCCC #2
NI6T	AL	CA	105	94	63	262	39	10218	NCCC #1
W6TK	DICK	CA	110	72	67	249	41	10209	SCCC #1
N6ZFO	*BILL	CA	103	102	44	249	40	9960	NCCC #2
K6LRN	DICK	CA	68	99	56	223	42	9366	NCCC #3
N6NF	TOM	CA	93	60	36	189	40	7560	
W6YL	SCOTT	CA	86	76	33	195	36	7020	NCCC #2
K6SRZ	ALAN	CA	79	92	6	177	38	6726	NCCC #2
W6SJ	*RANDY	CA	84	78	19	181	36	6516	SCCC #2
W6KY	*ART	CA	66	65	43	174	37	6438	SCCC #2
NE6I	*DENNIS	CA	63	55	16	134	33	4422	SCCC #2
K6DGW	*FRED	CA	53	41	30	124	33	4092	NCCC #2
K6EY	*BECKY	CA	66	33	0	99	33	3267	SCCC #2
N6WG	**BOB	CA	39	35	22	96	28	2688	NCCC #2
N7CW	*BUD	CA	62	0	0	62	31	1922	
K6CSL	BERT	CA	13	18	7	38	18	684	
N6TR	TREE	OR	159	161	107	427	45	19215	TR and Bert
NK7U	JOE	OR	139	126	98	363	43	15609	CPC
W7VJ	ANDY	WA	127	141	65	333	43	14319	
K6LL	DAVE	AZ	126	124	89	339	42	14238	SCCC #1
K4XU	DICK	OR	108	110	77	295	42	12390	
K7NV	KURT	NV	115	99	61	275	41	11275	NCCC #1
NØAX	*BILLOJ	WA	105	109	61	275	39	10725	CPC
KI7Y	JIM	OR	129	94	47	270	37	9990	CPC
N7LOX	*BRIAN	WA	109	81	58	248	39	9672	CPC
N7WA	*DINK	WA	88	100	50	238	38	9044	CPC
KL7WV	TIM	AK	109	102	12	223	39	8697	NCC
K7WA	*JIM	WA	89	50	29	168	32	5376	CPC
W7YS	*BILL	AZ	57	73	18	148	34	5032	PVRC & FRC #2
W7IJ	BILL	WA	42	29	23	94	32	3008	
KC7V	*MIKE	AZ	0	53	43	96	29	2784	
WA6PX	*JIM	OR	39	6	9	54	22	1188	
W3CP	*JIM	OR	14	21	14	49	21	1029	
N7VS	*STEVE	OR	16	0	0	16	11	176	
KW8N	BOB	OH	70	121	97	288	42	12096	MRRC
K8AZ	JOHN	OH	87	103	88	278	41	11398	NCC
N4ZR	PETE	WV	64	120	77	261	38	9918	PVRC & FRC #2
KV8Q	*TOM	OH	60	53	98	211	41	8651	
K8BB	DON	MI	55	79	76	210	37	7770	MRRC
K8MR	JIM	OH	11	58	85	154	38	5852	MRRC
W8WTS	*JIM	OH	38	41	42	121	35	4235	
W8TM	*PAUL	OH	46	82	1	129	30	3870	
N9RV	PAT	IN	106	146	105	357	44	15708	SMC #1
K9NW	MIKE	IN	82	114	124	320	42	13440	MRRC
W9RE	MIKE	IN	99	99	111	309	38	11742	SMC #1
N9CK	STEVE	WI	70	106	104	280	41	11480	SMC #1
K9ZO	RALPH	IL	81	108	78	267	42	11214	SMC #1
WT9U	JIM	IN	80	93	92	265	41	10865	SMC #1
KA9FOX	*SCOTT	WI	77	83	91	251	40	10040	SMC #1
K9MMS	*GARY	IL	74	90	78	242	38	9196	
WI9WI	JIM	WI	59	99	71	229	39	8931	SMC #1
K9AY	GARY	WI	57	86	79	222	38	8436	SMC #1
KK9K	RON	WI	35	51	82	168	38	6384	
K9QVB	*JOHN	IL	14	86	54	154	40	6160	
K9KM	*HOWIE	IL	28	71	64	163	36	5868	SMC #1
K1TN	*JIM	IN	37	7	0	44	18	792	
WW9R	PAT	WI	4	17	0	21	10	210	
KØOU	STEVE	MO	88	130	63	281	41	11521	SMC #1
NAØN	*PAT	MN	65	116	84	265	41	10865	MWA
WØZP	WAYNE	CO	87	123	66	276	38	10488	Coathanger
NØAT	*RON	MN	84	100	78	262	40	10480	MWA
KØAD	AL	MN	82	104	63	249	42	10458	MWA
KTØR	DAVE	MN	51	89	76	216	41	8856	MWA
WØRTT	*PETE	CO	80	78	52	210	37	7770	Coathanger
WØETT	*KEN	CO	92	53	50	195	37	7215	GMC
K4IU	*FRED	MN	25	49	63	137	36	4932	
KMØO	*TONY	MN	57	68	0	125	32	4000	
NØSXX	**GARY	CO	58	39	7	104	31	3224	GMC
ACØW	*MOO	MN	31	60	18	109	29	3161	MWA
WGØM	*MIKE	MN	36	35	1	72	26	1872	MWA
KØUK	*BILL	CO	23	18	9	50	22	1100	GMC
VE3DZ	YURI	VE3	63	94	107	264	40	10560	CCO#1
VE3KZ	BOB	VE3	51	77	70	198	39	7722	CCO#1
VA3NR	*CHRIS	VE3	38	67	67	172	36	6192	CCO#1
VE3FU	*CHRIS	VE3	36	61	68	165	36	5940	CCO#1
VE3IAY	*RICH	VE3	30	63	61	154	37	5698	CCO#1
VE3KP	*KEN	VE3	44	54	48	146	38	5548	CCO#1
VE5SF	*SAM	VE5	71	26	0	97	32	3104	
VA7ST	*BUD	VE7	68	29	0	97	31	3007	
VE3RZ	*TONY	VE3	7	65	27	99	30	2970	CCO#1
VE3EY	*NICK	VE3	34	65	0	99	26	2574	
VE3RCN	*KEVIN	VE3	14	7	21	42	20	840	CCO#1
G4BUO	DAVE	G	0	12	0	12	8	96	

Guest Ops

AC6T (at N6VR); K3NM (N2NC); K5OT (at K5NA); K5TR (N5RZ); K8AZ (N8AA); KA9FOX (at W9RPM); KL7WV (W3YQ); N5ZK (W5ASP); NK7U (KL9A); W3DOS (K9GY); W5KFT (K5PI); W6RGG (at AA6G); W6YI (N6MJ); W6YL (W6CT); W6YX (N7MH); W7VJ (AG9A)

February 2005 NAQP RTTY Results

Shelby Summerville, K4WW

Poor propagation? Obviously, it didn't have much effect on the latest NAQP RTTY. Wayne, K7WM, probably said it best: "Constant action. RF makes its own propagation!"

Of the 258 SO, and 7 M/2 logs submitted, there were 25 State/Province records surpassed, along with the NAQP RTTY record! Ty, K3MM, established a new NAQP RTTY record (149,574), eclipsing the old record, held by Don, AA5AU, (143,058). AA5AU established a new LA record, with his second place score (143,946). AA5AU had more multipliers, than K3MM, 198 to 194, but couldn't overcome the QSO difference, 771 to 727. Terry, AB5K, finished third, while establishing a new TX record (131,207). Following closely in fourth, establishing a new AZ record (131,124), was Dave, K6LL, again with more multipliers, 196 to 179, than AB5K, but unable to overcome the QSO difference, 733 to 669. Mark, K5AM, established a new NM record (126,854) with more QSOs than K6LL, 697 to 669, but K6LL's multiplier count, 196 to 182, made the difference. Eight, of the "top 10" stations, established State/Province records.

There were 10 DX logs submitted, with Andy, DH8WR/HC2 (94,116) leading the way. DX stations are certainly encouraged to participate, and strive for the required 200 QSO minimum, required for a plaque or certificate. Andy, DH8WR/HC2, fell only 7 QSOs short of the required minimum.

