NCJ

NATIONAL CONTEST JOURNAL

$4

September/October 2004

Volume 32 Number 5

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■ Comparing Receiver Performance in Popular HF Tranceivers

■ "Software for Contesters" —A New *NCJ* Column!

■ Mapping Contest Activity

■ Contesting for New Hams—A Dayton Youth Forum Presentation

Top Photo: The K8CC antenna farm—all on 5 acres.

Bottom Photo: The operators at K8CC for the 2003 ARRL DX CW contest: (l to r) John, K8JM; Mark, NU8Z; Dave, K8CC; Don, WX3M; Mike, WD8S. Read the K8CC profile in this issue!

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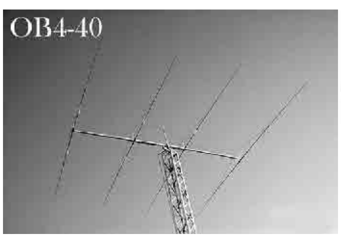

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Carl Luetzelschwab, K9LA

"Contesting for Fun" Column Ending

After three years of "Contesting for Fun," Brian, K7RE, is retiring from the regular columnist ranks. His column in this *NCJ* is his last. He took over from Bob, N4BP, starting with the September/October 2001 issue. Brian, thanks for all your efforts—your columns were enjoyable to read and brought lots of "yep, been there, done that" nods from me (and probably the other readers, too).

New Column—"Software for Contesters"

This issue starts a new column by Pete, N4ZR. It's titled "Software for Contesters," and will review any software that has an application to contesting. Please welcome Pete on board. I'm sure he'd welcome hearing from you about software you're using in your contesting endeavors.

Dayton Youth Forum

One of the presenters at the Dayton Youth Forum this year was 14-year old Aubri, KG4LTB. Her presentation was tilted "Contesting for the New Ham." She told of her ventures into the contesting world. Excerpts from her slide show are elsewhere in this issue. It goes without saying that we need more young hams in our facet of the hobby. They're out there—we just need to find them and help them continue our passion. I'd love to hear stories along this line from you, so if you have anything please send it in.

A DX Feature in *NCJ?*

Also in this issue, you'll find a feature by Tadek, SP7HT, titled "Use of Comparative Analysis to Estimate the DX Prowess of HF Receivers." I picked up this article from Doug, KF6DX (*QEX* Editor). I decided to run it in *NCJ* because contesters need good receivers for the very same reasons that DXers need good receivers—and the more I think about it, maybe we need them even more so than DXers.

Adventures in Contesting

The image on page 30 in the July/August 2004 *NCJ* is Rick K6VVA with the US Tower gals. This photo was taken at the Visalia DX Convention in April. I'll bet that he wishes this really *was* his NAQP team!

Errata

Pat, N9RV, noticed that K4ZA's article "Voice Techniques for Contesters" in the July/August *NCJ* was truncated abruptly. So, we're running it again—in its entirety this time! NCJ

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3CX800A7	4CX250R	YU-106	5867A
3CX1200A7	4CX350A	YU-108	5868
3CX1200D7	4CX350F	YU-148	6146B
3CX1200Z7	4CX400A	YU-157	7092
3CX1500A7	4CX800A	572B	3-500ZG
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3CX2500F3	4CX1500A	807	M328/TH328
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Use of Comparative Analysis to Estimate the DX Prowess of HF Receivers

By Tadeusz Raczek, SP7HT
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My article titled *The DX Prowess of HF Receivers* was published in the Sept/Oct 2002 issue of *QEX*. The inspiration to return to this subject has arisen during my recent translation work. Not related to my ham radio hobby, note that Poland became a regular member of the European Union on May 1, 2004. I have been involved in the translation of papers related to Local Government Finances. These papers commonly use a Comparative Analysis to study the relationship between factors in different countries. I have quickly recognized it would be a good idea to use that analytical method to compare the usefulness of receivers for DXing.

The ARRL Technical Laboratory published Orion test results ARRL Web site in December 2003 and in *QST* in January 2004. A month later, test results of upgraded K2/100 appeared in the February 2004 issue of *QST* followed by their review of the TS-480 and IC-7800. This triggered my second impulse to return to that subject. Being an ARRL member and having access to the ARRL Web site, I became a regular reader of Product Reviews Reports of HF transceivers.

In this article, you can see my findings and conclusions in this analysis and in Table 1. I have also included some graphs of swept BDR, IMD DR3 and phase noise measurements (taken from ARRL Technical Laboratory Extended Test Reports) to point out differences between "good" and "not good" receiver front-end design.

The Table

The far left and the far right columns in Table 1 perform ordinal functions: the left one designates the HF transceiver model and manufacturer and the right one designates in which *QST* issue the test results have been published. The position of other columns (from left to the right) reflects "the weight" I apply in estimating the influence of a particular receiver parameter on the DX prowess of HF receivers. So, in my opinion, BDR at 5 kHz (the second column) is the most important parameter and MDS (the tenth column) is the least significant receiver parameter. To continue with ordinal matters, I have put in my Table HF transceivers of the following manufacturers (alphabetically): Elecraft, ICOM, Kenwood, Ten-Tec and Yaesu. Each of their HF transceivers is (from top to the bottom) in historical order (as the test results have been published in *QST*). That makes it possible to evaluate changes of some receiver parameters during the last 13 years.

My intent was to gather measured receiver parameters in the form of a table that reflects "the weight" I apply to each parameter to estimate the DX prowess of HF receivers. After putting all results in the Table, I have been most interested in technical parameters. But, after a preliminary analysis of my Table, I have also found some historical aspects that I had not expected when I started this project.

Using the same sources of data, somebody can make a different Table, reflecting one's priorities in our ham radio hobby. To be correct, there are many specializations in our hobby, and respectively, many different priorities concerning properties offered by different kinds of equipment. Therefore, I want to point out that my Table is constructed to reflect the DX prowess of HF receivers. I hope that DX-oriented ham radio operators will be interested in its contents.

Why Are The Parameters In The Order They Are?

Since my early beginning as a ham (I got my first license in 1957 as a young boy) until now (a retired old man), I am entirely devoted to DX hunting. I estimate the value of a rig with respect to its usefulness for DXing. That is natural. I am not only a ham radio (HF) educated person, but I have also spent the last 35 years in professional ground and satellite microwave telecommunications. Assuming my life experience in radio communication, I feel free to have my own personal opinion in estimating the usefulness of HF receivers for DXing.

The Four Most Important Receiver Parameters:

- BDR at 5 kHz
- IMD DR3 at 5 kHz
- Phase noise at 4 kHz
- IP3 at 5 kHz (if measured, because usually it is known only at 20 kHz)

There are also other receiver parameters influencing the ability to copy weak DX signals in the presence of strong signals near the DX frequency, which I recognize being less important compared to these four. I will discuss them later.

I do not explain the meaning of these parameters. I hope anyone interested in DX hunting knows them. If anyone would like to refresh his memory, he can look at the ARRL Web site (shortened version: *QST* October 1994, pages: 35-38; detailed version: Test Procedures Manual–159 pages/1.47MB).

I have used in my Table *point test results closest to the listening frequency*. In the case of the ARRL Technical Laboratory tests, it is manually measured 5 kHz spacing for BDR and IMD DR3. DXers want to know these parameters also for closer spacing approximately 2 or 1 kHz from the listening frequency. Such results are presented on several Web sites.

But it is difficult to compare test results measured with different test procedures, measurement test set-ups and so on. Trying to be consistent, I have used only one source of data. There is also a danger in "deriving directly" 2 or 1 kHz "point" test results from Swept BDR or IMD DR3 graphs. The ARRL Technical Laboratory specialist states: "The computer is not skilled (yet) at interpreting noisy readings as a good test engineer, so in some cases there are a few dB difference between the computer generated data and those in the 'Product Review' tables. Our test engineer takes these numbers manually, carefully measuring levels and interpreting noise and other phenomena that can affect the test data." And there is a second statement from the ARRL Technical Laboratory: "We are still taking the two-tone IMD manually."

These statements mean for me that somebody unfamiliar with all measurement set-up and procedures nuance cannot use data derived "directly" from Swept BDR or IMD DR3 oscilloscope graphs close to the listening frequency instead of point results measured manually. Therefore, I have consequently used in my Table only manually measured test point data at 5 kHz and 20 kHz spacing.

Let us begin with the four most important parameters. Each DXer does remember: "*5 up please*". 5 kHz from the DX frequency is the place on the band, which is usually heavily occupied during a DX pile-up on the HF bands. A typical DX pile-up is 5 to 10 kHz wide. In the case of very heavy DX pile-ups, such as that of a new DXCC entity, the DX pile-up could be wider than 10 kHz. For any DXer the most important information is: how a particular receiver responds to many very strong signals 5kHz (or so) apart from the frequency of the weak DX signal.

Table 1
ARRL Tech Lab Receiver Test Data Comparisons

(Selected by SP7HT as on July, 2004)

All receivers have been measured in the following conditions: (Preamplifier OFF) / (Preamplifier ON); 14MHz; 500 Hz CW filter (or any bandwidth closest to 500 Hz); AGC OFF; High IP mode. All test results are in dB, dBm and dBc/Hz respectively.

I have distinguished four categories in my Table. **The highest/best** results of a particular parameter are marked with letter **A and bolded numbers**. The next groups of results are **high-grade** results (marked with letter B). In the third group are **good** results. Good results are marked with letter C. The fourth group are **poor** results. Poor results are marked with letter D. In my opinion, the three best receivers for DX hunting are: Orion, K2/100 and IC-7800.

Transceiver *(1)*	***BDR*** *(dB) Blocking Dynamic Range at **5 kHz*** ***(2)*** *Preamp OFF*	***IMD DR3*** *(dB) Two-Tone Third Order Dynamic Range at **5 kHz*** ***(3)*** *Preamp OFF*	***Phase Noise*** *(dBc/Hz at **4 kHz**)* ***(4)***	***IP3*** *(dBm) Two-Tone Third Order Intercept Point at **5 kHz*** ***(5)*** *Preamp OFF / ON*	*BDR (dB) Blocking Dynamic Range at 20 kHz (6) Preamp OFF / ON*	*IMD DR3 (dB) Two-Tone Third Order Dynamic Range at 20 kHz (7) Preamp OFF / ON*	*IP3 (dBm) Two-Tone Third Order Intercept Point at 20 kHz (8) Preamp OFF / ON*	*IP2 (dBm) Two-Tone Second Order Intercept Point (9) Preamp OFF / ON*	*MDS (dBm) Minimum Discernible Signal (10) Preamp OFF / ON*	*Published in QST * (11)*
K2 Elecraft	B: 126	**A: 88**	B: -124	No test result	**A: 136 /** B: 128	**A: 97 / A: 98**	**A: +21.6** / D: +6,9	B: +75 / B: +76	-131 / -138	March, 2000
K2/100 Elecraft	**A: 135**	**A=91**	B: -124	**A: +21** / D: +8	**A: 134** / B: 126	**A: 97 / A: 95**	**A: +21** / D: +8	**A: +80** / B: +79	-130 / -136	February, 2004
IC-781 ICOM	No test result	No test result	No test result	No test result	**A: 134 / A: 132.5**	**A: 102 / A: 97**	No test result	No test result	-134 / -140	January, 1990
IC-736 ICOM	No test result	No test result	D: -110	No test result	C: 121 / **A: 130**	**A: 95** / B: 92	No test result	D: +59	-133 / -139	April, 1995
IC-738 ICOM	No test result	No test result	D: -118	No test result	D: 119 / D: 119	B: 94 / B: 94	No test result	D: +61	-133 / -139	April, 1995
IC-775 DSP ICOM	No test result	No test result	D: -117, but peak: -110 at 17.5 kHz	No test result	**A: 136.7 / A: 132.2**	**A: 105.7 / A: 103.2**	**A: +20.85 /** C: +11.6	D: +55.7 / D: +55.2	-137.7 / -143.2	January, 1996
IC-706MkIIG ICOM	D: 86	No test result	D: -118, but peak: -108 at 15 kHz	No test result	C: 122.2nl / D: 119.5nl	D: 89.2 / D: 85.5	D: -1.3 / D: -11	D: +36.4 / D: +38.5	-136.3 / -141.5	July, 1999
IC-756PRO ICOM note 2	D: 104	C: 76	B: -130	No test result	B: 126.6 / B: 125.2 / C: 120.3	B: 94.6 / B: 92.2 / D: 88.2	B: +15.4 / C: +4.3 / D: -4.2	D: +63.7 / D: +62.6 / D: +42.8	-127.6 / -136.7 / -140.3	June, 2000
IC-756 PRO II ICOM notes 2 and 3	D: 100 / D: 97 / D: 94 (after repair)	C: 76 / C: 75 / D: 72 (after repair)	B: -130	D: -18.8 / D: -28.8 / D: -35.5 (after repair)	D: 118 / D: 116 / D: 111 (after repair)	**A: 97** / **A: 95** / C: 91 (after repair)	**A: +20.2** / C: +10.2 / D: -4.1 (after repair)	C: +75.6 / C: +70.7 / D: +58.9 (after repair)	-130.5 / -139 / -141 (after repair)	February, 2002

