NCJ

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In advance of WRTC-2002, referees trained in a number of areas, including the real-time Web scoreboard system. By luck of the draw, G4BUO (top photo, right) officiated at the winning operation of K1TO (seated) and N5TJ (left). Read about a WRTC referee's experience and more inside.

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Editorial

WRTC-2002

This issue contains the second half of Eric, K3NA's, article analyzing the scores of the top five WRTC2002 competitors. Enjoy the wrap-up, and note that supplementary figures are on the *NCJ* Web site.

There's also a behind-the-scenes article by Veijo, OH6KN, on how the Web scoreboard was done, and an interesting account of Dave, G4BUO's, experience as the referee for the N5TJ/K1TO team.

Contesting Articles

A recent discussion on contesting.com revolved around the ARRL's decision to move the detailed contest results to the web. What this opens up in *QST* is the possibility for more general contesting articles, such as Jack, W1WEF's, fine article in the September 2002 issue. This is just another venue for introducing the general ham public to the fun of contesting. So get out your favorite word processor and get to work!

Skipped Columns

As you'll see in the Table of Contents, this issue also has some regular columns missing. Again, I'm trying to work off the backlog of many excellent general and technical features, and several columnists volunteered to take this issue off. Thanks, guys.

Changes at *NCJ*

As you'll read in some of the columns in this issue, we have some changes at *NCJ* coming up.

This issue carries Joe, W5ASP's, last International Contests column. He's been at it for over 8 years, and he's decided to take a breather. He is working with Bruce, WA7BNM, to post international contest results on the *NCJ* Web site, so Joe isn't totally out of the picture yet. He also plans on contributing articles from time to time. Thanks, Joe, for all your years of service.

Wayne, K7WM, is devoting his full time effort to the NAQP RTTY contest manager duties. He plans to get NAQP RTTY up to two contests per year to fall in line with the other NAQPs. To help make this transition, Wayne will no longer be involved in the RTTY Sprints, and he will turn the RTTY Contesting column over to another RTTY contester.

Jay, WS7I, is taking over duties as the RTTY Sprint contest manager. Jay has been helping Wayne all along, so this should be a seamless transition. Thanks for taking this on, Jay.

John, WA9ALS, is taking over as the RTTY Contesting columnist. John has been RTTY contesting for about three years, and looks forward to contributing to *NCJ*. His first column will be in the January/February issue. Welcome aboard, John!

Our Cover

G4BUO poses with three-time WRTC champions N5TJ and K1TO as he prepares to referee their effort from Finland. Prior to the contest, G4BUO and other referees met to train in a number of areas, such as real-time score reporting to the Web.—*Carl Luetzelschwab, K9LA*

NCJ

Unlocking the Secrets of Success Part 2: WRTC-2002 Finland

Eric L. Scace, K3NA
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3.5 The Second Breakaway: 01-0330Z

Early morning, 4 to 6:30 AM in Finland: N5TJ+K1TO invest two of the next 2-½ hours jumping far ahead to their largest lead of the contest. All five teams are hanging out on 20 m, so what did Jeff and Dan do different?

DL2CC+DL6FBL get crushed during the 01Z hour because they were late to 20 m. They hop around between 40, 80 and then arrive on 20 late in the hour. While their multiplier total holds up, the low bands' low QSO rates and 1-point QSOs hurt. In one hour Frank and Bernd switch from *leading* by 18,000 points to *railing* Jeff and Dan by 22,000 points, still in second place, with more than 30,000 points over the other teams. But the failure to get to 20 m early hurts them.

KQ2M+N2NL start the 01Z hour hot on 20 m SSB. But the run tapers off after a half-hour and they switch away from 20 m to 40 and 80. Low rates of 1 point QSOs – a costly error – and avoidable if they had simply switched to 20 CW running and interleaved the low band QSOs instead. At 02Z they trail 57,000 points behind the leaders.

RA3AUU+RV1AW have a terrible start, working just 2 stations in 15 minutes at 01Z. But then they get a rich run of USA 2-point stations rolling along on 14040 kHz and interleave some low band QSOs. The Russians are 56,000 points behind the leaders at 02Z.

Similarly, N6MJ+N2ML get on 20 m, with a brief sprint on 40 m. Their rates are not as high and, because they can't interleave low band multipliers and QSOs, Dan and Dave slip to 78,000 behind the leaders.

And then, at 0208Z, N5TJ+K1TO run into trouble. Their 14036 run frequency stops working, and they work just two QSOs in the next ten minutes before getting established on 20 m SSB at 14341 kHz. It's seems just a short glitch, but the other four teams' scores catch up. DL2CC+DL6FBL briefly move into first before that SSB run kicks in for Jeff and Dan. It's a nice little run which Jeff and Dan carry up to 0303Z.

Here's another clever piece of operating: as their 20 SSB rates dwindle, the second op starts hunting down spots on 20 CW. They interleave five 20 m CW QSOs during the last 10 minutes of their SSB run, pick off two ordinary QSOs on 40 m while a 20 m run freq is lined up, and then are off again on 14055 at 0309Z.

Dave G4BUO, the on-site referee at N5TJ+K1TO's location, points out this is typical. "It's not that Jeff and Dan do something different from other top contesters. They do many little things a littler better—and they do it better not some of the time, but all the time. On SSB, they never raise their voice; they let the radio do the work and stay relaxed. They work efficiently and conserve energy for the long duration. The voice keyer is used for every possible transmission. The only 'live' on-air words spoken are the distant station's call sign. And because the keyers are doing the work, Jeff and Dan chatter continually about what is happening and what to do next."

Forty thousand points ahead, 8-½ hours to go—yet Jeff and Dan are in very serious trouble.

3.6 The Second Clawback and Third Breakaway: 0330-05Z

RA3AUU+RV1AW switch from CW to 20 m SSB at 0235Z. High in the band at 14334 kHz, they stuff 99 2-point QSOs in the log in just half an hour, collect a few mults on 40 m, then back to 14168 kHz for another 246 2-points QSOs in 93 minutes. All those Qs catapult Harry and Andrei from 70,000 points behind the leaders to the biggest lead of the contest achieved by any team: 54,000 points ahead of N5TJ+K1TO.

Jeff and Dan's CW run on 20 m peters out at 0330Z, and they click down to 40, which was unproductive. They spend 33 minutes on 14174, just above Harry and Andrei, and work 60 QSOs. But they give it up for another stroll through 40 m, working 1-point QSOs at one-quarter the rate of the Russians on 20 m SSB.

Every other team makes up ground on N5TJ+K1TO during this time. At 0430Z, KQ2M+W7WA, who've also had a good 20 m SSB run of 109 Qs in the preceding 47 minutes, pass DL2CC+DL6FBL on 20 m CW (working 61 Qs in the same timeframe) to take third place. It was one of the few points in the contest where raw rate on a single band paid off, and where phone rates were generally better than CW.

3.7 Europeans Lead: 05-0730Z

DL2CC+DL6FBL and N5TJ+K1TO are the first teams to hit 10 meters this morning. With just 22 and 16 QSOs made on 10 m yesterday, their early arrival pays off in a quick multiplier hit. The other three teams quickly lose 10 multipliers against these two.

Frank and Bernd not only hit 10 m, they also are interleaving 15 m and even 40 m QSOs and multipliers into their modest 20 m CW run rate. A switch to 20 m SSB at 06Z pays off with another little jump in relative score—enough to put N5TJ+K1TO back into third place, After a disappointing initial attempt to run 15 m. Jeff and Dan spend just 10 minutes before figuring out this is a mistake, and they hop back to 20 m to retake second place again. Frank and Bernd are hot, just a few QSOs behind Jeff and Dan for the next 40 minutes.

At 0650Z Frank and Bernd make their first attempt to run 15 m. The band's a bit more open now, and 29 QSOs and 7 multipliers go into the log in the remaining 40 minutes of this period. Even better, Frank and Bernd also aggressively interleave 17 QSOs from 10 m, including 9 multipliers, and another 8 QSOs from 20 m. Search and pounce generates almost as many interleaved QSOs as the running frequency on 21012 kHz! This burst puts them solidly into second place, 25,000 points ahead of N5TJ+K1TO, and even closer behind the first place RA3AUU+RV1AW.

KQ2M+W7WA hit 10 m and 15 m as early as Jeff and Dan, but, unlike Jeff and Dan, decide to stick with the band, with occasional sprints on 10 m. Their gamble almost pays off, and is a fascinating story of slight nuances in operating strategy. From 04Z, Bob and Dan's QSO relative point totals race upward, first due to N5TJ+K1TO's dalliance on 40 m, and later as they continue to focus on rate of 2-point QSOs. Just one lingering problem vexes them:

- At 01Z, Bob and Dan are tied with RA3AUU+RV1AW for multipliers, and are just 5 multipliers behind N5TJ+K1TO.
- Between 0156-0255Z, Bob and Dan run a solid hour of 143 20 m CW QSOs, without interleaving a single QSO from another band. They fall to 5 multipliers behind Harry and Andrei (who work 123 Qs on 20 m CW and SSB), and 12 multipliers behind Jeff and Dan (with 121 QSOs worked mostly on 20 m SSB). The extra multipliers more than make up for the smaller QSOs totals.
- Between 0348-0536Z, they run 235 Qs on 20 m SSB, interleaving just two QSOs (from 80 m and 40 m). They fall to 12 multipliers behind the Russian team (who work 162 Qs on 20 m SSB and CW) and 20 multipliers behind Jeff

and Dan (who work 132 Qs, mostly 20 m CW but also in a run on 20 m SSB and other bands interleaved) . In this period raw rate paid off—the extra multipliers worked by the other teams did not compensate for Bob and Dan's larger QSO total.

Once again, the failure to interleave QSOs casts a shadow over an otherwise excellent team performance. By 0730Z, this team has fallen to fifth place. Bob and Dan will finish the contest with the largest number of QSOs, and the largest QSO point total, but the smallest multiplier total. The lack of multipliers keeps them in fifth place until the end of the contest.

What about that first place team? At 05Z RA3AUU+RV1AW put on a little burst of speed on 14057 kHz, working 37 QSOs in just 10 minutes. Their rate fades a little after that, working another 74 on 20 m CW in the remaining 50 minutes of the hour. Harry and Andrei switch to SSB and start interleaving contacts on 10 and 15 m. Their pace is good but their multiplier total is falling behind. At 0730Z they are 50 multipliers behind Frank and Bernd, and 14 multipliers behind Jeff and Dan. With their high QSO total, Harry and Andrei remain 20,000 points ahead of Frank and Bernd, and 42,000 points ahead of Jeff and Dan. The lead is extremely brittle – at this late stage of the contest a 20,000 point lead represents less than 25 QSOs.

3.8 The Third Clawback: 0730-09Z

Just before 0722Z, 14043 kHz was a contester's desert: 7 QSOs in 10 minutes. In one of those little burbles that have no apparent reason, suddenly the frequency roars to life, with 21 QSOs in the following ten minutes. Maybe a nearby strong QRMing station moves away, or maybe one of those temporary ionospheric dead spots slides out of the way, or maybe the cluster networks announce a sport. But N5TJ+K1TO benefit at the same moment that the leaders, RA3AUU+RV1AW, wander away from the band for an attempt to run 10 m. 28036 kHz yields just one third the rate that Jeff and Dan harvest, and 28484 on SSB is only slightly better.

Over the course of 30 minutes, the Russian's lead sizzles away like a water droplet on a hot skillet. DL2CC+DL6FBL take first place at 0750Z—but with only a 1-3 QSO margin over Harry, Andrei, Jeff and Dan.

Another 30 minutes passes: 0820Z. Frank and Bernd move to 21039 kHz to run CW. It's a nice run – but N5TJ+K1TO wrap up a quick, short run on 10 m and move to 21228 kHz at 0825Z. In 45 minutes, Dan and Jeff race through 135 QSOs, shoving Frank and Bernd aside to a 48,000 point deficit.

KQ2M, W7WA, N6MJ and N2ML cannot keep up with Jeff and Dan's 15 m SSB pace. They lose ground as well, but they, too, are on 15 m SSB during much of this time and don't suffer as badly as the Germans on CW.

In retrospect, this makes sense. These teams had spent many hours on 15 m CW yesterday afternoon and evening. Once 15 m opened up with solid signals, a 100-watt station with good operators who has never been on 15 m SSB would be fresh meat for QSO-starved crowds. Furthermore, after 08Z, no more USA stations (at 2-points each) are available on 20 m. So the only game on 20 m is to run 1-point Europeans as fast as possible. RA3AUU+RV1AW figure this out quickly and get on the 15 m SSB running program just in time to arrest their free-fall in the standings. When 09Z pops onto the face of the clock, the Russians remain tied with Jeff and Dan for first place. Being aware of what bands and modes have already been run relatively heavily pays off here.

3.9 The Great Convergence: 09-1020Z

Another tight race:

09Z: Jeff and Dan running on 21228 SSB. Harry and Andrei running on 21044 CW.

0925Z: Jeff and Dan log 67 QSOs so far this hour. The rate slows down to 1 QSO per minute, and they switch to 21001 CW. Harry and Andrei log 60 QSOs, falling a few thousand points behind in score, and slide up one kHz to 21045 kHz. (Making room at the bottom of the band for Jeff and Dan, perhaps?)

0939Z: Harry and Andrei interleave a couple of 10 m QSOs and slide up to 21050. Jeff and Dan ooch up to 21002 and interleave multipliers from 10 and 20 m.

0955Z: Harry and Andrei work 44 QSOs in the last 15 minutes but decide to test the waters at 28040 on 10 m CW. Again, this makes sense: no 2-point North American stations reply on 15 m… so get on the band with the fastest raw QSO rate. Jeff and Dan log just 25 in the last 15 minutes but stay on 21002.

1010Z: Harry and Andrei log 26 Qs in the last 15 minutes on 10 m CW… but Jeff and Dan work 29 in the last 15 minutes on 15 m CW. Now Jeff and Dan attempt to run Europeans on 28495 SSB.

1020Z: Ten minutes, 15 QSOs – not good enough for Jeff and Dan. They return to 15 m, but this time to a SSB running frequency. Harry and Andrei aren't satisfied either with their 14 QSOs on 10 m. In a couple of minutes they bail out of 10 m and go to 20 m SSB, 14244 kHz, hoping for something fresh – maybe 2-point USA stations?

Not to be overlooked, DL2CC+DL6FBL and N6MJ+N2ML also have solid 15 m runs on both SSB and CW. Frank and Bernd interleave QSOs on each of the remaining four bands to pull just 2 QSOs behind the Russian team. Dan and Dave are right behind. first, second, third and fourth place are separated by less than 1% in score, just 20 QSOs!

KQ2M+W7WA also run 15 m SSB and CW, plus a 6-minute 7-QSO 10 m SSB sprint, to collect 186 Qs. While they gain a little on RA3AUU+RV1AW and N5TJ+K1TO, they fall further behind the other two teams and remain well over 50 QSOs behind fourth place.

3.10 The Fourth Breakaway: 1020-11Z

Harry and Andrei score big on 20 m SSB: 95 QSOs in a half hour! Only two were USA, but the European rate is excellent.

Jeff and Dan work only half that fast on 15 m SSB: 42 QSOs in 25 minutes ending at 1045Z. It's a rate improvement over 10 m, but they decide to try 20 m SSB for North America, too. This move occurs 17 minutes later than the Harry and Andrei, which allows the Russians to open up a 16,000 point scoring lead – once more in first place – but only by a precarious margin of 30 QSOs.

Dave G4BUO, the referee for Jeff and Dan, knows they are in the doldrums for these last couple of hours. Although more North American operators are on low bands or asleep, Jeff and Dan keep turning the beam back to the northwest in an attempt to pick up those 2-point QSOs. Dave thinks this just barely paid off some of the time: a few 2-pointers combined with European QSOs off the side and back of the beam. But it didn't pay off during this period.

DL2CC+DL6FBL has also moved to 20 m but on CW. They fall about 15 QSOs further behind… and are now tied with N6MJ+N2NL for third!

3.11 Sprinting to the Finish: 11-12Z

N5TJ+K1TO think 35 QSOs in the previous 13 minutes on 20 m SSB is a fine improvement. Happy campers on 14306 SSB, they run 204 QSOs in the last hour of the contest (along with 5 more QSOs containing multipliers on 15 m and 10 m). Wheeee! That was fun! It also puts them in first place (again).

RA3AUU+RV1AW decide 37 QSOs in the previous 13 minutes on 20 m SSB is *not* good enough—in the last few minutes, the number of callers on their run frequency has fallen off. In an attempt to find more rate, they switch to 20 CW and work 9 QSOs in 10 minutes. Obviously that was horrible, so they go to 15 SSB and then 15 CW for another 66 QSOs. Huge mistake: an 85 QSO hour can not compete with Jeff and Dan's 209 QSO hour. A few extra multipliers, compared to Jeff and Dan, help some. And, oddly, they get called by 12 USA stations for 2-point QSO values on 15 m, showing that the band is actually open across the Atlantic. But that's small

beer—it's not enough to overcome a 124 QSO deficit. Welcome to second place (again).

DL2CC+DL6FBL think 11 QSOs on 20 CW in the previous 13 minutes aren't good enough – and they are correct! At 1050Z they go to 10 m and work 27 QSOs in 20 minutes. That's not good enough either, so they try 15 m again. Note this famous definition of insanity: repeating the same action and expecting a different result. Frank and Bernd are not insane—instead of returning to 15 m CW, they try 15 m SSB this time. Thirty 30 QSOs flow into the log in 10 minutes, but the band dries up as Europeans start moving to 20 m to look for North Americans. Finally Frank and Bernd make the switch to what we already know is the big money band: 20 m SSB, yielding 109 QSOs in the last half-hour, including eight North and South American stations at 2-points each! Although Frank and Bernd gain on RA3AUU+RV1AW, time runs out before they can catch up. Third place, by just 20 QSOs.

N6MJ+N2NL think 30 QSOs on 15 m SSB in the previous 13 minutes feels pretty good. At 1110Z, the runs poop out for them, so while the Germans are moving from 10 m to 21190 kHz, Dan and Dave leave 21197 for 14142. Good to move on to 20… but they choose a frequency below the bottom of the USA phone band! They're a little slower than Jeff and Dan, logging 117 QSOs in the last 47 minutes of the contest, with no 2-point stations calling. A very satisfying fourth place finish for a young, new team to WRTC!

Who wouldn't be happy with 149 QSOs in one hour on 15 m CW? KQ2M+W7WA were very happy in the previous hour, and they stay on 15 m CW until 1127Z to grab another 52 1-point Europeans. They are unaware that others are running twice as fast on 20 m SSB. 15 m CW peters out for Bob and Dan at the same time the Germans give up 15 m SSB. But Bob and Dan go to 20 m CW, not 20 m SSB for the last half of the contest. Just 69 QSOs in the last half-hour — far below the run rates available on SSB. Bob and Dan remain in fifth. But their fifth place finish was under extraordinary circumstances: before the start of the contest, the interface hardware between their computer and their transmit radio was damaged. The entire contest was operated with manually-sent CW (no computer-generated keying) and human lung power.

4 Other Performance Aspects

Let's step away from the minute-by-minute logs to look at broader performance characteristics.

4.1 Passing Strategy

The total multipliers worked by the top teams spread over a large range: 394 to 473. Did teams pass stations to other bands for extra multipliers?

For this analysis, a "pass" is defined as an additional QSO, occurring within 10 minutes, with a station on a different band. Here are the passing statistics:

- N5TJ+K1TO passed 16 QSOs for 16 multipliers.
- RA3AUU+RV1AW passed 14 QSOs for 13 multipliers.
- DL2CC+DL6FBL passed 12 QSOs for 15 multipliers.
- N6MJ+N2NL passed 14 QSOs for 11 multipliers.
- KQ2M+W7WA passed just 7 QSOs for 5 multipliers.

Passing was employed far less frequently than in WRTC-2000, where the top five teams passed 25-53 new multipliers. Harry and Andrei, extremely aggressive passers at Slovenia, were merely average here in Finland.

KQ2M+W7WA were the only team whose passing performance differed significantly from the other top teams. Bob

Appendix: Analyzing logs with Microsoft Excel

This appendix describes how the WRTC-2002 logs were analyzed. You can use a similar procedure (with variations to accommodate differences in scoring rules) to compare your log with others in any contest. The process requires moderately advanced skills in using spreadsheet software. If you are not familiar with the capabilities of spreadsheet software, you may wish to find someone to help you.

The computer log files (text files in Cabrillo format) were imported into Microsoft Excel as separate worksheets for each station. Excel's File-Open command brings up a small wizard for importing text files. Delimited field format was used. The date column was converted to Excel's date format by choosing the correct options in the import wizard. Some columns, such as sent call sign and sent exchange, were not imported to save file space.

Next, the imported data was cleaned up. For safety, a duplicate worksheet was used in case errors were made necessitating a reversion back to the original imported file. A new column was created to contain a combined date + time field, using Microsoft Excel's DATE and TIME functions. Another new column concatenated the band and mode information together, necessary for later sorting steps. "/QRP" was removed from call signs manually with the Edit/Replace command. For WRTC-2002, the "R1", "R2", "R3" and "AC" IARU multipliers did not count; these were also eliminated with Edit/Replace. Each QSO in the log was assigned a sequence number to make it easy to re-order the log.

Additional information was then added to each log's worksheet. Duplicate contacts were uncovered by sorting the file by call sign, band and mode, and QSO number, using the Data/Sort function in Excel. A formula identified duplicate contacts by testing if the call sign and band-mode is equal to the previous QSO; dupes were marked in a new column with the word "dupe".

DXCC entities were a little trickier to mark. I constructed five arrays of prefixes and corresponding entity names. One array contained specific calls (e.g., 4U1ITU) that corresponded to a DXCC country. The remaining arrays contained prefixes of four (e.g., VP2V), three (e.g., 4X4), two (e.g., HK), and one character (e.g., I) in length and their corresponding country name. A new column was added to the log file to contain the DXCC entity name. A lengthy formula using the LOOKUP function tested the beginning of each call against these databases, starting with the longest calls or prefixes, for a match, and then labeled the QSO with the correct DXCC entity name.

The log was then sorted by DXCC entity name, band, and QSO number. The first QSO with a DXCC entity on each band was marked as a multiplier using an IF function. Similarly, a sort by IARU HQ name, band, and QSO number revealed the IARU HQ multipliers, which were marked.

The log was then resorted into chronological order (by QSO number). New columns were added to accumulate running totals of QSO points and QSO counts on each band, multiplier totals, and the score.

At this point, new worksheets can be created containing key statistics for graphing. This sheet contains one line for each minute of the contest. For example, the running totals (QSO points, multipliers) for each competitor at the end of each minute were automatically entered into this table using Excel's LOOKUP function.

The charts were created using Excel's charting functions. Some tweaking of colors, fonts, range of values displayed on each axis, and formats are always required to produce clean charts. These charts are viewable at the *NCJ* web site, **www.ncjweb.com**.

Once the charts were in hand, it was easy to spot unusual events and look back into the relevant log and statistics data for their cause. Occasionally, Excel's Data Sort tools were used to reorganize log data; e.g., sort by call sign to look for patterns where stations were moved to new bands for extra multipliers.

Finally, the draft of this article was circulated to the five teams, their referees, and the judging committee for review and amplifying remarks. I thank each of these individuals for their time and quick turnaround. Their comments clarified and improved the quality of the results. Nevertheless, I remain entirely responsible for the opinions expressed here and for any errors.

reports they intended to pass more heavily, but gave up this plan when their computer-radio interface failed.

4.2 Interleaved, Search and Pounce QSOs

Qualitatively, the teams appeared to differ more significantly in their willingness to interleave search and pounce QSOs on other bands between their running QSOs. We will define an "interleaved QSO" as one which occurs on a different band/mode combination than the previous QSO… and is also on a different band/mode combination than at least one of the next two QSOs. This definition includes one or two consecutive QSOs occurring on a different band/mode in the middle of a run.

Under this definition:

• N5TJ+K1TO: 235 interleaved QSOs, or 8.4%. These added 213 new multipliers.

• RA3AUU+RV1AW: 218 interleaved QSOs, 8.3%. These added 238 new multipliers.

• DL2CC+DL6FBL: 222 interleaved QSOs, or 8.9%. These added 209 new multipliers.

• N6MJ+N2NL: 113 interleaved QSOs, or 4.2%. These added 104 new multipliers.

• KQ2M+W7WA: 54 interleaved QSOs, or 1.9%. These added 39 new multipliers.

The quantitative data confirms the qualitative observation: the top three teams were significantly more agile in interleaving QSOs while running. About one out of every 12 QSOs was picked off from another band/mode!

The fourth and fifth place teams suffered missed multipliers caused by their failure to interleave QSOs. KQ2M+W7WA offset their lack of multipliers with the highest QSO point total. Besides raw QSO rate, this team broke their run from time to time to sprint through a batch of previously-identified mults. But at the end this approach fell short: Bob and Dan still needed about 25 more multipliers to put themselves in first place.

N2NL reports their second radio was usually spotting new Qs and mults on the *same* band as the transmit radio. These same-band interleaved QSOs do not show up in the analysis because, in most cases, the transmit radio was returned to the running frequency before the spotted QSO was fully logged. Thus the logging software would record the running frequency as the spotted QSO's frequency.

Theoretically, N6MJ+N2NL needed about 19 additional multipliers to move to first. But Dan and Dave worked 436 mults, almost as many as Jeff and Dan – probably because of the same-band spotted multipliers that they interleaved. Frank and Bernd found 473 multipliers on a much smaller QSO total – and report that they called other potential multipliers who did not hear them, so more were definitely available. Dan and Dave had a reasonable chance of finding those extra 19 multipliers if they had interleaved QSOs from different bands at a similar pace to the top teams.

4.3 Rate, QSO Points, and Multiplier Tradeoffs

Choosing an operating strategy to maximize score is one of the most difficult challenges of contesting. Such a strategy needs to maximize QSO run rates, take into account the mix of QSOs with different point values and allow time to search and pounce multipliers (especially on slower rate, lower frequency bands).

The top five WRTC-2002 teams, as a group, averaged 2693 QSOs at 1.373 points/QSO and 431 multipliers. The results of individual teams illustrate the impacts of trade-offs:

• KQ2M+W7WA had the largest QSO total, +5.6% above group average. Their mix of 1- and 2-point QSOs was –1.5% below average. Their multiplier total was the lowest, –7.4% below average.

• Conversely, DL2CC+DL6FBL had the largest multiplier total, +7.9% above average—exactly counterbalanced by their –7.9% below average QSO total. Their mix of 1- and 2-point QSOs was +1.2% above average, enough to reach third place.

• N6MJ+N2NL's QSO total was just –0.8% off of average. Their multipliers were just +0.2% above. Their 1- and 2-point QSO mix was the weakest of the group, –3.0% below average, pushing them down into fourth.

• RA3AUU+RV1AW were +5.4% ahead of the average mix of 1- and 2-point QSOs. But this strength was offset by their –2.0% below average QSO total and –1.9% below average multipliers.

• Inversely, N5TJ+K1TO's mix of 1- and 2-point QSOs was –2.3% below overage. But with a +3.5% above average QSO total and +1.2% above average multiplier total, it was to win late in the game.

4.4 Waiting in Pileups

When looking at DL2CC+DL6FBL's high multiplier but low QSO result, one wonders if too much time was spent unsuccessfully calling multipliers.

A great temptation when attempting to work a new multiplier is to sit on the multiplier's frequency, making attempt after attempt to break through the pileup. Hanging around a pileup will almost certainly cause the loss of a choice running frequency.

Experienced contesters report a strong correlation of failure between consecutive attempts to break a pileup: if one doesn't work the multiplier on the first attempts, subsequent attempts usually also fail. The skilled contester resists the temptation to hang around: he goes off to do something else more productive… and, in 5-10 minutes, returns to the multiplier's frequency to try again. This works because the ionosphere contains small-scale clouds and bubbles which can decrease one's signal strength at the multiplier's QTH for a few minutes – but then drift out of the way over the course of 5-10 minutes, to be replaced with another small-scale structure that allows signal strength to return to average or even above average.

Unfortunately, logs do not contain information about calls made which were unsuccessful. But we can examine successful, interleaved contacts to see how long the run was suspended. Based on this definition, the average waiting time for S&P QSOs for each team is:

• N5TJ+K1TO: 0.93 minutes. Jeff and Dan spent 3 hours 39 minutes calling their 235 interleaved QSOs.

• RA3AUU+RV1AW: 1.21 minutes. Harry and Andrei spent 4 hours 24 minutes calling their 218 interleaved QSOs.

• DL2CC+DL6FBL: 1.17 minute average. Frank and Bernd spent 4 hours 20 minutes calling their 222 interleaved QSOs.

• N6MJ+N2NL: 1.17 minutes. Dan and Dave spent 2 hours 12 minutes calling their 113 interleaved QSOs.

• KQ2M+W7WA: 1.69 minutes. Bob and Dan spent 1 hour 21 minutes calling their 54 interleaved QSOs.

The German team turns out to be about average for this group, assuming they didn't get distracted for long periods of time with unsuccessful attempts to interleave stations.

KQ2M+W7WA's much larger waiting time sounds warning bells. If one works multipliers off a list in batches, sticking around for extra attempts to break each pileup becomes even more tempting. After all, one doesn't have a current running frequency to keep warm and defend from poachers!

N5TJ+K1TO don't like to wait around! Their lower average waiting time provided them about 40 extra minutes of running time compared to their closest competitors – and that's a lot in a fast paced contest like WRTC!

4.5 Logging Accuracy

The judging committee compared WRTC logs against a database containing both the WRTC logs and 449 others received from around the world within a few hours of the close of the IARU contest. Ville, OH2MM, reports: "The jury was conservative in penalties with only obvious cases leading to point reduction. Although the UBN data reflects accuracy, the numbers are not directly applicable to the final penalties [set by the jury]." The jury examined each QSO flagged as "bad" or "not in log" individually to determine if a definite error occurred.

Variations in UBN performance among the top five teams had no material impact on their final standings. All operators are very accurate in their logging.

N6MJ+N2NL, with the second best raw accuracy rate, had roughly uniform performance on all bands. The other four teams had disproportionately higher potential errors on 20 m SSB.

5 Summary of Successful Strategies

Everyone does these things some of the time. The winners do them well *all* of the time. You can apply these tips to your contesting strategy:

Interleave search-and-pounce QSOs (especially multipliers) during the middle of runs. Check every band often for openings and new multipliers. Low bands that are just opening may not be very busy; multi-op stations may be calling CQ with few answers. Note that it is rare for raw rate on one band to be more successful than running + interleaved QSOs from different bands.

Run on the band that yields the greatest number of QSO *points*. The biggest raw QSO total may not win a contest where some QSOs are more valuable than others. Do not be deceived by the last 10/100 QSO rate meters.