Seven M/2 logs were submitted, with W6YX (N6DE, KJ9U, W6LD, N7MH, K6UFO) piloting the perennial West Coast powerhouse to a new M/2 record, 225,544. With 968 QSOs, it only seems a matter of time, until W6YX, or another M/2 station, breaks the 1000 QSO barrier.

NN6NN (N6EE, AK6DV, W6XK) with 170,649, edged W5KFT (KD5SQF, K5TWJ, K5PI), with 162,918, for second. W5KFT led in QSOs, 918 to 849, but couldn't overcome the NN6NN multiplier difference, 201 to 189.

The Team competition was very well represented, with 26 teams. While failing to surpass their existing record (560,772), SWACC (K6LL, K5AM, K7WM, W7WW, AD6WL) was clearly the one to beat. The SWACC score (551,410), easily outdistanced the SO1R team (W1ZT, K4GMH, K9MUG, WX4TM, K4WW) score (387,597). Larry, WØETC, again did his usual fine recruiting job for TCG, as TCG was represented with 6 teams. I believe that the team involvement leads to better individual scores. Please don't forget, if you're organizing a team, to register that team on the *NCJ* Web at **www.ncjweb.com/rttynaqpteamreg.php**.

If your team isn't registered prior to the contest, the score will not be counted!

I would be remiss, if I didn't pass along thanks to Wayne, K7WM, for the job he has done in the past as contest manager. I have some big shoes to fill! Also, special thanks to Bruce, WA7BNM, for handling the log checking!

There seems to be some misunderstanding of the rules, regarding the use of packet cluster, for Single Operator stations. **For clarification: "packet cluster use (viewing of spots) is not allowed for Single Operator stations."** To keep from having to convince me that you were only "sending spots, not viewing them," I highly recommend those Single Operator stations, refrain from sending spots.

Multioperator

Call	*Score*	*QSOs*	*Mults*	*State*
W6YX	225,544	968	233	CA
(N6DE, KJ9U, W6LD, N7MH, K6UFO)				
NN6NN	170,649	849	201	CA
(N6EE, AK6DV, W6XK)				
W5KFT	162,918	862	189	TX
(KD5SQF, K5TWJ, K5PI)				
K9SEX	140,624	752	187	TX
(K5GA, K5NZ)				
KS9W	112,365	681	165	IL
(N9NCX, KS9W)				
NØAC	109,210	670	163	IA
(KØWHV, NØNI, NØAC)				
KC2NUB	72,380	517	140	NY
(N2VJB, N2OPW, K2DB, W1TY)				

Soapbox

N7MQ: First ever NAQP. Still learning RTTY contesting, but making progress and having a ball!

VE9DX: Always happy to provide the mult anytime.

W6YX: We had a great time and are really pleased that we've broken the M/2 NAQP RTTY record two years in a row.

N4ZZ: My first NAQP RTTY and found it to be quite different from SSB and CW.

K3GP: Experienced some of the best sustained hourly rates ever. It was a blast.

Single Op, QRP

Call	*Score*	*QSOs/Mults*	*160*	*80*	*40*	*20*	*15*	*10*
W4DJ	21,522	211/102	0/0	22/15	106/40	56/30	26/16	1/1
K3SV	7564	124/61	0/0	70/34	49/24	1/1	4/2	0/0
K4AQ	6090	105/58	0/0	26/18	8/5	44/23	24/11	3/1
N2USM	888	37/24	0/0	0/0	15/8	22/16	0/0	0/0
VA3VF	540	30/18	0/0	0/0	0/0	30/18	0/0	0/0
K9HCK	143	13/11	0/0	0/0	9/7	4/4	0/0	0/0
KC9ECI	22	11/2	0/0	1/0	1/0	5/0	4/2	0/0

Team Scores

Team	*Score*
SWACC #1 (K6LL, K5AM, K7WM, W7WW, AD6WL)	551,410
SO1R (WX4TM, W1ZT, K9MUG, K4GMH, K4WW)	387,597
SWACC #2 (KI6DY, N7UVH, K8FC, KTØDX, WA6BOB, KK5OQ)	378,803
TCG Push Rods (W4GKM, AD4EB, N4ZZ, KE4KWE, W0ETC)	368,868
NCCC KB Lions (WK6I, N6OJ, NT6K, AC6JT, K6EP)	353,171
Great White North (VE1OP, VA3DX, VE2AXO, VO1HP, VE3HG, VA3PL)	334,243
TCG Crank Shafts (NB1B, N5ZM, KI8U, WB0DUL, WA4OSD)	254,777
TCG Cam Shafts (VA7ST, K3GP, W4BCG, W4LC, K7KAR)	238,976
Twilight Zoners (AB5K, N5VYS, KC5YKX, KS5V, KA5EYH)	237,865
NCCC KB Tigers (N6RCE, K6DGW, WB6TQG, K6KYJ, KO6LU)	166,494
BAWA (KE9S, AA9PB, K8IR)	155,554
CC Oldies & Newbies (VE3ESH, VE3FH, VA3PC, VE4YU, VE3RCN)	153,344
SMC#1 (N9CK, K9WX, AA9DY)	124,294
TCG Manifolds (WB4YDL, KH6GMP, N1KWF, K4BEV, XE2AC)	107,578
MWA Team 1 (WRØDK, KØTG, WØZQ, KØVG)	106,057
NCCC KB Bears (W6OAT, K6OWL, KJ6RA, W6ZZZ)	86,944
The Bartenders (W1TO, W8WEJ, AA4VV)	83,211
GMCC Dummy Loads (KØRFD, WAØRSX)	82,741
Dauberville DX Diddlers (W3OFD, KA3PVA, W3DSX, WR3H)	68,060
VECTOR (VE7FO, VA7IRL)	57,656
SMC #3 (N9LF, K9MI, N9LAH)	56,233
TCG Piston Rings (KSØM, KØXU, N1WI)	52,646
MWA Team 2 (KØPC, KCØRET, VE4VV, ACØW, KØPYK)	46,559
TCG Spark Pkugs (W9WI, KE4OAR, K4RO)	40,755
Unknown Contesters (N8PUG, WI8W)	18,388
SMC#2 (K9JS, N9KO)	12,084

KØHW: My goals in this contest were to get in all 10 hours and make 400 QSOs. I met both and exceeded the QSO goal.

K5AM: My first serious SO2R effort.

NN6NN: Lots of fun. We had a blast.

8P2K: My preparation for this contest lasted about a week.

K9SEX: Great M2 competition.

AA5AU: It was an interesting contest.

K3MM: Operated the first 10 hours straight.

K6LL: It will be interesting to see how the team competition turns out.

K7WM: Constant action. RF makes its own propagation!

VA7ST: Improving year over year. Aimed for 300 QSOs and beat the goal by 120.

W1ZT: I had some of the highest peak rates of any RTTY contest and a personal best score for NAQP RTTY.

WW4LL: Slow start, but it eventually picked up.