Transceiver (1)	***BDR*** *(dB) Blocking Dynamic Range at **5 kHz*** ***(2)*** *Preamp OFF*	***IMD DR3*** *(dB) Two-Tone Third Order Dynamic Range at **5 kHz*** ***(3)*** *Preamp OFF*	***Phase Noise*** *(dBc/Hz at **4 kHz**)* ***(4)***	***IP3*** *(dBm) Two-Tone Third Order Intercept Point at **5 kHz*** ***(5)*** *Preamp OFF / ON*	*BDR (dB) Blocking Dynamic Range at 20 kHz (6) Preamp OFF / ON*	*IMD DR3 (dB) Two-Tone Third Order Dynamic Range at 20 kHz (7) Preamp OFF / ON*	*IP3 (dBm) Two-Tone Third Order Intercept Point at 20 kHz (8) Preamp OFF / ON*	*IP2 (dBm) Two-Tone Second Order Intercept Point (9) Preamp OFF / ON*	*MDS (dBm) Minimum Discernible Signal (10) Preamp OFF / ON*	*Published in QST * (11)*
IC-746PRO ICOM note 2	D: 100 / D: 97 / D: 94	D: 74.9 / D: 73.5 / D: 71	D: -123, but peaks: -106 at 1 kHz -120 at 10 kHz	D: -18.25 / D: -28.2 / D: -35.55	B: 125 / C: 122.6 / D: 117.9	**A: 96.9** / **A: 95.5** / C: 92	**A: +20.0** / D: +9.3 / D: -1.8	C: +72 / C: +71 / D: +53.9	-131.9 / -139.2 / -142	May, 2002
IC-703 ICOM	D: 95.1 / D: 95.4	C: 76 / C: 76.3	D: -118	D: -14.4 / D: -20.6	C: 120.6nl / C: 121.9nl	D: 89 / C: 90.8	C: +11.1 / D: +1.9	D: +56.2 / D: +46.8	-131 / -140.8	July, 2003
IC-7800 ICOM	C: 115 / C: 112 / C: 110	**A: 89** / B: 84 / B: 83	C: -120	**A: +22** / D: +7.7 / D: +0.5	**A: 137**nl / **A: 138**nl / **A: 135**nl	**A: 104** / **A: 103** / **A: 102**	**A: +37** / **A: +21** / C: +11	**A: +98** / **A: +87** / **A: +84**	-127 / -138 / -142	August, 2004
TS-850S Kenwood	No test result	No test result	No test result	No test result	**A: 148 / A: 138**	**A: 99 / A: 99**	D: +7.5 / B: +17.5 (IPO ON)	No test result	- / -141	July, 1991 (8.83 MHz; 455kHz)
TS-950 SDX Kenwood	No test result	No test result	No test result	No test result	**A: 131.8** / **A: 133.9** (AIP ON)	B: 94 / **A: 95**	No test result	No test result	-138 / -127 (AIP ON)	Dec, 1992
TS-50 Kenwood	No test result	No test result	D: -115	No test result	D: 113 / D: 109	C: 90 / D: 88	D: +3 / D: -7	No test result	-132 / -139	Sept, 1993
TS-870S Kenwood	No test result	No test result	D: -116	No test result	C: 127.2 / C: 123	**A: 96.7 / A: 95**	No test result	D: +62.7 / D: +63	-128.7 / -139	February, 1996
TS-570S (G) Kenwood	No test result	No test result	No test result	No test result	D: 115nl / D:115nl	**A: 98**nl / **A: 97**nl	**A: +21.7** / D: +9.6	D: +60 / D: 58.4	-130 / -139	May, 1999
TS-2000 Kenwood	D: 103.4	D: 68.9	D: -118 but peaks: -108	D: -14.5 / D: -28.8	B: 125.6nl / C: 120.8nl	B: 93.9 / B: 92.4	B: +18.5 / D: +4.2	D: +59 / D: 58.4	-128.9 / -137.4	July, 2001
TS-480 Kenwood	D: 98 / D: 91	C: 75 / D: 71	D: -120	D: -18 / D: -32	C: 123 / D: 115	**A: 98**nl / **A: 99**nl	**A: +26** / C: +12	D: +64 / D: +63	-133 / -141	June 2004
OMNI 6+ Ten-Tec note 1	C: 119	No test result	D: -117	No test result	- / C: 123nl	- / **A: 97**	- / C: +12	- / D: +58	- / -133	June, 2000
Orion Ten-Tec	**A: 130.2**	**A: 93**	**A: -138**	**A: +22.1** / C: +11.4	B: 129.3 / B: 128.3	**A: 95.3** / B: 94.0	**A: +22.8 /** C: +12.9	D:+63 / D: +63	-128 / -136	January, 2004
FT-1000D Yaesu	No test result	No test result	No test result	No test result	**A: >143 / >154**	**A: 98 / A: 98**	**A: +21** / C:+10	No test result	-126 / -137	March, 1991
FT-1000MP Yaesu	C: 119	B: 83	D: -117, but many peaks	No test result	**A: 142 (Off) 137 (Flat)**	**A: 96.7** / B: 93.5	B +15 / D: +5	**A: +85.9 (Off) +87.5 (Flat) +87.5 Tuned**	-127.9 / -135.5 / -135.5	April, 1996

Transceiver (1)	BDR (dB) Blocking Dynamic Range at 5 kHz (2) Preamp OFF	IMD DR3 (dB) Two-Tone Third Order Dynamic Range at 5 kHz (3) Preamp OFF	Phase Noise (dBc/Hz at 4 kHz) (4)	IP3 (dBm) Two-Tone Third Order Intercept Point at 5 kHz (5) Preamp OFF / ON	BDR (dB) Blocking Dynamic Range at 20 kHz (6) Preamp OFF / ON	IMD DR3 (dB) Two-Tone Third Order Dynamic Range at 20 kHz (7) Preamp OFF / ON	IP3 (dBm) Two-Tone Third Order Intercept Point at 20 kHz (8) Preamp OFF / ON	IP2 (dBm) Two-Tone Second Order Intercept Point (9) Preamp OFF / ON	MDS (dBm) Minimum Discernible Signal (10) Preamp OFF / ON	Published in QST * (11)
Mark V FT-1000MP Yaesu	No test result	No test result	C: -123, but peak: -116 at 13.5 kHz	No test result	B: 128.7 / **A: 133**	**A: 100.7** / **A: 97.6**	No test result	D: +68.3 / D: +68.5	-126.7 / -134.6	Nov, 2000
FT-817 Yaesu	No test result	No test result	D: -117 but peaks: -113 at 6.2 kHz, -115 at 8.6 kHz	No test result	D: 106 / D: 103.9	D: 86.7 / D: 84.3	D: +5 / D: -5.6	**A: +84 / A: +84.3**	-125.9 / -134.3	April, 2001
FT-1000MP Mark V Yaesu	D: 107	D: 73	D: -117	D: -5.2 / D: -15.6	C: 122 / C: 122	**A: 98** / **A: 97**	**A: +20.3 /** C: +11.5	D: +68 / D: +64	-125 / -133	August, 2002
FT-897 Yaesu	D: 96nl	D: 66.6	D: -108	D: -24.25 / D: -32.2	D: 108.5 / D: 106.3	D: 88.6 / D: 86.2	C: +1.25 / D: -6.7	D: +67.5 / D:+61.6	-132.6 / -137.2	May, 2003

Notes:
******QST* Product Review columns and ARRL Web site: **www.arrl.org/members-only/prodrev**
No test result: some parameters have been measured from mid 2001, some from 1996 and later.
Note 1: only one set of numbers is listed because this radio uses a fixed-gain front end that is not switchable. Compare their BDR, IMD DR3, IP2 and IP3 results to other receivers by using similar MDS to determine which set of results to use (Preamplifier OFF / Preamplifier ON) for comparison.
Note 2: the IC-756PRO & PROII and IC-746PRO have two different gain preamplifiers. Results are for preamplifier OFF / Preamplifier #1 / Preamplifier #2. Preamplifier #2 adds more RX gain than Preamplifier #1 at the expense of dynamic range. Higher preamplifier gain reduces dynamic range performance in these receivers.
Note 3: The IC-756PRO II provided to ARRL Lab was discovered to be malfunctioning. After repair by ICOM service, its dynamic parameters have improved.

I think BDR at 5 kHz is the most important receiver parameter. Measured values are in the second column in my Table. In a typical DX pile-up there is a quite big probability that any signal, strong enough, situated close to the DX station's frequency, can cause receiver gain compression or receiver desensitization. Receivers have different levels of immunity against these negative effects. A particular receiver's immunity depends on its front-end design. BDR—Blocking Dynamic Range—describes a particular receiver's ability to maintain its sensitivity (or not to become desensitized) in the presence of a strong undesired signal on an adjacent frequency. HF transceiver producers prefer this parameter to be measured far from the listening frequency (wide spacing measurement produce "optimistic" results, giving higher BDR values—compare BDR measured close or very close to the listening frequency).

On the contrary, DXers want that parameter to be measured as close to the listening frequency as possible. Why? Because measurements made close to the listening frequency reflect real receiver abilities to copy extremely weak signals from a DX station in the presence of strong signal (signals) on adjacent channels. Since mid-2001, the ARRL Technical Laboratory has measured BDR not only at 20 kHz, but also at 5 kHz spacing from the listening frequency. For the HF bands these measurement are made on 3.520MHz and 14.020MHz. I use in my article results measured on 14.020MHz.

It is not true what some ham radio operators claim: these effects are "not present" in their receivers. Such a statement is false! Blocking/desensitization effects could appear in any receiver, even in such superior receivers as an Orion or an upgraded K2/100. In a real DX pileup blocking/desensitization, effects appear as less comfortable receiving conditions of weak DX signals in the presence of strong signals on nearby frequencies. This is only a matter of how strong the signal on a nearby frequency is. The blocking/desensitization level is very high for some "good" receivers (for example: K2/100 and Orion) but in "other" receivers, (for example IC-706MkIIG, FT-897 and others—see Table 1) blocking/desensitization level is significantly lower.

Why do I recognize BDR at 5 kHz as the most significant parameter for estimation of the DX prowess of HF receivers? Because the probability of blocking/desensitization effects, even by a single strong signal, is higher than any other negative effects caused by strong signals on nearby channels. Any strong signal anywhere outside of the listening channel receiver selectivity skirt can cause this effect if it is strong enough to surpass a particular receiver's dynamic range. In such a case, it is a fact that with the appearance of that strong signal, receiving conditions of a weak DX signal will be deteriorated.

Blocking Dynamic Range=Blocking Level–Noise Floor

BDR is expressed in dB relative to receiver Noise Floor. BDR at 5 kHz spacing is usually measured with Preamplifier OFF. Receivers offering BDR = 120dB at 5 kHz are recognized as high-grade receivers for that parameter. BDR values around 130dB are actually top grade ham radio HF receivers. Only receivers in the Orion and K2/100 HF transceivers have such high values of BDR at 5 kHz spacing. The two next receivers in turn are: FT-1000MP and OMNI 6+ HF transceivers with the BDR at 5 kHz value of 119dB. The OMNI 6+ result is respectable because it is measured with Preamplifier ON (there is no possibility to turn Preamplifier OFF in OMNI6+). The next one is the newest IC-7800 with BDR at 5 kHz value of 115 dB. Receivers with BDR at 5 kHz around 110dB and below that value (see Table) are less useful for DXing in today's DX pile-ups.

Receivers equipped with narrow band crystal filters in the first IF (among others: K2, OMNI6+, Orion) have a much higher value of BDR at 5 kHz than general coverage receivers equipped with a 15 kHz wide filter in their first IF. Except for the FT-1000MP (worse by 16dB) and IC-7800 (worse by 20 dB), all receivers with wide filter (15 kHz) in their first IF have their BDR at 5 kHz significantly worse than the upgraded K2/100. In the case of IC-756PRO, it is worse by 31dB (more than 5 S units on the S-meter scale) and in the case of IC-706MkIIG worse by 49dB (more than 8 S units on the S-meter scale). Other receivers in my Table are contained between the 31dB and 49dB marks. In case of a wide first IF filter, BDR is quickly decreasing as a strong signal is passed inside the pass band of that filter. That is clearly seen from the Swept Blocking Dynamic Range Figure 2 (for the TS-2000) and from data in the second column in my Table.

Figure 1 is a representation for receivers equipped with a narrow bandwidth crystal filter in first IF (K2 is an example). There is a narrow, deep null only around the proximity of the listening frequency. Figure 1 shows a deep null on 14.020MHz of approximately 12dB down compared to the flat part of the graph.

Figure 2 is an example of a receiver equipped with a wide filter (15 kHz) in its first IF. For that case, the deep null in the proximity of the listening frequency is not only significantly wider (about 45 kHz wide!) but is also remarkably deeper: almost 53dB down from 130dB level. Additionally, the flat part of the graph does not exist at all: we can see BDR fluctuations even 150 kHz away from 14.020MHz.

To illustrate that relationship I have intentionally chosen the worst Swept Blocking Dynamic Range graph measured since mid 2001, which is the TS-2000. Other receivers equipped with a wide filter (15 kHz) in the first IF have a little bit "better" graph (a little bit narrower deep null around the listening frequency and there are flat parts far away from the listening frequency). By comparing these two different approaches of receiver front-end design, anyone can judge which one is better for DX hunting. I can precisely say that the K2, OMNI6+, Orion and other receivers equipped with narrow bandwidth crystal filters in their first IF are narrow as "needle eye" and open only for desired signals somebody wants to receive. In contrast, receivers equipped with wide filters (15 kHz) in their first IF "are as wide open as barn doors", not only for the desired DX signal, but also any other disturbing signals (including DX pile-up signals) in the neighborhood (up and down) of the listening frequency. All signals passed via wide first IF filters are amplified by the receiver's first IF circuitry and can cause blocking, desensitization and inter-modulation (see below) at the receiver's second IF mixer.

IMD DR3 at 5 kHz is second in importance (third column in my Table). ARRL Test Procedures Manual enumerates this parameter as Two-Tone Third-Order Dynamic Range. IMD DR3 is an indication of a receiver's ability not to generate false signals because of the two strong signals on different frequencies outside the receiver pass-band. IMD DR3 is expressed in dB relative to receiver noise floor.

Two strong parent signals f_1 and f_2 of the same amplitude can produce third-order intermodulation products in the receiver. If f_1 and f_2 signals are strong enough, any receiver will produce intermodulation products ($2f_1$ - f_2) and ($2f_2$ – f_1) that are generated inside the receiver due to its limited immunity against Two-Tone Third-Order Intermodulation Distortion.

Special conditions can be met to produce an intermodulation product exactly on a specific listening frequency, f_{DX}. Two strong parent signals f_1 and f_2 have to have a special frequency relation to each other and with that specific listening frequency, f_{DX}. Therefore, for a typical DX pile-up, only some specific pairs of f_1 and f_2 frequencies can produce third order intermodulation products exactly on the frequency of the weak DX station, f_{DX}. That is why the probability of Two-Tone Third-Order Intermodulation products appearing on the listening frequency f_{DX} is smaller than blocking or desensitization of the receiver by any single signal. That is why I have ranked this parameter in second

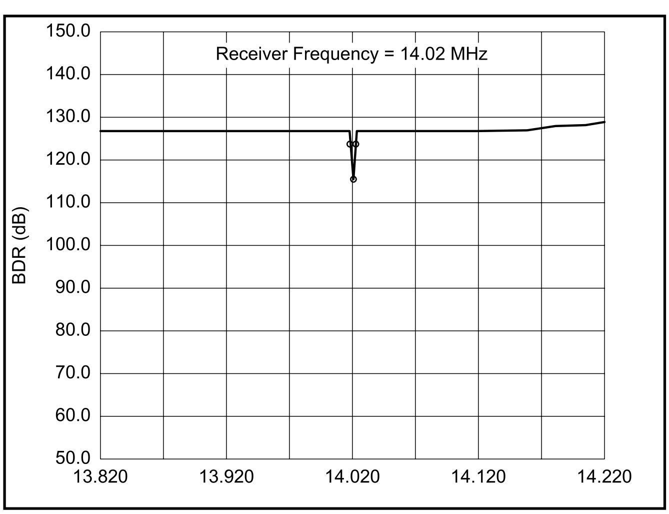

Figure 1—K2 Swept Blocking Dynamic Range.