Similarly, be aware of how much time has been invested in each band/mode to date. When a choice of bands is available, faster runs occur on neglected bands/modes.

Don't hang around attempting to work a CQing station – especially when running on another frequency! Bail out if success does not occur within *seconds,* not minutes – and try again later. Note that working multipliers in batches is less successful than interleaving; one wastes time waiting for the next attempt to crack the pileup. NCJ

A Day in the Life of a WRTC-2002 Referee

Dave Lawley, G4BUO

Dave, through the luck of the draw, was the referee for the eventual WRTC-2002 winners. Here are Dave's comments on his experience.

Imagine my delight when I learned I had been drawn as the on-site referee for the N5TJ/K1TO team. Winners of the last two WRTCs, they were favorites this time, and it would be the greatest pleasure to sit and watch these two do their stuff. The QTH they drew belongs to Timo, OH2HXP, who had only received his HF licence two months earlier. I told him that he was in for a real treat, watching the best ops in the world use his station. Timo lives north of Porvoo, about a 45-minute drive east from Helsinki. As we rounded a curve of the road, we could see his QTH slightly below the level of the road. To the right, in an easterly direction, the land immediately sloped up to a height of about 60 feet. The land to the west and south was dead flat, but it looked like there might be a little trouble working to the east.

Timo's wife and two young children had gone to stay with family, giving us full use of the whole house. Jeff and Dan immediately stripped Timo's basement shack down to a bare tabletop, and then started putting their equipment together. Once the station was set up they started checking the bands and found S9+ noise across 40 meters, peaking on the lower band edge. It sounded like electrical noise, so I got Timo to turn off every appliance in the house. The noise remained, and it seemed it must be coming in on the power lines. I started thinking we would have to contact the WRTC organizers to see if they could get the power company to investigate. Suddenly Jeff had an idea, and pulled out the power lead to a 12-V supply he had brought with him. The noise disappeared. The problem was an inexpensive switched mode supply bought at a hamfest. We replaced it with Timo's 30-A station supply and all was well.

It was getting late so we decided to go into Porvoo for some food, and the pair's dedication to the contest was immediately apparent, because they refused to have even a single beer. Along with the S50A/S59AA and K3LR/N9RV teams, we stayed overnight in a hotel in Porvoo and made a quick shopping trip to a local store on Saturday morning. I was unable to gain any real insight into the food choices of the world's top contesters. It was mainly snack stuff, with Dan showing a preference for trail mix.

Back at Timo's house, the guys made some adjustments to the station, having been very concerned the previous evening about the risk of blowing the front end of the second radio because the end of the Windom was only a couple of feet away from the beam. They used two ICE antenna protection boxes in series, and all was OK. They then spent nearly two hours practicing operating the radios, using the software and passing mults. The station consisted of two FT1000MPs, with Top-Ten decoders driving bandpass filters and an antenna transfer switch. This was homebrewed by Jeff, and was in fact a modification of his station SO2R antenna switch. The software was *CT*, running on a small desktop fitted with a W9XT card on the main station, and on a laptop for the search station.

After the contest, back at the hotel in Espoo, plenty of people asked me what tricks they used or what was their secret. There are no tricks, no secrets. Jeff and Dan are just very, very good at what they do. The whole contest for me was a demonstration of the pure art of contesting. There was no wastage of effort, minimal physical movement and total concentration. The last time these two had operated together was WRTC-2000, but it was clear they had given a lot of thought to this contest. In the hours leading up to the start while practicing, they were making notes and fine-tuning their strategy. Once the contest was underway, the CW or voice keyer was used at every opportunity, so the operator could talk to the spotter. This was always done efficiently and I never saw them waste any time by talking when they should have been receiving.

As in previous WRTCs, they had an agreement to swap positions every hour on the hour, with Jeff kicking things off. My recollection is that they spent the first two hours on CW, and from the start, Dan was lining up multipliers in the memories of the second radio. Like everything else, QSYing for a multiplier was done efficiently, with spotted frequencies put into the B VFO of the run radio via the Alt-A window in *CT*. One thing I have certainly learned from watching them is that although you decide to go for a mult, you should not get too hung up on working it. If he doesn't come back straight away, the priority is to get back to the run frequency and perhaps make several more QSOs

Outside the shack (left to right): Dave, G4BUO; Jeff, N5TJ; Timo,OH2HXP (host station owner); Dan, K1TO.

Inside the shack (left to right): N5TJ, K1TO and G4BUO.

Comments from the Ops

NCJ quizzed Dan and Jeff about general and specific aspects of their operating strategy. Here are their comments.

General Comments from Dan and Jeff

We had an idea what times might be best to run Ws, etc., but nothing anyone else wouldn't be expected to know at that level. One thing that would have been nice to know, in hindsight, is that from that far North the low bands do not close as quickly as we were used to. On 40 meters, signals to W actually got quite a bit better after "sunrise", and 80 meters was open to EU for a long time after that, too.

For a "predictable" contest where old data is available, like CQ WW from ZF or EA8, one might have a more semi-formal plan based on old results and previous personal experience. But for us to go to OH and operate WRTC, with its rules that change every time, while running 100 W to a low antenna … suffice to say, a detailed band plan is not going to be worth much. It would be interesting to know if many teams did use a plan that they stuck with.

We never had a "set" plan, except that we change chairs every hour. Other than that, it's pretty much go with the flow.

Specific Comments

NCJ: How did you decide which mode to use and when?

Dan and Jeff: Wherever we could get the best rate/points per hour.

NCJ: At what rate do you decide to abandon running to S&P?

Dan and Jeff: Good question. Which has no exact answer. If you mean abandon running completely in favor of S&P—never. Well, maybe a few times as we were looking for a new run frequency.

Now if you mean at what rate would we leave a pileup to go chase a mult, we would say at almost any rate. There were times when we would go grab a mult at rates probably in the 150 range. At rates around 100/hr it's pretty easy. The trick is to (as Dave pointed out) not get married to working the mult—you need to get back on the run frequency.

Clearly, this strategy implies that we relied heavily on the second station to find enough mults. We changed our run band enough that we rarely felt like we might be missing mults on the band we were running on. We did listen on the same band briefly, but the loss of productive listening time while the CQer is transmitting made that a less attractive option.

NCJ: What was your band change strategy?

Dan and Jeff: Pretty much the same as question 1. The only real delta was that we went to 40 meters early to pick up mults.

NCJ: What was your antenna direction strategy?

Dan and Jeff: To the US when it was open that way (points).

before trying again.

Watching these two at work made me reflect on my multiplier calling technique: although I try to defend my run frequency, I now feel I get too hung up on the importance of working the multiplier straight away. Perhaps the limitations of the location in an easterly direction were confirmed when they failed to snag the 9V HQ station for a double multiplier, despite returning to it several times over a period of 30 minutes or so. There was even the slightest whiff of frustration in the air when they heard other OJs work the multiplier but could not get through themselves.

Jeff was again in the chair for the first big phone run, and it happened that about this time Martti, OH2BH, turned up with some visitors, including Dave, W6AQ, who was making the official WRTC video. An extra pair of headphones provided an audio feed, so Dave was keen to capture footage of the *CT* screen and of Jeff running the pileup. Jeff was unflappable, despite the camera hovering only a few inches from his face. Dan and Jeff must have been aware of the visitors but their concentration on the contest was total.

Part of my role as referee was to make notes, but I must admit to padding the notes with some observations as the contest progressed, and also writing down the scoreboard figure that I was sending hourly using SMS. While Jeff and Dan did an outstanding job, very occasionally I heard them log an incorrect zone, and I even noted a couple times when I thought they copied a call incorrectly. My understanding was that these notes would only be used by the judges as verification of potential errors found during the computer cross-checking process.

As a European contester, it was interesting to observe the operating choices of the team. Early on, I was surprised that they QSY'd to pick up a PY mult on 15 meters. I was equally surprised, on the other hand, when I heard them say to one another that they wouldn't QSY for a DU as "there would be lots of them around later." They also beamed to the US much more frequently than I would have done, but with the 2:1 point differential for QSOs outside Europe this was clearly the right thing to do. Perhaps they did not realize how very strange I found it that even in OH, at the far north of Europe, there was an almost total lack of propagation to JA, while propagation in other directions was better than I had expected.

Jeff and Dan are undoubtedly the world's best, but by way of assurance to we mortals they, too, had times in the doldrums. At one point Dan remarked in frustration that he had gone five minutes without a QSO, and around that time I saw the last 10 rate in *CT* down to a figure of just 35. Though Dan's preference is definitely CW, it happened that he was in the chair for the last hour and ran into a great phone pileup on 20 meters, resulting in the pair's best hour for the entire contest. It was a great way to finish, and it rounded off an unforgettable experience for me as on-site referee. NCJ

K5ZD 2001 CQ WW CW Contest

Randy Thompson, K5ZD

Get Ready…

For me, major contests always begin well before 00Z. Despite winning CQ WW CW in 2000 and setting a new USA record, I knew I had been lucky. I beat K1AR in the log checking process, and John made it clear he was ready for a rematch. N2NT, KQ2M, W1KM and other serious single op competitors were all prepared for another run at the record during the peak of the sunspot cycle.

I try to make a major station upgrade each year. When I had the opportunity to purchase two 4-element 10-meter Cushcraft Yagis and some tower sections from K1SD in March, the target was identified. Ten meters was an aspect of my station I knew needed improvement.

I erected the tower sections to make a new 30-foot tower right at the peak of my hill. A TH7DXX that had been at 90 feet was moved to the new tower for primary use as a go-to antenna for the South. The 6-element LTA 10-meter beam was moved from being fixed on Europe at 20 feet to being fully rotary at 90 feet where the TH7 had been. The two new 4-element beams were stacked at 30 and 60 feet on the same tower. Now I had a 3-high stack for 10 meters with some real horsepower at the top.

Another project was to get the 40-meter beam on its own coax into the shack instead of sharing with 15 meters. This improved the antenna selection flexibility by allowing 40 and 15 to be used at the same time.

Another station improvement was the addition of a W5XD MK-1100 keyer. This is a wonderful external hardware accessory for *WriteLog* logging software that does all of the CW keying and audio switching needed for SO2R. Through the use of *WriteLog*'s excellent two-radio support and some keyboard macros, I could do all of the switching without ever having my hands leave the keyboard. A serious effort in SS CW provided all the practice needed to develop my technique. After more than 20 years of doing SO2R, this was the most automated system I had ever experienced, and I felt it had definitely improved my SS score.

Get Set…

Over the years I have developed a series of actions that help me prepare for the rigors of a 48-hour single op effort. They include having the station completely set up the weekend before, getting as much sleep as possible during the 6 days leading up to the contest, and trying to relax from the pressures of work.

The station was ready on time, but I still had one concern. There was a new source of line noise that had appeared a few weeks before. Rain usually makes it go away, but the month had been particularly dry and no rain was expected before the contest. On Wednesday, the noise was worse than ever with a solid S7 buzz across every band when beaming anywhere from North to West. I called K1AR's voice mail and left him a recording of the buzzing along with the message that I was out of it if the noise didn't go away.

The Thanksgiving holiday is both a help and hindrance for contest preparation. My in-laws live about 3 hours away in Woodstock, NY. We drove over to visit them on Wednesday evening. Of course this meant lots of turkey and football on Thursday, but also a few extra hours of sleep and a late afternoon nap. Friday morning I was able to sleep in a bit more, and we drove home Friday afternoon. Since I was asking my wife to return home early so I could do the contest, we stopped at a restaurant and had a large late lunch on Friday. It took forever to get in and out of the mall with all of the shoppers! We finally arrived home about 5 PM with the contest just 2 hours away.

I immediately turned on all the equipment and connected the antennas. The bands sounded fair, and amazingly, the line noise was completely silent. I took this as a good omen and headed off to bed for a short nap of about an hour. Not as much as the 3 hours I would have liked, but that was one of the things lost when we decided to eat out. Took a shower and was sitting at the radio ready to go at 2330Z. Much earlier than normal!

The bands were funny. Not great, but not bad either. Ten was punk, 15 was open a bit, 20 had signals. I decided that 40 meters was the place to start for the highest rate and found a frequency around 7022. I worked a few people to get warmed up and things were ready.

Go…Not!

As the clock rolled over, a large Eastern European multi-op station that had been down 1 KHz decided that they wanted to be on the same frequency I was. We engaged in dueling CQs to start the contest, each working just enough guys to stay but neither doing very well. I worked more QSOs on 15 meters on the second radio than I did calling CQ. After 10 minutes of this, I decided to find another spot and began moving up the band. Another 10 minutes of S&P (search and pounce) go by and still can't find a hole to call CQ.

This is a moment of panic for a single op. The adrenaline is pumping. You have spent months preparing for the contest and spent the last week totally focused on getting off to a big start. Now things start to slip away.

I switched to 15 meters to chase multipliers and get my head clear, then went down to 20 for more tuning and calling. Amazingly, I had managed to make 47 QSOs and a bunch of multipliers in the first 30 minutes. Twenty had some very loud signals from Europe and Asia, so I decided to find a frequency and see if I could get something going. I landed on 14020 and started a nice steady run. The frequency was quiet enough that I could use the second radio on 40 to chase multipliers. It was a pleasant surprise when K4ZW/JT called in with a very good signal on 20 m at 0051Z. The second radio shows QSOs logged all the way up to 7070! No wonder I couldn't find a clear frequency on that band.

I ended the first hour with 109 QSOs and 106 multipliers. I had my rate sheet from 2000 printed out and saw that I was doing OK, even with all the moving around. The next 2 hours continued with CQing on 20 and second radio S&P on

Table 1

K5ZD 2001 CQ WW CW Contest

Continental Breakdown

	160m	*80m*	*40m*	*20m*	*15m*	*10m*	*Total*	*%*
EU	11	134	790	871	733	611	3150	82.2
OC	0	0	8	10	2	7	27	0.7
SA	4	9	14	33	26	25	111	2.9
AF	0	2	15	22	17	15	71	1.9
NA	12	38	96	72	46	38	302	7.9
AS	0	1	20	74	46	29	170	4.4

40. At 0245Z, I was finally able to start a run on 40.

You often hear about sports teams that arrive at a big event saying all the right things, yet just seem to be flat. I now know what this feels like. Despite being fully prepared, I was surprisingly devoid of emotion and passion when the contest began. I assumed that I would get into it once things got started, but instead my attitude was getting worse. I kept going more on habit than desire. This is very disconcerting when you know there is still a long way to go.

At 0300Z, I decided to jump from 40 to 160 meters. I had noticed in the weeks before the contest that 160 was opening earlier rather than at European sunrise. The decision was a good one, as I worked 5 zones and 10 countries (many from Europe) during the next 15 minutes. Happy with this, I jumped back to CQing on 20 m for more rate. When 5H1X (K1XM op) called in at 0340Z, I already had 26 zones and 60 countries on the band! The next 30 minutes was a careful search up 80 meters working multipliers. I finally found a frequency to call CQ up at 3545, which became my home for the next 45 minutes (70 QSOs)! A few second-radio QSOs on 40 meters helped fill in some more multipliers.

The 05Z hour was a mix between 40 and 80 meters. I would run on one and listen on the other, then switch. By 06Z, I had 19 zones and 64 countries on 40 meters. The 06Z hour was mostly running on 7045. At this point I was keeping up with the rate from the previous year, but I knew it was being done through aggressive S&P and band agility. Conditions were clearly not as good as the previous

Table 2

K5ZD 2001 CQ WW CW Contest

Ratesheet

Hour	*160m*	*80m*	*40m*	*20m*	*15m*	*10m*	*Total*	*Cum*	*Radio 2*	
D1-0000Z	—+—	—+—	50/40	44/40	15/26	—+—	109/106	109/106	28	
D1-0100Z	-	-	37/12	68/13	-	-	105/25	214/131	37	
D1-0200Z	-	-	44/10	60/24	-	-	104/34	318/165	21	
D1-0300Z	15/15	17/19	8/4	27/9	4/6	-	71/53	389/218	8	
D1-0400Z	-	74/22	16/9	-	-	-	90/31	479/249	16	
D1-0500Z	-	30/7	57/7	-	-	-	87/14	566/263	17	
D1-0600Z	-	16/6	61/6	-	-	-	77/12	643/275	16	
D1-0700Z	-	4/3	19/11	2/1	-	-	25/15	668/290	3	
D1-0800Z	1/0	—+—	7/7	53/2	—+—	—+—	61/9	729/299	5	
D1-0900Z	3/6	5/4	2/1	50/4	-	-	60/15	789/314	10	
D1-1000Z	1/1	4/5	4/2	8/1	-	-	17/9	806/323	3	
D1-1100Z	-	2/1	3/2	12/3	3/4	-	20/10	826/333	3	
D1-1200Z	-	-	-	46/2	17/14	-	63/16	889/349	17	
D1-1300Z	-	-	-	21/1	-	37/37	58/38	947/387	3	
D1-1400Z	-	-	-	26/0	25/11	13/9	64/20	1011/407	38	
D1-1500Z	-	-	-	18/0	8/3	42/18	68/21	1079/428	16	
D1-1600Z	—+—	—+—	—+—	—+—	34/6	101/5	135/11	1214/439	34	
D1-1700Z	-	-	-	-	51/10	59/6	110/16	1324/455	22	
D1-1800Z	-	-	-	10/2	47/5	20/10	77/17	1401/472	20	
D1-1900Z	-	-	-	93/6	11/6	-	104/12	1505/484	11	
D1-2000Z	-	-	-	77/4	13/8	-	90/12	1595/496	13	
D1-2100Z	-	-	10/0	37/2	3/3	4/5	54/10	1649/506	6	
D1-2200Z	-	-	51/4	-	3/3	10/8	64/15	1713/521	13	
D1-2300Z	-	-	70/1	9/5	5/1	-	84/7	1797/528	14	Day 1: 374
D2-0000Z	—+—	—+—	36/0	20/7	2/0	—+—	58/7	1855/535	22	
D2-0100Z	-	-	48/1	2/1	-	-	50/2	1905/537	2	
D2-0200Z	3/1	-	52/5	18/7	-	-	73/13	1978/550	21	
D2-0300Z	-	4/3	46/3	6/3	1/1	-	57/10	2035/560	11	
D2-0400Z	1/1	4/1	33/3	2/1	-	-	40/6	2075/566	3	
D2-0500Z	1/1	19/2	18/1	5/1	-	-	43/5	2118/571	6	
D2-0600Z	-	1/1	77/3	1/0	-	-	79/4	2197/575	2	
D2-0700Z	1/1	2/1	93/0	-	-	-	96/2	2293/577	3	
D2-0800Z	—+—	1/0	59/0	2/0	—+—	—+—	62/0	2355/577	3	
D2-0900Z	1/1	-	28/4	5/2	-	-	34/7	2389/584	6	
D2-1000Z	-	1/1	11/3	16/0	-	-	28/4	2417/588	5	
D2-1100Z	-	-	3/0	45/1	16/1	-	64/2	2481/590	3	
D2-1200Z	-	-	-	-	114/4	44/9	158/13	2639/603	3	
D2-1300Z	-	-	-	-	5/1	141/6	146/7	2785/610	5	
D2-1400Z	-	-	-	-	110/5	27/2	137/7	2922/617	23	
D2-1500Z	-	-	-	-	116/3	12/1	128/4	3050/621	12	
D2-1600Z	—+—	—+—	—+—	—+—	96/4	25/4	121/8	3171/629	22	
D2-1700Z	-	-	-	-	11/0	108/1	119/1	3290/630	11	
D2-1800Z	-	-	-	-	27/4	49/2	76/6	3366/636	20	
D2-1900Z	-	-	-	11/5	76/4	7/5	94/14	3460/650	18	
D2-2000Z	-	-	-	58/2	32/2	-	90/4	3550/654	9	
D2-2100Z	-	-	-	84/4	5/0	1/2	90/6	3640/660	6	
D2-2200Z	-	-	-	73/0	18/2	9/2	100/4	3740/664	27	
D2-2300Z	-	-	-	74/3	2/0	16/3	92/6	3832/670	18	Day 2: 261
Total:	27/27	184/76	943/139	1083/156	870/137	725/135			635	

Table 3
K5ZD 2001 CQ WW CW Contest
Breakdown by Country

	160m	*80m*	*40m*	*20m*	*15m*	*10m*	*Total*
3B8			1	1	1	1	4
3D2			1				1
3V			1	1	1		3
3W				1			1
4J						1	1
4L				2			2
4U1I			1	1	1		3
4U1V			1	1			2
4X			1	6	1	1	9
5A					1		1
5B		1	3	2	4	1	11
5H			1	1	1	1	4
5N				1			1
5R					1		1
5X				1			1
6Y		1	1	1	1	1	5
8P	1	2	1	1	1	2	8
9A		2	13	14	6	12	47
9G						1	1
9H		1	2	1	1	1	6
9K				1			1
9M6				2			2
9V				1			1
A4			2				2
A6			1	1			2
BY				1			1
C6	1	2	2	1	3	1	10
CE		1	1	1	1	2	6
CE9				1	1		2
CM		1	5	2	1	2	11
CN		1	2	2	2	1	8
CT		1	3	6	3	5	18
CT3			1	3	1	2	7
CU			1	1	2	1	5
CX				1	2	1	4
DL	2	21	125	132	118	109	507
EA		3	14	33	22	20	92
EA6			1	2	2	2	7
EA8		1	3	4	4	4	16
EA9			1	1	1		3
EI		1	1	2	5	2	11
EK					1		1
ER			2	2	1	1	6
ES		1	2	4	4	2	13
EU		3	3	6	5	5	22
EX				1			1
EZ					1		1
F	1	5	39	41	34	26	146
FG		1	1	1	1		4
FM				1		1	2
FR				1		1	2
FY				1			1
G	2	5	51	48	43	30	179
GI			4	2	2	1	9
GJ				1	1	1	3
GM		1	6	5	4	3	19
GM/s			1	1		1	3
GU			2	2	2	3	9
GW	1	3	6	4	4	6	24
HA	1	6	26	25	22	24	104
HB		1	11	12	9	8	41
HB0				1			1
HC				1	1		2
HC8	1	1	1	1	1	1	6
HI			1		3	1	5
HK		1		1			2
HK0/a			1	1	1	1	4
HL				1			1
HP						2	2
HS				1	1		2
HZ						1	1
I		5	28	34	33	33	133
IS			2	2	1	1	6
IT9			1	2			3
J3		1	1	1	1	1	5
J8		1	1	1			3
JA			7	18	15	20	60
JT				1			1
JY			1	1		1	3
K	1	5	39	32	7	5	89
KH2						2	2
KH6			2		2	3	7
KL			1		1	1	3
KP2		1	1	1	1	2	6
KP4		1	4	2	3	3	13
LA		1	13	4	9	10	37
LU			1	9	6	8	24
LX			2	2	3	3	10
LY		4	15	19	16	10	64
LZ		1	8	9	8	13	39
OA			1	2	2	1	6
OE	1	1	8	8	6	8	32
OH		5	11	35	24	16	91
OH0			2		2	2	6
OK	1	19	83	68	61	58	290
OM		2	29	22	16	14	83
ON	1	4	9	11	12	4	41
OY					1	1	2
OZ		1	9	11	5	6	32
P4	1	2	1	2	2	2	10
PA		1	8	11	13	6	39
PJ2	1	1	2	2		2	8
PY	1		5	9	8	6	29
PY0F		1	1	1	1	1	5
S5	1	9	33	22	20	21	106
SM		3	17	35	17	11	83
SP		9	49	46	44	26	174
SU			1				1
SV			1	5	3	1	10
SV5					1		1
T9			4	4	4	2	14
TA					1		1
TF			1	1	2	1	5
TG						1	1
TI		2	2	2	2	1	9
TK			1	1			2
UA		2	41	83	55	35	216
UA2		1	4	3	1	3	12
UA9			3	28	16	2	49
UN			1	4	3	2	10
UR		5	49	35	42	18	149
V2		1	1			1	3
V4		1	1	1	1	1	5
VE	8	14	26	19	14	8	89
VK			1	4		1	6
VP5		1	2	2	2	1	8
VP9	1	1	1	1			4
VQ9				1	1	1	3
VU				4	1		5
XE			3	2	2	1	8
XT			1	1	1	1	4
YB				1			1
YL		2	14	9	11	10	46
YO			10	10	7	10	37
YU		4	22	29	24	22	101
YV		2	1	1	1	1	6
Z3		1	1	3	1	3	9
ZC4			1		2		3
ZD8			1	1	1	1	4
ZD9				1			1
ZF		2	1		1	1	5
ZK2			1				1
ZL			3	3		1	7
ZS			2	2	1	1	6

year, and they seemed to be getting worse rather than better.

During the 0700Z hour, I noticed that the main tuning knob on the FT1000 was getting harder and harder to turn. It finally just froze up and would not turn at all, even under great force. I kept CQing and working guys with the IC-765 while I tried to figure out what was wrong. I managed to find the necessary Allen wrench to get the tuning knob off, but couldn't see anything. Finally decided that I couldn't fix it or waste any more time.

I recalled that *WriteLog* had a feature to tune the radio using the mouse wheel. I read the help file and found how to make it work. This allowed me to tune the frequency of the FT1000 but the tuning rate was too fast. Back to the help file revealed the INI file command to change the tuning rate and I slowed it down to 100 Hz steps. It wasn't great, but at least I could tune stations in and work them.

At this point, my attitude was really at a low point. The rate was slowing down and the radio problems were distracting. I had only made 25 QSOs during the 0700Z hour and figured that I had to be falling behind.

I made no QSOs from 0801Z until 0813Z. This was probably a mental health break with a bathroom and food run. Twenty meters was starting to open so I established a slow steady run on 14015 for the rest of the hour. There were a few second radio QSOs on 40 meters, which pushed the multiplier totals to 24 zones and 82 countries on that band.

The 09Z hour continued the run on 14015 while also tuning the other bands. I worked 8P9Z, P40Q and ZV8O on 160 meters, and got FG/N4CD and XQ1ZW on 80 meters.

At 10Z, the wheels came off. Just 17 search-and-pounce QSOs in the next 40 minutes. There were some good multipliers, but the bands were broken. I was still bothered by the radio tuning knob problem, the lack of signals on 20 m, and a general disappointment in how things were going. With the sun coming up outside, and what should have been one of the highest rate hours, I made the decision to quit the contest. With my last QSO logged at 1037Z, I lay down on the floor of the radio room and went to sleep.

Restart

Something woke me up about 1125Z. I remember thinking that I had arranged my family's life to do this contest, so I should get up and keep going. Even if I wasn't going to win, I could at least enjoy the contest and see what I could wring out of the bands.

I came back on the air at 1129Z and worked a C6A, ZL, and a JA on 40 meters. Then found YZ1AU on 15 meters, but he was the only signal. Conditions stunk, so I just did a systematic S&P across all bands for the next 40 minutes. After the contest, I would learn that I had given up no QSOs to K1AR during this period. It was pure luck that I went to sleep during the absolute worst period of conditions!

The break and decision to quit had removed the pressure and expectations of being competitive from my mind. I was now free to just enjoy the fun of contesting. There is probably a lesson in this.

The 1200Z hour began to see conditions return. I was able to establish a run on 14022 and use the second radio to work some loud stations on 15 meters, which was still not really open. It took several calls to get each station.

At 1310Z I went to 10 meters and started working loud Caribbean and South American stations. I did two complete S&P passes across the entire width of 10 and managed to also work some Europeans. Fifteen must not have been too good at the time either, since at 1345Z I returned to CQing on 14008.

It is kind of hard to imagine just how disturbed conditions were at this point. The band seemed to randomly open to small pockets of the world and then close again just as fast. I spent the entire 1400Z hour calling CQ on 20 meters, but actually worked more stations S&P using the second radio on 10 and 15 meters. It wasn't until 1530Z that I stopped CQing on 14008 and decided to S&P full time on 10 meters.

With conditions so poor, and no guarantee they would be better the next day, I was keeping a keen eye on the higher bands and trying to make sure I got as many multipliers as possible. As I tuned around on 10 meters, I started hearing German stations coming in on the direct path with reasonable signals. I decided to call CQ and was rewarded with a nice run. It was perfect band for SO2R. The 10 meter frequency was perfectly clear with a steady rate, while leaving plenty of time and concentration available for calling stations on 15 meters. In the 1600Z hour, I had 101 QSOs on 10 meters and 34 more on 15. The bands were returning to normal!

This burst of rate fully re-engaged me into the contest. I really enjoy contesting and find it rather addictive once I get started. I was now thinking like a serious competitor and operating like one.

With the FT1000 tuning knob problem, each CQing band change was a dance. First I would find and establish a frequency using the IC-765. Then I would bring the FT1000 to that frequency using computer command. Finally, I would switch radios. It wasn't a big problem, but required a little bit of extra effort each time.

The 1700Z hour was mostly on 10 meters, with a jump to CQing on 15 meters occurring at 1744Z. I was fresh meat on a hot band, and the rate took off. One hour later, at 1855Z, I made the jump to 20 meters and the roll continued. The 19Z hour had 93 QSOs on 20 meters with 11 second-radio QSOs on 15, including VQ9X and 5R8HD. 20Z was more of the same with 77 contacts on 20 and 13 more on 15.

At 2138Z, I jumped down to 40 meters to see if I could find any long path multipliers. Worked a very loud JA3YBK and JI2KVW, but that was it. I turned the beam to Europe and set up shop on 7035 at 2153Z. This would begin an amazing run that may have been the deciding point in the contest.

After the first 24 hours, I had 1797/122/406 for about 2.7 million points. My best hope was to get to 6 million. No new record this year.

I stayed on 7035 calling CQ until 0433Z. During this period, I worked over 330 stations on 40 meters while also working nearly 100 QSOs on the second radio—many of them multipliers. Some of the goodies that called in on 40 during this period included 3B8/LA7MFA, T95O, 4X/OK1EE/P, ZS6DX, ZF2LA (*Wow, I'm considered a goodie!—Ed*), KL7FH and 5H1X. It was 3V8BB firing up just a few cycles away that ended the run, so I worked him for 40 meters country 98.

The first half of the 05Z hour was spent CQing on 3546 while chasing multipliers on 160 meters. It was back to 7031—my new home for the next 4+ hours—from 0539Z until 0953Z. Wow, another 260+ QSOs on 40 plus a few more multipliers on the other bands with the second radio. This late 40 meters opening did not happen the first night, so conditions were obviously returning to normal. I was also starting to think that I might be making a competitive score.

I took a short 10-minute break during the 10Z hour. At 1042Z, I established a 20-minute run of Europeans on 14032. After a little search-and-pounce across 20 meters to start the 1100Z hour, I was back to CQing on 14009 at 1111Z.