Single Op, By Call Area

Call	Score	QSOs	Mults	State
KI6DY	76,320	530	144	KS
K8FC	69,916	454	154	CO
KØRFD	65,208	429	152	CO
WRØDK	63,245	455	139	MN
KØHW	59,502	422	141	SD
KTØDX	56,718	411	138	CO
WØETC	54,264	399	136	IA
WØKXZ	52,705	415	127	SD
KØFX	52,116	404	129	CO
WBØDUL	35,844	309	116	CO
WØHW	35,685	305	117	MN
KØCF	35,500	284	125	IA
WØBR	31,635	285	111	KS
KSØM	26,136	242	108	MO
KØTG	25,806	253	102	MN
KØPC	25,787	241	107	MN
KØXU	20,304	216	94	NE
KØJJR	18,124	197	92	MN
WAØRSX	17,533	197	89	CO
WØLSD	15,204	181	84	CO
WØZQ	15,045	177	85	MN
ABØRX	14,454	198	73	MO
K6XT	14,276	166	86	CO
KCØRET	8694	126	69	MN
NTØF	6960	120	58	IA
NØKM	6678	106	63	CO
NØIBT	3995	85	47	CO
KAØEIC	3408	71	48	KS
ACØW	3150	70	45	MN
KØVG	1961	53	37	MN
KØPYK	888	37	24	MN
W1ZT	82,362	518	159	MA
NB1B	76,105	491	155	MA
N1MGO	71,850	479	150	MA
NY1S	58,896	409	144	ME
KB1JZU	47,710	367	130	MA
W1TO	39,878	314	127	MA
KT1I	30,747	277	111	MA
N1UZ	24,075	225	107	MA
N1KWF	22,204	244	91	NH
W1HY	19,950	210	95	RI
WN1OTV	19,012	196	97	ME
KB1IKD	12,403	157	79	NH
K5ZD	8236	116	71	MA
NG1I	5035	95	53	MA
W1LZ	315	21	15	NH
NC2N (EW1AR)	44,118	342	129	NY
W2NRA	21,105	201	105	NY
N2LK	20,925	225	93	NJ
N2FF	13,612	164	83	NY
WB2RHM/2	12,191	167	73	NY
WB2JEP	11,008	172	64	NJ
KF2XF	9035	139	65	NY
K2PAL	6882	111	62	NY
WA2UET	6545	119	55	NY
N1JM	5712	102	56	NY
WA2AFD	4698	87	54	NY
KB2SSS	4628	89	52	NY
N2KX	1581	51	31	NY
N2TA	1476	41	36	NY
N2USM	888	37	24	NY
AB0OX	480	30	16	NJ
K3MM	149,574	771	194	MD
W3OFD	26,730	243	110	PA
KA3PVA	22,504	232	97	PA
N3XL	16,884	201	84	MD
WA3AAN	15,540	185	84	PA
W3DSX	11,628	153	76	PA
K3SV	7564	124	61	PA
KA5DON	7497	119	63	MD
WR3H	7198	118	61	PA
K3LNT	7169	107	67	MD
W3/NH7C (NH7C)	4212	78	54	MD
AAØCY	3504	73	48	PA
KB3KOW	2394	63	38	MD
4U1WB (AJ3M)	2272	71	32	MD
W4ZE	1400	50	28	PA
N3RDV	234	18	13	PA
WX4TM	97,727	607	161	AL
W4GKM	93,324	606	154	TN
AD4EB	81,620	530	154	TN
K9MUG	75,848	499	152	AL
N4ZZ	73,852	499	148	TN
W4UK	72,618	494	147	SC
K4GMH	70,892	479	148	VA
KE4KWE	65,808	457	144	AL
K7SV	62,928	437	144	VA
K4WW	60,768	422	144	KY
WB4YDL	52,650	390	135	TN
W4BCG	48,762	387	126	TN
K4CC	48,081	341	141	FL
K4FJ	43,416	324	134	VA
W4LC	38,396	331	116	KY
WA4OSD	31,152	264	118	TN
AA2GS	29,580	290	102	KY
K4BX	24,416	224	109	TN
W9WI	24,000	250	96	TN
AG4ZG	23,265	235	99	FL
W4DJ	21,522	211	102	FL
W4GAC (KP2N)	20,832	248	84	FL
W3OA	20,100	201	100	NC
K4SB	15,563	197	79	GA
N4GVA	15,480	172	90	FL
KE4OAR	13,203	163	81	TN
K4IQJ	9685	149	65	AL
AA4VV	8704	136	64	NC
K4BEV	7728	112	69	TN
N1WI	6206	107	58	TN
K4AQ	6090	105	58	GA
K8OSF	5643	99	57	FL
KØCOP	4770	90	53	SC
NQ4K	4181	113	37	VA
K4RO	3552	74	48	TN
KI4SP	2655	59	45	AL
AI4JW	1710	57	30	VA
KE1F	1537	53	29	FL
WA4CAS	748	34	22	SC
WB4M	285	19	15	NC
K4DXU	260	20	13	TN
WA4NMS	110	11	10	TN
AA5AU	143,946	727	198	LA
AB5K	131,207	733	179	TX
K5AM	126,854	697	182	NM
N5ZM	58,092	412	141	AR
KK5OQ	48,688	358	136	MS
N5VYS	45,292	338	134	TX
K5BG	33,972	298	114	TX
KC5YKX	32,256	288	112	TX
KØCIE	22,473	227	99	OK
KM5FY	22,464	216	104	AR
KS5V	15,664	178	88	TX
KA5EYH	13,446	166	81	TX
W1DY	10,744	158	68	OK
K5MQ	10,560	160	66	LA
KC5NYO	8806	119	74	OK
NB5R	2356	62	38	TX
N5PA	1188	54	22	MS
KD5WZB	1066	41	26	TX
WK6I	109,746	603	182	CA
N6WS	95,764	538	178	CA
AD6WL	80,214	461	174	CA
N6OJ	79,050	510	155	CA

Call	Score	QSOs	Mults	State
NT6K	73,470	465	158	CA
W6FFH	60,494	406	149	CA
W6OAT	56,496	428	132	CA
WA6BOB	51,465	365	141	CA
AC6JT	47,925	355	135	CA
N6RCE	44,799	327	137	CA
K6EP	42,980	307	140	CA
K6DGW	41,715	309	135	CA
WB6TQG	29,648	272	109	CA
K6KYJ	28,702	254	113	CA
N6QQ	26,574	309	86	CA
KH6GMP	24,840	270	92	HI
KO6LU	21,630	210	103	CA
K6OWL	21,614	214	101	CA
W6OQI	21,340	220	97	CA
NC6P	11,972	146	82	CA
KJ6RA	8184	124	66	CA
K6BIR	6565	101	65	CA
N6RC	4680	90	52	CA
WB6JJJ	4312	88	49	CA
AH6OZ	4134	106	39	HI
KF6PKG	3740	85	44	CA
W6RKC	2255	55	41	CA
W6ZZZ	650	26	25	CA
WA6NOL	140	14	10	CA
K6LL	131,124	669	196	AZ
K7WM	107,514	594	181	AZ
W7WW	105,704	584	181	AZ
N7UVH	75,696	498	152	ID
WA7LNW	74,571	469	159	UT
WG7Y	59,920	428	140	WY
N7MQ	48,330	358	135	OR
KJ7NO	43,492	332	131	UT
W7TMT	39,975	325	123	WA
K7KAR	37,846	298	127	AZ
K7MM	37,516	332	113	WA
WQ7R	33,672	276	122	UT
N7BF	23,968	224	107	WA
K7ON	23,622	254	93	AZ
KW7N	22,310	230	97	ID
VE7IO/W7	6930	110	63	AZ
W7DPW	3948	94	42	WA
K7ARJ	3124	71	44	ID
KL1SF	2318	61	38	AK
KD7EJC	195	15	13	AZ
KL1RO	9	3	3	AK
K3GP	54,758	418	131	OH
KI8U	53,584	394	136	OH
W8UL	51,614	394	131	OH
WG8Y	39,556	319	124	OH
W8WEJ	34,629	291	119	WV
K8IR	33,180	316	105	MI
K8UT	31,218	258	121	MI
K8AJS	26,037	263	99	OH
WA8SDA	18,400	200	92	WV
N8PUG	16,020	178	90	MI
WF5X	6262	101	62	MI
KK9T	5940	108	55	MI
N8IW	5432	97	56	OH
WI8W	2368	74	32	MI
AB8ND	1776	48	37	MI
N9CK	96,066	593	162	WI
KE9S	78,694	539	146	WI
AI9T	77,182	518	149	IL
WT9Q	51,584	403	128	WI
AA9PB	43,680	364	120	WI
N9LF	36,738	314	117	IN
N5UWY/9	19,992	204	98	IL
K9MI	16,275	175	93	IN
K9WX	15,488	176	88	IN
AA9DY	12,740	182	70	IL
K9TR	9372	132	71	IL
K9JS	8174	134	61	IL
N9KO	3910	85	46	IL
AA9NF	3572	76	47	IL
N9LAH	3220	70	46	IL
K9HCK	143	13	11	IN
KC9ECI	22	11	2	WI
DH8WR/HC2	19,879	193	103	DX
L2ØH (LU9HS)	6844	118	58	DX
TF3KX	2460	60	41	DX
RV6YZ/6	1653	57	29	DX
YU7AM	546	26	21	DX
JA1BHK	286	22	13	DX
MWØCPZ	210	15	14	DX
GU6EFB	16	4	4	DX