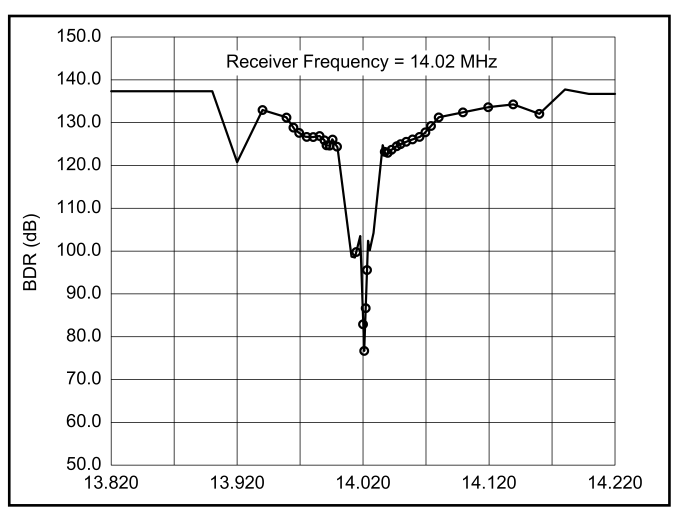

Figure 2—TS-2000 Swept Blocking Dynamic Range.

place, after BDR at 5 kHz. In the case of receiver blocking / desensitization, any single signal, anywhere, but close to the listening frequency f_{DX} can inhibit the reception of a weak DX station, if that signal is strong enough to produce the receiver blocking / desensitization effect.

The higher the IMD DR3 parameter, the higher is the particular receiver's immunity against intermodulation. For parent signals f_1 and f_2 spaced by 5 kHz, a value of 88dB means a high-grade receiver for that parameter. The three best receivers for that parameter are the Orion (93dB), upgraded K2/10 (91dB) and the new IC-7800 (89 dB). General coverage receivers with wide (15 kHz) first IF filters have IMD DR3 parameters worse than Orion, ranging from 10dB (FT-1000MP) to 26dB (FT-897). An old FT-1000MP is once again the best general coverage receiver equipped with a wide first IF filter.

We can observe the same rule as for BDR at 5 kHz: receivers equipped with a narrow crystal filter in their first IF have higher values of IMD DR3 at 5 kHz than general coverage receivers with wide (15 kHz) first IF filters. That is clearly seen from Swept Two-Tone, Third-Order IMD Dynamic Range graphs (Figure 3 for K2 and Figure 4 for TS-2000) and from data in third column in my Table. And the same conclusion (as in case of BDR at 5 kHz): comparing these two graphs, anyone can judge which receiver front-end design is better for DX hunting.

I have placed the influence of phase noise third (fourth column in my Table). For some receivers BDR and IMD DR3 results are "noise limited" (for instance BDR at 5 kHz is 96dBnl (noise limited) in the case of the FT-897). A particular receiver's phase noise contribution is masking and interfering through desensitization (during BDR measurement) or intermodulation products (during IMD DR3 measurement). The normal 1dB decrease of receiver sensitivity (during BDR measurement) cannot be measured due to a 1dB increase of phase noise. In all probability, the receiver has greater BDR than the measured noise-limited value.

The third limiting factor of modern receiver performance is local-oscillator phase noise. Phase noise contributes to poorer receiver BDR in the form of desensitization by nearby strong signals resulting from reciprocal mixing. In a real DX pile-up, a receiver with poor phase noise will not only receive signals the VCO is tuned to, but also some very strong signals that could be several kHz away from the listening frequency f_{DX} will be heard (like cross talk) on the listening frequency due to reciprocal mixing.

Frequency synthesizing VCO oscillators are more prone to generate phase noise sidebands than ordinary LC oscillators. Strong signals from the antenna can produce in such a receiver IF signals not only when mixing directly with the VCO carrier, but also when mixing with noisy sidebands of the VCO. Oscillator power noise density is expressed in dB referred to the carrier in a 1Hz bandwidth (dBc/Hz). The measurement is usually made as Transmitted Composite Noise Test from the carrier up to 22 kHz away. Only in the case of the Orion VCO oscillator can its phase noise be measured directly.

A new record of low VCO phase noise in ham radio HF equipment has been achieved recently in the Ten-Tec Orion HF transceiver: only -138dBc/Hz at 4 kHz from the carrier. But there is also some increase of phase noise 45–70 kHz from the listening frequency (see Figure 5). Very good synthesizer design is implemented in the ICOM IC-756PRO and IC-756PRO II HF transceivers (-130dBc/Hz). A typical phase noise graph for good VCO design is demonstrated in Figure 6. And finally, an example of quite poor design referring to VCO phase noise is shown in Figure 7. There is more than 20dB difference (in favor of Orion) in phase noise contribution between Figures 5 and 7. For DX hunting oriented operators it is clear which VCO oscillator design is better.

And finally, IP3 at 5kHz is fourth in importance (fifth column for 5 kHz and eighth column for 20 kHz spacing). This is Third Order Intercept Point at 5 kHz spacing (if measured, because usually only IP3 at 20kHz is known). IP3 is an extrapolated point at which the desired response and the Third Order IMD response intersect. The Third Order IMD products increase three times as fast as the pair of equal amplitude parent f_1 and f_2 signals. Increasing the power of parent f_1 and f_2 signals results in an increase of fundamental output signals in one-to-one ratio (until saturation will destroy the linear relationship).

The frequency separation of the two equal amplitude signals f_1 and f_2 can greatly influence intermodulation in a particular receiver. The worst situation is when there is not enough selectivity at the receiver front-end and both equal signals f_1 and f_2 can pass through the first IF filter. That causes intermodulation in the first IF circuitry and in the second mixer.

The IP3 parameter for the two best receivers in my Table deteriorates slightly when changing f_1 and f_2 spacing from 20 kHz to 5 kHz. Orion goes from +22.8dBm / +12.9dBm at 20 kHz spacing to +22.1dBm / +11.4dBm at 5 kHz spacing. The K2 goes from +21.6dBm / +8dBm at 20 kHz spacing to +21dBm / +8dBm at 5 kHz spacing.

On the opposite side are behaviors of general coverage receivers equipped with wide (15 kHz) first IF filters. Let us analyze (for example) IC-756PRO II Extended Test Results of IP3 at 20 kHz and 5 kHz spacing: IP3 is +20.2dBm / +10.2dBm / -4.2dBm at 20 kHz and decreasing dramatically to -18.8dBm / -28.8dBm / -35.5dBm at 5 kHz.

This is an enormous degradation of re-

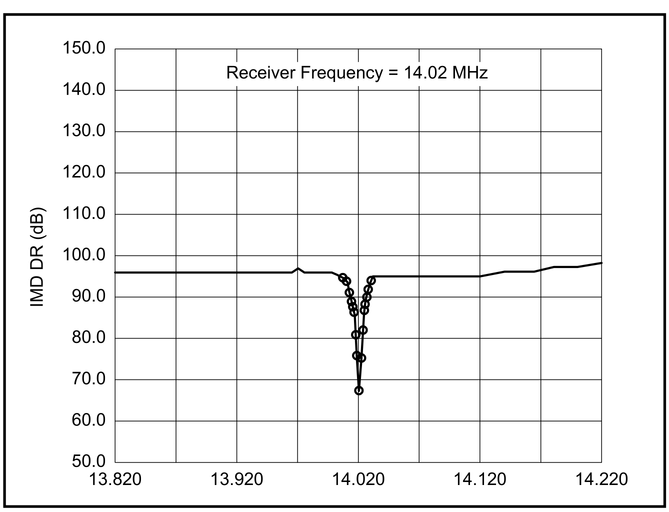

Figure 3—K2 Swept Two-Tone, Third Order Dynamic Range.

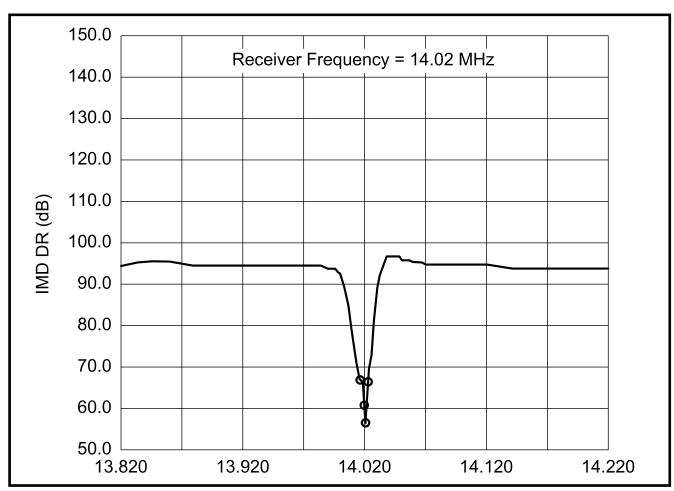

Figure 4—TS-2000 Swept Two-Tone, Third Order Dynamic Range.

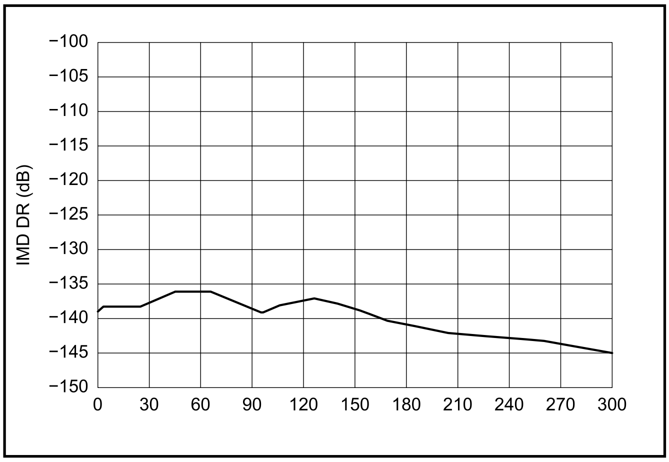

Figure 5—Orion Transmit Composite Noise / Receiver phase noise plots.

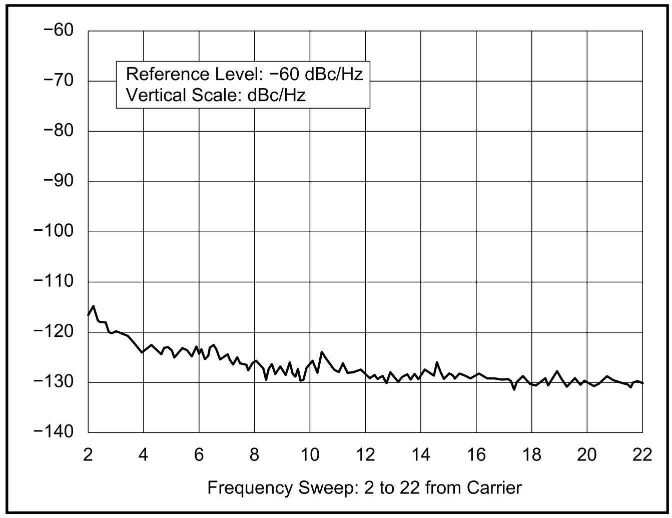

Figure 6—K2 Transmit Composite Noise / Receiver phase noise.

ceiver performance in the presence of strong signals close to the listening frequency. The 20 kHz and 5 kHz IP3 difference in IC-756PRO II receiver is reaching an enormous value of 39dB! That is almost 38dB worse compared to Orion (0.7dB) and K2/100 (0.6dB) test results. When comparing test results from the fifth column for 5 kHz and the eighth column for 20 kHz spacing, anyone can see similar IP3 deterioration in other general coverage receivers equipped with a wide (15 kHz) first IF filter. That is why I recognize such design as "not good" for DX oriented ham radio operators.

By evaluating "good" designs of receiver front-ends, we can assume that only receiver input circuits, including the first mixer, are "responsible for" its IP3 properties. But this is not true in the case of "not good" design with wide (15 kHz) first IF filters. In that case, first IF circuits and second IF mixer add their contribution of IP3 deterioration for a narrow spaced pair of equal amplitude f_1 and f_2 signals.

"Good" receivers have IP3 at 5 kHz in the range of +15dBm. Values around +20dBm characterize a receiver as high grade. Any dB more above the +20dBm level puts a receiver in the top grade group for that parameter. At this point, I have not mentioned that it is possible to "improve" the IP3 parameter artificially by making a receiver less sensitive, or by putting an attenuator before the receiver front-end. For example, turning on a 20dB attenuator results in an improvement in IP3 from a "poor" of -3dBm to a "good" of +17dBm.

I have recently seen discussions about front-end design offering IP3s in the range of +30dBm and even +40dBm. I am not enthusiastic in such upgrading. I recognize such designs are important only for some specific locations, like wireless communication command centers or for air / sea mobile use, when different transceiver antennas "almost touch each other" and there is a great possibility of electromagnetic induction of big signals in neighboring antennas. But this is not the case for shack-style ham radio practice. Ham radio antennas are not so densely populated.

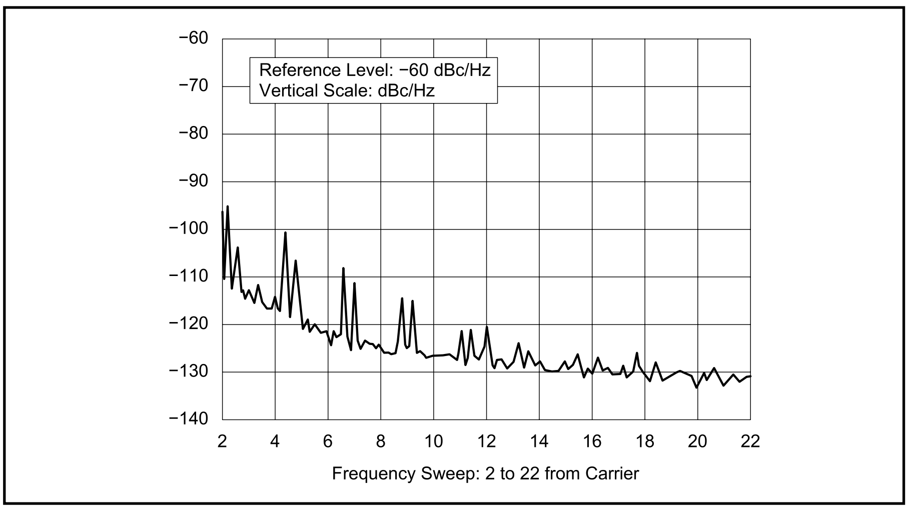

Figure 7—TS-2000 Transmit Composite Noise / Receiver phase noise.