When I finally listened to 15 meters at 1150Z, I discovered that the band was wide open! I immediately moved to 21004, and the rate exploded with 130 QSOs in the next 60 minutes. I repeated the discovery on 10 meters at 1245Z. The band was packed with signals. My main thought at this point was to run as fast as possible and try not to fall too far behind K1AR and KQ2M. There have been too many contests where I could keep up during the slow times, but lost due to a few high rate hours on the high bands.

Conditions were great, but up and down. At 1400Z, I moved back to 15 meters and established a run on 21002. This was a great frequency for the next 3 hours (312 QSOs) and let me do some second radio work on 10 meters (57 more QSOs). When 5H1X called in on 15 meters, I moved him to 28213 for a double multiplier. At 17Z it was back to running on 10 meters. Something I have never

done before, this movement back and forth between 10 and 15 may have helped me work more stations than if I had stayed on one band for the entire time.

The rate was slowing down during the 1800Z hour, and I was making a lot of band changes. The SO2R functionality of *WriteLog* was being handled completely by my subconscious. It is a good thing the software records the frequency of the QSO, because I was changing bands so much that I sometimes couldn't remember which band I was on (sleep deprivation may have had something to do with that). By now the FT1000 tuning knob was beginning to turn, although not freely, but at least I could do some tuning with it.

The 1900Z hour was spent mostly CQing on 15 meters with second radio action on 10 and 20. At 2030Z I moved the run radio to 14016. Signals from Europe were very loud and the band was crowded. I went looking for a quieter spot and ended all the way up at 14089. The rate was pretty good, although there was occasional competition from various digital mode stations. Finally one of them ran me off and I was on the move again. The FT1000 main tuning knob was about 70% free by this time so it was possible to tune down the band. I was looking in vain for an OH0 but found VP9/W6PH and 4U1ITU instead. Ended up CQing on 14036.

Sleep deprivation starts to introduce some interesting thoughts around this time. I recall thinking each station that called was revealing some aspect of their personality in how they called. It made for some very bizarre conversations with myself.

At 2126Z I had one of the more memorable QSOs of the contest. There were several stations calling and one of them had that hollow sound that only comes from being far away. I heard "ER" and asked for a repeat. SP3HC was calling at the same time and he responded as well as the "ER". It took some maneuvering but I finally had the "ER" station calling in the clear and it was 3W2ER! Cool multiplier (country 116) and a surprisingly good signal. 3W2ER later sent me a recording of his side of the QSO, and he did not hear any of the European callers—just me. So I ended up sounding like a lid since it took 3 tries to get his call.

Twenty minutes later, HB0/DL1RWB calls in for country 117. I stay on 14036 all the way to the end of the contest (the last 2 hours 45 minutes on that one frequency!). During the same time, 10 meters opens to Japan as well as I have ever heard it. Gives me lots of easy second radio QSOs to chase. On 20, I am called by JY5HX, and then have back-to-back QSOs a few minutes later with 9V1YC and FR5FD to get to 120 countries (a new personal record for one band in a single op effort).

The final score on the computer shows 3832/158/512 for 7,378,710 points.

After the contest I go up to 3830 to see how the competition has done. I am amazed when K1AR and KQ2M check in with numbers that are below mine. For a contest that I had assumed was lost, there was new hope.

Notes

It really was a tale of two contests. The first 14 hours were really frustrating and well off the excellent conditions we had become used to from the two previous years. Things started to recover, and by Sunday at 1200Z, we were experiencing the full joy that is CQ WW.

I believe the key component to my success in the contest was aggressive and continuous use of two radios. *WriteLog* and the W5XD keyer represent the state of the art in SO2R technology available today. By my count, I had 374 second-radio QSOs in the first 24 hours and another 261 in the second 24 hours (I define "second-radio QSO" as one that is made away from the band that I am actively CQing on). That is a total of 635 extra QSOs. Sure, some of them I would have worked later anyway, but the margin of difference over K1AR is the difference in the number of second radio QSOs we each made. You can see the number of second-radio QSOs in the accompanying rate sheet.

The FT1000 tuning knob problem was gone when I tried to use the radio a few days later. I can only assume that a bearing was broken and had jammed when it heated up during use early in the contest. As it cooled down, it returned to a position where it was not jamming the shaft mechanism. The problem has not reoccurred since.

It amazes me every year how big this contest has become. Reading 3830 score reports after the contest always reveals a number of calls with big QSO totals that were never heard all weekend! A look at the breakdown by country shows a lot of holes in the multiplier chasing that could be easily filled. Always room for improvement next year!

WriteLog showed a total operating time of 47:07. No wonder I slept for more than 12 hours after the contest!

NCJ

A New Dimension in Contesting: A Web Scoreboard for the Spectator Audience

Veijo Kontas, OH6KN
WRTC-2002, Score Communication

The advent of computers changed contesting dramatically starting in the '80s. The use of logging software became a must for serious contesters. Today's logging programs allow the contester to focus on making the QSOs and it takes care of about everything else: logging, multiplier follow-up, station control, spot follow-up, QSLs and more.

The second big change occurred with the explosion of the Internet and the Web in the second half of the 90s. The Web enables global access to about every imaginable piece of information. But the usage of the Web has not propagated to contesting as one would have thought. Questions are manifold: How to utilize the Web? What do the rules allow? Fears of the Internet eventually overtaking ham radio? And many others.

SOMETHING NEW AT WRTC-2002?

As WRTC took place the first time in Seatle in 1990, there was already a vision of somehow making the contest progress visible to spectators, like watching any sport on TV or at the stadium. Three WRTCs have taken place, all bringing something new. In 2001, it became evident that Finland would host the WRTC-2002. What exciting new items could Finland, the promised land of the Internet, telecom and Nokia, offer to the ham and contesting community? The answer was: use the Internet to make the WRTC contest a truly worldwide happening for the big audience.

Homepages are an easy way of attracting publicity and an excellent channel for information sharing. The **www.wrtc2002.org** pages were setup early by OH1NOA. But what else could be done? Visions wandered around the following topics: how to link the famous OH2AQ DX summit with the WRTC, real time scoreboard, sending video and audio from the contest stations, utilization of country wide text TV, and more. Finally, two main streams were chosen: DX summit linkage and scoreboard, while the rest were put to lower priority as additional future features.

OJ-SUMMIT

The target for the OJ-summit was simply to attract people to work the WRTC teams. It was a separate subpage of the OH9W summit showing all the spots with call signs OJ1-OJ8 or word WRTC in the comment field. During the contest about 1800 spots had been sent and the filtering of team identity was taking care of the major early fears of the system.

SCOREBOARD SYSTEM

The simple target of the scoreboard was to allow the audience to watch the progress of the teams during the contest. As a concept it was something dramatically new. It allowed the scores and the ranking to be followed during the contest, not after it.

How does any scoring system work, whether it is a sports event at the local school, a Formula One race in Monaco or WRTC? It is simple and has been around for centuries. First you collect the scores of the individual competitors, then you sort them to the ranking order according to the competition rules, and finally you post them on a visible screen. The process may be mainly manual at the local school event or totally automated as in Formula One (F1) racing. One important dimension of the F1 is that the score is available instantaneously to 100 million spectators around the world!

Score Collection

Not trying to invent something new, the WRTC scoreboard system was divided into the familiar phases: score collection, score processing, and score presentation. Oddly enough, the data collection phase required the most brain exercise. The problem consisted of three interdependent aspects: the spectator aspect, what information to present and how; the racing aspect, not to disturb the contesters, and the practical aspect, how to get the scores collected from an area of 140 km by 60 km.

The scoreboard system block diagram and the score entry format is presented in Figure 1.

The amount of information to be shown to the spectators defined what we needed to collect from the teams. Quite fast one could find basically three levels. The most important piece of information was clearly the main score. Second level was the number of QSOs and multipliers. The third level was a band breakdown. Quickly, the band breakdown was dropped. It is difficult to get directly from the programs, requires quite a lot of data, and the most important point is that it can reveal too much of the strategy of the teams. Level two

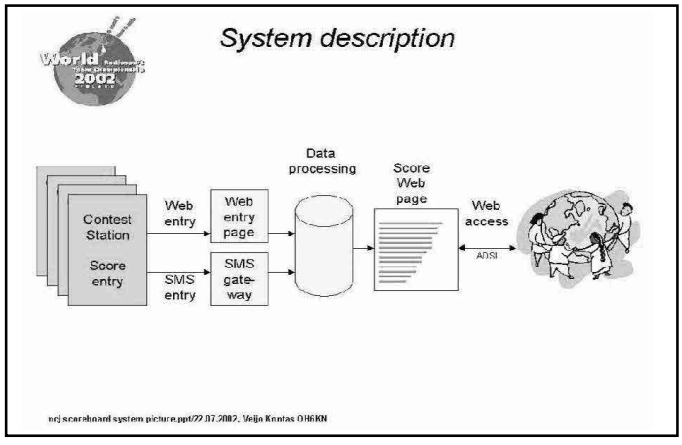

Figure 1—Block diagram of scoreboard system at WRTC-2002.

Figure 2—WRTC-2002 referees in training prior to the contest. The training helped the implementation of the scoreboard system be successful.

was fine as such, but how much additional information would it give to the big audience? The work concentrated on handing out the score, and it left the door open for the QSOs and mults.

The most delicate aspect, not disturbing the contesters, is analog to any measurement: the score sampling is not allowed to affect the observed phenomenon by any means. In F1 this is easy, since the car breaking the beam of invisible light between optical sensors affects neither the car nor the driver. What about a ham radio contest? Making QSOs at 300 plus an hour is very sensitive for any additional disturbance. If you lose the pileup rhythm, it will take a while to get it back up. There were two possibilities on the table: (A) either everything is handled fully automatically by the logging program and data transmission program or (B) someone else would do it manually.

The problems with a fully automated system (A) were thought to be too diverse and could have been almost impossible at this stage. The main problems were: 1. Second computer may be needed for data transmission. 2. The differences in the computers of the contesters are many (logging software, operating system, computer hardware, interface capabilities, etc) causing the need for lots of different solutions. 3. If the logging computer would crash, most likely this tiny piece of software would get the blame, since it is new in the system. 4. The organizing committee allowed any logging program to be used, and not all of them would have automated score available at a certain ouput port. The decision favored the manual method (B) since in WRTC there are the referees for each team who could do this task.

The scores need to be transferred efficiently to the data processing computer. We looked at the following possibilities: 1. Packet radio, 2. Web connection over modem, 3. GSM SMS (Short Message Service), 4. Data link over mobile phone (circuit or packet switched) and 5. Normal phone call.

Packet radio requires a packet system at all stations and seemed to be difficult to arrange. Web connection over a modem works everywhere, but requires a separate computer and the host station landline would be tied up periodically or maybe all the time. Datalink over mobile phone is similar to landline, i.e., it requires a computer, but doesn't tie up the landline. SMS is extremely popular and there are readily available services for SMS gateway. Also, WRTC organizers provided each team with a GSM phone (with SMS capability) to be connected throughout the week of the contest. For these reasons we selected SMS (3) and it proved to be a successful choice. As a backup system, we provided manual Web based score entry possibility (5), but only at the WRTC HQ in Espoo.

The referee sent the score once every hour on the hour. The SMS score entry consisted of a message "WRTC SCORE xxxxx", where xxxxx was the numerical score. After sending the message, the referee received an acknowledgement SMS containing the message, "Score xxxxx added to team yyyyy." After this, the acknowledgement SMS had to be deleted in order to maintain SMS space in the phone.

Score processing

The scores are first saved into a file by the score processing program. This file contains all of the messages sent during the contest. The score processing program parses each message and extracts the score and it links the score to the correct team by the phone number of the phone that sent the SMS. The program puts the teams into ascending order according to the score for the scoreboard screen. Finally it sends the acknowledging SMS to the SMS score originator.

Score Reporting

The scoreboard screen is the spectator window to the contest. There are two screens available: the statistics screen and the positions screen. Both screens are set to automatically refresh every 60 seconds.

The statistics screen contains ranking, time, team name, team score and relative percentage, with the best score being 100%. The teams are in ranking order with the best team on the top. The scores are presented as horizontal bars, the length of which is relative to the score. You can click on the team name and see all the entered scores for that team. The positions screen has the ranking, team name, and score in textual format.

Some quite lively discussion was held before the contest on what can be used as the team name. The conclusion was to show the team personal call signs, like N5TJ_K1TO, and not the station's on-air identity.

The Scoreboard in Action at WRTC-2002

The scoreboard was developed and tested during March-July of 2002. We wanted to concentrate on a bare bones scoreboard without fancy graphics or other bells and whistles in order not to bite off too much at a time. The orginal plan was to have everything ready for trials at WPX, but we missed the time window, so the first real trial was the WRTC contest itself. The system could quite easily be tested with a few guys entering scores through the web and SMS. Mr. Murphy seemed be ignorant of this project until Monday (July 10) of the WRTC week, when we realized that we had to change the computer and the location of the scoreboard server to the main server system of Elisa communications. Jouni, OH2JIU, worked hard to do the transfer and the system was running by Tuesday evening. Afterwards the move proved to be good, since the servers at Elisa were more reliable than the original environment. Eventually the scoreboard was ready to go!

Figure 2 is a picture of referee training. The publicity of the scoreboard system was kept low until we had discussed it with the judges of WRTC just to make sure that there would not be any jurisdictional problems with it. On Wednesday we launched the system through the WRTC Web and mailing lists. The main training of the system was given to the referees on Thursday. The excitement during the training was going up as the referees started to see their scores on the scoreboard screen. Before the contest there were two "score checkins" by the referees. By 1100 UTC on Saturday and after a few phone calls, all 52 test scores were on the screen. It was the time to do the final reset of the system for the contest!

At 1200 UTC all the red lights lit off and the race began. The adrenaline was also high at the scoreboard, since we had to wait for the first intermediate timing point at 1300 UTC to get the first results. Within a few minutes at 1300 UTC we saw that the first curves of the race had been cleared successfully and first team ranking was visible to the world. A few phone calls to the referees were required to get the first scores in, but after about two scoring rounds things went smoothly. After a few hours from the start of the race we started to see some consistent formation of the top teams, but the leading position quite often changed from hour to hour. The night and early Sunday morning brought some positive surprises from a few teams doing a tremendous improvement in their score to the tune of moving up 5-10 positions. Towards the end of the contest we saw that the few top teams were extremely close to each other and the final results would take lot of careful effort from the judges. At 1200 UTC, the contest was over and it was time to stop the engines. The scoreboard had worked perfectly the whole time!

After the teams and referees got back to the WRTC HQ in Espoo, we started to see a few problems with the results. Some of the last minute versions of the logging programs had problems with multipliers, which had resulted in some overly optimistic scores. But like in an F1 race, there are always some unfortunate dramatics in the game! The manually fixed score estimates were entered into the system later on Sun-

day. The checked scores and positions were published at the award dinner on Monday night. The top 10 had some changes, but there was a good correlation with the results from Sunday. This verified that even though the real time scoreboard shows the claimed results, they are very indicative of the final results, and thus the system is very usable. On top of that there is a positive involvement of the personnel on-site as well as out in the big wide world of ours. Sometimes the atmosphere in the lobby of the WRTC HQ was as heated as in the football finals. And indeed many sporadically felt a new coming of Amateur Radio contesting!

The Future

WRTC-2002 set the stage in utilizing the Web in contesting, but this is just the beginning. One can easily envision future development topics like direct real time link sfrom logging computers, fancy graphics with more details, audio and video links and many not-yet-recognized imaginary functions. With versatile entry systems (Web, e-mail), the concept can be easily expanded to cover the major worldwide contests. In WRTC, the competing teams did not know the scores and their rankings—but why not? Taking the heat is part of many other competitions!

There has been a tremendous amount of positive feedback on the scoreboard, but also some doubts and worries have come up, which need to be further studied. But the Web is here to stay and we have to learn to live with it, and indeed make it a benefit to Amateur Radio, not to overtake it.

ACKNOWLEDGEMENTS

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About the author: Veijo, OH6KN, was born in 1959. He was licensed in 1969. He was active in the 70s in both DXing and contesting. He went through a long QRT period in the '80s and early '90s. He came back to Amateur Radio in the mid-90s. His main interests are DXing, homebrewing (especially station automation), contesting and, more recently, DXpeditioning as 5W0VK and A35VK. He works as a Director of IC development for mobile phones at Nokia in Oulu.

NCJ

Phasing Verticals: An EASY Way

Scott Robbins, W4PA

There are many different methods for phasing verticals. They tend to get complex in a hurry, but I will describe one simple method for phasing a pair of them. There's a lot of "voodoo" and misinformation out there about phasing verticals. It actually is pretty simple and can be done merely by plugging a couple of numbers into simple equations to figure out how long to cut coax feedlines. It's really as easy as that—just doing some math and cutting coax.

This phasing method is commonly called a "90 degree out-of-phase 2 element cardioid array." "Cardioid" refers to the signal pattern in the direction of signal firing. It's shaped like a heart, with the bottom of the heart being the peak direction of signal (front), and attenuation of signal towards the rear.

You have to pick a band, and preferably a mode also, to put the verticals on. They'll only operate on one band, and really optimally only on one part of that band. If you set them up for 40-meter CW, they will work on 40-meter SSB, but with reduced gain and front/back ratio.

You also have to pick a direction for the array to point to. The last phased vertical array I had up with quarter-wave verticals was cut for 40-meter CW and pointed at Europe.

Here's how to do it.

Place the two verticals a quarter-wave apart at the desired frequency of operation, pointing in the direction you want them to fire. See Figure 1.

Erect and tune each vertical independently (without the other one in place) to the desired frequency, but see note number 3 under practical advice at the bottom.

Coax is used for phasing delay lines to be able to feed them properly at approximately 90 degrees out of phase. I'll explain "approximately" below.

Your feedline from the shack out to the antennas can be any length. This coax from the radio room is then connected to a T coax connector, and coax is then run from each side of the T to the feedpoints of the two verticals.

Now you have to calculate the length of each coax line to the vertical feedpoints from the T connector. You'll need to know the velocity factor of the coaxial cable you're using to feed the antennas. I used RG-213/U for my last array, so we'll use that for the example.

The velocity factor of RG-213/U is typically 66%. You need a "90-degree" coax line for the rear antenna. A 90-degree line is a physical quarter-wave at the desired frequency of operation, times the velocity factor (VF). Let's use 7.000 MHz for this example. A quarter-wave at 7.000 MHz is 35.14 feet. Multiply that by the VF of the coax (.66) and you come up with 23.19 feet of coax from the T to the feed point of the rear vertical.

Now, to feed the verticals 90 degrees out of phase, you need a "180-degree" coax cable to the front vertical. But the verticals aren't 50-Ω systems, so we can't simply calculate a 180-degree length of line. We need to force the correct voltages and currents to appear at the base of each vertical. In his excellent book *Low Band DXing*, ON4UN shows that this extra length of coax should be 71 degrees rather than 90 degrees. I fed mine using this value.

You need a coax line for the front vertical that is 71 + 90 = 161 degrees in length at 7.000 MHz. You have the 90-degree length of 23.19 feet from the rear vertical feed calculation. 71 degrees is 78.8% of 90 degrees. 23.19 x .788 = 18.27. 18.27 + 23.19 = 41.46 feet for your 161-degree front vertical coax from the T connector to the front vertical feed point. The impedance that your rig or amp will see at the T connector will be on the order of 20 + *j*15 Ω with this simple system, so you can either live with this or use a tuner.

That's it! Two properly cut pieces of coax (one 23.19 feet long and the other 41.46 feet long for 40m CW), a T connector, two verticals spaced a quarter-wave apart, and you'll have 3 dB of forward gain and 20 dB F/B ratio. Compare this with 4.5 dB and 12 dB F/B ratio for a typical "shorty-forty" 2 element 40m beam. This is a great way to start doing some pileup busting on the low bands.

Some practical advice from 15 years of using phased verticals:

1. Get as many radials down as possible. The last phased 40m array we had up at the W4PA/K4JNY contest station had 30,000 feet of radial wire. That's not practical for everyone, but at a minimum get 24 per antenna on the ground. More if you have the space and the desire!

2. Don't use a cheap T connector. K4JNY and I have fried enough of the knockoffs to have learned this lesson. 500 W is usually enough to cook them. Spend the 10 bucks for a real Amphenol T connector and save yourself trouble-shooting headaches later.

3) One thing you're going to notice with the phased verticals is that the resonant frequency is going to drop a couple of percent from the time you individually tuned the antennas to when you phase them as a system (because each vertical separately was about 36 + *j*0 Ω, but the phased feed impedance is about 20 + *j*15 Ω). If you're not going to use a tuner, it might be a good idea to tune each vertical independently a couple percent high in frequency, cut the coax lines to the desired frequency and then hook them up phased. Having a device like the MFJ259B SWR analyzer will make this a breeze. NCJ

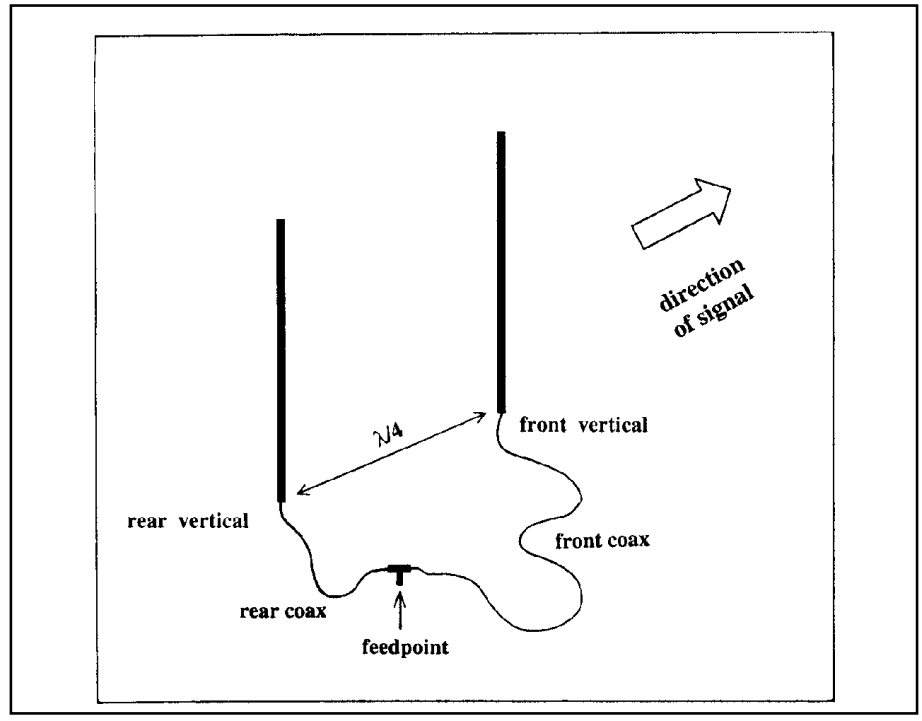

Figure 1—Two-element phased array layout.

“Stamp” out Idiot Lights

Brian H. Alsop, K3KO

What and Why

I got tired of the “idiot light” light emitting diode (LED) readouts from my antenna selector hardware. Things have gotten quite complicated with 11 transmit and 6 receive antennas. Some antennas are used on multiple bands. Selection is automatic about 90% of the time, with manual selection of alternate and receive antennas. I wanted the station to tell me IN WORDS just what antenna I had connected. Furthermore, I wanted the switching system to warn me when receive antennas are connected on inappropriate bands—thus preventing the conclusion that those bands are “dead” when they may not be.

This seemed like an ideal application for a BASIC Stamp microprocessor.[1] Previous articles in *QST*[2,3] showed the utility of utilizing “programmable interface chips” for other useful tasks. On the surface, it appeared to be easy to interface my automatic antenna switching hardware with the microprocessor chip and a two-line dot matrix text display. Moreover, it looked like a fun project. The result is shown in Figure 1. The overall cost, including the programming paraphernalia, is about $150. Not cheap, but I couldn’t think of a simpler way. The hardware is reusable, by connecting other inputs and reprogramming the Stamp. The cost of the programming equipment would not be incurred in subsequent projects. Additional D series Stamp modules are $29 each.

Particulars

My station uses computerized logging and contest programs (*LOG-EQF*[4] and *CT*[5]). These programs can produce binary output defining the current operating band on four LPT printer port pins. Strictly speaking, it is ABCD output, but it is commonly called “BCD” output. (This output, and the ACOM 2000A[6] amplifier, make it possible to have the equivalent of a no-tune 1.5 kW transceiver. One can jump bands almost instantly by pressing a key when a needed packet cluster spot shows up.) The way the programs function, a BCD output of 0001 would represent the 160 meter band, 0010 the 80 meter band, etc. I’ve taken this output and created a homebrew switch box, which selects the proper antenna for each of the nine MF and HF ham bands. It also selects the proper rotor for each antenna.

LEDs are also included to show which antenna is connected. For some bands, a separate toggle switch selects an alternate antenna. Some antennas are used on multiple bands. (There is a commercial product[7] that does this decoding and antenna switching for the non-WARC HF bands.) A description of this part of the antenna selector hardware (two IC’s and switching relays) is outside the scope of this article.

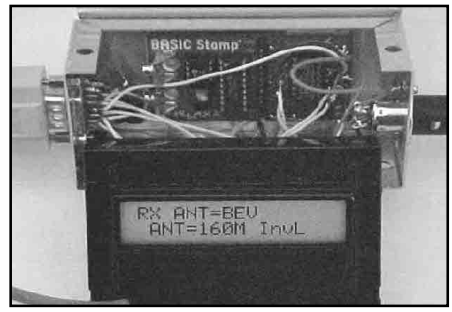

Figure 1—Photograph of finished project. The metal box contains the two Basic Stamp IC’s (left), the voltage regulator, (lower left), the 4050 IC (right) and the voltage divider resistors. The Stamp carrier board is used to mount all but the voltage regulator. The enclosure is 2 x 4 x 1.5 in. The LC display is housed in a plastic tape backup enclosure and painted with black Krylon spray. The piezoelectric sounder (not shown) is contained in the LCD enclosure. The entire project can be powered for several hours by a single 9-volt battery.

Can one get confused on just what antenna is connected? You bet. Thus, this project was born.

BASIC Stamps

There are several BASIC Stamp microprocessors available. The Parallax Web site describes these in detail. There also are software and chip carrier boards to permit easy programming. Once programmed, the chips retain the program in non-volatile memory and automatically start the program when power is applied. One can do all sorts of useful tasks with these Stamps. For example, there are commands which read push buttons (automatically debouncing the input), potentiometer settings, logical on/off inputs and RS232 inputs. The chips can put out logical 1 and 0’s, sound, signals to drive stepping motors and RS232 outputs.

I chose a complete kit using the BASIC Stamp Revision D. It has 8 pins that can be used as inputs or outputs, can be programmed with up to 80 instructions, and operates at 4 MHz. Its big brother, the BASIC Stamp 2, increases the size of a program that can be stored by a factor of 8, has 16 input-output pins, and operates at 20 MHz. Both can be programmed via available software and on chip input pins.

The compiler, which comes with the kit, utilizes PBASIC,[8] a variant of the BASIC language. It not only generates the source code, but also compiles it and installs the binary code on the chip. In these days of multi-megabyte programs, one has to live with 255 *bytes* of storage for the program (2048 bytes for the Stamp 2). What can one do with this seemingly minuscule amount of program space? It turns out that quite a lot can be done due to the availability of built-in functions.[9]

Overview of Design

Figure 2 shows the antenna readout project in quasi-schematic form. The BCD output is taken from the computer parallel port and the antenna switch box input junction, buffered and sent to the Stamp. Two other signals are also used. One (Vna) lets the chip know whether the normal antenna or an alternate antenna is being used. The second (Va)

Table 1

Parts List

1. Basic Stamp Revision D kit -P/N 900-3270. Radio Shack Parts 1-800-877-0072.
2. 4050 Buffer IC - P/N 900-3270. Radio Shack Parts.
3. 7805 Voltage Regulator - P/N 900-4493. Radio Shack Parts.
4. IC socket - P/N 900-4408. Radio Shack Parts.
5. Piezo Audio Transducer- P/N 900-1426. Radio Shack Parts.
6. ILM-216 (Scott Edwards Electronics) P/N 150990. Jameco 1-800-831-4242.
7. R1-R4 Part number vary - Radio Shack Parts
8. Enclosures - your choice. I house the STAMP module in an aluminum Minibox P/N 910-1193 from Radio Shack. The LCD display was housed in an old PC back-up tape plastic box
9. Connectors - your choice. I used a 5 pin DIN plug and chassis connector. Radio Shack P/N’s 910-4021 and 910-4035 for the cable from the STAMP box to the LCD display. The input connector for the STAMP box was a DB-9 male chassis mount. Radio Shack Parts P/N 910-1537.
10. Cables - Your choice. I used a factory made cable to connect to the Basic Stamp enclosure and a section of it for the cable to the LCD display. Jameco P/N 132345. Make sure there are nine wires in the cable.

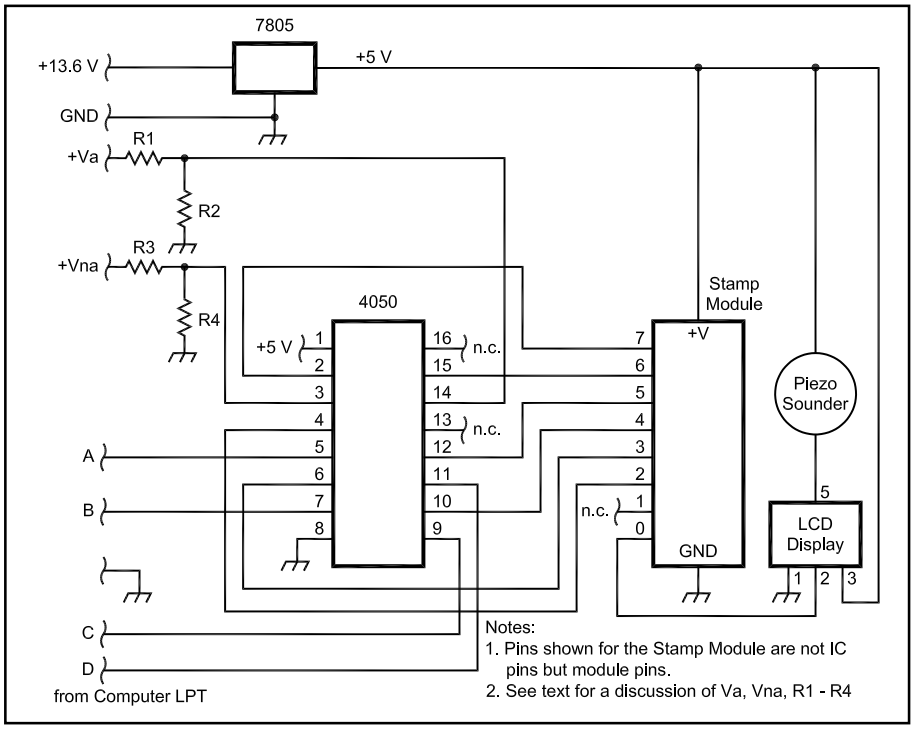

Figure 2—Hardware connections.

input tells the chip that receive antennas are being used. For the receive antenna mode, the program checks to see if RX antennas are being selected on bands other than 160 or 80 meters. If so, the piezoelectric sounder beeps continuously until the receive antennas are deselected. The BASIC Stamp then takes these inputs, decides which antenna and band is being used and outputs the appropriate text via the RS-232 port pin to a two-line, 16 character/line dot matrix, Liquid Crystal Display (LCD).