Call	Score	QSOs	Mults	State
TF3RB	1	1	1	DX
8P2K (8P6SH)	94,116	506	186	8P
NP4BM	24,888	244	102	KP4
XE2AC	156	13	12	XE
VE1OP	106,005	573	185	NS
VA3DX	82,880	518	160	ON
VA7ST	59,214	417	142	BC
VE6YR	47,580	366	130	AB
VE2AXO	44,856	356	126	PQ
VO1HP	44,756	334	134	LAB
VE3ESH	43,264	338	128	ON
VE7FO	40,320	315	128	BC
VE3FH	35,280	280	126	ON
VA3PC	35,046	297	118	ON
VE9DX	34,867	293	119	NB
VE3HG	34,866	298	117	ON
VE4YU	26,640	240	111	MB
VE3GSI	26,510	241	110	ON
VA1CHP	24,786	243	102	NS
VA3PL	20,880	240	87	ON
VA7IRL	17,336	197	88	BC
W1AJT/VE3 (W1AJT)	14,670	163	90	ON
VE3EBN	14,442	166	87	ON
VE3RCN	13,114	158	83	ON
VE7HBS	9306	141	66	BC
VE2FK	8424	117	72	PQ
VE4VV	8040	134	60	MB
VA7CAB	4524	87	52	BC
VE3UKR	1764	63	28	ON
VA3EC	792	33	24	ON
VA3VF	540	30	18	ON

Results, January 2005 NAQP CW Contest

Bruce Horn, WA7BNM
bhorn@hornucopia.com

Operators in the western US dominated the top-ten single op scores in the January 2005 edition of the NAQP CW contest with the first five places going to stations in California, Oregon and Arizona. N6MJ operated W6YI's station to a new overall single-op record of 367,928 points, just ahead of ZF2NT's old record of 367,360 points. KL9A piloted NK7U's superstation to a highly competitive second place showing and new Oregon record, while N6TR took third. N6RO was fourth from California, followed by Arizonan K6LL in fifth. N3BB nipped fellow Texan K5PI and Austin Powers teammate, operating K5TR, for sixth by a mere 47 points, while Californian K6LA took eighth. W9RE and W4PA rounded out the top ten from Indiana and Tennessee, respectively.

K7UP, operating from New Mexico, easily won the single-op QRP category with more than double the score of second-place Californian N6WG. WB8RTJ took third from Ohio, while VA3DF captured fourth from Ontario with WB8JUI in fifth from Ohio.

The N2IC multi-two crew took first place from New Mexico, narrowly missing setting a new multi-two record. K5KA took second from Oklahoma, while W6YX was third from California.

The Southern California Contest Club #1 team used top-ten single-op finishes by three of its members to take first place in the team competition by a wide margin over the second-place Northern California Contest Club Team 1. The Tennessee Contest Group #1 team captured third.

A number of new records were set. K1KD broke AA1SU's old Vermont record, while W5WMU broke his own Louisiana record by more than 30k. KO7X more than doubled WC7S's Wyoming record and N8II upped WA8WV's West Virginia record by 8k. N6KI, operating XE2MX, and VE9DX each broke their own Mexico and New Brunswick records, respectively, while TG9/NØAT and VP9/W6PH established first time records for Guatemala and Bermuda.

Please remember that one of the ways you can increase your final score is to increase your logging accuracy. A significant number of the logging errors found were the result of inaccurately logging the band on which the QSO took place, particularly when one station worked the same station on multiple bands in quick succession.

Team Scores

1. SCC #1		2. NCCC Team 1		3. TCG #1	
W6YI	367,928	N6RO	316,386	W4PA	258,960
K6LL	297,810	AE6Y	228,588	K4RO	209,664
K6LA	272,209	W7RN	196,504	N4ZZ	185,640
AC6T	225,544	K7NV	188,880	NA4K	140,499
K6AM	206,701	W6XU	151,956	W4NZ	126,730
Total	1,370,192	Total	1,082,314	Total	921,493

Team	Score
4. Austin Powers (N3BB, K5TR, W5KFT, KZ5D)	904,149
5. SMC 1 (W9RE, N9CK, NØAV, WT9U, W9IU)	859,288
6. Straight Flush (NK7U, NØAX, N7WA, KI7Y)	813,948
7. Parker County Posse Team No 3 (WØUO, K5BG, N5PO, W5FO, W5GN)	810,076
8. SECC Team #1 (K4FXN, N4GG, K4BAI, W4OC, KU8E)	790,808
9. NCCC Team 2 (K6RIM, KF6T, K6MR, N6ZFO, N3ZZ)	786,251
10. PVRC #1 (K3MM, N4AF, K7SV, N4CW)	784,551
11. CCO Team 1 (VE3EJ, VE3DZ, VE3IAY, VA3NR, VE3KP)	647,474
12. SCCC #2 (XE2MX, WN6K, K6XT, VP9/W6PH, W6EEN)	644,007
13. NCCC Team 3 (K2KW, ND2T, AD6E, K6SRZ, K6LRN)	586,410
14. PVRC #2 (N8II, WJ9B, W4AU, K4QPL, AC5RR)	581,223
15. Ozark Contest Club (N5DX, KM5G, N5ECT, W5OOO, K5DB)	579,733
16. MWA #1 (NAØN, KØAD, KMØO, VE4VV, TG9/NØAT)	549,640
17. Team Mississippi (N4OGW, W5XX, W5UE, WQ5L, KB5IXI)	527,149
18. FRC Domestic #1 (N2NC, AA3B, K3CT)	478,479
19. Azenmokers #1 (K8IA, K7UP, W7YS, KC7V)	454,857
20. TCG #2 (AD4EB, W9WI, K4LTA, K3CQ, K3WU)	407,309
21. Azenmakers #2 (K5YAA, N5UL, K7IA)	387,393
22. FCG Team #1 (K9OM, WD4AHZ, K8NZ, K4XS, W4EBA)	315,629
23. CCO Team 2 (VE3SMA, VE3JM, VE3GLO, VA3DF, VE3FU)	282,790
24. MWA #2 (KØMPH, NØBUI, NN7L, WGØM, NØIJ)	268,429
25. SECC Team #2 (N4GI, KA9EKJ, AA4LR, W4ATL, NA4BW)	266,072
26. TCG #3 (K5ZM, K4BEV, NY4N, KØEJ, KM4H)	246,701
27. GMCC Team #2 (WØETT, KJØG, KU7Z, KØDE)	239,621
28. YCCC Arctic (KT1V, WA1Z, W2AU, K1EP)	236,692
29. SMC 3 (KJ9C, W9WUU, K9SD, W9LYA, AK9F)	231,772
30. SCCC #3 (K6EY, W6TK, W6SJ, N6PE, W6LEN)	225,916
31. SMC 5 (K9QVB, W0UY, KA9F, K9PG)	212,028
32. NCCC Team 4 (K6DGW, N6EM, N6WG, W6OAT)	197,988
33. CCO Team 3 (VE3KZ, VE3RZ, VE3HG, VE3XD/W4, VE3RCN)	186,374
34. FCG Team #2 (K4PV, KN4Y, W4DJ, KE1F, N4KK)	171,683
35. FRC Domestic #2 (K3MD, K3WW)	166,544
36. GMCC Team #1 (NØSXX, KØRI, KVØK)	165,375
37. SMC 2 (KK9K, WI9WI, N9CO)	163,054
38. CCO Team 4 (VE3ZI, VE3FH, VE3JAQ)	158,699
39. TCG #4 (N4ZI, WA4OSD, W4HZD, N4DW, W4TDB)	147,056
40. PVRC Part Timers Take Two (NY3A)	145,692
41. YCCC Deep South (K1GU, W1JQ, W1WEF, NA1QP)	134,309
42. Lincoln ARC Team 1 (KTØK, KGØGY)	121,195
43. MWA #3 (K4IU, WA2MNO, ACØW)	115,127
44. PVRC #3 (K3STX, N4ZR, NN3W, K4GM, K4RT)	106,693
45. Austin Powers #2 (W5JAW, KI5DR)	102,757
46. Captain Zero and the One-Eyes (N1IW, K1IR, K0TV)	77,260
47. PVRC #4 (K1KO, W3YY, KI3O, K4VV)	74,943
48. NCCC Team 5 (KE6ZSN, KE6QR, N6XI, W6YL, AE6C)	74,774
49. MWA #4 (KTØR, WØYC)	55,507
50. SMC 4 (K9KM, KM9M, K9WX)	55,234
51. NCCC Team 6 (K6RB, K6OWL)	52,784
52. SECC Team #4 (WØAG, K4OGG)	50,157
53. TCG #5 (N2WN, KE4OAR, WM4Q, N1WI)	44,392
54. SECC Team #3 (W4NTI, WB4SQ, AE4Y)	43,519
55. Green River Valley ARS (GRVARS) (K9WA, KG9LZ)	32,211
56. CCO Team 5 (VA3EC, VE3MGY)	31,452
57. SCCC #4 (K6ZCL, N6AA, WA7BNM)	18,764
58. CTRI (AJ1M, N1HRA, W1VET)	17,390
59. Order of Boiled Owls of NY (K2SX, W2YK)	16,764
60. Diebold ARC (N8OH, W8XY, W8VE)	6830
61. Florida Contest Group Team #3 (NF4A)	5643