Let us estimate if a front-end design offering IP3 = +40dBm is the solution for receivers equipped with wide (15 kHz) first IF filter. From the DX hunting point of view, I think not. If such a receiver front-end has (for example) an IP3 of +20.2dBm at 20 kHz and it decreases down to –18.8dBm at 5 kHz, what would be the real improvement replacing that front-end (including the first IF mixer) with a design offering IP3 = +40dBm at 20 kHz? Not too much in the case of a typical DX pile-up. Still, for narrow 5 kHz spacing, deterioration of IP3 (including first IF circuits and second IF mixer) is 39dB. This means that for 20 kHz spacing IP3 would be excellent, but for 5 kHz a quite miserable +1dBm (+40dBm - 39dB = +1dBm), which is not an impressive value and worse by 20dB than 5 kHz IP3 achieved in Orion and K2/100. Such a low value of IP3 at 5 kHz spacing I recognize as "bad front-end design" for DX-oriented operators. This is my personal point of view: for me, most important are receiver properties at 5 kHz spacing (and closer). For 5 kHz spacing none of the general coverage receivers with wide (15 kHz) first IF filter can offer as good parameters as measured in the case of Orion and K2/100.

The main disadvantage of a general coverage up-conversion concept is its very wide first IF filter. For DX hunting, contesting and digital mode operation, a much narrower filter should be used. But a general coverage receiver design is forcing up-conversion in the first mixer.

That results in a quite high first IF (45MHz – 70MHz). It is not easy (and not cheap, either) to replace the 15 kHz wide first filter in the 45MHz – 70MHz range with a narrow one offering a bandwidth adequate for SSB. But some ambitious ham radio constructors follow this way: I know one Polish ham radio constructor (SQ9GAT) who has upgraded his old FT-1000MP with a narrower first IF filter.

Other Receiver Parameters (Less) Important For DX Hunting

Receiver sensitivity measures its ability to hear weak signals. Sensitivity is expressed in µV, dBm and sometimes in dBµV. MDS is the input level to the receiver that produces an output signal equal to the internal noise generated in the receiver. Therefore, MDS is sometimes referred to as the receiver noise floor. The typical MDS of a ham radio HF receiver is in the range -135dBm to -140dBm at 500Hz bandwidth.

By analyzing values from column 2 and 10 in my Table we can find that high sensitivity is sometimes an enemy of good dynamic range of the receiver. It counts for IC-706MkIIG and IC-756PRO, IC-756PRO II and IC-746PRO, when Preamplifier #2 is ON. Adversely, the three best dynamic range receivers in my Table are rather moderate in sensitivity.

Only in the case of a very wide DX pile-up and main World-Wide Contests shall 20 kHz BDR (column 6) and 20 kHz IMD DR3 (column 7) be taken into account. The same counts for IP3 at 20 kHz (column 8). Generally, these parameters are significantly better for 20 kHz spacing than for 5 kHz. That is why I have put them further down on my list of importance.

IMD DR2 and extrapolated IP2 are maladies of "not good" receiver front-end design (equipped with semi-octave wide RF filters at the front-end of the receiver). I don't care about them (and I am not going to use or to buy any "not good" design receiver).

An attempt to analyze the historical aspect, after putting all these parameters into my Table, has made me realize that there are not only strictly technical relationships but also some historical dependencies. I was surprised about that!

New models of HF transceivers of both American producers Elecraft and Ten-Tec have usually offered higher values of receiver dynamic range parameters. From March 2000 until December 2003, a prototype K2 (serial number 00495) was measured with the best dynamic range receiver at 5 kHz spacing. An Orion manufactured by Ten-Tec beat this record in December 2003. I have found in the February 2004 issue of *QST* test results of the same K2 (serial number 00495) but upgraded to K2/100 version. I have noticed that the 5 kHz BDR record now belongs to K2/100 (almost 5dB better than Orion). I have followed modernizations and upgrades implemented by Elecraft in recent years. Therefore I can say, "K2 is alive," almost every month some new upgrading is announced. There is sensitive feedback between K2 users and Elecraft designers. Elecraft staff checks proposals for improvement and many of the ideas have been implemented already. To be specific, between March 2000 and February 2004 some K2 receiver parameters have been significantly improved: 5 kHz BDR has been improved from 126dB to 135dB, which is a new record value for ham radio receivers, 5 kHz IMD DR3 has been improved from 88dB to 91dB (only Orion is better by 2dB), and IP2 has been improved from +75dBm / +76dBm to +80dBm / +79dBm. The same story is in the case of Ten-Tec's last two models: dynamic range parameters of Orion have exceeded previous OMNI 6+ results.

My historical findings in the case of ICOM, Kenwood and Yaesu for the last 13 years are not so positive. I have found a similar approach concerning receiver front-end design. Approximately until 1990 they have manufactured HF transceivers designed only for ham radio bands (some models included also the 160 meters band). Receivers have been generally designed as a double superheterodyne (for example, Kenwood used Ifs of 8,83MHz and 455 kHz). What was important in these receivers was the fact that they were equipped with narrow filters after the first mixer, with an SSB crystal filter as standard. It was possible to install also an optional narrow crystal filter for CW (Kenwood: 500Hz or 270Hz).

Later ICOM, Kenwood and Yaesu started to implement the general coverage receiver design. When comparing the dynamic parameters of previous and new generation of receivers, I have found that changing the receiver front end design concept has brought a deterioration of dynamic parameters. Specifically, ICOM top values of BDR and IMD DR3 at 20 kHz were measured for IC-781 and IC-775DSP. None of the later (new generation) models beat (or even approached) the IC-781 and IC-775DSP records. Only the newest IC-7800 offers these parameters. The Kenwood top values of BDR and IMD DR3 at 20 kHz were measured for TS-850S (a model from early 1990). None of the newer (new generation) models beat TS-850S specs (only the new TS-480 with a IMD DR3 at 20 kHz comes near). Finally, Yaesu top values of BDR and IMD DR3 at 20 kHz were measured for the FT-1000D (a model from early 1990) and an FT-1000MP (a model from mid 1995). None of the newer models matched these specifications (except the Mark V FT-1000MP with an IMD DR3 at 20 kHz).

At this point I have to underline that we can use only some parameters for historical comparisons over the last 13 years. 5 kHz dynamic range measurement results are accessible only for models measured since mid 2001 and later. A similar situation is found with wide band swept dynamic range measurements (since 1996). I have also found some difficulties in comparing composite noise data measured recently and 10 years ago (different graphs). Beginning from mid 2001, the testing range is wider than previous and since that time we have access to more complex test results.

Conclusion

First, from a technical point of view I have tried to demonstrate that comparative analysis is a valid tool to estimate the DX prowess of HF receivers. I have concentrated only on receiver dynamic parameters, having in mind the usefulness of the receiver for serious DXing. I have tried to point out that – thanks to a good job done by the ARRL Technical Laboratory—any ham radio operator can judge for himself the usefulness of a particular piece of equipment for his particular needs and habits as a ham radio operator. There are many other points of interests in our hobby. Using ARRL Technical Laboratory test results someone could make his own analysis, reflecting one point of interest.

Second, unexpectedly the historical aspect has appeared during my evaluation. With respect to that factor, I want to point out that ham radio operators should be cautious with marketing claims about "next top achievements" offered in new models. As you can see from the above historical comparisons, these claims are not always true. Sometimes, they are contrary to measurement results. Being pragmatic, it is better to have "limited confidence" for such claims, until we have seen a report in the Product Review column in *QST* or at the ARRL Web site and have a chance to make our own "comparative analysis". That is my friendly advice.

Acknowledgements

I want to thank Wes, SP2DX, and Charlie, WØYG, for their encouragement and useful comments during preparation of the final version of this manuscript in the English language.

SP7HT has been involved in DX hunting for the last 47 years. SP7HT was the very first DXer from Poland to reach DXCC Honor Roll (1981) and DXCC Honor Roll #1 (1986). For the last 35 years his occupation has been associated with ground and satellite microwave telecommunication. He has been retired since January 2003.

The Geography of Contesting in the United States

By Kenneth E. Harker, WM5R

Among those who have been in radio contesting for a while, it is well known that some contests favor certain geographic areas at the expense of others. A Top Ten US finish in the ARRL International DX Contest from Texas is considered quite an accomplishment because Texas is seen as a relatively disadvantaged location from which to operate that contest. Texas, on the other hand, is a great location from which to operate the ARRL November Sweepstakes. You may even notice in the contest results that more west coast stations operate in the Sweepstakes than other contests, and more east coast stations operate in the ARRL DX Contest than in other contests. Drawing maps of the locations of ARRL contest participants makes these, and other geographic trends in contesting, much easier to understand.

How To Draw the Maps

The ARRL now makes the complete line score results database of every ARRL contest (back through mid-2001) available on their Member's Only Web site at **www.arrl.org**. ARRL members can download the data in comma-separated or tab-separated formats, and use spreadsheet software or their own custom software to process the data to meet their own needs. Depending on the contest, the scores database includes call signs, scores, QSO totals, multiplier totals, ARRL/RAC section, DXCC entity, hours operated, contest club, power output, and other fields. The scores database for the Sweepstakes even includes per-band QSO total breakdowns. One thing that is missing, however, is an accurate geographic location field. The ARRL only really needs to know the section in which a contest operation takes place in order to determine awards, so collecting a lat/lon (latitude/longitude) value for each entrant has not been necessary.

To compute a latitude and longitude value for each contest participant, I match the call sign of the station used with its entry in the FCC database to get a US ZIP code. The ZIP code is then matched to a default lat/lon for each ZIP code. This is a fast and easy way to get roughly accurate lat/lon values for potentially thousands of contest entries. It is, of course, far from perfect; there are errors and omissions in the FCC database, contesters often operate from portable or secondary station locations, and two operations from the same ZIP code will be mapped on top of one another.

There are probably better, more general ways of collecting more accurate lat/lon values. Bruce Horn, WA7BNM, is considering adding a feature to his popular 3830 Score Submission Web forms (**216.133.253.197/**) to allow stations to self-report their geographic locations. Commercial sources of call book information, such as QRZ! and BuckMaster HamCall offer lat/lon values for stations in all countries—not just the United States. Given the limitations of the free mapping engine I use, however, I have limited my scope of interest to contesters in the United States. Using the FCC database and ZIP codes, in the aggregate, results in enough correct values to make the maps useful, so I have not had much incentive to try other methods of lat/lon determination.

Once my *Perl* program (using a MySQL database with the FCC and ZIP code data in it) has annotated the ARRL line scores database for a contest with lat/lon values for each contest entrant, another *Perl* program I wrote generates an input file for the map drawing engine to tell it where to put and what color to make each dot or push-pin. The mapping engine I use is the US Census Bureau TIGER Map Server. The TIGER Map Server (TMS) can be browsed interactively, or with a simple input file you can create in any text editor (or, in my case, with a *Perl* program) you can draw custom maps on-line.

The TIGER Map Server was developed in 1995 by the US Census Bureau as a proof-of-concept project that proved to be useful enough to leave up and running after the end of the experiment. It's a fine, free tool for building all sorts of maps of the United States. The server does not map anything outside of the United States, though, which is why I limit my maps to US contesters. It's also hard to draw a map with Alaska and Hawaii on it in addition to the 48 contiguous states without a lot of blank space on the map image, so I've limited my maps to the 48 contiguous United States. I also have no choice in map projection, but the default projection is useful enough.

For more technical information on how to use the TIGER Map Server, see **tiger.census.gov/cgi-bin/mapbrowse-tbl** and **tiger.census.gov/instruct.html**. The URL I use for map generation looks like **tiger.census.gov/cgi-bin/mapgen/.gif?lat=37.00&lon=-97.00&off=CITIES&wid=50.0&ht=25.5&iht=600&iwd=1000&murl=http://www.example.org/example.dat**.

For each contest I've mapped, I make three or four different maps. One shows just the locations of contest entrants as small dots. Another color codes the small dots by operating class and/or power output. I also draw a map where the Top Ten US scores in each entry class are drawn as larger push-pins instead of small dots.

The East Coast Advantage

The maps for the ARRL International DX Contest show that most of the US contest activity is in the northeast, from Boston to Washington, DC, east of the mountains. In particular, the area around Philadelphia seems to have a lot of contest participation. There are some other clusters of serious activity, notably in southern and northern California, the Seattle area, and the coasts of Florida. Compared to other ARRL contests, there are relatively fewer contesters entering from the Midwest. The map that highlights Top Ten performances will actually have 30 push-pins each for the single-op and single-op assisted classes: ten each for QRP, Low Power, and High Power. In total, there are 70 push-pins for Top Ten scores in the different entry classes and power levels. The vast majority of Top Ten winners are clumped together in the Boston to Washington metropolitan area. In the 2003 CW contest, only 18 of the 70 Top Ten finishes went to stations outside the area of the northeast and Midwest. See Figures 2 and 3.

The West Coast Advantage?

If there is any ARRL contest where the west coast has an advantage over the rest of the country, it might be the ARRL November Sweepstakes. Compared to the ARRL International DX Contest, the Sweepstakes have more Top Ten performances on the west coast and relatively fewer Top Ten scores in the Boston to Washington metropolitan area. However, the Sweepstakes maps do not necessarily show an overwhelming west coast advantage in the contest. Rather, they show Top Ten performances distributed all over the country. Stations in the 2003 phone contest seemed to have as much chance at success in Texas as they did in Idaho, Florida, California, Tennessee, Illinois, Maryland or Minnesota. One of the reasons that the Sweepstakes is so popular is that no one

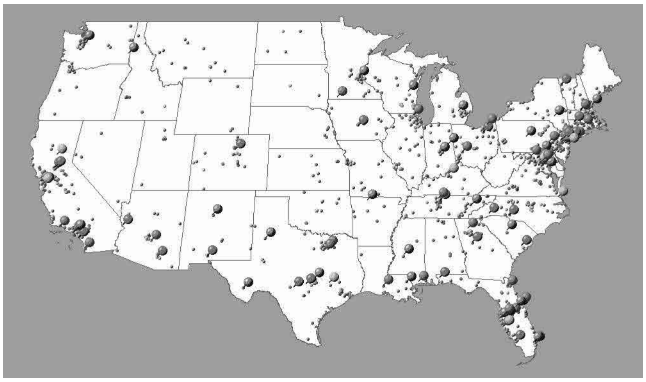

Figure 1—In 2003, many of the top scores in the ARRL 10 Meter Contest went to stations in the more southern latitudes.

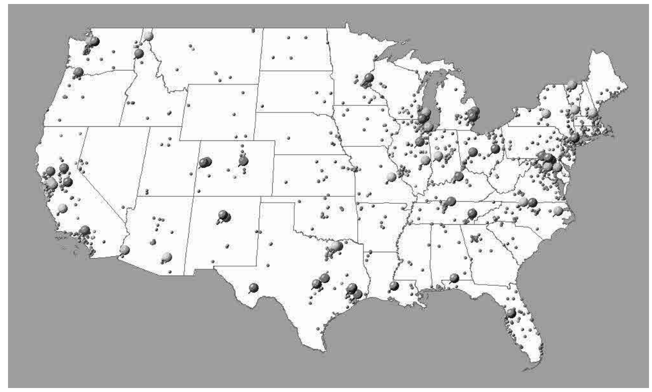

Figure 5—2003 ARRL SS PH entrants plus Top Ten.