Design Details

Starting in Figure 2 at the BCD input, there is a 4050 CMOS non-inverting buffer IC. I choose to buffer the BCD inputs from the computer parallel port for two reasons. First, if power is lost to the BASIC Stamp, it drives all BCD values to zero - no antenna! This is definitely not desirable. Second, the loading of the parallel port output is reduced. I had to reduce the input levels of the auxiliary antenna and normal/alternate antenna inputs to below 15 volts. This was done with voltage divider resistors. The buffer is connected to the +5 volt supply. One neat thing about this buffer—it can accept inputs up to about 15 volts, and the output will only be as high as the supply voltage. In this case, 5 volts is the supply voltage. It is an easy way to combine varying input voltage levels from different sources.

This is just what is being done with the Vna and Va inputs. These must be positive voltage signals. The values of R1- R4 are chosen to keep the input voltage to the chip within the 3-15 volts range. In my case, Vna is 24 volts. I choose R1 = 3.9 kΩ and R2 = 1 kΩ. These values divide the voltage so that about 5 volts appear on the 4050 IC input. Va is 13.6 volts. I chose R3 and R4 values to be 3.9 kΩ. This produces an input voltage of under 7 volts for the 4050 IC. The values are not critical. Quarter-watt resistors were used. It would be a good idea to make sure that the input voltages are devoid of negative going spikes.

These can occur if the source of either the Vna or Va is in parallel with a relay coil. When the relay deactivates, a large negative going voltage spike can be generated. The usual solution is to put a diode across the relay coil, which conducts on negative voltages. In my case, all voltage sources are conditioned at their source and no extra components are needed here. The IC was inserted in a socket. I know from experience, anything connected to antenna switches is subject to transients and can easily be destroyed, despite efforts to keep spikes out of the station. It also acts like a "fuse" to isolate the BASIC Stamp from errant input voltages.

The +5-volt supply for the 4060, the BASIC Stamp and the ILM-216 LCD[10] is obtained from an external +13.6-volt supply and reduced to 5 volts by a 7805 IC regulator.

In my case, Stamp pin 0 was chosen as the RS-232 output to drive the LCD display. Outputting text to the display is as simple as inserting a single command in the program. For example, the command: **SEROUT 0, n2400,("TEXT")** writes TEXT on the LCD display. I chose pin 6 and the receive antenna input pin, pins 2-5 as the ABCD input pins and pin 7 as the normal/alternate antenna input. That leaves one spare pin for future use.

I choose to locate the LCD display and sounder in the smallest possible enclosure and locate it prominently. The voltage regulator, buffer IC, and the BASIC Stamp were located in a separate remote enclosure.

That's it. It's not complicated and has a low number of components.

Programming Information

Programming the BASIC Stamp is relatively easy for anyone who has done any BASIC programming. I believe even those who have done no programming can utilize the supplied examples in the manual to program the Stamp for their applications. One simply attaches the programming cable to the PC and Stamp and runs the compiler. The compiler has a built-in editor. It creates, edits and stores programs in ASCII format. The compiled program is loaded on the Stamp and executed with one command. It is worthwhile to describe the key commands used in this application. In addition to the normal **IF/THEN**, **GOTO** and **GOSUB** commands one would expect to use, the following commands were used. The commands are shown in bold font.

PINS = %01111111—This tells the BASIC Stamp that pin 0 will be an output pin and the remaining pins are input pins.

b6 = 4* **PIN4**—This takes the value of Stamp pin 4 (either zero or 1 for off or on, respectively), multiplies it by 4 and puts the result in variable b6. In my case b6 ends up being the variable containing the values of 1 through 9, indicating the 160 - 10 meter bands, respectively. Its final value is obtained by b6 = pin2 + 2*pin3 + 4*pin4 +8*pin5.

PAUSE 2000—This pauses the program for 2000 milliseconds to permit various inputs to settle down. Also it is used after clearing the LCD display and before writing to it.

SEROUT 0, N2400, ("BAND=", #b5, "M")—This is the "PRINT" command, which displays the data in parentheses to the display. Here a baud rate of 2400 is used. The N in front of the baud rate indicates "inverted output'. The output is 0 or 5 volts (so called TTL level) with zero volts indicating an "ON" on pin 0. This protocol is necessary to drive the LCD display. The output this generates on the LCD is BAND = whatever the value of variable b5 is, appends an M to it, and jumps down to the next display

Table 2

DISPANT.BAS Program Listing

```
' Ant display program
' For Parallax Basic Stamp D
' Copyright © Brian H. Alsop, 192 Lake Rd, Henderson, NC 27536
October 13, 2000
' Compiler is not case sensitive.
' The next two lines are used to determine remaining memory
        'read 255,b2
        'debug b2
        PAUSE 2000
Main:
        PINS =%01111111
        SEROUT 0,N2400,(14,7,12)
Loop1:
        b8 = PIN6
        if b8=0 then L1
        SEROUT 0,N2400,(1,"RX ANT=BEV")
L1:
        b6 = 8*PIN5
        b6 = PIN2+ b6
        b6=  2*PIN3 +b6
        b6=  4*PIN4 +b6
        if b6>2 and b8=0 then Loop2
        if b6<3 then Loop2
        SEROUT 0,N2400,(7)
Loop2:
        SEROUT 0,N2400,(1)
        PAUSE 250
        LOOKUP b6,(0,160,80,40,30,20,17,15,12,10),b5
        if b8 =1 then L2
        SEROUT 0,N2400,(1,"BAND=",#b5,"m  ")
L2:
        SEROUT 0,N2400,(13," ANT=")
        BRANCH
b6,(Loop1,S160,S80,S40,S80,S20,S20,S20,S12,S20)
Paus:
        b9=b8
        goto Loop1
S160:
        SEROUT 0,N2400,(#b5,"M INVL")
        goto Paus
S80:
        SEROUT 0,N2400,(#b5," ")
        gosub Dip
        goto Paus
S40:
        b7=PIN7
        SEROUT 0,N2400,(#b5," ")
        if b7 = 0 then Dip
        if b7 = 0 then Paus
Beam:
        SEROUT 0,N2400,(" BEAM  ")
        goto Paus
S20:
        SEROUT 0,N2400,("4")
        gosub Quad
        goto Paus
s12:
        SEROUT 0,N2400,("2")
        gosub Quad
        goto Paus
Dip:
        SEROUT 0,N2400,("DIPOLE")
        return
Quad:
        SEROUT 0,N2400,("L QUAD   ")
        return
```

line—eg BAND=40M. The cursor ends up in the first character position of the next line.

LOOKUP b6,(0,160,80,40,30,20,17, 15,12,10),b5—b6 is the variable containing 1-9 representing the 160 meter through 10 meter bands. It is derived from the BCD input. Given its value (0 -9), LOOKUP goes down the list within the parentheses, selects the appropriate value and puts it in variable b5. For example, if the value of b6 is 3, it would determine that it is the 40 meter band and put a value of 40 in b5.

BRANCH b6, (LOOP1, S160,S80, S40,S30,S20,S20,S20,S12,S20)—This command jumps to routines that print out the type of antenna. For example, b6 is 6 (the 20 meter band), it will go to routine called S20. This will print out "4L QUAD" on the second line of the display. Note that routine S20 appears in four places. This is because the quad is a multiband antenna with one feedline covering 20,17,15 and 10 meters. Thus, the branch instruction will send it to the '4L QUAD" routine for each of those bands.

A flow chart of the program that does this is shown in Figure 3. The program automatically starts upon application of power. The first task is to initialize the LCD display. This initialization clears the screen and turns on the backlight. Next, all six input pins are read. The input is examined to determine if the RX antenna pin is ON. If so, the program displays "RX ANT = BEV" on the first line of the display and proceeds to the computation of band number. If no RX antenna is being used, the program skips the display step.

The computation of band number converts the BCD input to a number from 1 to 9 representing each of the MF and HF bands. The program then tests if the RX antenna option is incompatible with the chosen band. In my case the RX antenna can only be used on the 160 and 80-meter bands. If the choice is incompatible, then the program beeps and proceeds to determine the transmit antenna type. If the choice is compatible, and the band is not 160 or 80 meters, then the program looks up the band pneumonic. The band pneumonic is simply the band name, such as "40M" for a band number of 2. It then displays the band on the first display line.

Next the antenna type is determined considering the band and normal/alternate input line. The antenna type (such as "4L QUAD") is displayed on the second display line. The program then saves the RX antenna state and loops back to read the input pins again. This entire process takes less than one second.

The entire program ended up with about 50 lines of code and utilized about 250 bytes of storage. I suppose one could reduce the code's size more, but I didn't bother. It does not leave any space for further additions. Given this experience, I'd recommend that one consider using the BASIC Stamp 2 (with twice the number of I/O lines and much more memory) for more complicated projects. The actual dispant.bas ASCII source code is available for modification. Your program will be different because your antenna choices will be different.

Where to Next?

The Stamp opens up lots of possibilities because of its real world inputs and outputs. For example, it is advantageous for me to automatically position my quad in the same direction as my 40-meter beam (on separate towers). I do this manually now. This is because a rotatable 40-meter dipole is also attached to the quad mast and at right angles to the quad. Slaving the rotors would automatically turn the beam and dipole so that they are at right angles to one another. Flipping the normal/alternate switch would allow instant coverage for directions off the side of the beam.

This would be easy to do with the Stamp using the POT input command to determine desired direction and the

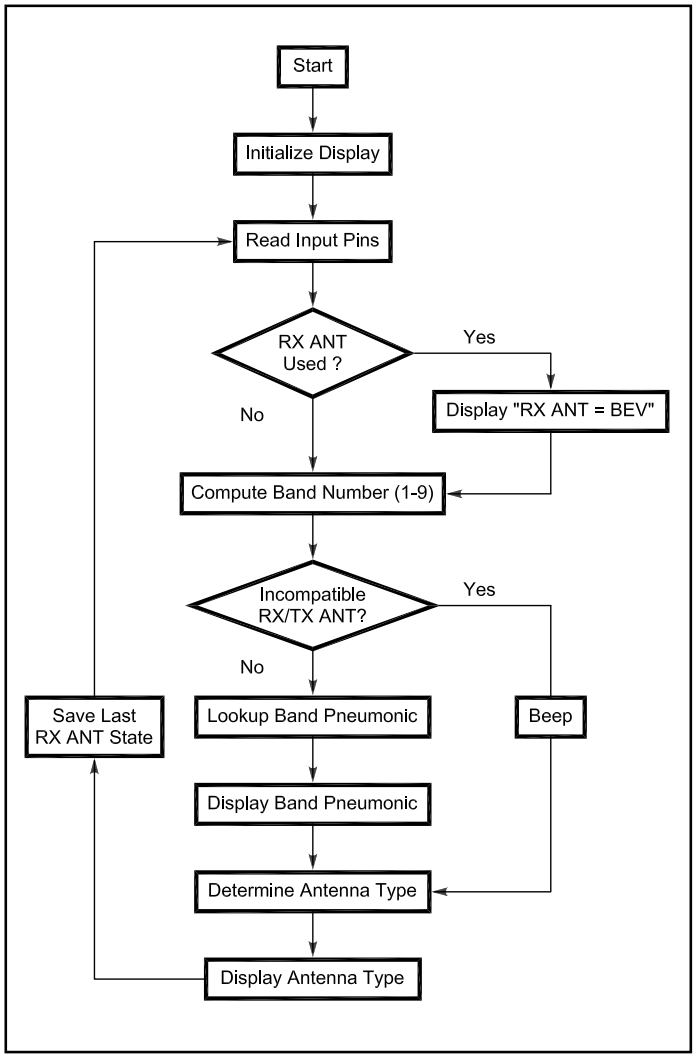

Figure 3—Abbreviated flow chart of display program.

RS-232 port to send the same position command to both digitally controlled rotors. One would only need to turn the pot to the desired direction, press a button, and the Stamp would take care of pointing both antennas. Another useful project could be the automatic switchover of the myriad of lines single operator, two radio category stations do when swapping radios. Lots of interlocks could be built into the software to prevent damaging both radios.

Summary

This was a fun project. I learned something new. The hardware is easily reused and adapted. If antennas change, one only has to change the coding to reflect the changes - no soldering. If one wants to do something else with the hardware, it is a simple matter of changing the inputs and reprogramming. This technology is quite amazing, reasonably affordable, and straightforward to use.

Author Profile

K3KO has been licensed since 1960 and holds an Amateur Extra License. His favorite modes of operation are CW and RTTY. He likes DXing and contesting. He retired five years ago from a career in nuclear reactor physics. His current station consists of a Kenwood TS850 and an ACOM 2000A amplifier. There are plans for more antennas.

Notes

[1]Parallax, Inc., Rocklin, CA 95765, www.parallaxinc.com.
[2]Pat Bunn, N4LTA, "A CW 'Stamp' Identifier", *QST*, Oct 1994, p 41.
[3]John Hansen, W2FS, "An Inexpensive Remote Base Controller using the Basic Stamp", *QST*, May 1998, pp 33-37.
[4]*Log-EQF*, www.itis.net/eqf.
[5]*CT*, www.contesting.com/ct.
[6]ACOM, Sofia, Bulgaria, www.hfpower.com/ACOM2000A.htm.
[7]Top Ten Devices, Inc., www.qth.com/topten/bdecoder.htm.
[8]PBASIC is a trademark of Parallax, Inc.
[9]Still not enough? Parallax also has a 50 MHz chip with 16 Kbytes of RAM.
[10]Scott Edwards Electronics, Inc., Sierra Vista, AZ 85635, www.seetron.com.

NCJ

Automated Antenna Selection for the ACOM 2000A Amplifier & 2000S Switch

Brian Smithson, N8WRL
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Introduction

ACOM International (www.hfpower.com) makes a very impressive, fully automatic legal-limit amplifier. When paired with the optional 2000S controller for their 2000SW antenna switch, it makes a convenient, full-power amplification system. See the review in *QST*, May 2000.

After the initial setup, the amplifier is capable of detecting the frequency of the signal from the transceiver, determining the antenna last used for that frequency, and then selecting and tuning up for that frequency, all in the time of a single CW "dit." I have several antennas for various bands, so I was looking forward to not having to worry about all the switching. After several months of operating, though, I noticed a problem.

The automatic antenna switching is great if that's the first thing you do after you change bands—transmit! But who does that? I found I wanted to change bands, select an antenna for that band and tune around for a while, looking for someone to call or a place to CQ. Only then do I transmit, and by then I've already had to select the antenna! So the automation in the amplifier is nice, but it happens too late. I needed something that monitors the radio to see what band I'm on and pick the antenna accordingly.

There are already several products on the market that decode band data signals from Yaesu radios (like my FT990) and drive relays to select an antenna. This doesn't do exactly what I want because:

1. I have several antennas that cover the same bands (tri-banders fixed in various directions and one that rotates, etc.), so I wanted to remember the more recent one I used as well as be able to select a different one when changing frequencies.

2. They don't tell the amplifier about the band change, so it would have no way of knowing which of the antennas I want it to tune for.

3. It wouldn't give me an opportunity for a home-brew project!

At the same time I had been reading about the micro-controller made by Parallax (www.parallax.com) called the BASIC Stamp. There have been other articles in *QST* about this and other micro-controllers (like the PIC). The Stamp has a small memory and is programmable in simple BASIC-like instructions downloaded from a PC. I readily admit to having poor electronic design skills, and even worse mechanical fabrication capabilities, so a project like this seemed like a great way to learn something all the way around. The one thing I do know is software, so at least I'd have that to lean on!

Goals and Requirements

I envisioned a little black box for the shack that did several things for me:

1. Monitor band changes from the radio and map them to legal antennas (usable for that band). Also, remember the antenna that I used the last time I was on this band and select that one first.

2. Allow me to scroll through the available antennas while at the same time protecting me from trying to transmit into an antenna not designed for the band I'm on (disabling the radio's transmitter).

3. Display band and antenna information on a small LCD screen (I had seen these at the Parallax Web site and they looked cool—I had to find a reason to use one in this project!)

4. Control the amplifier and antenna switch so that they both track with me as I tune the radio.

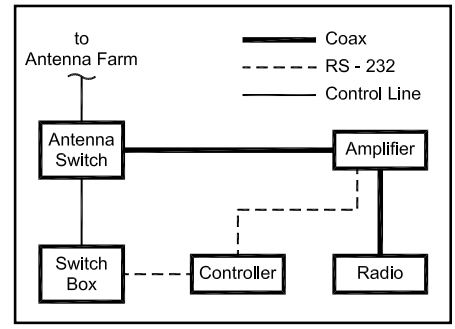
With these goals in mind, the input/output requirements began to take shape. I was going to have to:

1. Get band data from the radio. The FT990 (and similar models) has a **BAND DATA** jack. This provides a four-line binary indication of band, as well as transmit-to-ground and transmit-inhibit lines designed to interface with amplifiers.

2. Pass the transmit-to-ground signal to the amplifier's TX-IN jack. This is a signal from the radio to tell the amplifier that RF is on the way. Since this line comes from the band data jack, it is a simple matter to make this available out of the back of the controller through an RCA jack (to match the jack style on the amplifier). In the future I might be able to do something with this signal for exciter selection (SO2R?).

3. Pass the 'transmit-inhibit' signal from the amplifier to the radio, with some extra logic. The amplifier provides a **TX-OUT** jack that can be daisy-chained with a similar pair of jacks on the antenna switch to prevent the radio from transmitting before the amplifier or switch is ready. I want to pass this signal on to the radio via the band data connection but I also want to filter it based on the applicability of the selected antenna to the band in use. Even if the amplifier and switch are happy, I don't want to try to transmit into the wrong antenna for the current band.

4. Send antenna selection commands to the amplifier and switch. ACOM pro-



Block diagram of the controller in conjunction with the rest of the station.

The finished controller in action with radio tuned to 17 meters, antenna #1 (12/17 beam) selected.

vides serial ports and a protocol for this. (This turned out to be non-trivial, though!) My project uses the ACOM 2000S serial control capability, but with a few more logic lines you should be able to control virtually any selector. In fact, it wouldn't be hard to emit the right signals to eliminate the 2000S altogether. (I've been thinking about doing just this – essentially merging the two boxes.)

5. Cook up a way in software to list my antennas and the bands they work on so the Stamp knows what to do.

6. Provide a port for downloading programming in the future. This will be your key to telling the controller about your antenna system.

Operation

I think it makes sense to skip forward at this point to give you an idea of how the unit operates and what it does. Let's consider a typical single operator assisted contest situation. Twenty meters is open to Asia, so I'm hoping to enjoy a nice JA run. I have two tri-banders: one that rotates (antenna #5) and one fixed on Europe (#4). I turn #5 to Asia. I fire up the radio, amplifier, antenna switch, and the controller. I tune the radio to 20 meters and the controller senses the band and selects antenna #4, which is the default antenna for 20 meters. I want to work JA so I press the UP button on the controller to select #5. Sure enough, the Asians start pouring through.

I tune looking for a quiet spot. I find one in the middle of the band and key a quick "QRL?" I happen to notice the amplifier was last operating on 40 meters, so my transmission makes it sense my frequency and automatically retune to a 20-meter segment on the last antenna used there. It "broadcasts" this retune (more on this later), and the controller catches it and notices the amplifier wants to use the wrong antenna. A quick command reply tells the amplifier to select antenna #5, all before the rest of my "Q" is sent. I heard the whirring of the tuning motors, so to make sure, I re-send "QRL?" Hearing no complaints I start my CQ.

A while into my JA run, a spot arrives that my logging software recognizes as a needed multiplier: an SV on 15 meters. In a few minutes my JA run slows enough for me to switch VFOs and tune the radio to the SV's frequency. The controller senses my band change to 15 and selects antenna #4 (again, the default antenna for that band). The SV completes his call and I flick the dot side of my paddle to make the amplifier tune up for 15. I then toss in my call and work the SV.

Back to the first VFO—my 20 meter run frequency, which prompts the controller to select antenna #5 and tell the amplifier to get set up for that segment and antenna as well. I'm ready to call CQ again!

And so it goes. As I change bands throughout the contest, the controller compiles a nice band history of my activity and seems to anticipate my needs as I operate. There is no magic, of course, but it is neat to see the antenna and amplifier track as I change frequencies. Again, a very simple relay-based antenna selection unit would be just fine if you only had one antenna per band. But when things get a bit more complex, this project is a lifesaver.

The Project - First Steps

My first step was to learn about programming the Basic Stamp and wiring circuits to support it. Parallax has several starter kits. The one I chose was the Board of Education, which includes a Basic Stamp II, a 9-volt battery clip, a DB-9 serial port, and a small prototyping board with access to the stamp's I/O pins. It also included the software for the PC where you edit your programs and download them to the stamp. There is also an e-mail reflector hosted by Yahoo Groups called basicstamps (**groups.yahoo.com/group/basicstamps**) with many very knowledgeable members, all willing to help.

Scott Edwards wrote a great book *called Programming and Customizing the BASIC Stamp Computer* (McGraw-Hill 1998, ISBN 0-07-913684-2) that has all kinds of neat starter projects and basic wiring details. Scott also sells the LCD display I used at **www.seetron.com**.

Hardware

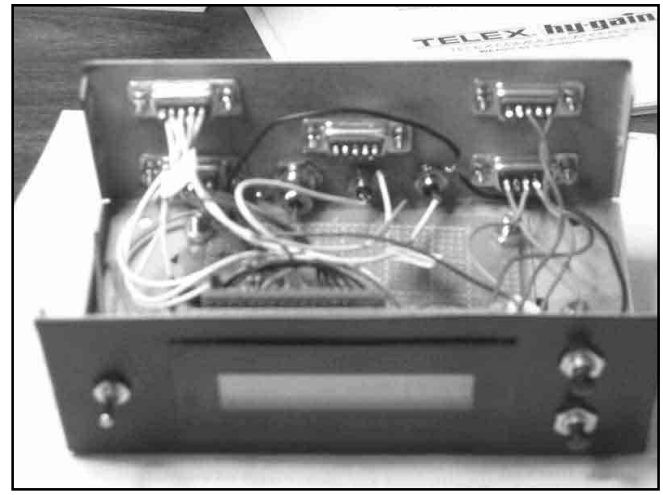
I knew I was going to have a few serial ports in this project, and I really don't have the equipment to drill or cut metal very well, so I bought a 4-port DB-9 serial switch box and yanked the rotary switch out of it. This gave me a nice-sized metal box for the project and five pre-drilled holes for serial connectors, not to mention the connectors themselves! In addition to the LCD, Seetron also had a nifty adhesive bezel kit that makes even the ratty jigsaw hole I had to cut in the front for the display look good. A few more round holes for switches and connectors completed the housing.

I prototyped the whole circuit to help me plan out the permanent installation. I used a Radio Shack prototyping board #276-168B, but I'm sure anything would do. Refer to the schematic (Figure 2), which is really a number of very simple circuits to connect the Stamp's I/O pins to the outside world. Here's a quick tour of the schematic:

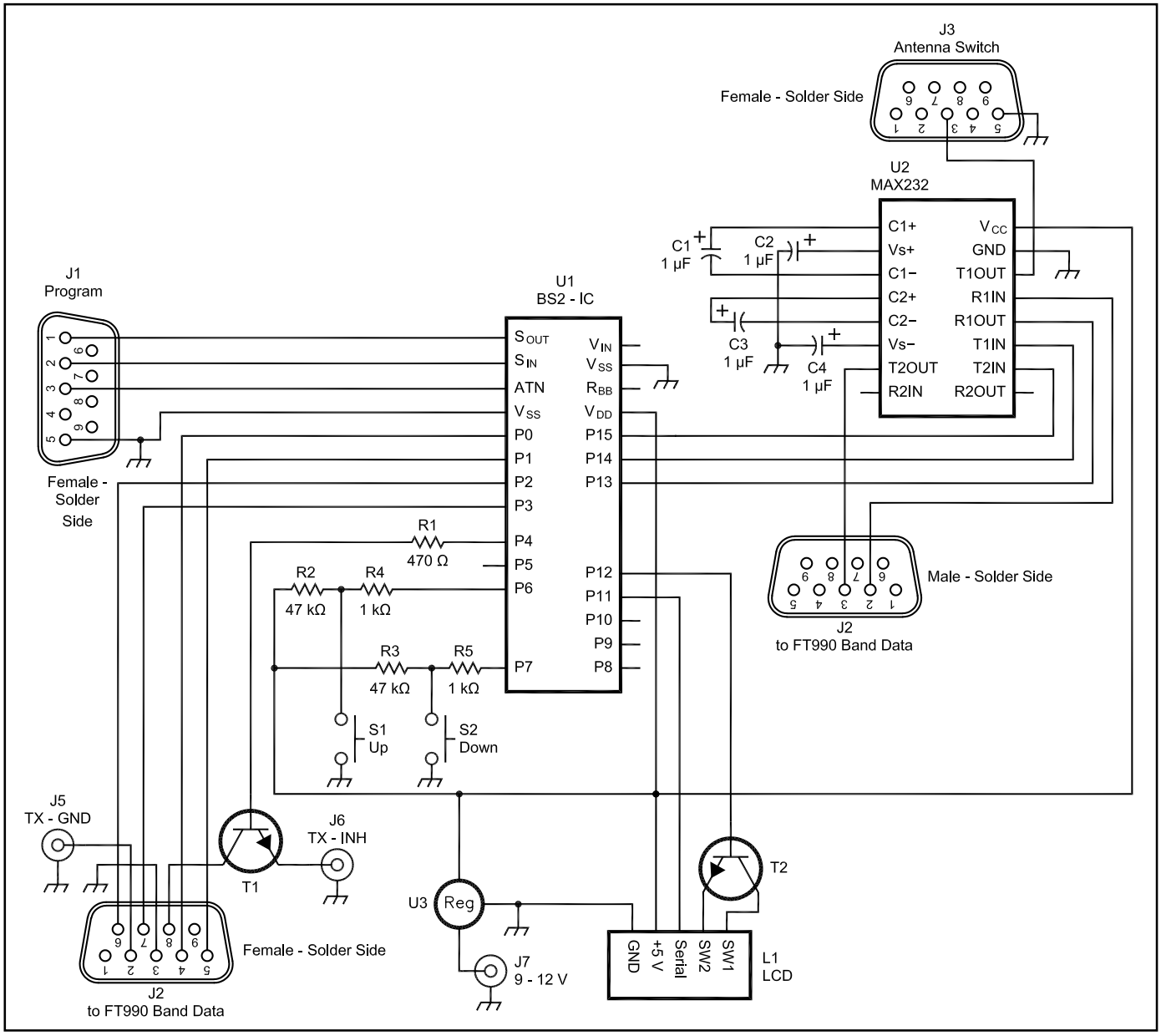
1. The Program RS232 jack is wired as recommended by Parallax to provide a serial communication port between the Basic Stamp and your PC. Connect it to download programs to the stamp.

2. The FT990 Band Data RS232 jack

Rear view of the controller, showing jacks.



Interior view of the finished controller, from the top front.



Schematic diagram of the controller.

is probably the busiest. It routes several of the radio's control signals:

• ***TX-GND*** *(pin 2 on the radio and the RS232 jack—they were numbered the same to avoid confusion) to a jack on the back of the cabinet to go to the amplifier's* ***TX-IN*** *jack so the radio can signal that RF is on the way.*

• *Band Data ABCD (pins 4, 5, 6, and 7) to pins 0, 1, 2, and 3 on the Stamp. These signals make up the 4-bit band "nibble" the stamp receives from the radio.*

• ***LINEAR*** *(pin 8) through a switching transistor to the* ***TX-INH*** *jack on the back of the cabinet to go to the* ***TX-OUT*** *line on the amplifier or antenna switch. This signal is used by the radio to sense if it is ok to transmit. As long as it is grounded, the radio will transmit. By passing the signal through the transistor and connecting the base of that transistor to a stamp pin, we can determine programmatically if we should allow the radio to transmit. Even if the amplifier and switch are satisfied, the stamp can still inhibit transmit if an antenna is selected that does not make sense for the current band. Other logic could be applied in the future as well.*

• *The two switches connected to stamp pins 6 and 7 are the up/down keys for antenna selection. The resistors are for current limiting and logic stabilization ("pull-up").*

3. A voltage regulator provides the 5 V for the stamp and the MAX232 chip. Note that the stamp has a built-in 5-V regulator, but I wasn't sure if it could provide enough current, so I opted for the extra component.

4. The LCD is connected to the stamp in a straightforward way except for the sw1/sw2 lines. When shorted, these lines turn on the LCD's backlight. I wanted to control when the backlight was on with programming in the stamp, so I routed them through another switching transistor controlled by a pin on the stamp. The program then turns on the backlight whenever the antenna or band is changed. It then starts a short timer that turns off the backlight when it runs out.

5. The Amplifier and Antenna Switch RS232 jacks simply route the TTL-to-RS232 output of the MAX232 chip as serial data to those devices. The antenna switch sends an acknowledgement, which in hindsight I should have routed back to the stamp for com-

pleteness, but is ignored in this diagram.

I'm sure the electrical engineers among you can improve on this circuit. Stan, LZ1IU from ACOM suggested capacitors at the legs of the voltage regulator, as well as better RF choking on all the I/O lines. I assembled everything on a Radio Shack prototyping board (#276-168B) but that's not at all critical.

Connections

You'll need to wire a cable to make these connections:

1. Connect a straight-thru RS232 cable between J1 and your computer. This will be used for downloading the program and can be disconnected once that is complete.
2. Wire a DIN plug for the FT990's band data jack to a male DB9 RS232 plug. Match the pin numbers to those on a DB9. Remember that the band data DIN plug is slightly different from the other ones on the radio. I got mine from The RF Connection part number DP8/262 (it says it's for Kenwood but it works). This goes from the band data jack on the radio to J2 on the controller.
3. Connect a NULL-MODEM RS232 cable from J3 to the 2000S's PC DB9 jack. Be sure to flip the slide-switch toward the PC serial jack.
4. Connect a NULL-MODEM RS232 cable from J4 to the amplifier's "RS232 Interface" DB9 jack.
5. Connect an RCA patch cable from J5 to the TX-IN jack on the amplifier.
6. Connect an RCA patch cable from the TX-OUT jack on the amplifier to the TX-IN jack on the 2000S controller.
7. Connect an RCA patch cable from the TX-OUT jack on the 2000S to J6.
8. Connect a suitable DC connector (center pin positive) to J7.