Single Op Top Ten

Call	*Score*	*QSOs*	*Mults*	*160*	*80*	*40*	*20*	*15*	*10*	*Team*
W6YI (N6MJ)	367,928	1243	296	78/29	205/53	304/58	239/56	221/52	196/48	SCCC #1
NK7U (KL9A)	358,124	1261	284	86/35	278/52	230/53	246/52	242/54	179/38	StFlush
N6TR	329,376	1128	292	80/32	205/52	217/54	276/55	188/54	162/45	
N6RO	316,386	1134	279	99/35	183/46	212/52	212/49	251/54	177/43	NCCC 1
K6LL	297,810	1103	270	37/22	120/43	263/53	208/49	239/55	236/48	SCCC #1
N3BB	274,343	1093	251	95/35	184/51	276/50	292/57	201/47	45/11	AustPwr
K5TR (K5PI)	274,296	1039	264	68/33	172/49	240/51	290/56	210/52	59/23	AustPwr
K6LA	272,209	1051	259	11/7	175/45	252/57	252/54	206/55	155/41	SCCC #1
W9RE	260,160	960	271	188/47	244/52	182/53	129/45	110/37	107/37	SMC 1
W4PA	258,960	996	260	142/42	287/52	213/52	160/54	121/39	73/21	TCG #1

Single Op QRP Top Five

Call	*Score*	*QSOs*	*Mults*	*160*	*80*	*40*	*20*	*15*	*10*	*Team*
K7UP	111,240	618	180	28/15	93/32	106/37	171/45	189/36	31/15	Azmkr#1
N6WG	45,406	311	146	24/10	44/21	72/34	68/32	44/26	59/23	NCCC 4
WB8RTJ	41,275	325	127	26/17	103/38	62/28	69/24	42/14	23/6	
VA3DF	37,723	317	119	15/9	81/32	73/29	85/29	35/11	28/9	CCO 2
WB8JUI	34,686	282	123	14/10	115/42	62/29	47/23	32/14	12/5	

Top Multi-Two

Call	*Score*	*QSOs*	*Mults*	*160*	*80*	*40*	*20*	*15*	*10*
N2IC	594,174	1806	329	183/48	370/57	375/60	402/61	354/59	122/44
K5KA	499,352	1687	296	231/49	417/57	404/57	379/56	156/40	100/37
W6YX	475,456	1564	304	70/27	289/53	328/59	275/56	332/57	270/52

Single Operator Scores

Call	*Score*	*QSOs*	*Mults*	*QTH*	*Team*
KT1V	114,072	588	194	NH	YCCC Arctic
WA1Z	90,384	538	168	NH	YCCC Arctic
NY1S	82,080	513	160	ME	
K1KD	77,280	460	168	VT	
W1FJ	72,414	447	162	MA	
K5MA	62,604	444	141	MA	
K1JB	57,624	392	147	ME	
W1JQ	53,067	361	147	CT	YCCC Deep South
K1HT	40,704	318	128	MA	
N1IW	38,280	319	120	NH	Captain Zero and the One-Eyes
K1IR	37,878	354	107	MA	Captain Zero and the One-Eyes
K1DAN	36,875	295	125	NH	
W1END	18,270	203	90	NH	
K1EP	12,474	162	77	MA	YCCC Arctic
K1TW	12,166	158	77	MA	
W2JU	10,950	146	75	CT	
W1SRG (K1RDD)	8,305	151	55	MA	
N1HRA	7,072	104	68	RI	CTRI
W1ES	3,388	77	44	MA	
W1VET	3,120	80	39	RI	CTRI
WA1IIE	2,272	71	32	ME	
KØTV	1,102	38	29	NH	Captain Zero and the One-Eyes
NA1QP	589	31	19	CT	YCCC Deep South
N1MD	25	5	5	CT	
N2NC	242,374	958	253	NJ	FRC Domestic #1
K2QMF	31,096	299	104	NY	
W5KI	26,643	249	107	NJ	
W2LE	25,252	236	107	NJ	
WB2AA	21,534	222	97	NJ	
W2AU	19,762	241	82	NY	YCCC Arctic
K2SX	14,280	170	84	NY	Order of Boiled Owls of NY
KC2LYQ	13,680	180	76	NY	
KR2Q	11,466	182	63	NJ	
N2GC	9920	160	62	NY	
N2ZN	9639	153	63	NY	
N2GM	6435	117	55	NJ	
W2LC	5346	99	54	NY	
N2QOR	4650	93	50	NJ	
WB2ABD	4080	85	48	NY	
W2QOB	3024	72	42	NJ	
*AE5X	2948	67	44	NY	
W2YK	2484	69	36	NY	Order of Boiled Owls of NY
WB2DVU	2040	60	34	NY	
K3MM	255,117	921	277	MD	PVRC #1
AA3B	186,525	829	225	PA	FRC Domestic #1
N8NA	146,160	696	210	DE	
NY3A	145,692	684	213	PA	PVRC Part Timers Take Two
K3MD	138,432	672	206	PA	FRC Domestic #2
K3WU	62,088	398	156	PA	TCG #2

Call	*Score*	*QSOs*	*Mults*	*QTH*	*Team*
W3BBO	58,344	429	136	PA	
K3STX	49,609	373	133	MD	PVRC #3
K3CT	49,580	370	134	PA	FRC Domestic #1
NA3V	37,820	310	122	PA	
K3WW	28,112	251	112	PA	FRC Domestic #2
NS3T	19,691	203	97	MD	
*K3WWP	16,154	197	82	PA	
K3KU	9048	156	58	MD	
AA2AD	6100	122	50	PA	
*N3XL	4275	95	45	MD	
NF3R	2911	71	41	MD	
AD8J	704	32	22	PA	
K3WQ	88	11	8	MD	
KB3KYZ	16	4	4	DE	
W4PA	258,960	996	260	TN	TCG #1
N4AF	228,854	901	254	NC	PVRC #1
K4RO	209,664	896	234	TN	TCG #1
K9OM	200,564	812	247	FL	FCG Team #1
N4PN	191,520	798	240	GA	
N4ZZ	185,640	840	221	TN	TCG #1
K4FXN	172,208	752	229	KY	SECC Team #1
N4GG	170,154	822	207	GA	SECC Team #1
K7SV	167,980	740	227	VA	PVRC #1
K4BAI	165,888	768	216	GA	SECC Team #1
W4OC	160,638	653	246	SC	SECC Team #1
WJ9B	146,076	777	188	FL	PVRC #2
NA4K	140,499	699	201	TN	TCG #1
N4CW	132,600	650	204	NC	PVRC #1
W4NZ	126,730	667	190	TN	TCG #1
KU8E	121,920	635	192	GA	SECC Team #1
N4GI	116,234	653	178	FL	SECC Team #2
W4AU	114,264	621	184	VA	PVRC #2
K4QPL	108,936	612	178	NC	PVRC #2
N4ZI	104,052	598	174	TN	TCG #4
AD4EB	96,600	552	175	TN	TCG #2
K4PV	96,552	596	162	FL	FCG Team #2
W9WI	90,072	556	162	TN	TCG #2
K4LTA	81,305	505	161	TN	TCG #2
K3CQ	77,244	492	157	TN	TCG #2
K1GU	75,317	451	167	TN	YCCC Deep South
K4BEV	68,704	452	152	TN	TCG #3
AC5RR	56,536	382	148	VA	PVRC #2
KA9EKJ	52,200	360	145	AL	SECC Team #2
AA4FU	51,330	354	145	NC	
AF4OX	50,976	354	144	SC	
NY4N	49,491	351	141	TN	TCG #3
K4IQJ	46,107	327	141	AL	
N2WN	41,100	300	137	TN	TCG #5
K1KO	40,992	336	122	VA	PVRC #4
WD4AHZ	39,520	380	104	FL	FCG Team #1
WØAG	39,186	311	126	GA	SECC Team #4