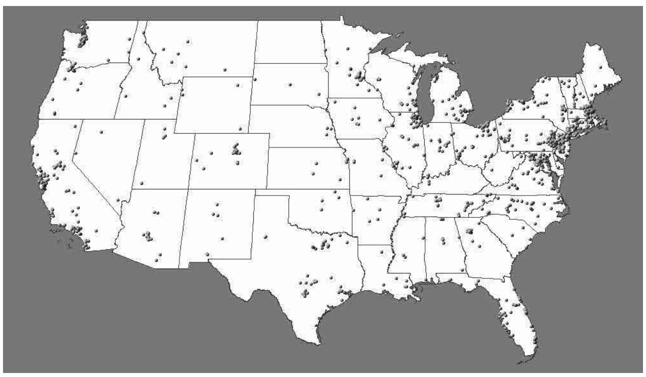

Figure 2—2003 ARRL DX CW entrants.

Figure 6—2003 January VHF entrants plus Top Ten.

Figure 3—2003 ARRL DX CW entrants plus Top Ten.

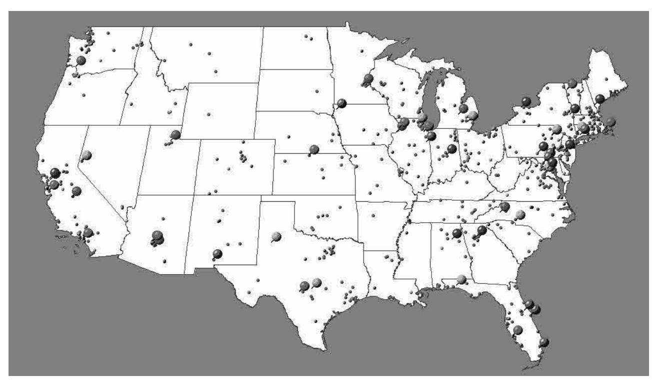

Figure 7—2003 June VHF entrants plus Top Ten.

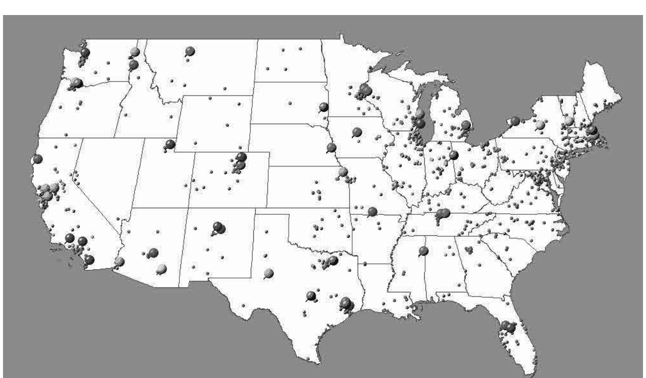

Figure 4—2003 ARRL SS CW entrants plus Top Ten.

Figure 8—2003 September VHF entrants plus Top Ten.

area of the country is at a distinct disadvantage. See Figures 4 and 5.

One Contest is Not Like the Others

The ARRL sponsors three all-band VHF+ contests each year, in January, June and September. The contests use the same exchange and almost exactly the same rules and scoring formulas. But when it comes to participation and where the top scores come from, the June contest is very different from the January and September contests. Top scores in the September and January contests are dominated by stations in the northeast and Midwest. The only Top Ten scores from the west coast at all are in the Single-Op Portable category, a category in which there are typically only about 20 or so logs submitted for each contest. Almost all the Top Ten scores in these two contests come from the Boston to Washington metropolitan area and the Midwest. The June contest, however, is very different. Not only is there substantially more participation throughout the country in June, in years with good 6-meter propagation there are Top Ten scores from all over the country. Six meters is a great equalizer, and offers stations outside of the northeast and Midwest a better chance to compete for Top Ten status. See Figures 6, 7 and 8.

Conclusion

My goal in drawing these contest maps is to be able to visualize the broad geographic trends in the US contest scene. I welcome suggestions and ideas for how to make the maps more useful. K5TM, K5TR, N5KO, and K2UA all offered help to make the maps what they are. You can view many more maps of ARRL contests of recent years at **www.wm5r.org/maps/**.

Resources

- **www.wm5r.org/maps/**
- **www.arrl.org/members-only/contests/scores.html**
- **www.arrl.org/news/features/2003/07/01/2/**
- **tiger.census.gov/cgi-bin/mapbrowse-tbl**
- **tiger.census.gov/instruct.html**

*A ham since 1993, Ken Harker WM5R is a computer scientist for a company that specializes in Internet performance monitoring and analysis. He holds an Extra class license. He is a former president of the University of Texas Amateur Radio Club, and is the current Webmaster for the Central Texas DX & Contest Club. You can contact the author by surface mail at 7009 Fireoak Dr, Austin, TX 78759, on the Web **(www.wm5r.org/)**, or via e-mail at **wm5r@arrl.net**.* NCJ

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Five Easy-to-Apply Contest Tips from a Rabid Contester

Mike Dormann, W7DRA

We shouldn't be serious all the time, so here are some tips from Mike that are on the lighter side. These are sure to make you stand out amongst other contesters!

1. Lifting weights and running is important to build up strength for sending TEST WB7HQV/VY9 WB7HQV/VY9 TEST seven thousand six hundred eighty nine times in a contest with a hand key.

2. As in all spiritual experiences (like vacationing with the wife to Fiji for the ARRL DX TEST), practice prayer and fasting. For contesting at home, stop eating and drink only water during the duration of the contest.

3. When you see your rate going down, maybe it's hygiene. Take a hot shower. You will see your rate shoot up.

4. As much effort as it is to work a single contact (copy in log and dupe sheet/throw send receive switches while smelling the HV supply), a distinctive signal is important. Try keying your ARC5 VFO, removing a filter cap or two on a buffer stage power supply, or maybe shorting out a parasitic cap in the final amp. Some have been known to use a garden hose on the driver—be sure to let it dry before the contest (works best with solid state gear). Working a SSB contest using AM is another example.

5. Interrupting high rate stations (K9DX, K7RAT, etc) and asking them how they are doing is always a good idea, and also calling a station they have already worked on frequency. It allows the rate station to take a really needed break. They always express their appreciation with comments. NCJ

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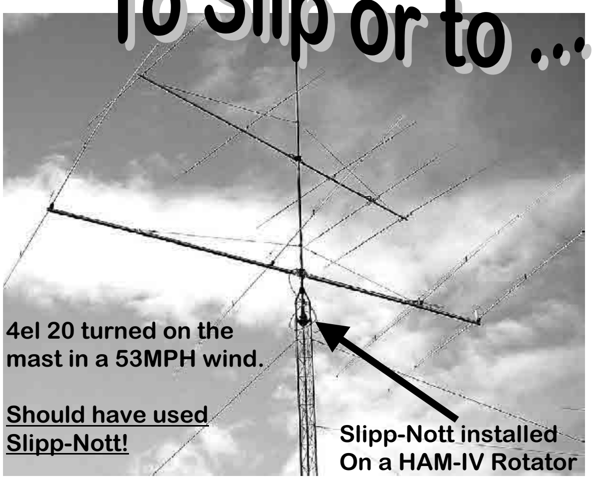

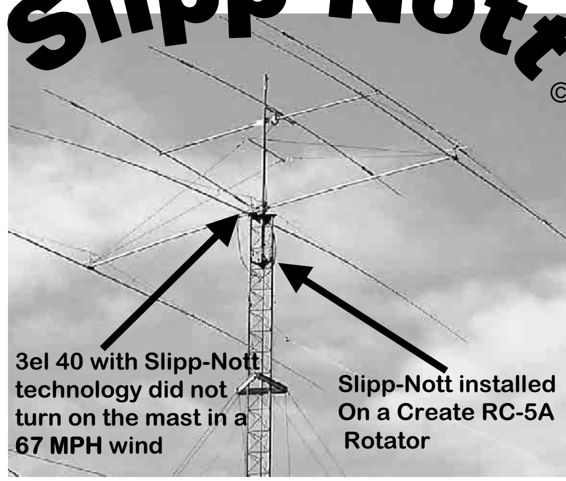

Two examples of 4130 Chrome-Moly mast that did not turn in the rotators in a 67MPH wind.

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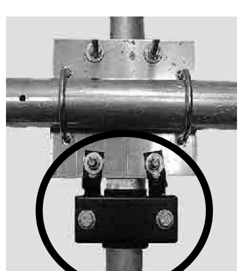

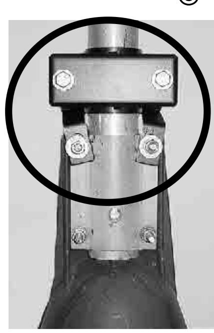

Use on rotators to stop slippage. Alternative to pinning masts and risk stripping gears. Use on antennas to stop slippage on mast.

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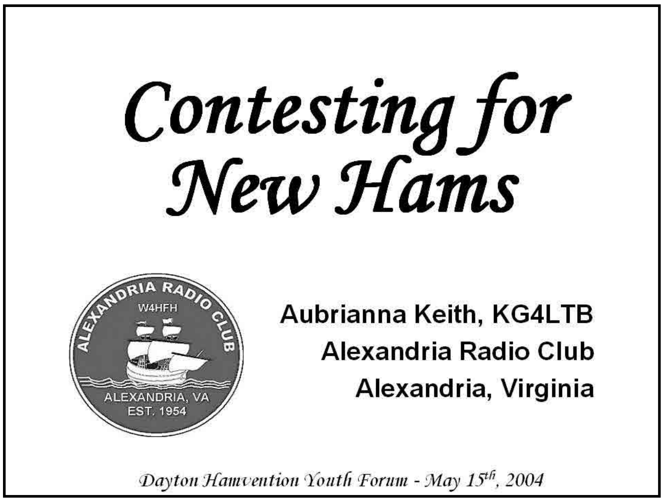
Contesting for New Hams

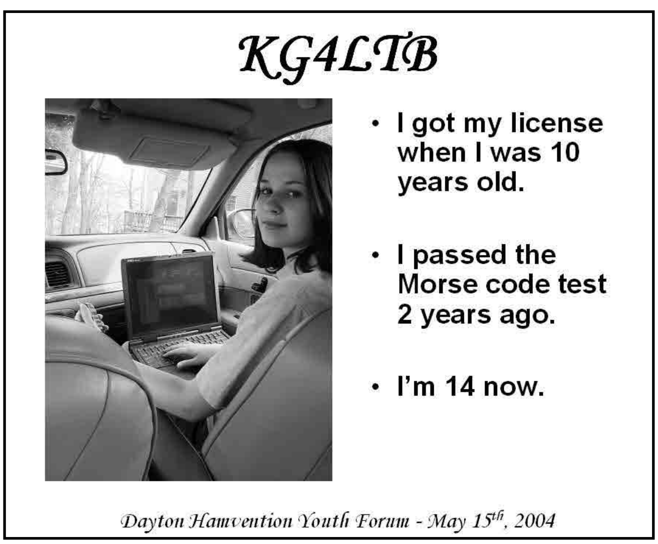
A Presentation by Aubri Keith, KG4LTB

At the Youth Forum at Dayton this year, 14-year old Aubri, KG4LTB gave a presentation on contesting. It's certainly good to see younger hams enjoying our passion. This is a golden opportunity for us more "seasoned" contesters to bring these youths along with mentoring. Maybe we can take a bite out of our ever-increasing average age!

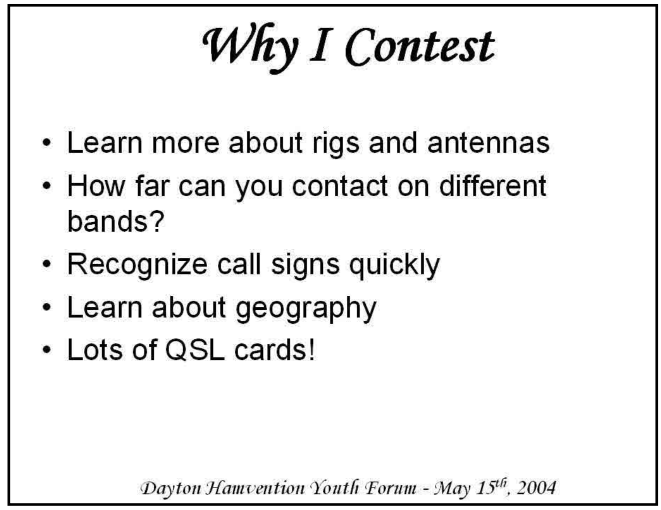
These 10 slides were selected from the 45 slides that Aubri used. For her full presentation, contact her or her Dad, N8IK, at **n8ik@arrl.net**.



Slide 1



Slide 2



Slide 3

Slide4

Goal Setting

- Decide what you want to do and plan a strategy
- Time available
- What resources are available?

Dayton Hamvention Youth Forum - May 15th, 2004

Slide5

Virginia QSO Party

- Held in mid-March every year
- Sponsored by the Sterling Park ARC of Sterling, Virginia
- Results are announced in June at the Manassas Hamfest
- Entry categories are based on license class and category of operation
- Mobiles get bonus points

Dayton Hamvention Youth Forum - May 15th, 2004

Slide 6

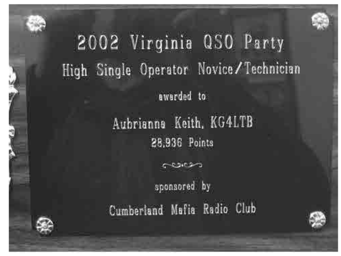
Maximizing My Score

- Novice/Technician Category
- Mobile operator
- How many counties can I activate for bonus points – for Virginia each new county I make a contact from is 100 extra points
- Look for multipliers

Dayton Hamvention Youth Forum - May 15th, 2004

Slide 7

Record Score in 2002



- All-time high score for Novice/Techs
- 28,936 points based on 234 QSOs and 46 multipliers
- Activated 52 counties, *every* county/city in Virginia north of I-64

Dayton Hamvention Youth Forum - May 15th, 2004

Slide 8

Winning Score in 2003

- Good enough to win the Novice/Technician category
- 5,860 points based on 160 QSOs and 15 multipliers
- Activated 25 counties, west and central Virginia north of I-64

Dayton Hamvention Youth Forum - May 15th, 2004

Slide 9

See You in the Next Contest!

Dayton Hamvention Youth Forum - May 15th, 2004

Slide 10

Voice Techniques for Contesters

Don Daso, K4ZA
k4za@juno.com

Because of a press error, the final page of the following article was not printed in the July/August 2004 issue. We are re-publishing the article here in its entirety.