Software

The program is downloaded to the Stamp using the tools provided by Parallax. It is arranged to make configuring your station easy. The code and a description of its various sections can be found at the *NCJ* Web site, **www.ncjweb.com**.

Conclusion

This has been a fun project for me and taught me a lot about programming a micro-controller with limited resources as well as cooking up and wiring simple circuits. As a Computer Science guy by profession, I've always been able to assume there are ones and zeros. Playing around with the analog side of the interfacing was fun.

I've got some more ideas for down the road, including possibly connecting a second radio and using the **TX-INH** lines to operate SO2R, but I need to get better at normal single op contesting first!

As I said, I think this could be adapted to other switching arrangements and computer-interfaced amplifiers besides the ACOM. Be sure to share your experiences on the reflectors!

Special Note on Auto-Tune

After using this controller for several months I made a change to one of the antennas that affected the tuning. The ACOM manual has very explicit instructions on the 'auto-tune' procedure: be sure to follow them! I took some shortcuts, including letting the controller drive the amplifier's antenna selection during tuning, and it apparently really confused the amplifier. Over the next couple of days, I got less and less output for the same drive, eventually getting low gain faults on other antennas as well. The answer was to unplug the serial control cable from the back of the amplifier, issue a CLR of all USR tuning settings and re-tune all the antennas. NCJ

NCJ Profiles—Chad Kurszewski, WE9V

Paul Gentry K9PG
paul@k9pg.com

This month we're sticking around my neck of the woods, which I don't like to spend a lot of time in during contest season. I like to run around the planet racking up the QSOs. I have yet to win, or be a part of a winning team, in a CQWW. I've been second and third several times—maybe this year will be different?

There are quite a few of W9s that are very active. Folks like W9RE, N9RV, and K9ZO come to mind, along with WE9V. I've known Chad for about 10 years now. We first met at the old KS9K super station in far southeast Wisconsin in the early 90s, and we've been good friends ever since. Chad and I have a pretty good rivalry in the NAQPs and the Sprints. We've also done well as a team, winning both modes of the Jan 1997 NAQP along with several second- and third-place finishes in various contests.

Here's more from Chad!

Ah yes, the Black Hole. Home sweet home.

My first exposure to ham radio was when I was walking down the halls of the engineering building at Marquette University. I heard some strange voices coming from a room and peeked in. A guy spun the dial and said, "This guy is in Germany." Spun the dial again, "This guy's in Czechoslovakia," and again, "England." I was hooked. He gave me a code practice tape, and it took a while to learn the code. Since I was an electrical engineering student, the theory came quite easily.

I've been licensed since 1987, when I earned a Technician class license. My first callsign was N9GVT, but I only had it about one month, as I quickly passed my General and Advanced licenses and became KE9HJ. Less than a year later, I passed my Extra exam and became WE9V. Even though we can change our calls with the FCC's vanity callsign program, I've decided to keep WE9V for the long term. I've had this call since 1988.

My first station was a 5-band vertical on my parents' roof and a Drake TR-4 (no CW filters). I operated my first contest, the ARRL DX SSB contest, about 4 months after getting my license. I was definitely hooked on the quick QSO method and the challenge of the contest. I still remember to this day that I'd listen to K4XS on 10 meters and be in awe of his speed and rhythm. I also remember listening to "OK1 Radio Indiana" for his method. The guys who got me into ham radio were shack-on-belt types, so I really didn't have contest mentors. I just picked up what I could from listening.

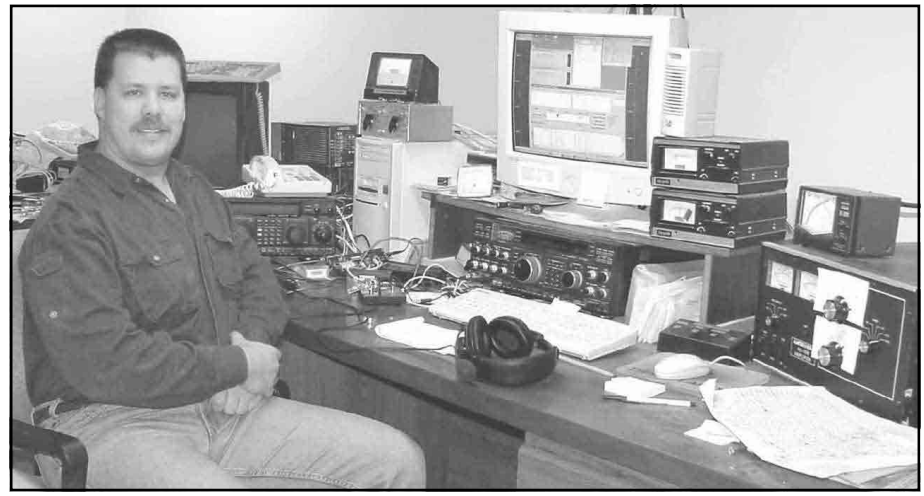
I operated a lot of the contests. Not seriously at first, but becoming more serious with time. Then I met KS9K at the Greater Milwaukee DX meeting. I've heard about Paul and his big station, and was anxious to meet him and try to convince him to let me, a pretty young guy compared to the others at the DX meeting, to come and operate. Somehow I convinced him and I came and operated the ARRL DX SSB contest in 1990 with their crew. They even let me start the contest, and I must have run JAs like no one they've ever seen before, because all of the operators were standing behind me watching with various surprised looks on their faces. That began my long relationship with Paul and helping him constantly improving his station.

My parents lived about 30 minutes from Paul's, so I was at Paul's most of the time helping out or operating. When I got my first job in LaCrosse, WI, it was about a 3.5-hour drive to Paul's, but that didn't stop me. We talked about station building nearly every day on the telephone and I'd send off designs via fax. By the time that he left for Virginia, most everything in and outside the shack had been designed by me, except the FT-1000MP radios. I designed 14 of the 15 Yagis, phasing boxes, low band wires, computer interfaces, station switching and even the amplifiers. I traveled to KS9K to operate the big contests, but many of the smaller ones I operated from W9UP. It was a one-tower station on 10 acres outside of LaCrosse.

It was during my stay in LaCrosse that I got hooked up with KA9FOX and N0BSH (now K9NW). We did multi-ops from W9UP, or argued who got to single op, and we planned our first Dayton trip together. I don't know what year that was ('92?), but we've been hooking up every year since then. We started the "Sultans of Shwing" right about then as a team name for the Wisconsin QSO party, and we began hosting the SOS Hospitality Suite on Thursday nights at Dayton.

After living away for 3 years, I got a job at Motorola in Northern Illinois, which moved me back closer to KS9K. Since I was so much closer now, I began operating just about every contest I could. Just so I could contest more, I began doing RTTY contests—even CW! Those who knew me years ago knew that I really didn't like CW. Now, I'm beginning to like CW almost more than SSB, mostly due to the ease of finding a frequency and not putting up with the nasty frequency battles. I bought my first house in 1998, and immediately began building a modest station. Outside, I have two towers. The main tower is 100 feet of Rohn 45. Antennas on the main tower include a two-stack of KLM KT-34XAs at 50 and 100 feet and a Cushcraft XM240 for 40 meters at 108 feet. The back tower is 56 feet of Rohn 25. It supports a third tribander (Mosley TA-34) at 56 feet and a Cushcraft A3WS at 61 feet.

Inside, the station is designed to be a SO2R station, but can be easily changed to support a small multi-op. The hardware includes a Yaesu FT-1000 and Ameritron AL-1500 amplifier for the main station, and a Yaesu FT-920 and Swan MK-II amplifier for the second station. There are several gadgets that I've homebrewed, including a 10-in/2-out SO2R box. I got married in 1999, and my time for contesting is slightly reduced from before. I now enjoy hosting guest ops such as K9PG



Chad at a WE9V operating position.

and KO9A (ex-KB3AFT) and the occasional multi-op.

Since I started computer logging around 1992, there have been over 79,000 contacts with my callsign. I also guest operate at other stations and participate in multi-operator efforts. I've been a part of over 237,000 QSOs at other stations, including K4JA (ex-KS9K and W9JA), W9UP, W0AIH, KH7R, 6D2X, FS5PL and K9NS.

The Black Hole is difficult to win from, but I still very much enjoy participating. I've learned to compete against myself, against my state, and against my region. I take the little victories. So in that respect, I enjoy operating all of the contests from stateside only to DX. I'm not too sure that I have a favorite contest, as they each have their own special appeal. If I had to pick one, it would probably be the January NAQPs. This is quite a fun contest from the Midwest.

Chad and his "modest" station have done very well since it was built. Not only does his station hold the record for the Wisconsin QSO Party and both modes of NAQP and Sprint, he also won the 2001 10-meter contest in the low power mixed mode category, setting a new record in the process. The funny thing is that he started the contest QRP until I talked him into going low power.

Ham radio has played a large role in Chad's life also. While he didn't meet his wife directly through it like VE2AWR, he wouldn't have met her if it weren't for this hobby. Chad met Shirmela at the wedding of KA9FOX back in 1995. Neither of them remember talking at the reception, but they were caught on video tape exchanging a few words. It wasn't until later that year that Scott and his wife set up Chad and Shirmela on a semi-blind date for New Year's Eve. It must have worked out well because they were married on July 17, 1999.

Sweepstakes is coming up quickly! The key to making SS fun is getting activity up and getting some new blood into the game. I hear that the PVRC and NCCC are planning big efforts, and rumor has it that the SMC is, too. Remember what W4AN said: "Imagine how much fun contesting would be if each of us got just one person into our sport." So, how about trying just a bit harder to drum up some more activity in your contest club, or hosting a small multi op for Sweepstakes to show someone the ropes? That could do a lot towards curing those dreaded Sunday doldrums. NCJ

Op Ed: Club Competition Considered Harmful

Ken Harker, WM5R
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I am of the opinion that club competition, as implemented by the ARRL, can often do more harm than good. Club competition can seriously affect the relationships between members of a club, driving wedges between those with large stations and those with smaller stations, or between those who are serious about the club competition and those who are not. Club competition often has the unintended effect of scaring off potential future contesters who feel intimidated by the need to perform at a high level. The arbitrary distance and attendance rules for club competition can unnecessarily marginalize the relationships between some members and their preferred radio club. These problems with the implementation of the current club competitions in ARRL contests are known, but not widely discussed. I suggest that a change might be in order.

"Managing" a Limited Number of Scores Turns Off Club Members

Both the Local and Medium categories of club competition in ARRL contests have limits on the number of contest entries that club members may submit on behalf of their club. In the case of a Local club, this is 10 scores, and in the case of a Medium club, 50. In either case, ARRL General Contest Rule 8.8 states that a club may not "manipulate" its number of entries to enter a lower entry category than it normally would, given the number of club members wishing to compete in the contest. In other words, a club in which 56 of the club members actually get on the air for the ARRL 10-Meter Contest cannot submit only the 50 highest scores in order to enter the club in the Medium club category. Claiming that only 50 of its members are eligible for club competition in that contest is "manipulating" the club entry.

Would the situation really be any different if, even though 56 members made QSOs that weekend, only 50 actually submitted their scores to the ARRL to officially enter the contest? What if six of those 56 would have made QSOs that weekend, but for the sake of the club competition, stayed off the air instead? Perhaps a club organizer pipes up at a meeting with "If we want to be serious about the Medium club competition, we can only submit 50 entries. I'm not suggesting that anyone stay off the air, or that anyone in particular would be blamed if we went over 50 entries because we aren't allowed to manipulate the contest entries, but if we want to be serious about this, only 50 people can submit scores." I'm certain this sort of thing is more common than we would like to believe.

Even though the ARRL club competition rules prohibit the clubs from manipulating contest entries to the benefit of the club's competitiveness, all of the above can and does happen. Club members who might push a club over the 10 or 50 score limit (especially in the International DX and Sweepstakes contests, where each operator can contribute two scores) are routinely made to feel pressure to not operate or to operate only with a planned multi-op. Club members who live just outside the arbitrary club radius can also be under tremendous pressure to not enter the contest at all. Organizers within Local and Medium clubs manipulate their club members' contesting behavior specifically to benefit the club's competitiveness in the club competition. The effect of this is that club members who would not normally contribute the largest scores are intimidated into staying off the air, or making a few token QSOs at a multi-op, instead of doing what they would otherwise choose to do.

Pressure to Perform Well Turns Off Club Members

Even in clubs where the number of contest entries is predictably in the Local or Medium category, club members can and do alter their contesting behavior because of the club competition rules. Many of the clubs that enter the club competitions are contest clubs whose primary focus is on contesting, and some have even been founded for the express purpose of competing in ARRL club competitions. Most of the clubs that enter the club competition, however, are either general interest or shared contesting/DXing interest clubs. These clubs collectively engage a large number of operators who may not consider contesting their main interest in ham radio, but are open-minded to it and probably enter events casually on many weekends. How well are these operators served by the ARRL club competition rules?

In my experience, many of the DXers, experimenters, and other more casual operators (for lack of a better term) are significantly turned off by the club competition. When clubs decide to "get serious" about club competition, either in trying to win their category or just trying to beat the neighboring club, attitudes about how well one does in the contest change. If you enter the contest and submit a score, there is no way to avoid public scrutiny of it when the results come out. Operators who normally make tiny scores are often intimidated off the air altogether once their club becomes "serious" about the club competition, lest their scores look too "puny" or "pathetic." I've heard several comments that echo the following sentiment: "The vibe that I've felt is that what the club really wants is more members with a tower on each band and skills to make 200+ Q's an hour. I feel tolerated but not overly welcomed." When the casual operators feel that getting on in the contest is no longer fun, they tend not to get on in the contest.

Distance and Attendance Rules Marginalize Club Members

Many clubs that participate in the ARRL club competitions have a few members who don't necessarily fit the ARRL's definitions in the Club Competition Rules. A Local club might very easily have a member who lives more than thirty-five miles away from the club "center," or who lives just across the border in the neighboring ARRL section. A Medium or Unlimited Club might very well have a member who, despite being active in most respects with the club on local repeaters, nets, or e-mail, just cannot attend club meetings. A club member might have moved across the country, but wishes to remain involved in club affairs through email and HF radio—and there may not be an active contest club in the new area. Are these club members well served by the ARRL club competition rules?

A member of a club who wishes to compete in the Local Club category, who lives just outside of the 35-mile radius, actually faces a terrible dilemma. If she gets on in the contest, even if it's at a multi-op within the 35-mile radius for that club, she invalidates the club as a Local club entry. The only way she can support her contest club in its desire to enter the Local Club category is to not contest. Medium and Unlimited Club members who live 150 miles away from where a club regularly meets on week nights may have to jump through hoops just to attend a "meeting" or two, even though they may be connected and involved with the group in any number of other ways, just to be "official." This does not

really create the best relationship between contester and club. These club members are not well served by the ARRL club competition rules.

The rules for the ARRL Club Competition have a negative effect on many clubs and their club members. "Managing" a limited number of scores, often done in distasteful ways to avoid being too overtly in violation of the rules, turns off some club members from contesting. The pressure to perform well turns off other club members who would otherwise like to get on the air and make contest QSOs, but feel intimidated by the need to be "serious" about the club competition. The arbitrary distance and attendance rules marginalize some club members who are made to feel that they need to stay off the air to remain in good standing with the "serious" members of the club. ARRL club competition in the Medium and Local categories can result in alienation and marginalization of club members and contesters.

Team Competitions: A Better Way

A better, more flexible alternative to club competition is team competition. Team competition is a feature of contests sponsored by *NCJ* and deserves to be used in more contests. The basic distinctions between teams and clubs are that the membership of a team needs to be "registered" with the contest sponsor before the contest, and the team membership does not need to be tied to a particular radio club and all the arbitrary exclusions of radii and meeting attendance. Team competition would avoid many of the problems that exist in the ARRL club competition, and would provide new opportunities for competition.

In a team competition, the membership of a team is registered with the contest sponsor before the contest starts. A typical team might consist of ten planned contest efforts from a single contest club, and the team name might be "Tennessee Contest Group #1" (and there might be a "Tennessee Contest Group #2" as well...). Pre-registration of team members commits only those contesters who want to be serious about the team competition to the cause of the team. Even if the team is composed entirely of members of a given radio club, it does not place any extra pressure on other members of the radio club to perform beyond their comfort zone. Ten members of a fifty member club can be "serious" about battling it out with the club in the next section or state without needing to jump through hoops of "managing" entries or intimidating their fellow club members to stay off the air.

In the *NCJ*-sponsored contests, team competition is limited to teams of ten single operators. This is a good fit for the nature of those contests and the size of their activity base. For large contests, there's no reason why the number of scores that contribute to a team score cannot be larger. For the ARRL Sweepstakes, there could be three categories of teams: 10, 25, and 50 competitors, for example.

Team competitions can support not only inter-club rivalries, but all sorts of new opportunities would open up for group competitions. Intra-club rivalry is one example that already happens frequently in NCJ contests. Larger clubs can form multiple teams and battle it out amongst themselves. Clubs that don't traditionally enter the ARRL club competitions could get into the fun, as well. University clubs could form alumni teams with operators scattered across the country. Alumni of large corporations could do the same thing, i.e. "Team Ex-IBM." Or what about an "Army vs. Navy" team competition? "Team K2 Forever" could be formed entirely of operators using Elecraft K2s. FISTS could organize teams. The World Wide Young Contesters club could organize teams. How many potential contesters could find a team they feel at home in, instead of feeling stuck because they belong to a club that's more "serious" than they want to be in the contests?

Summary and Alternative

Club competition in the ARRL contests has many serious problems. Not all of the members of radio clubs participating in the club competitions are served well by the rules of club competition. Some club members are marginalized, intimidated and otherwise encouraged to stay off the air in the contests in order that the club might benefit. This is discouraging and can turn off potential future contesting greats.

A better alternative is team competition, such as that implemented in the contests sponsored by *NCJ*. Team competition supports the desire of clubs to compete against one another and can open up entirely new opportunities for contester involvement and competition. More contesters can get involved, fewer are marginalized or excluded, and the sport of radio contesting would be healthier as a result. I hope that others will consider this as well, and I encourage everyone to discuss this with fellow contesters. NCJ

Contest Helper

With SS upon us, here's a little helper to get those sections correct (especially those in California and Canada!).

1	
Connecticut	CT
Eastern Massachusetts	EMA
Maine	ME
New Hampshire	NH
Rhode Island	RI
Vermont	VT
Western Massachusetts	WMA
2	
Eastern New York	ENY
New York City-Long Island	NLI
Northern New Jersey	NNJ
Northern New York	NNY
Southern New Jersey	SNJ
Western New York	WNY
3	
Delaware	DE
Eastern Pennsylvania	EPA
Maryland-DC	MDC
Western Pennsylvania	WPA
4	
Alabama	AL
Georgia	GA
Kentucky	KY
North Carolina	NC
Northern Florida	NFL
Puerto Rico	PR
South Carolina	SC
Southern Florida	SFL
Tennessee	TN
Virgin Islands	VI
Virginia	VA
West Central Florida	WCF
5	
Arkansas	AR
Louisiana	LA
Mississippi	MS
New Mexico	NM
North Texas	NTX
Oklahoma	OK
South Texas	STX
West Texas	WTX
6	
East Bay	EB
Los Angeles	LAX
Orange	ORG
Pacific	PAC
Sacramento Valley	SV
San Diego	SDG
San Francisco	SF
San Joaquin Valley	SJV
Santa Barbara	SB
Santa Clara Valley	SCV
7	
Alaska	AK
Arizona	AZ
Eastern Washington	EWA
Idaho	ID
Montana	MT
Nevada	NV
Oregon	OR
Utah	UT
Western Washington	WWA
Wyoming	WY
8	
Michigan	MI
Ohio	OH
West Virginia	WV
9	
Illinois	IL
Indiana	IN
Wisconsin	WI
0	
Colorado	CO
Iowa	IA
Kansas	KS
Minnesota	MN
Missouri	MO
Nebraska	NE
North Dakota	ND
South Dakota	SD
Canada	
Maritime	MAR
Newfoundland/ Labrador	NL
Quebec	QC
Ontario	ON
Manitoba	MB
Saskatchewan	SK
Alberta	AB
British Columbia	BC
Northwest Territories/ NWT/Yukon/Nunavut	

NCJ

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Visualizing Band Openings with ACE-HF

I don't know about you, but I've spent my share of time running propagation predictions, poring over printouts and transferring pertinent data and notes to another sheet of paper to make band plans (*guidelines* would be a better word!) for contests.

Although this has always been a tedious task, it's kind of been a labor of love. But there comes a time with any repetitious task when you finally blurt out, "there's got to be an easier way!"

How would you like some help with this task? The recently-introduced ACE-HF propagation prediction software may be just what you're looking for. This software was announced in May, and was first shown at HamCom in Arlington, TX this summer.

The ACE part of ACE-HF stands for Animated Communications Effectiveness. ACE-HF is an outgrowth from ACE-VLF, software developed for the US Navy to predict the effectiveness of submarine communications. The ACE method shows a sequential series of area coverage maps. When showing the maps one after the other, a movie-like display is produced. The images may be shown one at a time, or repeated rapidly at various speeds.

ACE-HF uses VOACAP as the computational engine. If you've ever played with IONCAP, VOACAP or ICEPAC (or the area coverage versions of VOACAP and ICEPAC), you'll feel right at home with ACE-HF.

The ACE-HF software was developed by Richard (Dick) Buckner, P.E., with advice from George Lane, who was previously the senior HF propagation engineer for the Voice of America and who sponsored most of VOACAP's development.

Enough for the introductory remarks—let's see what ACE-HF can do for us in a contest scenario. With CQ WW CW right around the corner, let's assume I'm going to do a single band 15-m high power effort.

The first order of business is to input the general parameters: my location, mode, transmit antenna (my end), receive antenna (DX end), the predicted smoothed sunspot number for November 2002 (the ACE-HF manual gives a web site where you can get that info), noise environment at receive end of path, and a couple other items.

Once that was done, I ran worldwide area coverage predictions on 15m for every hour of the day. The end result was an animation of the 24 worldwide area coverage maps versus time. Four of the 24 frames are shown in Figure 1.

I chose to present the area coverage maps as areas where the SNR was above my desired target (for this exercise I went with the default value in ACE-HF). You have the option of doing the area coverage maps as reliability (50% and 90%) or required power gain (nominal, 10 dB less system gain, and 10 dB more system gain).

Figure 1 visually shows where in the world my signal, given the parameters I entered, is above the SNR target I chose. Due to Figure 1 being black and white, the areas where the SNR is above my target SNR are the dark black areas. The real maps in ACE-HF are in color, and are shaded to delineate where the SNR is above and where the SNR is below the target value. The terminator is also included on the maps.

At 1000 UTC (5AM local time at my QTH), 15 meters is not predicted to get my signal anywhere in the world above my target SNR. At 1100 UTC, a couple areas are predicted to open up toward the southeast.

At 1200 UTC, many areas are predicted to have my signal above my target SNR—including the Caribbean, South America, Africa and southern Europe. An hour later, at 1300 UTC, my signal is predicted to be above my target SNR to Central America, most of Europe and the Mideast (in addition to those areas predicted at 1200 UTC).

Thus these hourly area coverage predictions give you a visual picture of where in the world your signal is above your target SNR. When utilized in the movie feature, it gives you a full-day picture of what's predicted to happen, but in a short period of time. This up-front visualization may help you with your contest planning. And as stated earlier, you have the option of doing the area coverage maps as Reliability or Required Power Gain. That last option is an interesting one, as it could give you a visual presentation of station improvements, station degradations, and even help with High Power versus Low Power decisions.

Once you have the area coverage limits firmly in mind, you may want to shift to ACE-HF's point-to-point predictions

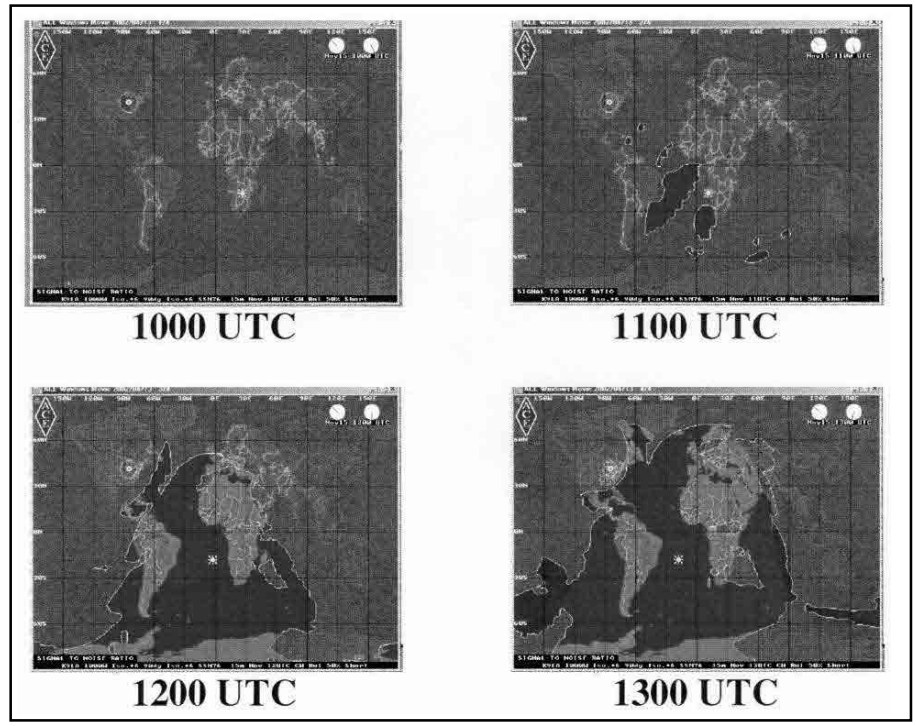


Figure 1—Worldwide area coverage maps produced by ACE-HF. The predictions are for coverage on 15 meters from K9LA for CQ WW CW weekend.

to zero in on your favorite contest area. In just a few seconds, you can see how the circuit changes with time, and the pop-up menu allows you to quickly examine the effect of changing power, antenna settings, or any other system parameter.

This was not a "how to use it" article. There' a 28-page Help Tutorials manual that will address that aspect of ACE-HF, along with much information on how ACE-HF goes about its business. This article was more along the lines of "what can I use it for in contesting". Hopefully I've shown you the capability of ACE-HF, and perhaps given you some ideas about how you can use it in your specific contesting activities.

In addition to the unique area coverage movies that allow you to visualize where your signal will be heard above a designated level, ACE-HF does everything VOACAP does. You can get MUF charts, Best Frequency charts, Elevation Angle charts, and a bunch of other charts. Additionally, there is a unique "Summary Chart" that shows SNR or Reliability limits as a function of both frequency and time-of-day. This chart may quickly become a favorite tool for examining circuit integrity.

For more information about ACE-HF, visit the ACE-HF web site at **www.acehf.com**. You can even take a more thorough tour of ACE-HF there, and the display screens are in color showing what everything really looks like. You can also download the Help Tutorials manual as a Word file or as a pdf file. If you want to talk to Dick personally, give him a call at 970-586-5142 during the day or e-mail him at **support@acehf.com**. NCJ

Contest Calendar

Compiled by Bruce Horn, WA7BNM
bhorn@hornucopia.com

Here's the list of major contests to help you plan your contesting activity through February 2003. The web version of this calendar is updated more frequently and lists contests for the next 12 months. 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 at my *Callbook* address or via e-mail at **bhorn@hornucopia.com**. Good luck and have fun!