Call	Score	QSOs	Mults	QTH	Team
AA4LR	39,120	326	120	GA	SECC Team #2
W4ATL	37,932	327	116	GA	SECC Team #2
KA4NWS	37,629	333	113	SC	
KM4FO	35,406	281	126	KY	
K8NZ	35,217	301	117	FL	FCG Team #1
KN4Y	34,391	289	119	FL	FCG Team #2
KR4M	33,480	279	120	SC	
K0EJ	30,480	254	120	TN	TCG #3
K4ZGB	28,202	239	118	AL	
K4XS	21,338	227	94	FL	FCG Team #1
WA4OSD	20,800	208	100	TN	TCG #4
*NA4BW	20,586	219	94	GA	SECC Team #2
W4DJ	19,796	202	98	FL	FCG Team #2
W4EBA	18,990	211	90	FL	FCG Team #1
W4NTI	18,600	186	100	AL	SECC Team #3
*K4BX	17,927	197	91	TN	
VE3XD/W4	15,760	197	80	FL	CCO Team 3
*K4AQ	15,756	202	78	GA	
N7DLS	14,784	168	88	TN	
WB4SQ	13,446	162	83	GA	SECC Team #3
N4LF	13,125	175	75	FL	
KE1F	12,628	154	82	FL	Florida Contest Group Team #2
W4DAN	12,420	180	69	TN	
W3YY	11,550	154	75	VA	PVRC #4
AE4Y	11,473	149	77	GA	SECC Team #3
KI3O	11,390	170	67	VA	PVRC #4
K4VV	11,011	143	77	VA	PVRC #4
K4OGG	10,971	159	69	GA	SECC Team #4
W4KAZ	10,005	145	69	NC	
W4HZD	9928	146	68	TN	TCG #4
*KI4FWE	9664	151	64	VA	
NN3W	8905	137	65	VA	PVRC #3
W6UB	8576	128	67	TN	
N4KK (K9VV)	8316	154	54	FL	FCG Team #2
N4DW	7686	122	63	TN	TCG #4
K4GM	7560	126	60	VA	PVRC #3
K4LW	6160	112	55	GA	
W4BW	5974	103	58	GA	
NF4A	5643	99	57	FL	FCG Team #3
W4TDB	4590	85	54	TN	TCG #4
K3MZ	3600	75	48	VA	
KC3QU	3293	89	37	AL	
K4RT	2760	69	40	VA	PVRC #3
KE4OAR	1860	62	30	TN	TCG #5
KM4H	1728	48	36	TN	TCG #3
N2YO	1430	55	26	VA	
WM4Q	1222	47	26	TN	TCG #5
KI4EGT	1222	47	26	GA	
N4NTO	902	41	22	NC	
N4HXI	792	44	18	NC	
W4OGG	247	19	13	TN	
N1WI	210	15	14	TN	TCG #5
K4DXU	36	6	6	TN	
*K2EKM	20	5	4	VA	
N3BB	274,343	1093	251	TX	Austin Powers
K5TR (K5PI)	274,296	1039	264	TX	Austin Powers
N5DX	221,725	905	245	AR	Ozark Contest Club
W5WMU	219,480	885	248	LA	
N4OGW	203,904	864	236	MS	Team Mississippi
W5KFT (K5OT)	191,290	814	235	TX	Austin Powers
K5YAA	188,775	839	225	OK	Azenmakers #2
WØUO	183,338	841	218	TX	Parker Cnty Posse Team No 3
K5BG	165,440	752	220	TX	Parker Cnty Posse Team No 3
N5PO	164,566	769	214	TX	Parker Cnty Posse Team No 3
W5FO	164,369	779	211	TX	Parker Cnty Posse Team No 3
KZ5D	164,220	714	230	LA	Austin Powers
K5UN	158,340	754	210	TX	
KM5G	139,008	724	192	AR	Ozark Contest Club
W5XX	137,970	657	210	MS	Team Mississippi
N5UL	137,310	690	199	NM	Azenmakers #2
W5GN	132,363	693	191	TX	Parker Cnty Posse Team No 3
*K7UP	111,240	618	180	NM	Azenmokers #1
K5GN	109,650	645	170	TX	
W5JAW	102,567	573	179	TX	Austin Powers #2
W5UE	91,525	523	175	MS	Team Mississippi
N5ECT	83,700	540	155	AR	Ozark Contest Club
WQ5L	80,364	543	148	MS	Team Mississippi
W5OOO	78,880	493	160	AR	Ozark Contest Club
K5XR (W5ASP)	77,161	511	151	TX	
N5CHA	61,758	423	146	TX	
K7IA	61,308	393	156	NM	Azenmakers #2
K5DB	56,420	455	124	AR	Ozark Contest Club
KØGEO	48,856	394	124	TX	
N5DY	28,290	246	115	OK	
K5WAF	22,684	212	107	TX	
K5SF	18,360	204	90	TX	
KØCIE	15,912	204	78	OK	
KB5IXI	13,386	194	69	MS	Team Mississippi
N5UM	13,359	183	73	TX	
WK5K	9694	131	74	TX	

Call	Score	QSOs	Mults	QTH	Team
N5TJ	8556	138	62	TX	
AA5WE	7998	129	62	TX	
W1WEF	5336	116	46	MS	YCCC Deep South
*N5WLA	3906	93	42	TX	
KI5DR	190	19	10	TX	Austin Powers #2
W6YI (N6MJ)	367,928	1243	296	CA	SCCC #1
N6RO	316,386	1134	279	CA	NCCC Team 1
K6LA	272,209	1051	259	CA	SCCC #1
AE6Y	228,588	886	258	CA	NCCC Team 1
AC6T (at N6VR)	225,544	968	233	CA	SCCC #1
K2KW	212,121	819	259	CA	NCCC Team 3
K6AM	206,701	817	253	CA	SCCC #1
N6NF	204,204	884	231	CA	
K6RIM	165,845	809	205	CA	NCCC Team 2
KF6T	165,087	747	221	CA	NCCC Team 2
K6MR	156,026	706	221	CA	NCCC Team 2
N6ZFO	153,853	709	217	CA	NCCC Team 2
W6XU	151,956	756	201	CA	NCCC Team 1
N3ZZ	145,440	720	202	CA	NCCC Team 2
ND2T	143,514	714	201	CA	NCCC Team 3
AD6E	138,690	670	207	CA	NCCC Team 3
WN6K	128,576	656	196	CA	SCCC #2
W6EEN (N6RT)	100,206	586	171	CA	SCCC #2
K6DGW	87,007	521	167	CA	NCCC Team 4
K6EY	76,908	493	156	CA	SCCC #3
K6CTA	73,935	477	155	CA	
K6SRZ	62,205	435	143	CA	NCCC Team 3
W6TK	58,212	378	154	CA	SCCC #3
N6EM	57,799	359	161	CA	NCCC Team 4
K6XV	49,950	333	150	CA	
W6SJ	47,614	358	133	CA	SCCC #3
KQ6ES	46,440	344	135	CA	
*N6WG	45,406	311	146	CA	NCCC Team 4
K6RB	44,336	326	136	CA	NCCC Team 6
K6XX	41,987	347	121	CA	
N6PE	39,615	285	139	CA	SCCC #3
KE6ZSN	38,144	298	128	CA	NCCC Team 5
K6LRN	29,880	249	120	CA	NCCC Team 3
*K6III	26,784	216	124	CA	
KE6QR	22,470	210	107	CA	NCCC Team 5
NO6X	20,790	210	99	CA	
K6ZCL	17,672	188	94	CA	SCCC #4
*W6OT	11,232	144	78	CA	
N6XI	9295	143	65	CA	NCCC Team 5
K6OWL	8448	128	66	CA	NCCC Team 6
W6OAT	7776	144	54	CA	NCCC Team 4
AD6FR	7040	110	64	CA	
N6WK	6527	107	61	CA	
N6NC	6160	110	56	CA	
K6CSL	5916	102	58	CA	
KG6HAF	4320	80	54	CA	
W6LEN	3567	87	41	CA	SCCC #3
W6YL (W6CT)	2485	71	35	CA	NCCC Team 5
AE6C	2380	68	35	CA	NCCC Team 5
AD6ZJ	2301	59	39	CA	
N6AA	912	38	24	CA	SCCC #4
W6QE	736	32	23	CA	
WA7BNM	180	15	12	CA	SCCC #4
W6RKC	32	8	4	CA	
*N2YM/6	28	7	4	CA	
NK7U (KL9A)	358,124	1261	284	OR	Straight Flush
N6TR	329,376	1128	292	OR	
K6LL	297,810	1103	270	AZ	SCCC #1
K8IA	242,277	973	249	AZ	Azenmokers #1
W7RN (KL2A)	196,504	847	232	NV	NCCC Team 1
K7NV	188,880	787	240	NV	NCCC Team 1
N0AX	180,810	861	210	WA	Straight Flush
N7WA	144,014	754	191	WA	Straight Flush
KO7X	131,400	657	200	WY	
KI7Y	131,000	655	200	OR	Straight Flush
K9JF	129,162	618	209	WA	
KQ7W	115,940	620	187	WA	
K5ZM	96,298	541	178	OR	TCG #3
K7ZS	84,494	509	166	OR	
N7LOX	78,155	539	145	WA	
W7YS	75,960	422	180	AZ	Azenmokers #1
KB7Q	75,682	479	158	MT	
N7ZN	57,246	406	141	ID	
K7BG	56,880	395	144	MT	
N7MAL	45,240	348	130	AZ	
W7TMT	34,771	319	109	WA	
KC7V	25,380	270	94	AZ	Azenmokers #1
KU7Z	23,980	220	109	UT	GMCC Team #2
K7NTW	22,572	228	99	WA	
AE7DX	21,632	208	104	NV	
AB7RW	17,888	172	104	WA	
W7HS	16,268	166	98	UT	