Babies can scream for what seems like hours on end, without any apparent damage. You can shout yourself hoarse during an afternoon's football game. Or find yourself without voice at the end of the CQ WW contest. Why? What has happened? The answer involves understanding proper use of your voice, compared to the *misuse* of your voice. We are speaking, of course, of habits—things that began as casual indulgences, methods of being socially acceptable, then slid into habitual behavior. So, our football fan might not be able to shout as loudly as he or she would like. Or perhaps you have saved yourself for just this contest weekend, and can't believe you can hardly speak Sunday morning, just when the bands are opening to Europe. Such examples may sound familiar. I will explain why such cases occur, and how to prevent those that relate directly to phone contest operating.

A Few Words About Technique

I've always liked the inherent value in the slogan (popular in police procedurals): "Work like you train; train like you work." Good voice technique is about giving you freedom. Freedom comes from choices and confidence: choices about what kinds of sounds to make; confidence in the knowledge that whatever sounds you choose or want to make, you'll be able to do so, without effort or strain. Tiny muscle movements create your voice. Getting the muscles of your voice in shape can give you self-confidence. What do you do when you want to get in shape? You exercise! What happens with correct exercise? Your voice works effortlessly. So, when you step up to the mike, you have no worries about your voice. Singers and performers know and practice this. Phone contesters, cramming a year of "performing" into a single weekend, can benefit as well.

Some Common Mistakes

First, we have to cultivate an awareness of our own voice - how we are using it, and how our posture may interfere with good voice use. This means more than simply examining how the articulating organs work, or the throat, or how we breathe. We have to look at these, of course, but we must also look at the "whole body function" picture. Let's start with some common mistakes and some common *misuses*:

Try to watch yourself (maybe point your video camera at yourself) the next time you're in a pileup, calling. You may find yourself stretching out with your neck and head. This is great for demonstrating the "Reach Out and Touch Someone" idea, but bad posture for your voice. Try it. You will feel the strain. It's a natural reaction, but not good for the voice. In fact, a picture of it could simply be titled: *How To Get A Sore Throat.*

Pulling your head back, instead of dropping the jaw, when taking a breath to speak. This effectively closes part of the throat. It also puts your larynx in an improper relationship with your breathing. The movement may seem small, but inevitably, you end up losing control of the soft palate and sounding overly nasal. Your jaw release is slowed down. You'll be short of breath, and, for want of a better term, you'll have a stiff tongue. Resonation and articulation suffer.

Pulling down is associated with pulling the head back. Your rib cage slumps toward your stomach; your shoulders are pulled forward, narrowing across the top of the chest. This all makes you feel low in energy - almost depressed. Breathing is overly constricted; the voice lacks adequate support. This often forces abdominal muscles to move too much, making your voice a monotone.

Pulling back in. Typically, this makes you breathe mostly in the upper chest. The relationship between vertebrae is such that the back loses much of its width at the place where your lungs are largest, making it difficult to speak long phrases. And if you get excited, under the least little bit of stress, too much adrenalin will be produced. Vocal control will almost disappear. This makes for a shrill voice.

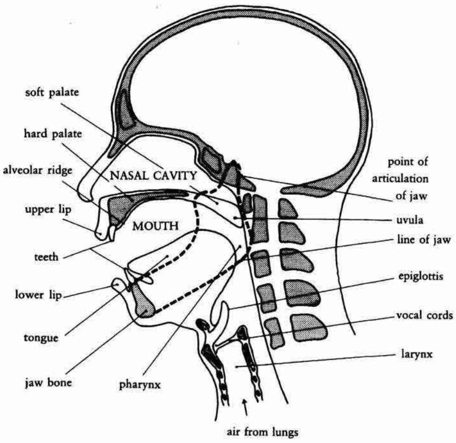
Ways To Eliminate These Four Problems

A comfortable chair (one that fits your body size) and a boom microphone headset will do the most to guarantee proper posture during a contest. What's left, besides winning? Practice, in speaking correctly, that is.

Keep the joint of your jaw open and free at all times. Don't worry about how far apart the teeth are; just allow your jaw to move freely. Remember to think

> ***Ergonomics***
>
> The information on posture contained in this article pertains to ergonomics—a term derived from two Greek words: *ergon*, which means work, and *nomoi*, which means natural laws. So, we are talking about human capabilities relating to work. In recent years, studies have been made to suggest postures that minimize unnecessary static work, and reduce forces acting on the body.
>
> *The guiding principles are:*
>
> • being able to use or adopt different, but equally healthy and safe, postures;
> • when force has to be exerted, the largest muscle groups should do it;
> • activities should be performed with the joints near the mid-point of their range of motion (especially head, trunk, and upper limbs).

> ***Anatomy Of Speech***
>
> A few minutes examination of the anatomy involved should convince you that the process of speaking is more complicated than you perhaps thought:
>
> • That some practice may be in order to be a good voice op.
> • That your vocal cords, mouth and throat, nose and sinuses, and above all, your breathing, combine in unique and special ways to produce sound.
>
> One key to success is a boom mike headset, so that only a conversational tone is needed as you speak.



Anatomy of speech organs.

they've learned it through research, or through practice, you can sometimes hear this in the voice of the seasoned Caribbean-contester's exchange. He's not fully articulating the FIVE-NINE thousands of times - those are all rough-on-the-voice consonants— but rolling out a smoother and faster FIFE-NI litany instead.) Keep your neck loose and free, use a good chair and mike, and you eliminate most of the potential for voice strain while contesting.

The Mechanics

You can view the lungs, the throat, and the mouth and nose as a system of tubes and valves that simply regulate airflow. When speaking, you actually breathe out and direct air through your throat, mouth or nose, thereby creating different sounds. Such sounds largely depend on:

A. The vocal cords,
B. For vowels, the shape of the mouth (determined by the position of the tongue), and
C. For consonants, the obstruction of airflow (by valves, tongue or lips).

For instance, say "*t-d-t-d-t-d"* over and over, and you'll notice that your mouth is doing exactly the same thing to produce the *t* and the *d*. The only difference is that you switch the vocal cords on and off.

Your voice is produced by vibration of your vocal folds. Put simply, the vocal folds are two bands of smooth tissue that lie opposite each other. They are located in the larynx, commonly called the voice box. The larynx is positioned between the base of the tongue and the top of the trachea (windpipe), or the passageway to the lungs.

At rest, the vocal folds are open to allow an individual to breathe. To produce sound, our brain precisely coordinates a series of events. First, the folds come together in a firm but relaxed way. Once closed, air from the lungs then passes through them, causing vibration, thus making sound. The sound from this vibration then travels through the throat, nose and mouth (resonating cavities). The size and shape of these cavities, along with the size and shape of the vocal folds, helps determine our vocal quality.

Variety within an individual's voice is the result of lengthening or shortening and tensing or relaxing the vocal folds. Moving the cartilages, or soft, flexible bone-like tissues to which the folds are attached, makes these adjustments possible. For example, shortening and relaxing the vocal folds makes a deep voice; lengthening and tensing them produces a high-pitched voice.

Posture, practice and other mitigating circumstances (not all of which we can control) can all affect that vocal quality. For the contest operator, the best options are proper practice, proper procedures and the best possible environment.

Some Thoughts On Voice Maintenance

Improper care usually results from ignorance. Remembering our crying baby, we might assume the voice to be tireless. And the stamina IS amazing, considering the abuse it can suffer. You speak from when you get out of bed until day's end, regardless of weather, in smoke-filled rooms, in cold or dry rooms, sometimes with a cold or allergies, and so on. The idea of maintenance may

The Operating Chair

A well-designed chair for you to sit in is one of the most important parts of a good contest station. It will favorably affect posture, circulation, as well as the amount of effort required to maintain a good comfort level, and the amount of pressure on the spine. Comfort *will* affect your rate, regardless of propagation.

The following recommendations should be followed:

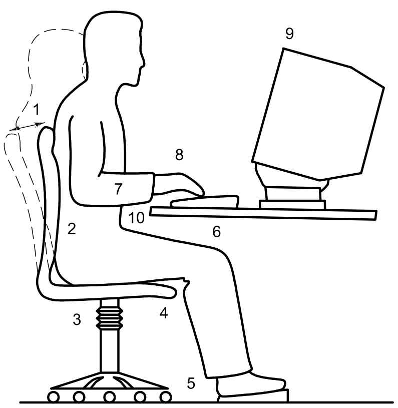
- Your seat should adapt to you, not vice versa.
- Chairs should be stable and fully and easily adjustable while you are seated.
- Your chair's seat pan and backrests should be upholstered and covered in a material that absorbs perspiration.
- Your seat pan height should be adjustable and should transfer your weight through the buttocks, not the thighs.
- Your backrest should adjust up and down, as well as backward and forward, or flex with your body's movement for good lumbar support. A forward tilt of the seat may relieve stress in some applications (allowing the backrest to follow you movements in performing certain tasks).
- You should have wheels or casters on your chair (hard casters for soft floors and soft casters for hard floors). Your chair should then preferably have five legs. This offers improved stability and reduces the risk of you tipping over.
- The front of your seat should be of a "waterfall" design in order to provide sufficient clearance for your thighs and to prevent reducing your circulation.
- Your seat should swivel, especially since you'll probably be making many lateral movements.
- Staying in the same position for long periods causes fatigue. Knowing this, and being able to changes chairs or move around comfortably, will help lessen such fatigue.

You should be able to adjust the height of the seat—you didn't think secretaries put typewriters and workstations at lowers heights just for looks, did you?

- If seat height cannot be adjusted, you should have a footrest, which will help relieve pressure under the thigh. This should be angled and covered with a non-slip surface to provide comfortable support for your feet. (Perfect for incorporating a footswitch, too!)
- Set up your station to avoid unnatural postures. You shouldn't have to lean forward or backward unnecessarily to operate any gear or view any screen.
- Your station gear should be designed so that all gear or equipment requiring frequent access or adjustment is within acceptable reach distances.

To aid in your decision, spend a few minutes answering the questions about your chair use (designed to help you evaluate your needs) on the Web at **ergo.human.cornell.edu/Pub/AHquest/seatingeval.PDF**

Remember, no one chair will fit or work for all persons, regardless of what salesmen may tell you.



(1) Seat Back Adjustability
(2) Good Lumbar Support
(3) Seat Height Adjustability
(4) No Excess Pressure on Underside of Thighs and Backs of Knees
(5) Foot Support if Needed
(6) Space for Postural Change, No Obstacles Under Desk
(7) Forearms Approximately Horizontal
(8) Minimal Extension, Flexion or Deviation of Wrists
(9) Screen Height and Angle Should Allow Comfortable Head Position
(10) Space in Front of Keyboard to Support Hands/Wrists During Pauses in Keying

Check your posture to make sure it is right. NCJ seem strange, but for those who have suffered, it is all too real.

Understanding begins with knowing something about how the voice works, about the throat and resonating chambers. The larynx is usually the focal point, because it receives the most abuse. The larynx is where the vibration, friction, manipulation, and therefore irritation, take place. The larynx is essentially a valve located in the trachea, containing the vocal cords. The vocal cords are simply two pieces of tissue - they are not muscles, and do nothing themselves. Their function depends on muscles located in the throat. When you swallow, for instance, you force the cords together. Phonation causes them to elongate or thicken. We *choose* to speak. This choice, this concentration, relaxes the muscles around the cords during phonation, letting them vibrate. If surrounding muscle tension forces the cords together unnecessarily while they are phonating (almost in a swallowing position), friction will occur. Hoarseness, laryngitis and rawness are the result. What can you do if this type of irritation occurs?

Inhalation of warm vapor is the most effective aid. But this is not too conducive to high rates on any band. Hot liquids, throat lozenges or cough drops do not help the larynx. Anything swallowed goes down the esophagus and into the stomach, not down the trachea to your lungs. (Remember, the larynx is part of the respiratory system, not the digestive system.) For anything to help your voice, it must be in a gaseous form. Warm water vapor is always helpful, unless there are lung or allergic complications. This tells you a comfortable amount of warm humid air is good in your shack, or at least good for you. But warm moist air in the shack often becomes difficult because heating systems (in use during contest season in much of the USA) dry the air considerably.

Caffeine constricts the vocal cords. It also dehydrates them. And since you need as much liquid as possible, you should choose something to drink beside the ever-popular coffee or Coke. Spring water can be very good, as can natural juices.

If you get a headache from all the QRN, QRM or whatever, consider the medication you use. Take only aspirin, if possible. Other medications can distend the capillaries, and under severe stress, could cause bleeding if your vocal cords are irritated.

Final Thoughts

Finally, here are some thoughts on manipulating the voice itself. I like to use the MONITOR feature built in to my Kenwood to listen to myself, especially while setting up the speech processor. But listening during contests is something I no longer do, because I found I was modifying my speech pattern when speaking. Specifically, hearing myself this way caused me to change my breathing—making me glottilize my vowels (I was stopping more abruptly than normal). This minor irritation made me modify my voice; this caused further changes, and so on. So, pay particular attention to your own voice if you use this feature. Simply recording yourself speaking will point out any changes to your normal speech pattern.

Finally, don't lay off before the contest. I used to concentrate on CW before the big phone weekend, thinking this was a good idea. You need to practice and work out, though, just like an athlete—using your voice, and working on the skills I've described. Practice promotes good habits, and equally important, builds stamina, something all contesters need.

So train well and understand your anatomy, combining this knowledge with good posture and breathing exercises. Combined with a good station, and some good propagation, you, too, can be a creative phone contester. NCJ

Contest Addiction

By John W. Thompson MD, K3MD
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In this complex modern world, where we have seen evidence of a large increase in obsessive-compulsive disorders as a result of response to stress, such as bulimia, video game addiction, drug addiction, glue-sniffing, sexual addiction, etc, I think we should recognize the signs and symptoms of Contest Addiction.

The usual victim of this sinister disorder is a middle-aged to elderly kind of nerdy but competitive Amateur Radio operator, although the disease can strike at any age group, and there have been reports of recent cases striking those in the adolescent age group.

These individuals do not necessarily fall into the category of phone, code or digital cases. The usual suspect has operated primarily one mode, but when he or she became bored with this mode, he switched to another mode. The most telltale sign of contest addiction is a repeated switching from HF to VHF contesting, or a foolish attempt to operate both VHF and HF contests, which often (usually) fall during the same time period.

The contest addict will scan *NCJ* or the *Rate Sheet* duly at the beginning of any given week, and then spend the weekend trying to operate one or more contests, even though the may be very sucky contests. The addict will be found on a hot June day in a small room with the air conditioner going and 2- to 4-kilowatt amps running in the same room, calling CQ on two VHF bands at the same time. Several weekends later, this individual will be found operating 5 W during Field Day.

The family and significant others of the contest addict will know that the disease cannot be cured, only ameliorated, by symptomatic treatment. The family of the addict will know that the addict starts to slide out of any and all social interaction at Thanksgiving. Other behaviors surface such as to get someone (anyone) else to rake the leaves at the time of the CQWW SSB contest.