November 2002

IPA Contest, CW	0600Z-1000Z and 1400Z-1800Z, Nov 2
Ukrainian DX Contest	1200Z, Nov 2 to 1200Z, Nov 3
ARRL Sweepstakes Contest, CW	2100Z, Nov 2 to 0300Z, Nov 4
NA Collegiate ARC Champ, CW	2100Z, Nov 2 to 0300Z, Nov 4
ARCI Running of the QRP Bulls	2100Z, Nov 2 to 0300Z, Nov 4
IPA Contest, SSB	0600Z-1000Z and 1400Z-1800Z, Nov 3
High Speed Club CW Contest	0900Z-1100Z and 1500Z-1700Z, Nov 3
DARC 10-Meter Digital Contest	1100Z-1700Z, Nov 3
Japan Int. DX Contest, Phone	2300Z, Nov 8 to 2300Z, Nov 10
WAE DX Contest, RTTY	0000Z, Nov 9 to 2359Z, Nov 10
OK/OM DX Contest, CW	1200Z, Nov 9 to 1200Z, Nov 10
Anatolian ATA PSK31 Contest	1800Z-2400Z, Nov 9
LZ DX Contest, CW	1200Z, Nov 16 to 1200Z, Nov 17
All Austrian 160-Meter Contest	1600Z, Nov 16 to 0700Z, Nov 17
ARRL Sweepstakes Contest, SSB	2100Z, Nov 16 to 0300Z, Nov 18
NA Collegiate ARC Champ, SSB	2100Z, Nov 16 to 0300Z, Nov 18
RSGB 1.8 MHz Contest, CW	2100Z, Nov 16 to 0100Z, Nov 17
CQ Worldwide DX Contest, CW	0000Z, Nov 23 to 2400Z, Nov 24
ARRL International EME Contest	0000Z, Nov 23 to 2400Z, Nov 24

December 2002

QRP ARCI Hol. Spirits Sprint	2000Z-2400Z, Dec 1
QRP ARCI Topband Sprint	1800 local, Dec 4 to 0600 local, Dec 5
ARRL 160-Meter Contest	2200Z, Dec 6 to 1600Z, Dec 8
PSK31 Death Match	0000Z, Dec 7 to 2400Z, Dec 8
TARA RTTY Sprint	1800Z, Dec 7 to 0200Z, Dec 8
TOPS Activity 80-Meter Contest	1800Z, Dec 7 to 1800Z, Dec 8
ARRL 10-Meter Contest	0000Z, Dec 14 to 2400Z, Dec 15
Great Colorado Snowshoe Run	0200Z-0400Z, Dec 15
AGB Party Contest	2100Z-2300Z, Dec 20
OK DX RTTY Contest	0000Z-2400Z, Dec 21
Croatian CW Contest	1400Z, Dec 21 to 1400Z, Dec 22
DARC Christmas Contest	0830Z-1059Z, Dec 26
RAC Winter Contest	0000Z-2400Z, Dec 28
Stew Perry Topband Challenge	1500Z, Dec 28 to 1500Z, Dec 29
Original QRP Contest, CW	1500Z, Dec 28 to 1500Z, Dec 29

January 2003

AGB NYSB Contest	0000Z to 0100Z, Jan 1
SARTG New Year RTTY Contest	0800Z to 1100Z, Jan 1
AGCW Happy New Year Contest	0900Z to 1200Z, Jan 1
AGCW QRP Winter Contest	1500Z, Jan 4 to 1500Z, Jan 5
ARRL RTTY Roundup	1800Z, Jan 4 to 2400Z, Jan 5
Hunting Lions in the Air	0000Z, Jan 11 to 2400Z, Jan 12
Midwinter Contest, CW	1400Z to 2000Z, Jan 11
North American QSO Party, CW	1800Z, Jan 11 to 0600Z, Jan 12
NRAU-Baltic Contest, CW	0530Z to 0730Z, Jan 12
NRAU-Baltic Contest, SSB	0800Z to 1000Z, Jan 12
Midwinter Contest, Phone	0800Z to 1400Z, Jan 12
DARC 10-Meter Contest	0900Z to 1059Z, Jan 12
LZ Open Contest, CW	1200Z to 2000Z, Jan 18
MI QRP January CW Contest	1200Z, Jan 18 to 2359Z, Jan 19
North American QSO Party, SSB	1800Z, Jan 18 to 0600Z, Jan 19
ARRL January VHF Sweepstakes	1900Z, Jan 18 to 0400Z, Jan 20
Hungarian CW Contest	0000Z to 2400Z, Jan 19
CQ 160-Meter Contest, CW	2200Z, Jan 24 to 1600Z, Jan 26
REF Contest, CW	0600Z, Jan 25 to 1800Z, Jan 26
BARTG RTTY Sprint	1200Z, Jan 25 to 1200Z, Jan 26
UBA DX Contest, SSB	1300Z, Jan 25 to 1300Z, Jan 26

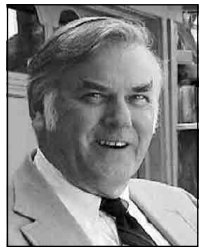
February 2003

10-10 Inter. Winter Contest, SSB	0001Z, Feb 1 to 2400Z, Feb 2
Minnesota QSO Party	1400Z to 2359Z, Feb 1
FYBO Winter QRP Field Day	1400Z, Feb 1 to 0200Z, Feb 2
Delaware QSO Party	1700Z, Feb 1 to 0500Z, Feb 2 and 1300Z, Feb 2 to 0100Z, Feb 3
Mexico RTTY International Contest	1800Z, Feb 1 to 2400Z, Feb 2
North American Sprint, Phone	0000Z to 0400Z, Feb 2
CQ/RJ WW RTTY WPX Contest	0000Z, Feb 8 to 2400Z, Feb 9
Asia-Pacific Sprint, CW	1100Z to 1300Z, Feb 8
Dutch PACC Contest	1200Z, Feb 8 to 1200Z, Feb 9
YL-OM Contest, CW	1400Z, Feb 8 to 0200Z, Feb 10
FISTS Winter Sprint	1700Z to 2100Z, Feb 8
RSGB 1.8 MHz Contest, CW	2100Z, Feb 8 to 0100Z, Feb 9
North American Sprint, CW	0000Z to 0400Z, Feb 9
QRP ARCI Winter Fireside SSB Sprint	2000Z to 2400Z, Feb 9
ARRL School Club Roundup	1300Z, Feb 10 to 0100Z, Feb 15
ARRL Inter. DX Contest, CW	0000Z, Feb 15 to 2400Z, Feb 16
YL-OM Contest, SSB	1400Z, Feb 15 to 0200Z, Feb 17
CQ 160-Meter Contest, SSB	2200Z, Feb 21 to 1600Z, Feb 23
REF Contest, SSB	0600Z, Feb 22 to 1800Z, Feb 23
UBA DX Contest, CW	1300Z, Feb 22 to 1300Z, Feb 23
High Speed Club CW Contest	0900Z to 1100Z, Feb 23 and 1500Z to 1700Z, Feb 23
North Carolina QSO Party	1700Z, Feb 23 to 0300Z, Feb 24
CQC Winter QSO Party	2200, Feb 23 to 0359Z, Feb 24

International Contests

Joe Staples, W5ASP
10031 Meadow Lake Lane
Houston, TX 77042
w5asp@earthlink.net

Changing Times



When I wrote the first of this series of columns on International Contests for the July/August 1994 issue of *NCJ*, it was my intent to provide those in the contest community with better access to the results of "foreign" contests. Use of the Internet was just beginning to spread among contesters, and the exchange of contest results via email was sporadic at best. The publication and distribution of the official results was often delayed by a year or more, and even then did not reach all participants. As a result, activity in such contests by domestic stations was rather limited. The newcomer to contesting had little incentive to get involved. At the time it seemed a good thing to do.

But times change. Thanks to the efforts of many contest sponsors, and to the hard work of those such as Bruce, WA7BNM, Mike, N7WA, and their associates, contests scores, both claimed and final, are now being posted to various Web sites promptly and efficiently. The idea of personally gathering scores and submitting them to a publication that won't reach the readers for several months just doesn't seem as rational as it once did. There is a better way, and now seems to be the time to make the change.

This will be the last of the International Contests columns to report detailed contest scores. Plans are already underway to expand the present NCJ website to provide easy access to the final results of foreign contests as they become available, rather than waiting for the next issue of the NCJ. Although the column will no longer appear as a regular feature of the NCJ, there will be occasions to return

2001 All Asian DX Contest

	Class	Pts	Mlts	Score
CW				
CANADA				
VE7UF	M	357	177	63189
VE3MQW	M	89	62	5518
VE3BUC	M	25	21	525
VE7NI	14	29	20	580
VE6B	21	30	27	810
VA3UZ	21	23	16	368
VA3RU	21	18	16	288
VE7GL	M/S	814	258	210012
USA—ZONE 3				
WN6K	M	688	247	169936
N6ZZ	M	476	215	102340
WO6M	M	282	145	40890
AD6AJ	M	257	102	26214
W7HS	M	190	126	23940
N6TW	M	161	110	17710
K6CSL	M	48	39	1872
AA6EE	M	34	33	1122
KE6QR	M	27	21	567
W7DRA	7	46	26	1196
WA6FGV	21	272	104	28288
K6III	21	145	73	10585
W7KN	21	100	56	5600
KA6SGT	21	32	27	864
W7GG	M/S	1088	355	386240
K6ZM	M/S	1076	335	360460
USA—ZONE 4				
K9DX	M	362	164	59368
K5NZ	M	308	140	43120
N5PO	M	295	122	35990
W4NZ	M	133	90	11970
K0CIE	M	93	68	6326
W5FO	14	284	101	28684
K8AJS	14	66	44	2904
WB0YJT	21	29	21	609
WA0OTV	21	19	17	323
W0TM	M/S	369	171	63099
USA—ZONE 5				
K3ZO	M	412	195	80340
K1KI	M	141	88	12408
K4BAI	M	116	83	9628
N3RD	M	128	73	9344
W1RM	M	102	70	7140
W4SAA	M	66	49	3234
K1GU	M	62	41	2542
NA2M	M	39	28	1092
N4BP	21	325	110	35750
N1RR	21	190	96	18240
K3SWZ	21	73	40	2920
WA2VQV	21	30	23	690
K3TW	21	25	20	500
W4ZV	28	248	63	15624
N4MM	28	20	10	200
PHONE				
CANADA				
VE7XB	M	312	114	35568
VE7FO	M	217	100	21700
VE7XO	M	141	90	12690
VE3BUC	M	128	86	11008
VA3UZ	M	65	49	3185
VE6AO	21	149	61	9089
USA—ZONE 3				
W6AFA	M	796	258	205368
WN6K	M	520	187	97240
W7ZR	M	340	146	49640
K7JJ	M	227	101	22927
K2RED/6	M	212	104	22048
K6III	M	109	60	6540
KI6PG	M	35	29	1015
WA6FGV	21	170	71	12070
WV6E	21	69	38	2622
KB7SCF	21	37	22	814
USA—ZONE 4				
AB0MV	M	725	253	183425
W9LYN	M	71	62	4402
W3UA	M	30	29	870
K4IU	M	23	21	483
K4BP	M	21	19	399
W8KNO	M	18	16	288
K0DAT	M	18	15	270
K0UK	M	6	6	36
KK0SS	21	239	99	23661
N4MM	21	96	65	6240
WA5OYU	21	104	59	6136
W0TM	M/S	744	269	200136
USA—ZONE 5				
K3ZO	M	747	256	191232
N3RD	M	497	213	105861
K3WW	M	368	175	64400
N4GG	M	106	80	8480
K3DI	M	57	48	2736
K1KI	21	698	146	101908
K3TW	21	55	46	2530
NA2X	28	26	11	286

2001 UBA (Belgian) DX Contest

	CLASS	QSO	MLT	PTS	SCORE
CW					
VA3UA	A10	73	15	258	3870
N4MM	A10	37	12	130	1560
W1END	A10	51	11	137	1507
VA3TTN	A15	135	22	413	9086
VE7NI	A15	19	1	80	80
VA3TTT	A40	48	13	129	1677
VE3KZ	B	664	94	1868	175592
K3ZO	B	425	68	1310	89080
K3WW	B	382	70	951	66570
K4BAI	B	152	34	362	12308
VE2AWR	B	69	20	207	4140
K0CIE	B	38	20	149	2980
K9BG/4	B	36	13	162	2106
N0IBT	B	11	15	96	1440
K4IU	B	25	10	85	850
VA3UZ	D	150	38	437	16606
SSB					
VE3KZ	A10	192	28	714	19992
WB0IWG	A10	46	17	230	3910
N4MM	A10	31	15	162	2430
VP5AZ	B	266	50	812	40600
W2UDT	B	30	24	300	7200
VA2IC	B	39	30	215	6450
K4IU	B	50	26	196	5096
VE2AWR	B	35	22	136	2992
K7ZO	B	38	17	136	2312

to the subject of international contesting to address specific topics.

This will be an ongoing effort on my part. There are a number of options that need to be explored, especially with respect to acquiring final scores and standings directly from foreign contest sponsors. Also, I hope to see to it that the NCJ website provides up-to-date information and links for use by those who enjoy this aspect of contesting. If things go as planned, much of this should be in place by the time the next issue of the NCJ hits the street. An update on all this will appear in that issue.

Fortunately, the comprehensive and timely reporting by N7WA of "Claimed Scores" for international contests is now well established. These scores are regularly posted to both the 3830 Reflector and the CQ-Contest Reflector. For those who happen to miss the initial posting, the information can be easily found in the Archives for these reflectors which are available at the contesting.com website. The "information superhighway" is truly out there for all who care to use it.

2001 OK-OM DX Contest

	QSO	*Pts*	*Mlt*	*Total*
SO/AB HP				
N4AF	379	1107	291	322137
K2SX	238	702	187	131274
K3ZO	224	648	183	118584
K3WW	214	582	170	98940
N6ZZ	207	573	160	91680
W3BYX	192	486	151	73386
K5ZD	135	405	120	48600
N9RV	102	288	88	25344
W2UDT	116	252	100	25200
W6YA	77	195	65	12675
K0COP	56	144	53	7632
AA3VA	23	51	22	1122
SO/40M HP				
KR1G	88	258	63	16254
SO/AB LP				
K9QVB	297	855	217	185535
W2CVW	195	579	156	90324
AE0Q	140	414	116	48024
VA3UA	106	282	98	27636
VE1KB	112	216	95	20520
WO4O	88	234	79	18486
VE2AWR	57	165	52	8580
VE7NI	56	132	51	6732
TI5/N0KE	47	141	47	6627
KC9TV	40	96	37	3552
N3NZ	29	81	29	2349
VA3IX	24	24	14	336
SO/40M LP				
K2TV	11	27	11	297
SO/20M LP				
VE7NI	13	27	11	297
VE7VF	16	18	14	252
VE3BR	10	10	10	100
SO/15M LP				
W2YK	65	153	53	8109
VE7NI	32	90	29	2610
VE7VF	13	33	13	429
SO/10M LP				
W1END	82	240	62	14880
W3DAD	36	108	31	3348
K2TV	28	66	28	1848
VE7VF	12	18	12	216
VE7NI	11	15	11	165
SO/AB QRP				
VA3TTT	203	579	164	94956
K3WWP	78	210	71	14910
VE9DX	62	174	56	9744
K3TW	52	138	49	6762

2001 SP (Polish) DX Contest

	Category	QSO	Pts	Mlt	Score
USA					
W0AIH	MOMB	426	1278	49	62622
N4PL	SOMB CW	327	972	63	61236
N2KU	SOMB CW	308	924	56	51744
N1RR	SOMB CW	243	729	56	40824
KM5G	SOMB CW	116	348	41	14268
W1END	SOMB CW	87	261	36	9396
N6ZZ	SOMB CW	67	195	29	5655
W2CVW	SOMB CW	28	84	19	1596
K3WW	SOMB MIXED	528	1575	68	107100
W1/VA3PL	SOMB MIXED	622	1839	56	102984
K5ZD	SOMB MIXED	425	1275	63	80325
NO9E	SOMB MIXED	411	1224	46	56304
N2CAR	SOMB MIXED	214	642	46	29532
W2UDT	SOMB MIXED	111	333	31	10323
K1BV	SOMB MIXED	107	321	29	9309
KG2QF	SOMB MIXED	44	132	25	3300
K4IU	SOMB MIXED	49	147	16	2352
W1FS	SOMB MIXED	30	90	13	1170
N3XOF	SOMB SSB	524	1569	48	75312
W4EEH	SOMB SSB	327	981	35	34335
W6AFA	SOMB SSB	95	282	24	6768
W4OEL	SOSB 15 CW	50	147	16	2352
KX9DX	SOSB 15 CW	57	165	14	2310
W2BVH	SOSB 15 CW	18	54	12	648
K0COP/4	SOSB 15 CW	5	15	4	60
K3TW	SOSB 15 MIXED	134	402	16	6432
N6KUZ	SOSB 15 SSB	37	108	14	1512
WJ3J	SOSB 15 SSB	7	21	6	126
KE4PMS	SOSB 15 SSB	6	6	5	30
K1CC	SOSB 20 MIXED	349	1044	16	16704
KE1DZ	SOSB 20 SSB	146	438	16	7008
KG6FFX	SOSB 20 SSB	7	21	6	126
CANADA					
VE3QAA	SOMB CW	357	1071	62	66402
VE1OP	SOMB CW	152	456	34	15504
VE7NI	SOMB CW	12	36	12	432
VE3KZ	SOMB MIXED	109	327	33	10791
VE2AWR	SOMB MIXED	79	237	22	5214
VA3IX	SOMB MIXED	26	78	16	1248
VE6POL	SOMB SSB	53	159	21	3339
VE6CDO	SOMB SSB	22	66	14	924
VE3BUC	SOMB SSB	20	60	14	840
VA3UA	SOSB 15 CW	61	183	16	2928
VE3PND	SOSB 20 CW	105	306	16	4896
VA7LC	SOSB 20 CW	9	27	8	216
VE7MG	SOSB 20 MIXED	11	33	8	264
VA3TTT	SOSB 40 CW	13	39	11	429
VA3KA	SOSB 40 MIXED	57	171	16	2736

2001 JIDX Phone Contest

	Class	*Qs*	*Pts*	*Mlt*	*Score*
USA—ZONE 3					
KA6BIM	AB	848	1313	169	221897
N7ZT	AB	189	327	71	23217
KA6SAR	ABL	780	1126	139	156514
W6AFA	ABL	772	1100	126	138600
W7BX	ABL	400	620	94	58280
WN6K	ABL	414	621	92	57132
N6WS	ABL	77	117	53	6201
KC7WDL	ABL	53	78	43	3354
K6OWL	ABL	51	98	32	3136
K6III	ABL	37	55	31	1705
K7ATA	ABL	20	33	17	561
K7ZO	28	263	518	45	23310
KA6PUW	28L	447	890	47	41830
WA6FGV	28L	224	448	44	19712
K6HNZ	21	581	581	47	27307
WA7QQI	14	19	19	16	304
USA—ZONE 4					
AB0MV	AB	496	790	101	79790
W5PF	AB	160	268	77	20636
K5NZ	AB	137	220	72	15840
K5CWR	ABL	359	359	94	33746
K0DAT	ABL	69	116	48	5568
K0UK	ABL	47	62	39	2418
K9HY	28	27	26	21	546
N4MM	28L	33	66	23	1518
USA—ZONE 5					
K1JN	AB	150	213	88	18744
K3ZO	AB	102	138	62	8556
AB2FA	AB	42	70	33	2310
K4JAF	ABL	109	187	60	11220
KA2MGE	28	82	164	36	5904
WB0IWG/3	28L	6	12	6	72
CANADA					
VE7AVV	AB	448	598	101	60398
VE7XO	AB	150	245	75	18375
VE7XB	ABL	305	517	95	49115
VA3UZ	ABL	127	217	70	15190
VE7NS	ABL	125	205	70	14350
VA3IX	28L	19	38	17	646
VA6MA	14L	5	5	5	25

VHF Contesting

Jon K. Jones, N0JK
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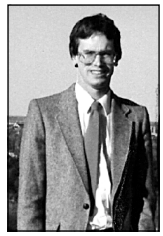
September 2002 VHF QSO Party: Worst Overall Conditions in Years



If you thought the June contest was slow, "The September VHF QSO Party was a real quiet contest… zero Qs, zero grids!" de WB9UAI.

No E_s, Aurora, or significant tropo was reported. It rained hard here in Kansas Saturday and I was able to only operate on Sunday. Operated all day Sunday from EM08 and made only 3 contacts. One was a 6meter QSO with K0HA—not a bad groundwave contact for only 10 W. "KA0MR and N0JK QSOs on 50.125 CW—tnx—K0HA EN10." I heard some scatter, but unlike the June contest, I was unable to complete any QSOs. I heard N3EMF (FM19) for about 5 minutes on 50.140 ragchewing about 432 MHz skeds, but I was unable to get his attention.

Bill, K0HA, had some luck with 6-meter scatter, working W3SO (FN00), W4RX, K3YTL (FN11), W2FU (FN13) and N3EMF (FM19) among others. He noted 6-meter scatter peaked at an azimuth of 80-90 degrees. VE3CDP/W9 (EM58) worked KC4PX (EL98), NW5E and VE3OIL on 6-meter scatter. A tough contest here in North America.

DX stations had better luck. YS1JBL heard "LW3DX CQ test 58/59 OK in YS" at 0258 UTC September 15 and "worked several LU stations on 50.130 MHz with Miguel, LU6DQV, very strong." This was tropical nighttime TEP.

Too bad the contest was not a week earlier. On September 7 a geomagnetic storm occurred. Saturday afternoon most of the US had a 3-hour opening to the Galapagos. Guido, HC8GR, worked coast to coast on 6 meters. Saturday evening had a great Aurora, and I made several auroral QSOs on 2 meters running only 10 W and a small Yagi.

This from Jerry, WB9Z, in EN60: "The Sept. VHF contest was nothing to get excited about for me. No E-skip, just a few meteor scatter Qs for excitement. Here's the numbers compared to June's: Sep—169 x 55, June—379 x 134. Big difference. I put about 30 hours into each contest. My numbers were up a little on the rest of the bands."

This from Curt Roseman, K9AKS. "Attached are the all-time [grid square—post 1985] QSO highs on six meters in the June contest. Certainly 1987 and 1992 were great years on six, but it was not until 1996 that anyone broke 1000 Qs on 6 meters. Then, it has happened in each year during which six has been pretty good. The reason is simple: the addition of six meters to many HF rigs."

ALL-TIME HIGH QSO TOTALS, SIX METERS

JUNE VHF CONTEST

1985-2001

BAND	*QSOs*	*GRIDS*	*CALL*	*CLASS*	*YEAR*	*SECT*	*Q/GRID RATIO*
50	1358	245	W5KFT	L	98	STX	5.54
50	1212	233	N5HHS	S	98	STX	5.20
50	1161	269	W5KFT	L	96	STX	4.32
50	1104	260	W5KFT	L	00	STX	4.25
50	1090	221	W5UWB	S	98	STX	4.93
50	1077	262	N5HHS	B	99	STX	4.11
50	1066	240	W1XE	L	98	CO	4.44
50	1031	234	K0GU	S	98	CO	4.41
50	1023	232	N5HHS	S	96	STX	4.41
50	1020	260	K5AM	B	00	NM	3.92
50	1009	210	W8CM	S	98	NTX	4.80
50	992	219	K5IUA	M	98	STX	4.53
50	991	<219	WB2WIH	B	00	SFL	
50	985	256	K5CM	S	87	OK	3.85
50	983	229	AA9D	M	98	IL	4.29
50	976	278	WB0DRL	L	92	KS	3.51
50	975	239	W5UWB	B	00	STX	4.08
50	969	279	K5JL	M	87	OK	3.47
50	953	214	WD5K	S	98	NTX	4.45
50	944	258	W7XU	L	98	SD	3.66
50	918	<210	N5WS	S	98	STX	
50	909	171	W2SZ	M	01	WMA	5.32

International Contests

(Continued from page 33)

2001 Oceania DX Contest

	Class	*QSOs*	*Pts*	*Mlts*	*Score*
CW					
USA					
K3ZO	SO/AB	91	229	36	8244
N6AA	SO/AB	79	190	36	6840
N5DO	SO/AB	76	200	33	6600
AC7LX	SO/AB	40	92	21	1932
W4OV	SO/AB	32	89	17	1513
K7TQ	SO/AB	29	69	17	1173
K4UI	SO/AB	12	29	10	290
W7DRA	SO/40M	16	80	8	640
Canada					
VE3MQW	SO/AB	64	148	33	4884
VA3UZ	SO/AB	49	126	27	3402
VE4MF	SO/AB	19	49	14	686
VE3ABX	SO/10M	9	27	7	189
PHONE					
USA					
K3ZO	SO/AB	168	280	50	14000
NA2X	SO/AB	32	75	20	1500
N4GG	SO/AB	22	35	15	576
W8KNO	SO/AB	17	29	12	348
N6AA	SO/AB	3	3	2	6
N4MM	SO/15M	5	10	5	50
WA5SWN	SO/10M	6	18	4	72
Canada					
VA3UZ	SO/AB	53	110	35	3850
VE3MQW	SO/AB	40	84	23	1931
VA3IX	SO/AB	11	15	9	135

DX Contest Activity Announcements

Bill Feidt, NG3K
bill@ng3k.com

Now is the time to submit your announcements for the ARRL International DX Contests. If you want your listing to appear in the January/February 2003 issue, I'll need to receive it no later than November 25.

You can submit your data using the form that you'll find at **www.ng3k.com/Contest/consub.html**.

If you would prefer to e-mail me your information, please be sure to include:

- Callsign to be used
- DXCC entity
- CQ Zone (for the CQWW contests)
- Entry class anticipated
- QSL route
- Your callsign and public e-mail address
- Operators and other information of likely interest

Send your information to **bill@ng3k.com**.

You can review what has been received to-date at **www.ng3k.com/Contest/conasc.html**. This page is continuously updated as new announcements are received.

73, Bill, NG3K

ARRL 160 M Contest (December 6-8, 2002)

Call	*Entity*	*Class*	*Operators*
FS	St Martin	???	FRC group
P40TA	Aruba	SO HP	K6TA
ZF2AH	Cayman Is	SO LP	W6VNR

Thanks to: K6TA, OPDX, W6VNR.

ARRL 10 M Contest (December 14-15, 2002)

Call	*Entity*	*Class*	*Operators*
8P9Z	Barbados	SOHP Mixed	K4BAI
C6ANK	Bahamas	SOLP Mixed	W9AU
D44TD	Cape Verde	SO SSB	I4UFH
P40K	Aruba	M/S HP	K6KO, K6TA
ZF2AH	Cayman Is	SOHP SSB	W6VNR

Thanks to: I4UFH, K4BAI, K6TA, W6VNR, W9AU.

ARRL DX CW Contest (February 15-16, 2003)

Call	*Entity*	*Class*	*Operators*
V26G	Antigua	SO	N2ED
VP9/W6PH	Bermuda	SOAB LP	W6PH

Thanks to: N2ED, W6PH. See **www.ng3k.com/Misc/adxc2003.html** for further details and updates.

CQ World Wide DX CW Contest (November 23-24, 2002)

Call	*Entity*	*Class*	*Operators*
8N1OGA	Ogasawara	???	JA team
8P5A	Barbados	SOAB	W2SC
9M6NA	East Malaysia	SOSB 15M	JE1JKL
C53M	Gambia	M/M	Team
CN2R	Morocco	SOAB	W7EJ
CY0MM	Sable	???	VE3NZ, VE3EY, VE3NE
D44TD	Cape Verde	M/S	IK4UPB, IK2NCJ, IK2JUB and others
DU1/N2NL	Philippines	SOAB LP	N2NL
EA8ZS	Canary Is	M/M	OH2U, EA8ZS, OH1RY, OH1MA
ES6Q	Estonia	M/S	ES5TV, ES5RW, ES5MC, ES5RY, ES5QX, ES5RAH, ES5RN, ES5MG
GM7V	Scotland	M/M	GM3WOJ, GM0NAI, GM4CXM, GM0GA, MM0CCC, GM4YXI
HC8N	Galapagos	M/M	N5KO and others
IG9A	African Italy	SOSB 80M	IT9GSF
IH9P	African Italy	SOSB 40M	OL5Y
JW5E	Svalbard	M/S	JW5NM and others
LZ8T	Bulgaria	SOSB 80M	LZ2FV
MJ0ASP	Jersey	SOSB 20M	F5SHQ
P40A	Aruba	SOSB	KK9A
P40E	Aruba	SOAB HP	CT1BOH
P40W	Aruba	SOAB	W2GD
PJ2T	Neth Antilles	M/M	W4PA, NP2L, W0NB, W8TK, WA9S W0CG, K8GT, N1ZZ, W9EFL
PT5A	Brazil	M/M	PP5JR, PY5EG, K1ZM, N7NG, OH2K N5ZO, N7BG, W6NV, N6CW, OH2MM, KH6ND, N6TJ, N6AA
RU1A	Russia (Europe)	M/2	RU1AA, RW1AC, RV1AW, UA1ARX RN1AM, RX1AA, RA1ACJ and others
S9	Sao Tome	SOAB LP	K1XM
TM5CW	France	???	F5SJB
V26K	Antigua	SOAB LP	AA3B
V47CA	St Kitts	???	VE3BW
VE2IM	Canada	SOAB HP	VE3DZ
VP2E	Anguilla	M/S	KC5EA, N5HGB, N5AU and others
VP9/W6PH	Bermuda	SOAB LP	W6PH
WP2Z	Virgin Is	M/?	K3TEJ, AB2E
ZZ8Z	Brazil	SOAB LP	PY8AZT

Thanks to: AA3B, CT1BOH, ES5RY, F5SHQ, F5SJB, GM3WOJ, IK4UPB, IT9GSF, JE1JKL, JW5NM, K1XM, K3TEJ, KK9A, LZ2CJ, N2NL, N5AU, N5KO, N6TJ, OH2XX, OH9MM, OL5Y, OPDX, PY8AZT, RW1AC, VE3DZ, VE3NE, W0CG, W2GD, W2SC, W6PH, W7EJ. See **www.ng3k.com/Misc/cqc2002.html** for further details and updates.

Contesting on a Budget

Paul Schaffenberger, K5AF

The "Nickel Fix" that Saved Your Bacon

It was 1969. The strobe light flickered with blinding intensity as my college rock band belted out Jimi Hendrix's "Purple Haze," our amplifiers cranked up to a setting of 11 on a scale of 1 to 10. As the song ended, the bottom literally fell out of our sound when the bass amplifier blew a fuse.

What was a group of aspiring rock superstars to do? We had no spare fuses, and the 24-hour Wal-Mart was not going to be around for at least another 20 years. It was then that I was introduced to the "nickel fix". Our guitar player ran to the nearest candy machine and plunked in a nickel for a package of gum. He then took the aluminum foil off one of the pieces of gum, wrapped it around the blown fuse, and inserted it into the amp. Presto! We were back in business!

The gum wrapper was not the "nickel fix". In retrospect, it was a dangerous and ill-advised fix at best. The real "nickel fix" was the spare fuse for each amp that we carried religiously after that experience.

There are many inexpensive items that we can keep around the shack that help us survive the challenges that Murphy throws at us during almost every contest. Moreover, there are innovative workarounds that often cost nothing that allow us to continue the contest, even though wounded.

If ever there was a consensus "nickel fix" that had the potential of saving a contest, it is the clamp-on ferrite RFI choke. We often use antenna and rig combinations in contests that we don't use in routine operating. Therefore, we sometimes discover RFI problems for the first time in contests. Several of you mentioned curing problems on the fly with clamp-on filters. Jim, N3BB, was among those who mentioned that RFI problems were among the most common. While Jim emphasizes prevention in his station design through careful routing and "choking" of cables, he also recommends a "first aid" kit be available which includes a VOM, RF chokes, tape, cable ties, plus soldering gun and solder. Ed, N1UR, also takes a proactive approach, ensuring that every cable going in or out of his computer has a toroidal choke attached.

A corollary "nickel fix" that I've used is a .005 μF bypass capacitor. I usually keep one handy with small alligator clips attached. I'll attach it across the suspicious line or component (relays being particularly vulnerable) that might be picking up RFI, and if it solves the problem I make the installation permanent.

Of course, such high-use or high importance items as spare fuses, tubes, and patch cords should be close at hand. It is a good idea to review carefully what your contesting strategy is most dependent upon and keep appropriate spare parts or systems. My low-power wire-antenna station depended heavily on my homebrew band-switching antenna tuners. I only needed three of these tuners, but always kept a fourth in reserve.

Of course, a spare transceiver may ultimately be one of the cheapest "nickel fixes" that you can ever have available. Given that many capable transceivers are available for literally nickels on the dollar, it is an easy expense to justify.

Perhaps the most interesting "nickel fix" involved keeping the gray matter properly aligned. Chuck, K3FT, posts notes all around his equipment and keyboard to ensure that in the heat of battle he doesn't have a mental meltdown. Ed, N1UR, echoes this idea and notes that it is essential to mark antenna and rig configurations as well as the obvious things, like amp and tuner settings. Ed's recommendation for mental errors involving busted and/or unique callsigns? Download the K1EA Master Callsign Database and use it!

The second aspect of the "nickel fix" concept is the innovative work-around that saves the day. Sometimes a "virtual fix" is all that's needed. Randy, K5ZD, lost the tuning control on his FT-1000 during a contest and was able to configure his *WriteLog* software to allow him to tune using his mouse wheel.

Another computer workaround was noted by Jim, KI7Y. When the network at W7RM crashed, he used paper clips to short the appropriate pins on the female DB9 serial connector to make the system work. He later configured dummy shorting DB9 connectors to have them available for quick reconfiguration when needed.

According to the respondents, power supplies frequently cause us challenges. Tom, W7WHY, had a power supply go out on him during the 10-meter contest. He pulled the battery from his car, hooked it to a charger, and proceeded to win the W7 call area that year! Mike, W9RE, lost the power supply to his prop pitch rotor during a DX contest, so he pulled a car out to the tower and used the car battery to power the rotor and move the antenna. Jim, N3BB, discovered his keyer power supply didn't work well on 50 Hz current during WRTC 2000, so he lashed up a cable to power the keyer from his rig.