Call	Score	QSOs	Mults	QTH	Team
KC7NUP	16,102	194	83	NV	
AA6RR	6136	104	59	WA	
WA6PX	5890	95	62	OR	
NG7Z	4300	100	43	WA	
N7VS	1652	59	28	OR	
*W7GB	1127	49	23	WA	
K7ARJ	450	25	18	ID	
N7EIE	252	21	12	WA	
W7LR	64	8	8	MT	
NN5J	177,366	721	246	MI	
N8II	155,411	667	233	WV	PVRC #2
N8BJQ	103,462	578	179	OH	
K8FH	100,580	535	188	OH	
KV8Q	78,498	534	147	OH	
K8AJS	68,475	415	165	OH	
K8JQ	51,090	390	131	WV	
AF8A	48,640	380	128	OH	
W8UE	41,987	347	121	MI	
*WB8RTJ	41,275	325	127	OH	
N4ZR	37,859	289	131	WV	PVRC #3
*WB8JUI	34,686	282	123	OH	
AE8M	32,128	251	128	OH	
*W8TM	22,794	262	87	OH	
AJ1M	7198	122	59	WV	CTRI
N8CPA	7018	121	58	OH	
*K8DDB	5439	111	49	MI	
*N8IE	5432	97	56	OH	
N8OH	5400	100	54	OH	Diebold ARC
W8WTS	2920	73	40	OH	
W8XY	1290	43	30	OH	Diebold ARC
K8GT	1276	44	29	MI	
N8IY	1024	64	16	WV	
KB6NU	989	43	23	MI	
K8IR	266	19	14	MI	
*W8VE	140	14	10	OH	Diebold ARC
W9RE	260,160	960	271	IN	SMC 1
N9CK	215,730	918	235	WI	SMC 1
KJ9C	147,911	701	211	IN	SMC 3
K9QVB	129,162	618	209	IL	SMC 5
KK9K	126,336	672	188	WI	SMC 2
WT9U	123,310	590	209	IN	SMC 1
K9MMS	109,138	554	197	IL	
W9IU	81,989	503	163	IN	SMC 1
W9IL	70,751	509	139	IL	
K1TN	44,390	386	115	IN	
W9WUU	42,795	317	135	WI	SMC 3
K9WA	30,935	269	115	IL	GRVARS
K9JWI	28,560	280	102	IN	
K9SD	27,240	227	120	IL	SMC 3
WI9WI	21,808	232	94	WI	SMC 2
K9KM	21,489	247	87	IL	SMC 4
KM9M	18,700	220	85	IL	SMC 4
KA9F	15,484	158	98	IN	SMC 5
K9WX	15,045	177	85	IN	SMC 4
N9CO	14,910	210	71	IL	SMC 2
WW9R	9152	143	64	WI	
K9JE	9088	128	71	IL	
W9LYA	7130	115	62	IL	SMC 3
AK9F	6696	108	62	IL	SMC 3
K9LA	5445	99	55	IN	
N9BOR	4410	98	45	IL	
K8ZZV	3542	77	46	WI	
*KB9YSI	2898	69	42	IL	
KB9S	2166	57	38	WI	
N9TTX	1550	50	31	WI	
KG9LZ	1276	44	29	IL	GRVARS
K9PG	500	25	20	IL	SMC 5
*N4IY	468	26	18	IN	
NAØN	183,738	813	226	MN	MWA #1
NØAV	178,099	739	241	IA	SMC 1
KØCAT (K9WIE)	160,696	758	212	MN	
KØAD	132,977	689	193	MN	MWA #1
WØETT	120,540	574	210	CO	GMCC Team #2
K6XT	118,900	580	205	CO	SCCC #2
KMØO	118,118	649	182	MN	MWA #1
WØZP	116,103	687	169	CO	
KTØK	103,306	658	157	NE	Lincoln ARC Team 1
KØMPH	97,361	583	167	MN	MWA #2
NØSXX	91,204	604	151	CO	GMCC Team #1
KJØG	78,676	442	178	CO	GMCC Team #2
WØZA	75,312	523	144	CO	
WØUY	66,882	426	157	KS	SMC 5
NØBUI	65,340	484	135	MN	MWA #2
KØRI	62,363	413	151	CO	GMCC Team #1
K4IU	53,480	382	140	MN	MWA #3
KTØR	41,293	347	119	IA	MWA #4
WA2MNO	37,557	321	117	MN	MWA #3
NN7L	37,107	399	93	MN	MWA #2
WGØM	34,521	311	111	MN	MWA #2
NØIJ	34,100	310	110	MN	MWA #2
AE9B	32,230	293	110	MO	
KØPC	28,808	277	104	MN	