The contest addict is one of the individuals who actually operates all the major contests during the contest season, as well as some of the non-DX contests such as CQWW 160 SSB and CW, 10-Meter Contest, ARRL 160-Meter Contest, Sweepstakes CW and SSB, PAQP, WPX SSB, etc. A sure sign of contest addiction is someone who operates the ARRL 160-Meter Contest one week after the CQWW CW contest. Another sure sign is someone who blows the entire Memorial Day weekend operating the CQWW WPX CW contest.

A severely addicted contester undergoing therapy.

In fact, the very existence of the WPX CW contest is good evidence of the wide prevalence of contest addiction, as there is no earthly reason why you would need an additional contest at this time. The same could easily be said for the NAQPs. (Contesting in August?)

There are different forms of the disease. One of the most common forms is the "log-checking" subtype. This type checks the log incessantly for 30 or however many days (in the case of the Sprint, now only 7) to find any inconsistencies. This individual is obsessed with his or her UBN rating listing, and has been known to resort to databases to improve the score 1 to 3 percent by reducing QSOs that are removed from the log. This form of addict can be easily spotted by the fact that he or she actually understands how logs are checked and actually understands the score-reduction criteria, which have been scientifically analyzed and found to be more complex than the IRS system of determining tax due.

One of the more sinister symptoms of contest addiction is that the individual will be constantly buying a particular rig or linear in the hope of improving his or her score on the basis of something called "1 kHz desensing," "20 kHz desensing," "dynamic range," or "instant tune-up." Thus, a perfectly good rig that has been used for years in successful contesting efforts will find itself on eBay and go to the so-called "bottom feeder" contest element.

A by-product of contest addiction is that the affected may spend an inordinate amount of money on contest equipment or DXpeditions, even sometimes spending "non-mad" money to buy equipment.

A sure sign of contest addiction is making the trek to the Dayton Hamvention, even if the journey spans thousands of miles, with the express wish of telling contest stories to other contesters about fantastic rates, 160-meter steerable arrays, giant linears and so forth. The conversations may take place with or without the consumption of ethanol to aid in exaggeration.

Dealing with the contest-addicted is very difficult, as they are fixed in their radio shacks and are often competitive and aggressive. They are prone to losing their tempers and have been trained in the "attack-dog" concept of chasing everyone else away from "their" CQ frequency for years.

Treatment can be difficult. If the individual can be converted to the RTTY subtype, then the individual can talk, and even watch TV, while operating. This is true even for the severely affected SO2R variety, which has been shown to be recalcitrant to any treatment.

I wish you luck in dealing with the contest addicted, as you may know one or more of them. NCJ

Field Day—It Is Not a Contest. Or Is It?

Jim Brown, K9YC
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Ah, but it *is* a contest, and in the 49 years I've been a ham, it has always been a contest! But it is a different sort of contest, one that emphasizes group effort among local clubs and ad hoc groups, emergency preparedness, temporary setups, socializing, public relations, nurturing new hams, and most important, *low power and simple antennas!*

Field Day is a contest that is won by a group effort by many people, not by big money spent on elaborate antenna farms, complex antenna switching, expensive radios and big power amps. It is a contest where a good operator with 100 W and a dipole can be competitive. In short, it is a contest for folks who either can't or don't care to "buy" a big score.

Our local ham club maintains two repeaters and holds monthly meetings, each with a speaker who presents an interesting program, but Field Day is our biggest club activity by far. We did quite well on Field Day this year, and may place in the top 5 in our category. If we did, it will be because we planned for it for half a year, because…

- A team of six guys spent Friday afternoon putting up a half dozen fine antennas
- Some more guys came in Saturday morning and set up the rest of the gear
- Some more guys came in and spent time operating, some more contributed the work to get us nearly all the possible bonus points.
- Some more guys showed up to cook, several of our guys used the GOTA station to recruit new/inactive hams and contributed 400 QSOs
- Some more guys showed up to tear down when it was over.
- Several of us built antennas specifically for Field Day, and we learned stuff in the process.

If I had my way, all contests would be limited to 100 W and there would be separate classes for those who, either by choice or necessity, use only wire antennas. An increasing number of hams live in cities, where big antenna farms are difficult or impossible. In my 49 years as a ham, I've never run more than 100 W and I've never had an HF beam. It is a blot on our hobby that folks like us can't be competitive in most contests.

I think it's great that some of us are able to build nice antenna farms on remote sites, and I'm becoming a partner in one myself. But success (or even viability) in contests should not be limited to those who can. In my opinion, Field Day is the single most important activity in ham radio, and by far the most important contest.

NCJ

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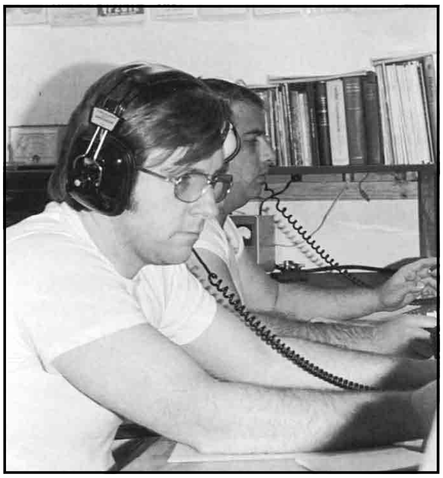
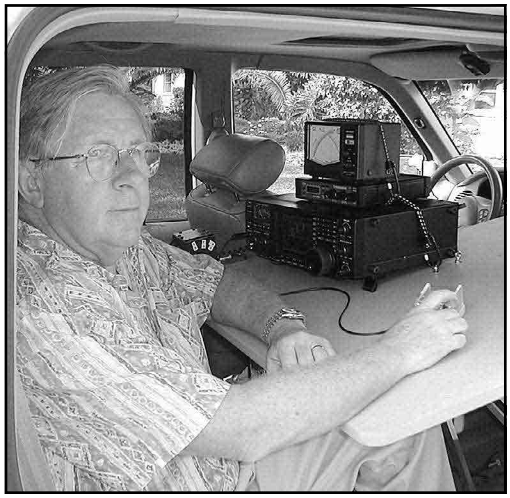
NCJ: Then and Now

(Thanks to K5RC for the photos!)

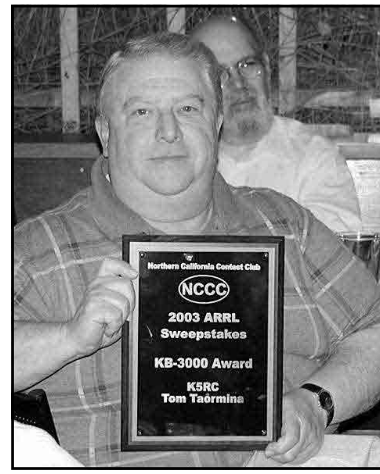
Then: 1979 Now:



George, K5KG (front) and Tom, K5RC (back)

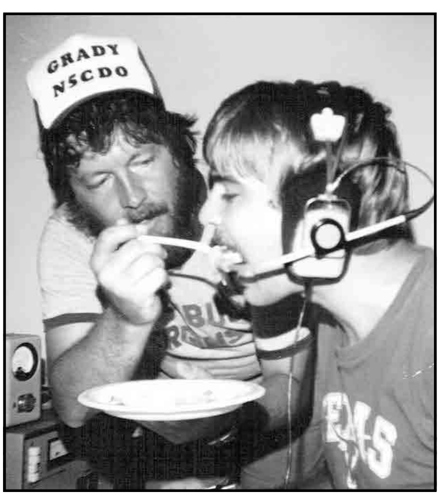


George, K5KG

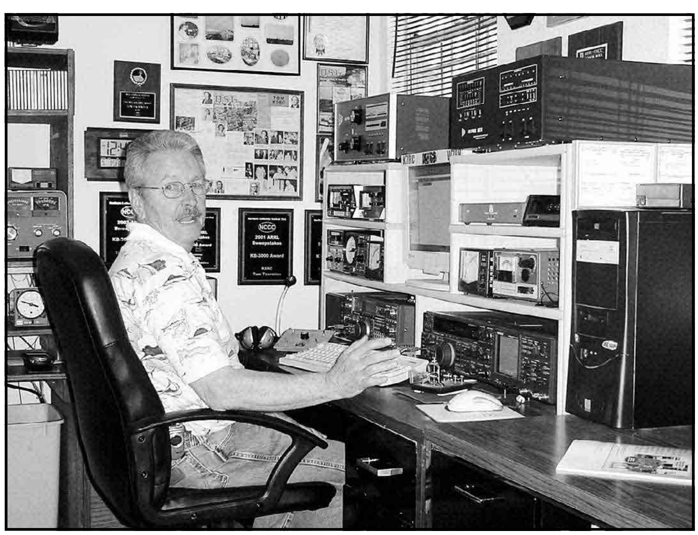


Tom, K5RC

Then: 1984 Now:



Grady, W5FU (left, then N5CDO) and Randy, K5ZD (right)



Grady, W5FU (at K5RC)

Randy, K5ZD

NCJ

SO2R Station Design Considerations—Part 3: Tailoring the Human Interface

By Hal Kennedy, N4GG

In Part 1 of this series we took a look at the role of handedness in SO2R station layout, and in Part 2 we examined SO2R audio switching functions. Parts 1 and 2 were based on survey data developed on the *cq-contest* reflector. In this part, we will look at how our brains attempt to perform simultaneous tasks, and ponder how this might be put to use in SO2R station design. This final article is not based on collected data—it is a "thought piece" offered to stimulate consideration of personalizing station design for maximum efficiency.

Mental Processes—Doing Two Things at Once

Let's begin by reviewing an experiment the late Richard Feynman conducted as a young man. Feynman, for those unfamiliar with him, was a man of eclectic interests and genius intellect. Among his rich legacy are *Feynman Diagrams*, which have formed the basis for teaching quantum mechanics since he devised them in 1950. Feynman was instrumental in the Manhattan Project and he received the Nobel Prize in Physics in 1965. At his funeral, a peer described him as the greatest intuitionist of the 20th century.

Feynman was a life-long experimenter as well as a theorist. The following story is paraphrased from his biography *Genius, The Life and Science of Richard Feynman*[1]. I recommend the book—his life's story reads like a novel.

Working together with John Tukey, Feynman became interested in his ability to count out 60 seconds in his head. Initial trials determined he and Tukey could both count out a minute in their heads with good accuracy. Wanting to understand how it was done, the men began introducing distractions and measuring the effect on counting accuracy. One such experiment included running up and down stairs to raise Feynman's heart rate. Feynman and Tukey eventually made a crucial observation. Feynman could simultaneously read and keep track of time, but he lost track of time while carrying on a conversation. For Tukey it was the opposite. Tukey could recite poetry and count seconds in his head, but he could not accurately count seconds when reading.

Discussing how they kept track of time, it became apparent the two men were using different mental processes to accomplish the task. Feynman *heard* a voice in his head counting out the numbers. Tukey *saw* the numbers in his mind, as if they were numbered pages flying off a paper calendar. Feynman could not *listen* to the counting in his head and *listen* to a conversation at the same time. Tukey could not *look* at the numbers in his head and *look* at his book at the same time. Both men could do one visual and one auditory task at the same time with relative ease; but neither could do two auditory or two visual tasks well at the same time.

Feynman's experiment offers insights for everyday living as well as for SO2R station design. People are not taught how to count out 60 seconds in their heads, but they will instinctively do it one of two different ways, either by *hearing* or by *seeing* the numbers in their mind. This is consistent with some of us being visual learners while others are auditory learners. It may also explain why you sometimes disagree with a colleague. Perhaps his or her conclusions arose from a different mental process than yours.

Feynman's experiment explains why SO2R operation is difficult at first—the operator is trying to process the output of two receivers—two auditory information streams—at the same time.

Learning and Conditioning

An attribute of humans is their ability to improve upon, if not fully overcome, some of what seem like inherent limitations. Within limits, we have the ability to learn to perform complex tasks with increasing ease as we become conditioned to provide the requisite response to a given set of stimuli. Given enough practice, complex tasks can become easy to perform. This is called proficiency. With even more practice, complex tasks can be performed instinctively, without the use of much or any of our cognitive capability. Psychologists refer to this stage of conditioning as mastery learning or *automaticity*.

A good example of mastery learning involves driving to work. Have you arrived at work without any memory of driving there? The cognitive part of your brain was probably busy thinking through the affairs of the day, while the complex task of driving was handled in the background on "autopilot." When you were a beginning driver, it took all of your intellect just to stay on the road. As you practiced driving, less and less of your cognitive capacity was needed. Eventually, driving to work enters the stage of automaticity—it requires no thinking at all.

The ability to listen to two receivers simultaneously can be learned just like driving is learned. How do I know this? By speaking to lots of successful SO2R operators. Their story is always the same—SO2R operating was difficult at first but became nearly instinctive after a lot of practice. The SO2R mantra is: "Practice, Practice, Practice." Of his ability to show others his techniques, N5TJ once said: "With experience comes knowledge and cunning. I can't stand here and tell you the secrets, as many of them are second nature to me now." Jeff has operated SO2R to the point of mastery learning. It's curious that the better we become at something, the less able we are to explain how we do it.

Fortunately, practicing the key skill in SO2R operating—listening to two audio streams at once—can be done in more ways than contesting. Contest experience is, however, undoubtedly the best experience of all. It is said that Bill Fisher, W4AN, used to leave two rigs blaring away while he was building his mountaintop station—to improve his ability to copy two QSOs and perform other tasks at the same time.

Workload and Fatigue

If we accept that listening to two receivers simultaneously is inherently difficult, and that it can be learned, what else is there to consider?

The last consideration before we get to "How do I design my station?" is to realize that making an SO2R station as easy as possible to operate is important for two reasons.

First, the practice time required to condition oneself, or "learn the tasks," depends on how complex the tasks are. The easier the task set, the easier it is to attain proficiency and to move past proficiency to automaticity, should this be your goal.

Second, contesting is an endurance

sport. As we head into that second 24 of 48 hours, fatigue degrades our abilities in a hierarchical way. The first to suffer is our cognitive or reasoning capability. Anything about our SO2R operating that hasn't become an item of proficiency starts to suffer early, i.e., performance of tasks we haven't learned well suffers first. As fatigue gets worse, performance of tasks we are proficient at begins to degrade, and tasks requiring reasoning are being done slowly and with increasing error. Meanwhile, however, those tasks we have mastery-learned continue to be performed well. Just before we become totally dysfunctional, the instinctive tasks are all that we can manage.

An SO2R station of inefficient design may be acceptably easy to operate at the start of a contest; but it will induce fatigue faster, be harder to operate, and be less productive once fatigue sets in compared to an optimized design.