Even peripherals such as headphones can have their own set of problems requiring innovative fixes. Irritated by the high frequency response of a set of audio headphones he had recently purchased, Henry, K4TMC, inserted several layers of paper towels in the earpieces that made the headset contest-worthy. According to Ken, WM5R, when it was discovered that there was no adapter for a headset during the 2002 June VHF Party, George, K5TR, "whipped together something that involved lots of RCA connectors and a big bypass cap sort of loosely insulated with electrical tape that managed to hold together for the entire contest." Necessity is the father of invention, as they say!

DXpeditions often necessitate innovative fixes to problems, as they are often done under austere conditions. George, K5KG, in his many trips to J7, had several interesting experiences. He had purchased some power strips with surge protection that kept burning up. After considerable testing, he determined that the problem was most likely the 50 Hz ac. He removed the damaged components and used the strips without incident.

Another of George's nickel fixes at Dominica required a little help from Mother Nature. He wanted to get on 6 meters, but did not have a mast for his 6-meter beam. A local ham went to a nearby jungle and brought him a long, straight bamboo pole that did the job nicely.

As antenna fixes go, a wire backup or secondary antenna can really help during a contest. Ed, N1UR, has used a 40-10-meter dipole hung vertically from a 50-foot tree as a very effective secondary antenna. Tom, W7WHY, quickly placed a wire dipole in his attic when a storm damaged his beam and tower during CQWW. While he didn't win the contest, it "kept him in the fun."

Amplifiers seem to be a "nickel fix" subject unto their own. We certainly push them to the limit, and we sometimes pay the price. In a perfect world, the amplifier should be overbuilt and underutilized. In the real world, the opposite is often true.

Cooling seems to be the best "budget fix" for several amp problems mentioned. Several contributors mentioned using extra fans, or improving airflow in the

amp. An interesting DXpedition anecdote came from Mike, N7MB, who related that when his trusty 30L-1 fan started squealing, he was at a loss about what to do, as there was no lubricant readily available. He finally used suntan lotion to successfully lubricate the fan motor! On a recent trip to Dominica, George, K5KG, was greeted to billowing smoke when he turned on his amp. He found the problem to be a burned bypass capacitor. He simply removed it and the amp worked as normal.

In asking for inputs, I wanted to validate "war stories" I had heard about running two-hole amplifiers with a single tube. Scott, K9MA, provided an excellent rundown on how this can be done, but noted that this primarily applies to grounded-grid designs. If a two, three, or four-hole amp has a shorted tube, it must be carefully removed and the plate termination isolated so that it doesn't arc in the amp compartment. Output current and drive should be adjusted accordingly (reduced by one-half if one of two tubes is removed, by one-fourth if one of four tubes are removed, etc). Because the plate impedance will be affected, tuning settings will be slightly different. However, operation on most bands will be possible. This is likely to work better on CW than SSB, as ALC circuitry is designed for a full tube complement. This is not for the technically faint-of-heart. Contact Scott for more technical details.

There are certainly more stories out there about how inexpensive and innovative fixes saved the day, but I think you get the idea. We can plan for every contingency, and there are certainly many inexpensive items that can help "save the day". But when Murphy strikes at an unexpected time and place, contesters meet the challenge with innovation and resilience. Thanks to all who contributed: N1UR, N3BB, K3FT, K4TMC, K5KG, K5ZD, WM5R, KI7Y, N7MB, W7WHY, K9MA and W9RE.

Subject for Jan/Feb: Cheap computing power: how to buy it and use it. With the plethora of inexpensive new and used computer systems and peripherals out there, how can we harness this capability to improve our operations? What are the best systems and peripherals to buy? What software will take the community to the next level? What capabilities will you add to your station next?

Contest Tips, Tricks & Techniques

Gary Sutcliffe, W9XT

Contesting from Outside the Target Area

The object of many contests such as the CQWW or ARRL 10- and 160-meter contests is to work "anyone, anywhere." Other contests highlight a specific area. For those in the target area, the game is still to work anyone, anywhere, but the rest of the world must concentrate on a smaller area for their contacts. This can have some interesting effects on operating strategy and tactics.

Contests with the format of working a single state, country, or continent include the various state QSO parties, Worked all Europe, and All Asia contests. Although many North American contesters may not have considered it, the ARRL DX contests are actually single target contests for operators outside the continental United States and Canada.

K8MR operates many out-of-state QSO parties. Part of the reason is to reciprocate those that operate his QSO parties. Jim likes to go mobile for the OH, MI and PA QSO parties. He likes the FL and CA QSO parties because of their size. The WI QSO Party is also good for him because it has good activity for the state's size, and is the right distance for good propagation on 40 and 80 meters during the day, and on 80 at night.

N9JF also likes the state QSO parties. He would like to eventually work all counties, and this is a good way to work them. K9UQN would like to work all counties, too, and apparently just about everything else. Besides the most popular awards like DXCC and WAZ, Don likes to collect other awards, such as those offered by different radio societies.

Don starts out by making a list of the awards he wants to work. He then uses the Web to find contests that will help him make the "kills" he needs to qualify for those awards, and marks them on the calendar. After checking with his wife to avoid conflicts with other planned family activities, Don plans his operating for the next few months. In 15 years of contesting, Don has acquired over 200 different awards.

N9JF and K8MR suggest keeping a list of the posted plans of mobiles and a map of the target state handy. With these tools you can track the progress of mobiles. Mobiles activate a lot of the rarer counties in QSO parties. Counties are usually multipliers in state QSO parties. Whenever I work a QSO party mobile that I don't have information on, I try to ask them what their next county is, and when they expect to be there. If an especially rare one is coming up soon, I may adjust band changes accordingly.

K5ZD likes the smaller regional contests, especially the European country contests. Randy feels it is a great way to get acquainted with the ops in those regions. Part of the challenge he likes is to work stations on non-optimal bands such as 40 or 80 meters for the SAC, or on scatter on 10 meters when propagation does not permit a direct path.

N9JF likes the ability to set the beams once and not have to deal with them for the entire weekend unless there is a long path opening. Jim enjoys the JA high band CW tests when conditions are good, as well as a number of the European country contests including the French, Hungarian, and CQ-Mir tests.

Depending on your location relative to the target area, you might find periods of time where there is no propagation to the target area. Ken, KC9UMR, notes that keeping motivated during these times can be difficult, especially in a multi-op effort. Splitting a contest up into parts because of limited propagation is an advantage to K8MR. Jim will operate while the band is open and do other important non-ham things in between.

Most casual or not so casual out of target operators will spend their time searching and pouncing the same target stations. If you want to move ahead of the pack, you need to find some additional contacts. K8ZD feels you should spend time calling CQ towards the target area. According to Randy, "Victory comes not from working the guys who are in the contest, but those who aren't."

N9JF generates extra contacts by asking stations to QSY to other bands and modes, especially if the activity level is low. He relates one case where he made 14 contacts and was the winning out-of-state entry. Most of those contacts were with one station that he moved to work on several band/mode combinations!

Jim passes along a few other suggestions. His most important tip is to read the rules. Some of these contests have unusual rules and not accounting for them can hurt your score. Jim likes to make a list of suggested frequencies. Next he acquires a list of the counties and their abbreviations.

Bill, AA4NU, sums up his strategy by "think like a local". This means operating when they will be operating and sleeping when they are sleeping. It also means matching your band plans to theirs.

Ari, OH5DX (until recently OH1EH), offers some comments for operating the ARRL DX contests from the non-target area, outside the United States and Canada. One disadvantage Ari has is his 60° north latitude. That really hurt higher band propagation to North America except near sunspot maximums.

When he has propagation on the higher bands, he pays special attention to frequency selection. Ari likes to stay in the US General and Novice segments to maximize the number of stations available.

The lower bands are a bit different. Ari finds it difficult or impossible to get good runs going, so he depends on S&Ping most of the time. He notes were the target stations usually operate, especially on 40 and 80 meters. On 75 phone they are usually around 3805 and listen down, and are at the low end on 80 CW. He finds that he can usually only work the big guns on 160. Ari tries to find them on a higher band and make a schedule for 160.

It used to be a problem to log by computer in some of the smaller contests because the major logging programs did not support them. Today many of the logging programs allow the user to configure the program to handle different contests. N9OH has generated a set of contest modules for *WriteLog*. These include a large number of state QSO parties and more are being developed. They can be downloaded for free from his Web site at **www.xnet.com/~sjwordr/ham/modules**.

That wraps up this installment of CTT&T. Special thanks go out to AA4NU, KC9UMR, K5ZD, K8MR, K9UQN, N9JF, N9OH, and OH5DX for offering their suggestions on operating this class of contests.

Topic for January-February 2003 (deadline November 20): Open Microphone

Send in your ideas or suggestions for future topics. You can use the following routes: Postal Mail: 3310 Bonnie Lane, Slinger, WI 53086. E-mail: **w9xt@qth.com**. Be sure to get them to me by the deadline.

RTTY Contesting

Wayne Matlock, K7WM
k7wm@arrl.net

Results: The 2002 *NCJ* RTTY North American QSO Party

Well, propagation didn't totally go south on the July 2002 NCJ RTTY NAQP, but it came close. For the single operators that recognized what was going on, their 2-hour break was taken. The multi-2 guys just had to sit there and suffer through the silence. It sometimes seems that to have the propagation go bad, all you have to do is schedule a RTTY contest.

At K7WM, the NAQP started about the month of April. Ron, K5DJ, needed to get to Mexico to have some dental work done, and he wanted to attend the Ft. Tuthill/Flagstaff Hamfest, which is normally the last weekend of July. I suggested he plan on just coming out the week before Ft. Tuthill and we could take care of the dental work, do the NAQP and attend the hamfest (all in one week). Now the only thing that was needed was to convince him that he could survive the July heat in Cibola for at least one week, and then we would be up in the cool pines of Flagstaff. Little did I know that all-time heat records would be set the week he was here. Oh, well.

The night before we were to pick Ron up at Phoenix International Airport, he tried to get hold of us to inform us that he had severely strained his back and was not coming. As we had left early the day before his arrival in Phoenix to spend the evening with son and family prior to picking him up, he couldn't get hold of us. But being the trouper that he is, he came on and we picked him up the following morning and headed to Cibola. We were lucky in the sense that it only took two trips to Mexico to take care of the dental work he wanted done, but with his back being as bad as it was, it was quite painful for him to sit for any period of time. And even the one-hour trip to Mexico was painful.

While he wasn't absolutely required to be in a sitting position, he was in a horizontal one. This upright, horizontal requirement continued for the entire period he was out west, during the trips to Mexico, the NAQP, and the hamfest at Ft. Tuthill. Being constrained as he was, he was unable to enjoy some of the finer sights of Cibola—the Colorado River, Painted Canyon, etc, and limited himself to movement between the couch and bed. Perhaps another time.

The 2002 NCJ RTTY NAQP officially started with a bang at 1800Z on July 20 and ended at 0600Z July 21. Single operators are limited to 10 hours of operation out of the 12 hours. Multi stations can operate the entire 12 hours. As the NAQPs are low power only contests, antennas and location become extremely important. While the contest itself is not a "rate" or "mult" contest, a fine balance between rate and mults needs to be maintained to ensure maximum score.

Don, AA5AU, once again established himself as the premier SOLP operator with a winning score of 78,023. Don maintained a 45.1 QSO rate for the 10 hours operating and a 2.6 to 1 QSO versus mult ratio. This can be considered an exceptional rate/mult considering the solar storm that started about half way through the contest.

The real battle came between Shelby, K4WW, and Nick, W4GKM, for second and third place, with Shelby edging out Nick by a mere 600 points. Nick had more QSOs but Shelby had more mults. Another battle was taking place for fourth and fifth place between Mike, K4GMH, and Tom, WX4TM, with Mike taking the fourth place spot. In this case, Tom had more mults than Mike, but that wasn't enough to offset the QSO advantage that Mike had. A close examination of the top ten listings for score, QSOs, and multipliers (Table 1) shows some interesting data.

For the first time in the contest, teams were organized by EU stations and registered for competition. Unfortunately, with the propagation acting the way it did and the time of the contest, the EU teams did not fare well at all. The Porch Dogs, comprised of AA5AU, AE5P, K4WW, KC5HIG and N5ZM, got off the porch and clawed, scratched, barked, chewed, and dug their way to a combined score of 216,920, and took the team category (it has to be the dog chow).

The Flaboys, comprised of AF4Z, K4PX, KC4HW, KT4FY and WB4EQS took second place team with a combined score of 151,997.

Results, operating breakdown and

Table 2

July 2002 NCJ RTTY North American QSO Party

Team Scores

The Gee Bees

G0URR	1036
G3URA	0
GU0SUP	2268
GW4KHQ	49
MU3EFB	4
	3357

Porch Dogs

AA5AU	78023
AE5P	11076
K4WW	60040
KC5HIG	23861
N5ZM	43920
	216920

Notnuffrtty

AA9RR	18939
K4GMH	53144
N8YYS	18400
WA0SXV	0
WA9ALS	31088
	121571

Northridge Shakers

K6HGF	22995
K6RE	34727
N6EU	20491
VK4UC	42
WA6BOB	15480
	93741

Flaboys

AF4Z	32860
K4PX	24531
KC4HW	34375
KT4FY	28620
WB4EQS	31611
	151997

The Shaeferhunds

DF4OR	0
DK3VN	0
DL4RCK	858
DL6JZ	1015
IT9BLB	14274
	16147

Baud Boys

AK0A	29321
K1US	5194
KI6DY	46920
VE6RAJ	0
W1ZT	49476
	130911

Table 1

Top Ten Score, QSO and Mutiplier Totals

2002 July *NCJ* RTTY North American QSO Party

	Scores		*QSOs*		*Multipliers*
AA5AU	78,023	AA5AU	451	AA5AU	173
K4WW	60,040	W4GKM	407	K4WW	152
W4GKM	59,422	K4WW	395	WX4TM	147
K4GMH	53,144	W1ZT	372	W4GKM	146
WX4TM	52,185	K4GMH	364	K4GMH	146
VA3DX	51,976	VA3DX	356	VA3DX	146
W1ZT	49,476	WX4TM	355	KE4KWE	145
KI6DY	46,920	KI6DY	345	N5ZM	144
NN6NN	44,759	W1SRD	322	NN6NN	143
N5ZM	43,920	NN6NN	313	KI6DY	136

Table 3

July 2002 NCJ RTTY North American QSO Party

Top 10 Single Op and Multi-Two Breakdowns

Single Op Top 10 Breakdowns

Call	*Name*	*QTH*	*80 m*	*40 m*	*20 m*	*15 m*	*10 m*	*QSOs*	*Mults*	*Score*
AA5AU	DON	LA	16/14	87/37	149/46	130/46	69/30	451	173	78,023
K4WW	BO	KY	18/11	72/27	142/42	112/43	51/29	395	152	60,040
W4GKM	NICK	TN	1/0	76/32	145/45	140/45	45/24	407	146	59,422
K4GMH	MIKE	VA	18/12	81/29	118/37	101/41	46/27	364	146	53,144
WX4TM	TOM	AL	40/20	91/35	108/37	82/36	34/19	355	147	52,185
VA3DX	GLENN	ON	28/19	47/19	92/32	149/47	40/29	356	146	51,976
W1ZT	GEORGE	MA	16/10	59/21	140/36	122/44	35/22	372	133	49,476
KI6DY	BOB	KS	4/4	49/24	119/39	120/42	53/27	345	136	46,920
NN6NN	CHET	CA	3/2	46/32	138/47	94/42	32/20	313	143	44,759
N5ZM	EARL	AR	10/8	54/27	107/39	93/45	41/25	305	144	43,920

Multi-Two Breakdowns

Call	Name	QTH	80 m	40 m	20 m	15 m	10 m	QSOs	Mults	Score
N0AC	BILL	IA	15/11	112/38	160/48	136/43	69/33	492	174	85,608
W6YX	LELAND	CA	7/2	106/43	209/51	86/40	33/18	441	154	67,914
K7WM	WAYNE	AZ	5/5	57/32	102/45	115/45	52/28	331	154	50,974
W1GZ	CHAZ	VT	8/4	24/17	77/32	106/41	28/19	243	113	27,459

top ten in score-qso-mults are listed herein. Jay, WS7I, is to be thanked for the thankless job of log checking and log tabulating.

This is my last column as the *NCJ RTTY Contesting* columnist. I would like to take this opportunity to thank Dennis, K7BV, for all the helpful advise at my start several years ago and to all the wonderful RTTY Operators around the world who have contributed to the column with articles and tips and advice. John, WA9ALS, will be taking over the column come January 1, 2003. I know there will be the same operators who will assist John with facts and features to fill the column.

Other changes in the *NCJ RTTY Contesting* world are that Jay, WS7I, will be taking over the two *NCJ* RTTY Sprint contests. All logs for the RTTY SPRINT are to be sent to **rttysprint@ncjweb.com**. All questions are to be directed to Jay. I will be doing the *NCJ* RTTY NAQP in its entirety. Plans are being made to have two RTTY NAQPs a year, bringing the RTTY NAQP into line with the SSB/CW NAQPs. Dates will be published as soon as they are firmed up. Team registration is to be made via the NCJ website at **www.ncjweb.com**. All log submittals for the RTTY NAQPs are to made via **rttynaqp@ncjweb.com**. Logs are to be in Cabrillo format only.

Like the funny bunny said, "That's all, Folks." A very 73 to all from Lonesome Cibola, and I hope to see everyone in the contests.

Table 4

July 2002 NCJ RTTY North American QSO Party

Individual Scores

Call	*Name*	*QTH*	*QSOs*	*Mults*	*Points*
W1ZT	GEORGE	MA	372	133	49476
NY1S	JOE	ME	300	118	35400
WA1EHK	MAY	CT	242	109	26378
N1NB	MUTT	CT	240	105	25200
WB8IMY/1	STEVE	CT	194	93	18042
WA1Z	BOB	NH	169	75	12675
N4CW/1	BERT	ME	148	82	12136
K1XX	CHARLIE	NH	159	75	11925
W0BR/1	TOTO	CT	130	61	7930
K5ZD	RANDY	MA	115	68	7820
K1US	JON	ME	98	53	5194
W1VET	RON	RI	53	39	2067
N2WK	WAYNE	NY	271	115	31165
WA2LXE	PHIL	NJ	135	80	10800
N2AUK	STUART	NY	117	40	4680
KF2XF	DON	NY	73	32	2336
K3FH	MIKE	PA	174	98	17052
N3NZ	NOEL	PA	104	53	5512
K3WW	CHAS	PA	97	49	4753
NY3C	MAC	DE	24	18	432
K4WW	BO	KY	395	152	60040
W4GKM	NICK	TN	407	146	59422
K4GMH	MIKE	VA	364	146	53144
WX4TM	TOM	AL	355	147	52185
KE4KWE	TOM	AL	294	145	42630
KC4HW	JIM	FL	275	125	34375
AF4Z	DON	FL	265	124	32860
WB4EQS	RON	FL	257	123	31611
W4LC	JIM	KY	255	114	29070
KT4FY	STEVE	FL	265	108	28620
W4UK	JERRY	SC	265	108	28620
K4PX	GEORGE	FL	221	111	24531
WD4DDU	ADAM	VA	229	104	23816
W4BCG	BILL	TN	217	106	23002
KE4OAR	CHUCK	TN	169	110	18590
K4IQJ	DICK	AL	131	82	10742
W6IHG	JERRY	VA	134	71	9514
W4OX	DOUG	FL	132	70	9240
KB4ET	ITSABITCH	FL	123	65	7995
KC4SAW	JOHN	TN	100	67	6700
N4AN	ROY	AL	46	31	1426
KV4CN	DAVE	NC	30	24	720
NI4S	ANDY	NC	27	20	540
W4JH	ACK	TN	21	8	168
K0COP	DAVE	NC	8	4	32
AA5AU	DON	LA	451	173	78023
N5ZM	EARL	AR	305	144	43920
NA4M	PHIL	TX	282	123	34686
KC5HIG	TOM	AR	223	107	23861
WA0SXV	MIKE	NM	230	102	23460
K5NRC	CHARLES	AR	221	103	22763
K5NZ	MIKE	TX	198	105	20790
AC5AA	DUANE	TX	154	90	13860
K5AM	MARK	NM	166	75	12450
AE5P	ARMY	TX	142	78	11076
KI5XP	CHARLIE	LA	134	51	6834
KI5DR	SCOTT	TX	108	55	5940
K5PI	ROB	TX	76	50	3800
W5CTV	CHRIS	LA	58	30	1740
WA5VBE	JIM	AR	50	31	1550
AD5EN	CHARLIE	TX	45	32	1440
W5WZ	SCOTT	LA	48	26	1248
N5ZC	RICH	TX	22	15	330
N5BA	BRIAN	TX	9	7	63
NN6NN	CHET	CA	313	143	44759
W1SRD	STEVE	CA	322	127	40894
KR6E	BEN	CA	287	121	34727
KH6ND	MIKE	HI	287	120	34440
N6EE	RON	CA	248	118	29264
Call	*Name*	*QTH*	*QSOs*	*Mults*	*Points*
K6HGF	DOUG	CA	219	105	22995

Call	Name	QTH	QSOs	Mults	Points
K6XT	ART	CA	211	98	20678
N6EU	RUSS	CA	199	103	20497
W6ZL	BIGWAVE	CA	212	96	20352
WA6BOB	BOB	CA	180	86	15480
K6EP	ERIC	CA	151	86	12986
AC6JT	BRYAN	CA	137	82	11234
N6TQS	DOUG	CA	93	58	5394
K6OWL	MARK	CA	46	36	1656
W6JOX	CHUCK	CA	33	28	924
K7ZUM	ZOOMIE	OR	239	117	27963
W7CT	JIM	UT	220	90	19800
AC7VF	ERIC	ID	152	74	11248
WG7Y	BOB	WY	176	60	10560
W7WHY	TOM	OR	95	54	5130
WS7I	JAY	WA	62	33	2046
W7DPW	DAVE	WA	19	14	266
K8IR	JIM	MI	193	108	20844
W8UL	JOHN	OH	208	104	21632
N8YYS	SPIKE	WV	184	100	18400
KD8FS	ALLAN	MI	190	96	18240
K8SIA	JIM	MI	155	88	13640
NX8C	NEIL	MI	97	62	6014
K8HF	HARRY	OH	52	35	1820
W9HLY	VERN	IN	293	125	36625
WA9ALS	JOHN	IN	268	116	31088
AI9T	STEVE	IL	249	123	30627
AA9RR	TIM	WI	177	107	18939
N2BJ	BARRY	IL	169	74	12506
KE9S	JEFF	WI	54	38	2052
K9WX	TIM	IN	47	38	1786
K9SZ	JOE	IL	48	33	1584
K9RT	DICK	IN	36	15	540
N9KO	CALVIN	IL	19	17	323
KI6DY	BOB	KS	345	136	46920
W0ETC	LAR	IA	263	127	33401
AK0A	BILL	KS	269	109	29321
W0TY	TONY	MO	221	112	24752
K0IDT	RON	NE	220	106	23320
W0HW	CHAZ	MN	209	76	15884
KT0DX	STEVE	CO	181	84	15204
K0JPL	PAUL	MO	132	62	8184
WB0O	BILL	ND	109	70	7630
K0XU	JIM	NE	103	58	5974
KS0M	DICK	MO	85	53	4505
N0AT	RON	MN	56	29	1624
K0BX	JOEY	MO	53	23	1219

Call	Name	QTH	QSOs	Mults	Points
N0LZ	JOHN	NE	22	21	462
W0RY	BOB	CO	24	15	360
N0IBT	DAVE	CO	17	15	255
WA0PSF	RON	KS	6	6	36
VA3DX	GLENN	ON	356	146	51976
VE3IAY	RICH	ON	196	100	19600
VA3PC	PAUL	ON	187	99	18513
VE3BUC	DON	ON	173	86	14878
VE9DX	ANDY	NB	149	87	12963
VE4COZ	IREK	MB	148	79	11692
VA3WN	TRAVIS	ON	114	59	6726
VE5SF	SAM	SK	58	39	2262
VE7ASK	BUD	BC	104	66	6864
VE7MOB	MERV	BC	11	10	110
VO1/ OE1KTS	TOM	NF	11	8	88
PJ2EL	ERNIE	DX	308	135	41580
9A5W	NIKOLA	DX	270	106	28620
LP7H	JAVIER	DX	193	75	14475
IT9BLB	JOE	DX	183	78	14274
IK0HBN	SANTE	DX	149	80	11920
YU7AM	ARPAD	DX	100	46	4600
GU0SUP	PHIL	DX	63	36	2268
HA9RU	JANOS	DX	52	33	1716
OK2BXW	JAROMIR	DX	40	32	1280
XE2AC	599	DX	40	27	1080
ZL2BR	FRANK	DX	37	29	1073
G0URR	ROBERT	DX	37	28	1036
DL6JZ	WOLF	DX	35	29	1015
DL4RCK	WALTER	DX	33	26	858
YL2KF	VILNIS	DX	31	21	651
F6FJE	PETER	DX	20	19	380
SM7BJW	KURT	DX	18	16	288
SM7BHM	EWE	DX	19	14	266
JA1BHK	MAZ	DX	13	10	130
SP8FHJ	HENRY	DX	13	8	104
DL3PS	FRANZ	DX	12	8	96
GW4KHQ	JOHN	DX	7	7	49
VK4UC	JOHN	DX	7	6	42
SP6IHE	JAN	DX	6	6	36
YO2BEH	NELU	DX	6	6	36
7L4IOU	HISAMI	DX	4	3	12
JA1BWA	CHIRU	DX	3	3	9
YO3APJ	ADRIAN	DX	3	3	9
JH7IMX	SHUN	DX	2	2	4
MU3EFB	MU3EFB	DX	2	2	4

Check Logs: VA3DX, NG7Z, WA3XRZ

Results, January 2002 NAQP SSB Contest

Bruce Horn, WA7BNM
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Once again, N6MJ annihilated the competition by turning in a 400k+ score for first place in the single op category. Dan broke his own year-old record and is the only single-op contestant to score more than 400k points. K9PG used a record-setting multiplier total to take second place and break his old Illinois record by 90k points. Paul is the first to break the 300 total multipliers barrier. K4XS also broke the old total multiplier record, which he set the previous January, while nudging W6EEN (N6RT) for third place. K7CO drove W7CT to fifth place, while smashing the old Utah record by 135k points. VE5MX used the VE5DX station to beat his own January 2000 Saskatchewan record and take sixth. K7RI took seventh, while K5RC broke his own January 1999 Nevada record for eighth. W7WA squeaked by N6NF for ninth place. As was the case a year earlier, a contester had to score more than 300k points to make the Top Ten.

The K9NS crew added an incredible 200,000 points to the record they set during the January 2001 contest to win the multi-two category. WJ1Z also beat the year-old record while taking second place, but wasn't able to overcome the K9NS low-band advantage. N6RO turned in what would have been, until recently, a winning score from the West Coast, but was only good for third in this contest.

In the team competition, the Southern California Contest Club #1 team easily out totaled the 4-person Tennessee Contest Group #1 team for first place with the second highest team score ever, while the Mad River Radio Club #1 team took third. The same teams had the same order of finish in the January 2001 contest. The Southern California Contest Club continues to hold the three highest all-time team scores.

In addition to these top scores, many new state and province records were set. Notable were KH6ND adding more than 100k points to his old Hawaii record, while K0WA beat the Kansas record by 80k points. VE1OP more than quadrupled his Nova Scotia record, and K2DO broke the 10-year-old New York record. In addition to those already mentioned, new records were set in Alaska, Colorado, Indiana, Kansas, Louisiana, Minnesota, Missouri, North Carolina, Quebec, Tennessee and Virginia. Forty-five of the 61 state and province records are now no more than three years old.