Call	Score	QSOs	Mults	QTH	Team
K3WT	24,948	252	99	MN	
ACØW	24,090	219	110	MN	MWA #3
KGØGY	17,889	201	89	NE	Lincoln ARC Team 1
KØDE	16,425	225	73	CO	GMCC Team #2
WØYC (K8GU)	14,214	206	69	MN	MWA #4
KVØK	11,808	144	82	CO	GMCC Team #1
*NØLY	11,607	159	73	MO	
KØTK	10,300	206	50	MN	
WØQQS	10,230	155	66	MN	
KNØV	9324	126	74	MN	
KEØL	9108	132	69	MN	
KØGSV	7020	130	54	MO	
KCØRET	5974	103	58	MN	
KØIR	4700	94	50	MN	
KØEWS	4462	97	46	SD	
WAØIAF	3915	87	45	IA	
KØKX	3120	80	39	MN	
VE3EJ	235,755	845	279	ON	CCO Team 1
VE3XB	138,600	700	198	ON	
VE3DZ	137,970	730	189	ON	CCO Team 1
VE3ZI	121,149	641	189	ON	CCO Team 4
VE5ZX	110,201	637	173	SK	
VE3IAY (at VE3RM)	108,944	619	176	ON	CCO Team 1
VA3NR	98,667	577	171	ON	CCO Team 1
VE3SMA (at VE3OSZ)	97,825	559	175	ON	CCO Team 2
VE3JM	95,900	548	175	ON	CCO Team 2
VE5SF	91,784	596	154	SK	
VE6BMX	88,960	556	160	AB	
VE5MX	88,184	584	151	SK	
VE3KZ	86,376	488	177	ON	CCO Team 3
VE4VV	84,303	551	153	MB	MWA #1
VE7FO	74,260	470	158	BC	
VE2AWR	74,102	469	158	PQ	
VE3KP	66,138	438	151	ON	CCO Team 1
VE1RGB	61,858	394	157	NS	
VE1AWP	52,800	400	132	NS	
VE3RZ	42,545	335	127	ON	CCO Team 3
VE3GLO	39,151	329	119	ON	CCO Team 2
*VA3DF	37,723	317	119	ON	CCO Team 2
VA7LC	30,622	251	122	BC	
VA3EC	30,360	264	115	ON	CCO Team 5
VE3HG	26,643	249	107	ON	CCO Team 3
VE3FH	18,966	218	87	ON	CCO Team 4
VE3JAQ	18,584	202	92	ON	CCO Team 4
VE9DX	15,840	180	88	NB	
VE3RCN	15,050	175	86	ON	CCO Team 3
VE3FU	12,191	167	73	ON	CCO Team 2
*VE6EX	10,305	229	45	AB	
VE4YU	7378	119	62	MB	
VE3TW	5341	109	49	ON	
VA7MM	4606	94	49	BC	
VE3UKR	3333	101	33	ON	
VE3GKB	1617	49	33	ON	
VA3HUN	1537	53	29	ON	
*VE3MGY	1092	39	28	ON	CCO Team 5
VA2SG	551	29	19	PQ	
*VE3LMS	350	25	14	ON	
VE2DWA	108	18	6	PQ	
XE2MX	189,240	830	228	XE	SCCC #2
VP9/W6PH	107,085	605	177	VP9	SCCC #2
TG9/NØAT	30,504	248	123	TG	MWA #1
HP1AC	1972	68	29	HP	
VP5AZ	528	24	22	VP5	
CU2JT	9,089	49	61	CT	

* Indicates QRP entry

Multi-Two Scores

Call	Score	QSOs	Mults	QTH
N2IC (N6ZZ, WBØO, N2IC)	594,174	1806	329	NM
K5KA (K5KA, N5RZ, N5OT, AG9A)	499,352	1687	296	OK
W6YX (W6LD, N7MH, KX7M, KJ9U)	475,456	1564	304	CA
W5NN (K5NZ, K5GA, N1LN, NO5W, K1OJ, NT5TU)	466,249	1549	301	TX
KØSR (K0SR, K0OB)	406,368	1494	272	MN
W4MYA (W4MYA, WA4PGM)	345,564	1324	261	VA
KØOU (KØOU, W7FB)	241,472	1078	224	MO
K8MAD (W8MJ, W1NN, K8MR, K8CC, K8BB)	119,364	609	196	OH
KL7DX (KL7FH, AL1G)	2624	82	32	KL7
W7FC (W7BD, K7EF)	130	13	10	OR

Check Logs: N1NN, W7QF

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- Better than 1.1:1 SWR below 30 MHz

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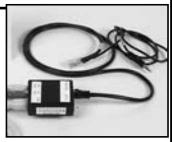

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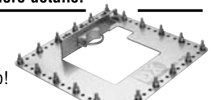
Stainless Radial Plate with Coax Attachment



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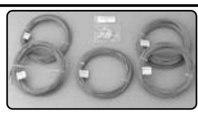
Makes radial attachment a snap!
- Fits pipe, 4x4 and 6x6 posts
- 0.125" thick 304 stainless steel
- High current coax connection to radials
- Accommodates 60-120 radials

DXE-RADP-1P	Complete with 20 stainless bolt sets	**$49.95**
DXE-RADP-1HWK	20 sets of 0.25" stainless hardware	**$4.95**
DXE-8x16RT	Coax jumper cable—interface cable for easy connection to Hustler BTV	**$13.95**
DXE-CAVS-1P	Stainless saddle clamp, for attachment to round tube 0.5" to 1.75" o.d.	**$7.89**
DXE-363-SST	Silver/Teflon® bulkhead	**$6.95**

Radial Kit



Kit includes 12 radials cut to length, four each for 10, 15, and 20 meters. 1/4 inch ring lugs are included. Just strip the wire ends, crimp, and solder. Attach to a radial plate to maximize the performance of your HF vertical antenna.

DXE-RADW-1K	12 radial wire set for 10, 15, and 20m	**$14.95**
DXE-RADW-40MK	4 radial wire set for 40m	**$12.95**
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Verticals on Sale! Best Antenna Value Anywhere!

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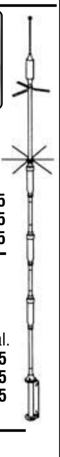

Easiest assembly and tuning of any multi-band vertical.

4BTV	(10, 15, 20, 40m)	**$108.75**
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6BTV	(10, 15, 20, 30, 40, & 75-80m)	**$168.75**

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Reversible Beverage System RBS-1P

- Two Beverage antennas in the same space, receive in opposing directions
- Both antennas can share common feedline to one receiver or use two feedlines to different receivers
- Simply apply 12-15 Vdc to the feedline to switch receive direction

DXE-RBS-1P **$129.00**
DXE-FVC-1 Feed point voltage coupler when purchased with RSB-1P **$59.00**

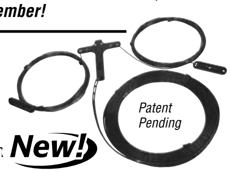
8-Direction Transmit Four Square With Controller

New!

- W8JI design provides increased gain and F/B over other designs
- EIGHT directions plus Omni
- 5 KW CW/10 KW PEP SSB
- Proven high power DX Engineering RF Relays
- Professional quality circuit board layout for reliable performance
- Weatherproof welded stainless steel enclosure and chassis
- Delay line assemblies available
- 160, 80, and 40m bands—other bands available soon

DXE-TFS-1P **$695.00**
First units available in September!

HOT WYRZ™ Ladder Fed Dipole Antenna



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New!

- Rugged, lightweight design
- Stainless steel hardware
- Includes 100 feet of premium ladder feedline

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RFI Suppression Beads

- Reduce or eliminate ignition/injector noise
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- Hear many more stations
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- Special large-mass beads
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- Mobile or home use—any RFI application

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- Exact fit to tubing sizes
- 18-8 stainless steel U-bolt
- As-cast rippled surface on saddle

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Starting at just $3.99!

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PPC-IS-50UX-CO Flange, 2KW at HF, 375W at VHF... **$56.95**
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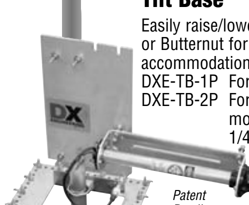

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Easily raise/lower your Hustler, Hy-Gain or Butternut for tuning, weather, or CC&R accommodation.

DXE-TB-1P	For Hustler verticals;	**$39.95**
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Receive Four Square With Controller

New!

- W8JI design
- Performance of a 2-wavelength Beverage antenna in a fraction of the space
- Better than EWE, Flag, Pennant, or K9AY arrays
- Operates from 100 kHz to 30 MHz
- 4 directions selectable—superior F/B
- Can use with DX Engineering 102 inch Active Antenna for full size performance

DXE-RFS-1P Receive Four Square with Controller ... **$289.95**

Active Receive Antenna

DXE-ARAV-1P

New!

- W8JI design
- Operates from 100 kHz to 30 MHz—killer SWL antenna!
- Receive only
- Same performance as a full size antenna
- Uses 102 inch whip for antenna element
- Directional arrays easily set up using DX Engineering Receive Four Square
- Can be vertical or dipole configuration

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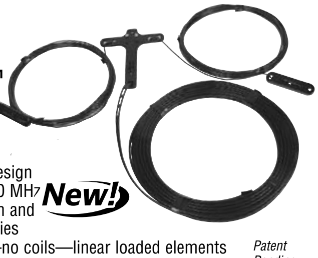

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**Auto transformer matches low impedance of short antennas for lower SWR.*

DX Engineering Current Baluns

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- High efficiency, low loss—designs by W8JI
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