Team Scores

1. SCCC #1		*2. Tennessee Contest Group #1*		*3. Mad River Radio Club #1*	
N6MJ	413,192	N4ZZ	298,840	K8ND	247,000
W6EEN	341,360	W5TM	291,180	W8MJ	229,156
K6LL	291,816	K4MA	221,610	ND8DX	198,254
W6TK	204,702	K4RO	204,981	NU8Z	180,841
K6AM	185,730			K5IID	104,760
Total	1,436,800	Total	1,016,611	Total	960,011

4. SMC #1 (K9PG,K9ZO,W9RE,WE9V) 893,657
5. SCCC #2 (K6LA,XE2/W6RW,W7WW,N6KI,N6TW) 840,248
6. The EH Team (VE5DX,VE1OP,VX2AWR,VX4VV) 624,459
7. MWA #1 (KT0R,AC0W,N0AT) 605,169
8. South East Contest Club #1 (K4WI,AA4LR,W4ATL,W2JJC,K4BAI) 597,737
9. Tennessee Contest Group #2 (VE5SF,K4BP,NY4T,NQ4U) 594,376
10. SMC #2 (WT9U,W9IU,KX9DX,WA9IRV,N9GUN) 583,592
11. Grand Mesa Contesters of Colorado Team 1 (AB0MV,N4VI,K0GAS,W0ETT) 549,583
12. NCCC #1 (K5RC,AE6Y,K6LRN) 440,773
13. FCG #1 (K4XS,W4SAA,WC4E,K4FCG) 420,596
14. West Texas Rowdies (KE5OG,N5DO,AD5GD,NW5M,KD5MXR) 392,324
15. MWA #2 (N0FP,K0MPH,WB0TRA,WA2HFI) 334,690
16. Grand Mesa Contesters of Colorado Team 2 (K0UK,KI0II,W0AJ) 328,308
17. TDXS (KG5U,N5ZK) 288,192
18. North Coast Contesters #1 (AD8J,WA3SES,N3FR,N3SD) 277,538
19. Tennessee Contest Group #3 (KE4OAR,W4NZ,N4YQ,K0EJ) 275,320
20. Order of Boiled Owls (K2DO,KS2G) 269,056
21. SMC #3 (K0XM,AE9B,AA9RT) 266,353
22. PVRC Last-Minute Trio (NX9T,K4EP,NI4S) 264,917
23. Laurel ARC (N5NQ,N5PA,N5KKG,KC5YDR,KB5IXI) 204,191
24. SMC Lafayette (W9TN,N9KT,K9WX,N9LF) 182,345
25. Mad River Radio Club #3 (N8KM,KW8W,N8EA) 167,661
26. Tennessee Contest Group #5 (N7DLS,AF4QB,NN4T,W9WI,KG4ABM) 155,106
27. SMC #5 (K9MMS,WB9RRO) 149,665
28. Connecticut Radio Society Team Alpha (W1JQ,W1CRS) 142,372
29. Mad River Radio Club #2 (WZ8P,K9NW,W8RU) 125,420
30. Green River Valley ARS (KE0FT,KB9LIE,K9OT,NO9S) 114,558
31. Mad River Radio Club #4 (K8MR,K8AAX) 109,879
32. Tennessee Contest Group #6 (K4LTA,W0ETC,W4PA,KC4URW,N5NW) 95,961
33. South East Contest Club #2 (WB4SQ,W4NTI,K4GA,WB6BWZ) 83,008
34. North Coast Contesters #2 (ND8L,W8GN,K8NZ) 82,582
35. Tennessee Contest Group #4 (K4OOO,W4JPG,W4TDB,WM4Q) 62,825
36. SMC #4 (W9YS,KB9VHA,N9KO) 34,084

Single Op Top Ten Breakdowns

Call	*Score*	*QSOs*	*Mults*	*160*	*80*	*40*	*20*	*15*	*10*	*Team*
N6MJ(at W6KP)	413,192	1508	274	18/10	59/33	202/53	363/60	210/59	656/59	SCCC #1
K9PG	369,026	1226	301	122/33	196/51	363/59	287/61	154/54	104/43	SMC #1
K4XS	345,411	1163	297	41/22	70/37	230/57	398/61	309/61	115/59	FCG #1
W6EEN(N6RT)	341,360	1255	272	16/11	90/35	175/49	227/59	282/60	465/58	SCCC #1
K7CO(at W7CT)	340,935	1337	255	35/13	141/44	243/47	327/51	299/52	292/48	
VE5DX(VE5MX)	333,568	1303	256	7/4	76/37	135/45	239/56	251/58	595/56	EH Team
K7RI	321,640	1496	215	2/1	11/5	123/37	353/56	455/58	552/58	
K5RC	318,908	1307	244	16/8	36/21	211/48	393/58	183/53	468/56	NCCC #1
W7WA	314,412	1379	228	14/7	34/15	103/33	250/55	174/55	804/63	
N6NF	314,264	1304	241	26/8	56/24	179/51	367/54	326/54	350/50	

Multi-Two Breakdowns

Call	*Score*	*QSOs*	*Mults*	*160*	*80*	*40*	*20*	*15*	*10*
K9NS	860,139	2583	333	153/37	305/52	541/61	787/64	400/62	397/57
WJ1Z	677,088	2351	288	84/29	160/41	362/53	813/60	523/56	409/49
N6RO	562,264	2098	268	60/16	83/27	174/47	442/59	549/58	790/61

Single Operator Scores

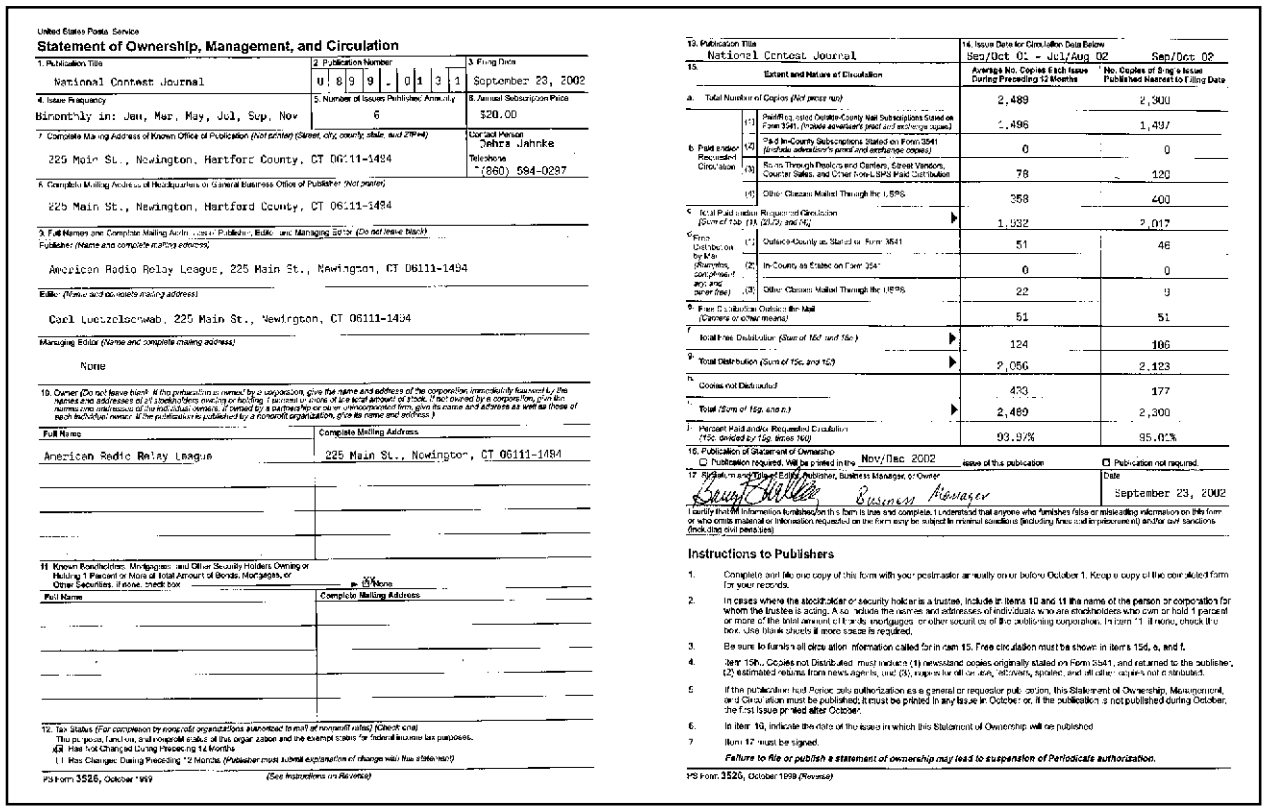
Call	Score	QSOs	Mults	QTH	Team
W1JQ	113,580	631	180	CT	CRS Team Alpha
K1KD	72,534	462	157	VT	
AB1R	64,774	466	139	ME	
KZ1O	63,788	431	148	NH	
KM3T	29,003	299	97	MA	
W1CRS	28,792	236	122	CT	CRS Team Alpha
N1IXF	20,256	211	96	CT	
W1VET	19,110	195	98	RI	
N1HRA	12,480	192	65	RI	
K5ZD	11,266	131	86	MA	
KB1HJW	5,565	105	53	MA	
N1BCL	5,203	121	43	VT	
WA1ZYX	4,851	99	49	NH	
KD1EA	3,150	75	42	MA	
K2DO	156,716	812	193	NY	Order of Boiled Owls
KS2G	112,340	685	164	NY	Order of Boiled Owls
K2ONP	95,450	575	166	NY	
N2ED	17,388	189	92	NJ	
N2LQQ	4,752	99	48	NY	
K2RED	3,534	93	38	NY	
W2QOB	2,052	54	38	NJ	
KA2NMP	1,104	46	24	NY	
KC2HVT	192	16	12	NY	
AD8J	184,756	836	221	PA	NCC #1
W3GH	114,912	608	189	PA	
K3WW	86,394	561	154	PA	
K3SWZ	61,344	426	144	PA	
WA3SES	43,500	348	125	PA	NCC #1
W3IQ	41,418	354	117	PA	
N8NA	40,256	296	136	DE	
N3FR	39,184	316	124	PA	NCC #1
W3TWI	35,793	291	123	PA	
W3LL	28,890	270	107	MD	
N4GG	17,919	181	99	MD	
NS3T	15,543	157	99	MD	
AI3M	13,840	173	80	MD	
AA3WI	13,600	160	85	MD	
N3SD	10,098	153	66	PA	NCC #1
KT3D	7,854	119	66	MD	
N3GXY	6,156	114	54	PA	
N3DFF	1,624	56	29	PA	
K4XS	345,411	1163	297	FL	FCG #1
N4ZZ	298,840	1205	248	TN	TCG #1
K7SV	263,444	983	268	VA	
K4MA	221,610	890	249	NC	TCG #1
K4RO	204,981	903	227	TN	TCG #1
KT4ZX	158,603	797	199	KY	
NX9T	153,406	734	209	NC	PVRC Last-Minute Trio
K4BP	150,220	740	203	TN	TCG #2
K4WI	132,506	634	209	AL	SECC #1
NY4T	127,764	676	189	TN	TCG #2
AA4LR	127,280	688	185	GA	SECC #1
W4ATL	126,945	651	195	GA	SECC #1
KE4OAR	122,304	637	192	TN	TCG #3
W2JJC	121,396	682	178	SC	SECC #1
K4BAI	89,610	515	174	GA	SECC #1
NQ4U	86,994	486	179	TN	TCG #2
K4EP	82,318	521	158	VA	PVRC Last-Minute Trio
KO4MM	77,550	517	150	NC	
K4LTA	66,880	440	152	TN	TCG #6
N7DLS	53,248	416	128	TN	TCG #5
AF4QB (NY4N)	52,448	352	149	TN	TCG #5
W4NZ	52,128	362	144	TN	TCG #3
N4YQ	50,518	377	134	AL	TCG #3
K0EJ	50,370	345	146	TN	TCG #3
W4SAA	48,326	331	146	FL	FCG #1
N4CW	43,840	320	137	NC	
KW4DA	40,500	300	135	NC	
WB4SQ	39,672	348	114	GA	SECC #2
NN4T	35,376	264	134	TN	TCG #5
KK4TA	33,375	267	125	FL	FCG #2
NI4S	29,193	263	111	NC	PVRC Last-Minute Trio
K4OOO	27,108	251	108	TN	TCG #4
W4NTI	23,100	210	110	AL	SECC #2
KT4Q	21,935	205	107	GA	
WC4E	20,900	209	100	FL	FCG #1
N3HO	17,152	268	64	FL	
W4JPG	13,783	179	77	TN	TCG #4
W4TDB	13,612	166	82	TN	TCG #4
K4GA	12,300	150	82	GA	SECC #2
W4EBA	10,212	148	69	FL	FCG #5
KT4OO	8,905	137	65	SC	
WM4Q	8,322	114	73	TN	TCG #4
W9WI	7,986	121	66	TN	TCG #5
WB6BWZ	7,936	128	62	GA	SECC #2
KW4E	7,168	112	64	GA	
KG4ABM	6,048	108	56	TN	TCG #5
K4FCG (K4OJ)	5,959	101	59	FL	FCG #1
K3CQ	5,187	91	57	TN	
K1SO	5,016	76	66	VA	
VE3BUC/W4	4,410	90	49	FL	
KD5CTJ	4,320	90	48	VA	
WA4JA	3,888	81	48	TN	
W7LN	3,393	87	39	VA	
W4PA	3,268	76	43	TN	TCG #6
W4JH	3,212	73	44	TN	
W4OGG	2,655	59	45	TN	
N8IK	2,627	71	37	VA	
KC4URW	2,183	59	37	TN	TCG #6
KT4FJ	1,530	45	34	VA	
KD4MJM	666	37	18	VA	
W5TM (W5AO)	291,180	1055	276	OK	TCG #1
W5WMU	225,212	923	244	LA	
KE5OG	171,080	910	188	TX	West Texas Rowdies
N5DO	165,360	780	212	TX	West Texas Rowdies
KG5U	162,288	784	207	TX	TDXS
AA5UN	149,326	758	197	TX	
N5ZK (W5ASP)	125,904	688	183	TX	TDXS
W5MK	86,907	491	177	AR	Ozark Contest Club
N5NQ	68,040	420	162	MS	Laurel ARC
KC0JB	59,944	472	127	TX	
K5GN	54,663	399	137	TX	
N5PA	45,621	333	137	MS	Laurel ARC
N5KKG	45,592	328	139	MS	Laurel ARC
AD5GD	35,148	348	101	TX	West Texas Rowdies
W5ETM	26,562	233	114	TX	
KC5YDR	26,059	253	103	MS	Laurel ARC
WQ5L	24,640	224	110	MS	
KN5Z	22,880	208	110	TX	
KB5IXI	18,879	203	93	MS	Laurel ARC
NW5M	17,776	202	88	TX	West Texas Rowdies
K5KA	7,526	106	71	OK	
WD0HWX	7,208	106	68	TX	
KD5MXR	2,960	80	37	TX	West Texas Rowdies
W5WZ	2,128	56	38	LA	
AB5FS	1,470	49	30	OK	
N6MJ (at W6KP)	413,192	1508	274	CA	SCCC #1
W6EEN (N6RT)	341,360	1255	272	CA	SCCC #1
N6NF	314,264	1304	241	CA	
K6LA	254,980	1045	244	CA	SCCC #2
KH6ND	246,186	1269	194	HI	
W6TK	204,702	939	218	CA	SCCC #1
K6AM	185,730	906	205	CA	SCCC #1
N6KI	147,067	697	211	CA	SCCC #2
AD6WL	143,927	709	203	CA	
NT6K	78,960	560	141	CA	
W6AFA	76,260	492	155	CA	
AE6Y	66,960	432	155	CA	NCCC #1
K6ZM (K6WG)	66,582	486	137	CA	
K6LRN	54,905	395	139	CA	NCCC #1
W6OAT	26,450	230	115	CA	
N6TW	24,310	221	110	CA	SCCC #2
WA6DLM	18,720	195	96	CA	
KD6KHJ	18,700	187	100	CA	
WI7F	12,792	156	82	CA	
KH6/ F5IDM	10,164	154	66	HI	
K6NA	7,874	127	62	CA	
K6BIR	6,800	100	68	CA	
W6ZZZ	6,136	118	52	CA	
K6III	5,488	98	56	CA	
KG6CMS	5,340	89	60	CA	
KG6DEX	4,674	82	57	CA	
K6OWL	4,655	95	49	CA	
K6ZCL	4,292	116	37	CA	
WB6NFO	3,666	78	47	CA	
K6DGW	3,408	71	48	CA	
NC6P	1,421	49	29	CA	
W6RKC	968	44	22	CA	
N6BXO	49	7	7	CA	
K7CO (at W7CT)	340,935	1337	255	UT	
K7RI	321,640	1496	215	WA	
K5RC	318,908	1307	244	NV	NCCC #1
W7WA	314,412	1379	228	WA	
K6LL	291,816	1158	252	AZ	SCCC #1
W7NN	276,624	1356	204	WA	
W7ZR	224,812	1036	217	AZ	
K7MM	212,553	1017	209	WA	
N7LOX	199,593	993	201	WA	
W7WW	188,580	898	210	AZ	SCCC #2
WS7V	115,995	703	165	WA	
KL1V	109,572	794	138	AK	
KW7N	96,096	546	176	ID	
WA7YAZ	95,299	607	157	UT	
N3HXQ/ KL7	89,813	551	163	AK	
KN5H	87,657	479	183	AZ	
K3DUW	64,242	498	129	OR	

Call	Score	QSOs	Mults	QTH	Team
KI7Y	30,397	269	113	OR	
K7ZO	26,402	307	86	ID	
KC7WDL	9,520	140	68	WA	
NN7P	7,622	103	74	WA	
KK7X	6,222	102	61	ID	
KC7MAW	5,642	91	62	WA	
K8ND	247,000	988	250	OH	MRRC #1
W8MJ	229,156	971	236	MI	MRRC #1
ND8DX	198,254	833	238	OH	MRRC #1
NU8Z	180,841	937	193	MI	MRRC #1
WA8WV	123,985	685	181	WV	
WZ8P	110,126	697	158	OH	MRRC #2
N8KM	105,216	548	192	OH	MRRC #3
K5IID	104,760	540	194	WV	MRRC #1
K8MR	93,632	532	176	OH	MRRC #4
K8AO	82,248	552	149	MI	
ND8L	55,322	398	139	OH	NCC #2
N8OH	52,515	389	135	OH	
AK8B	38,178	303	126	OH	
KW8W	31,941	273	117	OH	MRRC #3
N8EA	30,504	248	123	MI	MRRC #3
W8KNO	28,704	276	104	OH	
W8GN	26,510	241	110	OH	NCC #2
WI8W	25,440	240	106	MI	
K8IA	23,377	241	97	MI	
K8AAX	16,247	211	77	MI	MRRC #4
KA8PXF	13,246	179	74	OH	
K9NW	13,110	190	69	OH	MRRC #2
W8XY	7,973	119	67	OH	
KB8UMD	5,445	99	55	MI	
N8CXQ	2,257	61	37	OH	
W8RU	2,184	56	39	MI	MRRC #2
K8CZ	1,380	46	30	OH	
K8NZ	750	30	25	OH	NCC #2
N5NW	90	10	9	OH	TCG #6
K9PG (@K9XD)	369,026	1226	301	IL	SMC #1
K9ZO (KB9UWU)	257,226	997	258	IL	SMC #1
W9RE	220,657	839	263	IN	SMC #1
WT9U	189,244	748	253	IN	SMC #2
W9IU	178,450	830	215	IN	SMC #2
KX9DX	164,340	830	198	IL	SMC #2
K9MMS	146,328	728	201	IL	SMC #5
WA1UJU	99,575	569	175	WI	
W9TN	58,786	442	133	IN	SMC Lafayette
AA9PB	58,443	363	161	WI	
N9KT	55,151	421	131	IN	SMC Lafayette
K9JLS	48,236	389	124	IL	
WE9V	46,748	377	124	WI	SMC #1
AA9RT	46,494	369	126	IL	SMC #3
K9WX	45,408	344	132	IN	SMC Lafayette
WA9IRV	41,262	299	138	WI	SMC #2
KB9LIE	40,824	324	126	WI	Grn River Vly ARS
W3HDH	33,600	280	120	IL	
W9YS	28,829	227	127	IL	SMC #4
N9LF	23,000	250	92	IN	SMC Lafayette
K9OT	13,940	164	85	WI	Grn River Vly ARS
N9GUN	10,296	143	72	IL	SMC #2
N9WW	6,976	109	64	IL	
W9FGH	6,201	117	53	IL	
KB9VHA	5,192	88	59	IL	SMC #4
WB9RRO	3,337	71	47	IL	SMC #5
N9KO	63	9	7	IL	SMC #4
K0UK	265,856	1072	248	CO	GMCC Team 2
KT0R	232,971	983	237	MN	MWA #1
AC0W	219,936	948	232	MN	MWA #1
K0WA	211,950	942	225	KS	
AB0MV	210,816	976	216	CO	GMCC Team 1
KG0US	181,280	824	220	MO	
N0AV	174,251	803	217	IA	
N4VI	162,484	829	196	CO	GMCC Team 1
N0AT	152,262	769	198	MN	MWA #1
N0FP	124,806	682	183	MN	MWA #2
K0XM	117,369	567	207	KS	SMC #3
W0NO	107,387	667	161	KS	
AE9B	102,490	554	185	MO	SMC #3
K0GAS	100,467	549	183	CO	GMCC Team 1
K0MPH	98,728	602	164	MN	MWA #2
KD0OM	96,192	576	167	CO	
WB0TRA	85,860	540	159	MN	MWA #2
KB0MZG	84,402	521	162	KS	
W0ETT	75,816	486	156	CO	GMCC Team 1
K0FG	73,728	576	128	MO	
KM0O	69,300	450	154	MN	
KE0FT	58,989	371	159	IA	Grn River Vly ARS
W0BR	57,951	411	141	KS	
KI0II	54,003	383	141	CO	GMCC Team 2
KC0CZI	50,193	507	99	MO	
N0YYO	49,104	372	132	KS	
KI0ND	49,000	392	125	CO	
N0MY	27,888	249	112	MN	
WA2HFI	25,296	248	102	MN	MWA #2
W0ETC	23,540	220	107	IA	TCG #6
N0QE	19,306	197	98	KS	
WB0ULX	14,602	149	98	SD	
W0/ OM3LZ	14,586	187	78	CO	
K0XE	12,782	154	83	CO	
K9IUA	9,135	145	63	IA	
W0OSK	8,700	116	75	CO	
W0AJ	8,449	119	71	CO	GMCC Team 2
KC0IIN	1,590	53	30	CO	
KC0KSA	1,457	47	31	CO	
W0IE	1,188	44	27	KS	
AB0OX	841	29	29	MO	
NO9S	805	35	23	IA	Grn River Vly ARS
KE0F	340	20	17	CO	
KC0LUX	90	10	9	MO	
VE5DX (VE5MX)	333,568	1303	256	SK	The EH Team
VE5SF	229,398	1038	221	SK	TCG #2
VE7IN	191,492	977	196	BC	
VE1OP	182,451	997	183	NS	The EH Team
VG7DP (VA7DP)	102,795	623	165	BC	
VX2AWR (VE2AWR)	77,262	474	163	PQ	The EH Team
VE7FO	76,152	501	152	BC	
VE6YR	47,334	343	138	AB	
VA6RA	46,575	405	115	AB	
VE3AGC	41,261	341	121	ON	
VX4VV (VE4VV)	31,178	262	119	MB	The EH Team
VE6ZA	28,912	278	104	AB	
VE3EBN	21,582	218	99	ON	
VA3SWG	19,800	198	100	ON	
VE3WIB	19,208	196	98	ON	
VA3TSL	18,973	204	93	ON	
VX9MY (VE9MY)	17,400	232	75	NB	
VE9WH	17,248	176	98	NB	
VE3KP	13,104	144	91	ON	
VE3UDK	9,880	130	76	ON	
VA3KOC	3,984	83	48	ON	
VE3WZ	3,388	77	44	ON	
VA3IX	1,026	38	27	ON	
XE2/ W6RW	225,311	967	233	XE	SCCC #2
WP3GW	1,763	43	41	KP4	
XE1RCF	1,595	55	29	XE	
VK2CZ	6,120	136	45	DX	
LU3DR	2,604	62	42	DX	
VR2BG	180	15	12	DX	
SP6IEQ	120	12	10	DX	

Multi-Two Scores

K9NS	860,139	2583	333	IL
(K9HMB,K9PW,KO9A,W9RM)				
WJ1Z	677,088	2351	288	VT
(WJ1Z,KK1L,K1WEY,K1LI)				
N6RO	562,264	2098	268	CA
(K3EST,K6AW,KI7WX)				
N5YA	356,125	1375	259	TX
(N5YA,K5WO,N5KR,KZ5A)				
N9KI	352,665	1383	255	WI
(N9PQU,K8IR)				
W6XK	346,937	1489	233	CA
(W6XK,N6EE)				
K0SN	292,578	1209	242	WI
(K0SN,NS9R)				
W4WS	281,250	1250	225	NC
(N4VHK,N0KTY,KB6MTH,KG4CZU,KG4NEP)				
N0NI	255,440	1240	206	IA
(N0AC,N0NI)				
W9UR	183,876	924	199	IN
(K4AT,W9UR)				
W7DX	179,361	949	189	WA
(N0AX,KD7FYX,KD7DQO)				
K0GQ	143,948	742	194	MO
(K0OU,KC0DXK,KC0DEA,N0EVH,W0RDE)				
N5LYG	122,615	685	179	TX
(N5LYG,KM5VI,WA5UZB)				
NE1C	106,880	668	160	VT
(KX1X,AA1YW,KB1FTX,KB1FSU,KB1FVL,KB1GJR,KB1FWN)				
K4YTZ	93,942	614	153	SC
(AE4VJ,WA2EMF,N4UFP)				
KB7TYA	91,166	577	158	UT
(KB7TYA,NT7Y)				
VE3MIS	82,967	509	163	ON
(VE3IMG,VE3SQG,VE3JMY,VE3IAB,VA3UA)				
K5BSA	49,068	348	141	TX
(KA5SOT,WA5TET,KC5YSL,KD5IQO,KR1ZAN,KD5QXE, KD5JVF,KD5HHZ,KD5HDR,KD5CTT,KC5QAI)				
W6SD	44,694	382	117	CA
(W6SD,Elsie,Ginger,Rachael,Marilynn)				
K9OZ	34,844	281	124	IL
(K9OZ,K9GAL,AB9AX)				

Check Logs: KG4KFJ, PY2TO



United States Postal Service
Statement of Ownership, Management, and Circulation

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National Contest Journal	0 8 9 - 0 1 3 1	September 23, 2002
4. Issue Frequency	5. Number of Issues Published Annually	6. Annual Subscription Price
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The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes:
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PS Form 3526, October 1999 (See Instructions on Reverse)

13. Publication Title: National Contest Journal	14. Issue Date for Circulation Data Below: Sep/Oct 01 - Jul/Aug 02	Sep/Oct 02
15. Extent and Nature of Circulation	Average No. Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date
a. Total Number of Copies (Net press run)	2,489	2,300
b. Paid and/or Requested Circulation (1) Paid/Requested Outside-County Mail Subscriptions Stated on Form 3541. (Include advertiser's proof and exchange copies)	1,496	1,497
(2) Paid In-County Subscriptions Stated on Form 3541 (Include advertiser's proof and exchange copies)	0	0
(3) Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Paid/USPS Paid Distribution	78	120
(4) Other Classes Mailed Through the USPS	358	400
c. Total Paid and/or Requested Circulation (Sum of 15b. (1), (2),(3), and (4))	1,932	2,017
d. Free Distribution by Mail (Samples, complimentary, and other free) (1) Outside-County as Stated on Form 3541	51	46
(2) In-County as Stated on Form 3541	0	0
(3) Other Classes Mailed Through the USPS	22	9
e. Free Distribution Outside the Mail (Carriers or other means)	51	51
f. Total Free Distribution (Sum of 15d. and 15e.)	124	106
g. Total Distribution (Sum of 15c. and 15f)	2,056	2,123
h. Copies not Distributed	433	177
i. Total (Sum of 15g. and h.)	2,489	2,300
j. Percent Paid and/or Requested Circulation (15c. divided by 15g. times 100)	93.9%	95.0%

16. Publication of Statement of Ownership
☐ Publication required. Will be printed in the Nov/Dec 2002 issue of this publication. ☐ Publication not required.

17. Signature and Title of Editor, Publisher, Business Manager, or Owner: Business Manager — Date: September 23, 2002

I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including civil penalties).

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3. Be sure to furnish all circulation information called for in item 15. Free circulation must be shown in items 15d, e, and f.
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6. In item 16, indicate the date of the issue in which this Statement of Ownership will be published.
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PS Form 3526, October 1999 (Reverse)

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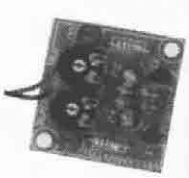

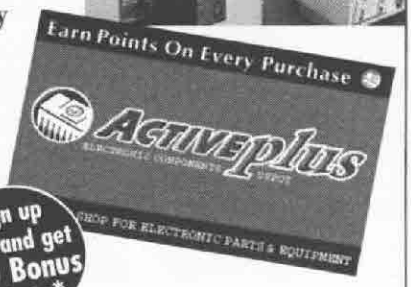

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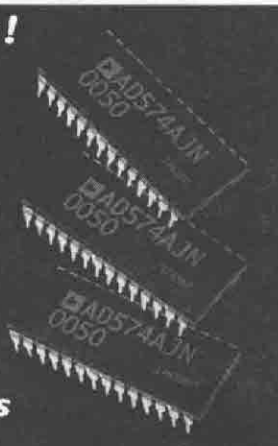

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949E, 300W Antenna Tuner	$139
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C4S	10/12/15/17/20/40m, 7 el	$679
C4SXL	10/12/15/17/20/40m, 8 el	$979
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R84	$.85/ft

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T200-96	96', 15 square feet	$2049
T300-88	88', 22 square feet	$1989
T400-80	80', 34 square feet	$1899
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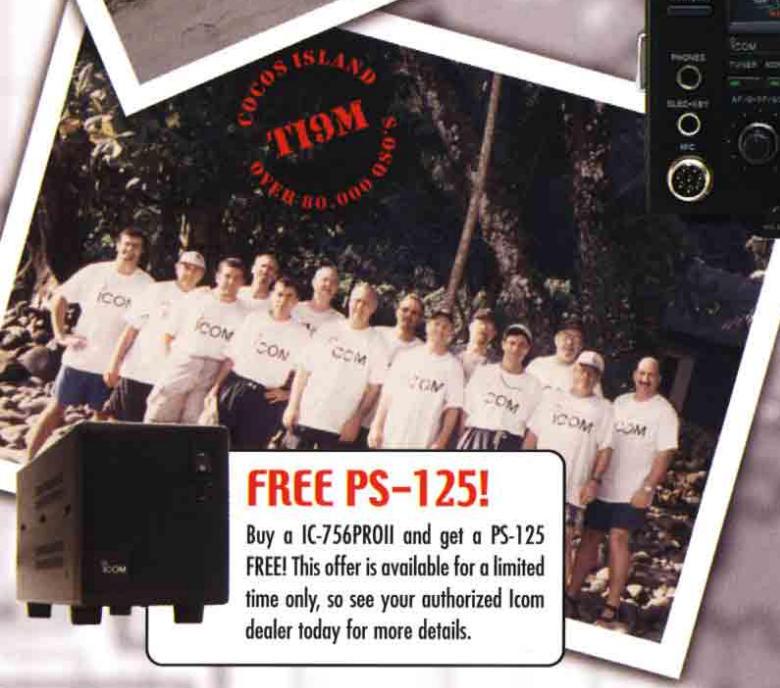

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-Glenn Johnson WØGJ , A50A WW SSB Contest

The IC-756PROII's worked great - we ran them for 11 days, non-stop, ...5 radios, 80,000 QSO's... all bands 160 through six meters... SSB,CW, RTTY, and PSK31! The built-in antenna tuners nice... we could run antennas on other bands... the 40m vertical on 15m... the 30m vertical on 10m... . Temps always above 80...sometimes 110 deg in the operating tents. Humidity above 90% all the time! Radios performed flawlessly. Everything you could want for operating convenience in one box. When you are on the receiving end of the entire world calling you in a pileup, it helps to have a top-notch rig to work them all! I liked the radio so much, I bought one and brought it home!

-Bob Voss N4CD, TI9M DXpedition

I was very impressed with the reliability of the IC-756PROII transceivers and IC-PW1 linear amplifiers, given that our environment on the island was challenging in some respects. At the CW site, there was so much talcum-powder fine volcanic ash blowing around that the radios, amplifiers, and everything else in the tent was covered with a thick layer of dust. I was especially concerned about the 'PW1s given that the fans were running almost continuously, pulling in this dust. We also had a troublesome generator which caused large fluctuations in voltage and frequency (we eventually replaced it). Even with these conditions, the ICOM equipment ran perfectly for 10 days, 24 hours per day. I'd feel confident taking your equipment to any location on the planet.

-Michael Mraz N6MZ, XRØX DXpedition

THE ICOM ADVANTAGE

TRINIDADE ISLAND PWØT OVER 64,000 QSO'S

WORLD RECORD BAKER HOWLAND ISLANDS KIB OVER 96,000

COCOS ISLAND TI9M OVER 80,000 QSO'S

SAN FELIX ISLAND XRØX OVER 68,000 QSO'S

KINGDOM OF BHUTAN A50A WW SSB CONTEST

Find out more

www.icomamerica.com

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