Table 1

SO2R Operator Task List

Task	*Frequency*	*Human Interface*	*Alternative(s)*
Receiver 1 Audio	Continuous	Auditory	None
Receiver 2 Audio	Continuous	Auditory	None
Typing	Frequent	Tactile+Visual	Tactile Only
Display Read	Frequent	Visual	Task Reduction & Tailoring
CW Sidetone	Frequent	Auditory	Visual or None
SSB Monitor	Frequent	Auditory	Visual or None
S&P Tuning	Frequent	Tactile+Visual	Reduce Visual, Point & Shoot
PTT	Frequent	Tactile	Tactile Only
Manual Keying	Occasional	Auditory+Tactile	Tactile only (keyboard)
Band change	Occasional	Tactile+Visual	Automate
SO2R Audio Functions	Occasional	Tactile+Visual	Tactile only
Antenna Positioning	Occasional	Tactile+Visual	Partial Automate (Point and Go)
In-Band Ant Switching	Occasional	Tactile+Visual	Minimize Visual
Distractions	Multiple	Any/All	Eliminate
Other Tasks	Multiple	Any/All	See Discussion

Task Allocation

Have you noticed yourself or others closing their eyes when trying hard to dig a signal out of QRM or noise? We all do it—but what exactly are we doing? We are closing down the visual interface to our brains as a means to devote 100% of our cognitive capacity to our auditory interface. Allocating our finite cognitive capacity among required tasks, and allocating the available throughput of our auditory, visual and tactile input/output channels is at the heart of optimizing station design for efficiency. Two additional design considerations were covered in Parts 1 and 2—allocating complex manual tasks to our dominant hand, and arranging the receiver audio streams to best advantage.

We have many tasks to accomplish while operating SO2R, and, fortunately, we have lots of choices in station design regarding allocating those tasks. One design goal is keeping information other than the two receiver's audio outputs out of our auditory interface. While we have no choice but to do what Feynman found so difficult—listening to two things at once—we do have opportunities to allocate the remainder of our operating tasks to non-auditory interfaces.

SO2R Station Design Considerations

Table 1 presents the tasks required to operate a generic SO2R contest station. Most of the table applies to other categories of contesting as well. Each task in the first column is accompanied by a view of the frequency with which that task occurs and the allocation of that task to the human interface in a typical station. The last column presents suggestions for alternate, potentially more efficient ways to get the task accomplished.

Individual stations and individual operators will differ from the generic, and you may disagree with the generic data as presented—that's fine. It is suggested you rework Table 1 to reflect your present (or contemplated) SO2R station design and task allocations, as a baseline from which to consider changes. The tasks have been arranged in descending order of frequency of occurrence, with the view that the most frequent tasks offer the best opportunity for overall efficiency improvement. Another view would be to rank the tasks in order of complexity. The frequency of occurrence *and* the complexity of a given task need to be assessed when looking for efficiency impacts and improvements. Let's review the table row by row.

Receiver Audio: We have no choice but to listen to the audio from two receivers at once, but we have many options on how to go about it. See Part 2 of this series for a discussion of SO2R audio switchology.

Typing: How much do you look at your keyboard? A well-known contester claims he frequently runs at high rates (above 100/hour) for long periods with his eyes closed! He credits his ability to do this to taking a touch-typing class. Watch a good administrative assistant (AA) type—they virtually never look at the keyboard and they look at the computer monitor infrequently. Good AAs can also carry on a conversation while they type—they have practiced typing to the point of automaticity. We can substantially reduce two demanding visual tasks by improving our typing skill—watching the keyboard and watching the monitor for typing mistakes.

Display Read: Our computer displays are full of important and not-so important information—they are our number one visual task. A detailed discussion of displayed information is beyond the scope of this article, as is a detailed discussion of ergonomics, but some general comments about the interface are in order. Display size and position are big drivers of SO2R operating efficiency. Displays that are too large and too close can cause headaches, while displays that are too small cause fatigue in addition to not having enough room to show us all we may want to see. Multiple displays carefully positioned around the operating position are a good alternative to a single display, and LCD technology has made this easier to implement. Visual clutter induces fatigue—display only what you need. In the case of multiple displays, frequently viewed information can be placed on the "front and center" display, while infrequently viewed information can be placed on a display off to one side. One attribute of *Windows*-based programs like *Writelog* is the ability to allow significant tailoring of the information display(s). Running *Writelog* on two displays at N4GG allows me to determine what is displayed on each, along with the window size and shape, font type and size, and color and position of the presented data. Minor changes are made to tailor the displays to each contest as part of pre-contest setup.

CW Sidetone: For automated sending from the F-keys, most operators listen to a sidetone mixed into one or both audio channels. There are at least three good ways to move this information to the visual interface: 1) Drive an LED with the keying signal, 2) Run a CW reader in software and display the outgoing CW on your computer display, and 3) Simply watch the meters on the transmitter or amplifier. Once you have moved the CW sidetone to a visual interface, try going one step further and ignoring it at least most of the time. Several respondents to Part 2 of this series indicated they were better off without sidetone. A CW sidetone is required for manual keying, but why are you manual keying? See the manual keying discussion below.

SSB Monitor: The concepts for CW sidetone apply here as well. Try modulating an LED with the outgoing audio, or watch your amplifier's meters if you feel you must know (*know*, not *hear*) what's going out on the air. Once you are comfortable receiving this information via a visual rather than an auditory interface, try ignoring it altogether.

S&P Tuning: As typically performed, this task includes both tactile and visual interfaces. The visual interface can be minimized to the degree you can stop caring about exactly what frequency you are on. Packet spot point-and-shoot is sometimes an available alternative offering a reduction in required thought, no visual or tactile interface to the radio, and allowing one's hands to stay on the keyboard.

PTT: If you have to look for, or at, your PTT switch, even occasionally, consider implementing it such that you don't. Rigid mounting to a large board is one approach for foot switches. Foot switches are preferable to hand switches—our foot has nothing else to do, our hands are already busy.

Manual Keying: There is nothing new here—many top contesters claim they do little or no manual keying. Manual keying requires auditory feedback—keyboard keying does not. All the major contest software programs provide visual readout of keyboard-sent CW, and it can be argued this need not be looked at (per the discussion above on typing). Keyboard sending also has the advantage of keeping your hands on the keyboard, eliminating lateral hand motion.

Band Change: Done manually, band changing presents high workload tasks for our tactile and visual interfaces. Making matters worse, manual band changing tasks must be performed in a set sequence and require conscious thought. Every task can be automated, however, so this is a good area for workload reduction. Most logging programs will move the radio to a new band *and* frequency by simply typing the frequency in as if it were a call sign—eliminating the visual and tactile tasks of reaching for the radio, changing its band, and turning the VFO knob. Unfortunately, automation beyond this point gets expensive. Auto-band auto-tune linears are obvious workload savers, but they are often foregone due to cost. Band decoders and relay-driven switches for automated antenna and bandpass filter (BPF)/stub switching will reduce visual, tactile and cognitive workload for modest cost. Automating antenna and BPF switching has a high payoff, in part because manual switching cannot become instinctive. When selecting switches and switch positions you have to *think* about what band you are leaving and *think* about what band you are going to. Beyond time loss and fatigue, manual switching also introduces risk. Antenna switching mistakes can be costly and they become increasingly easy to make as we become fatigued. It's easy to fry a BPF or a balun at the top of the tower at 3AM.

SO2R Audio Functions: A conclusion from Part 2 of this series is that SO2R audio functions require some switching during the course of a contest. As a minimum, operating situations necessitate changing the audio settings back to SO1R at times. The tactile task of throwing the switches is a given, but the visual task of finding the switches can be eliminated. The commercially available SO2R switch boxes work well, but they have to be reached for, and looked at, to operate. Most homebrew designs I have seen are split—the relays and logic circuits are in a box behind the operating desk, wired to a small hand controller sitting next to the keyboard. With practice, the switches on the hand controller can be thrown instinctively and need not be looked at. Push buttons may be superior to switches in this application.

Antenna Positioning: Old style rotor control boxes require holding down a switch while watching a position indicator. Most modern rotor controls are of the "point and go" variety, where a dial is turned to set the desired position and a button is pushed to start the turning—from that point the rotator finishes the task on its own. The modern approach reduces time-consuming visual and tactile tasks. Kits are available for converting old style rotor controls to modern style—they are worth their small cost. We can go several steps farther with this, however. Consider illuminating the meter lights in the rotor control boxes via the antenna switching. Only the position meter for the active antenna is lit, reducing the task of selecting which rotator to turn from one requiring thought to one that is instinctive. Fully automatic positioning is possible as well. Most logging programs can output beam-headings on a serial COM port, which can drive the active antenna rotor directly. This approach is typically implemented with a "push-to-go" button to engage the process, but the button-pushing task can be instinctive, particularly since the task of thinking about the correct beam heading has been eliminated. In my experience, this step in automation is usually a step too far. It does not address, for example; long path, skew path or positioning strategies for stacks.

In-Band Antenna Switching: If you have multiple antennas for the same band, including stacks, you will be making in-band antenna changes. These require thought and include visual and tactile tasks. The thought required for *some* antenna changes can be reduced with practice, e.g., reaching for the "Southeast Yagi" button when you hear an LU calling can become nearly instinctive. The tactile and visual tasks can be minimized through judicious design. Push buttons and switches can be positioned such that they do not have to be looked at. Thinking through switchology can pay dividends as well. As an example, antenna relays can be used to reduce antenna changes requiring two or more manual switch throws to one button push.

Distractions: Our worst enemy—eliminate them.

Other Tasks: This includes anything not in Table 1, and is a good place to summarize:

1. Eliminate unnecessary tasks.
2. Automate tasks where possible.
3. Design those tasks that cannot be automated as instinctive as possible.
4. Allocate non-automated tasks among tactile, visual and auditory interfaces to minimize workload.
5. For SO2R stations, minimize tasking the already taxed auditory interface.

Wrap-Up

In this series of articles, we have looked at many, but not all, of the human interface considerations in designing an efficient SO2R station. Some of the answers to "What's the best design?" can be determined from what has been presented, but others are very much rooted in personal preference and personal attributes. Some characteristics of the human side of the human-station interface are predictable, while others are individual. Hopefully, these articles have encouraged thinking about which are which, and how to design a station with that knowledge in hand.

I would like to thank my good friend William Frey for his insights and help with this article. Bill, I just have to get you interested in ham radio!

Notes

[1] *Genius, The Life and Science of Richard Feynman* by James Gleick, Pantheon Books, New York, 1992.

NCJ

2004 June VHF QSO Party from ZF1DC

Jim Holt, K4BI / ZF2BI
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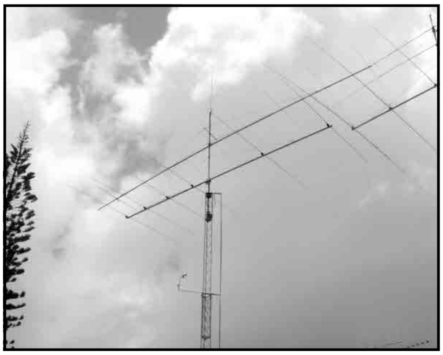
This operation originally was to have involved not only a strong 6-meter effort, but was to feature 144 and 432 MHz EME activity as well. Unfortunately, this plan came unglued and therefore became a limited multi-op entry from the station of David, ZF1DC and his dad, Roger Corbin, ZF1RC located at Georgetown, Grand Cayman.

The ops were David Corbin, ZF1DC (no prior contest operating experience, but great experience in dealing with pile-ups, VHF propagation and lots of enthusiasm), Ron Hooper, W4WA (a thoroughly seasoned HF and VHF contester) and Jim Holt, K4BI/ZF2BI (30 plus years of VHF contesting experience).

The station equipment included a Yaesu FT-847 transceiver driving an ACOM 1-kW amp to a large M^2 Yagi for 6 meters, and a Yaesu FT736 transceiver driving a Commander 1-kW amp to a large M^2 Yagi for 2 meters.

The propagation we experienced during the contest was unusual. While we had many hours of signals coming in from the US, a quick inspection of our logs shows that for the most part the openings were concentrated in the southeast region, with only brief extensions of the first hop and very brief second hops that allowed contacts outside of the 4th call district. We might just as well have left the 2-meter station turned off; it only produced one QSO via meteor scatter.

Six meters was another story; the first few hours after starting, 6 meters was closed (other than some scatter bursts) and we made many, many unanswered CQs. Obviously, the band did finally open and we did our best to take advantage. The openings we had on both Saturday and Sunday were not what I'd categorize as biggies, but with persistence, we made contacts, even though we had to request repeats time and again due to the deep QSB.



Two and 6-meter Yagis at ZF1DC.

The ops: David, ZF1DC (sitting on left); Ron, W4WA (sitting on right) and Jim, K4BI (standing).

The band finally closed for our contesting in the early evening Sunday night. I think it's safe to say that our 6-meter openings weren't typical (very strong signal strengths). We observed that the signals of many of the stations we worked were remarkably weak. While we didn't hear any other DX signals, we'd very much hope that the re-write of the contest rules that's in process would open the door to contest credit for DX stations working other DX stations. This one rule change would likely bring about an increase in contest activity from not just the Caribbean, but other areas as well.

I suspect that many would at some point like to try VHF contesting from a place like Grand Cayman. Let me assure you that when the bands are open, it is very, very good. But when they're closed, it's horrid.

In closing, on behalf of Ron and myself, we thank David and Roger Corbin for allowing the use of their excellent station, as well as the Corbin family's wonderful hospitality to both of us. Our thanks go also to those from the US who took the time to work us. NCJ

COMTEK announces

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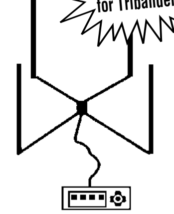

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Antenna Interactions—Part 6
Antennas Pointing in the Same Direction

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Reviewing our progress to date:

- Part 1 introduced meta-tools that give more comprehensive maps and statistics about antenna radiation patterns.[1]
- Part 2 applied those meta-tools to twisted stacked Yagis where the antennas point in different directions, identifying some problem situations that contesters may encounter.[2]
- Part 3 examined self-interactions of unused antennas within a stack, applying a new meta-tool to compare complete sky-hemisphere patterns. Examples of siting problems in the design of a contesting station antenna farm were given but siting issues were not fully explored.[3]
- Part 4 introduced current tapering to clean up stack patterns.[4]
- Part 5 identified impairments by identical antennas in the near field located on the same tower, or turned 90° on a separate tower.[5]

[1]Notes appear on page 32.

Same Azimuth, Separate Towers

We continue to examine scenarios involving a short stack of 6-element 20-meter OWA Yagis, mounted at heights of 1/2 and 1 λ. A third, identical Yagi stands 3/4 λ above ground on a separate tower; we will refer to this as the "multiplier Yagi."

Part 5 of this series examined the scenario when the multiplier Yagi pointed to an azimuth at right angles to the stack's azimuth.

Today we examine the case when both the stack and the multiplier Yagi point to the same azimuth. A contest station designer is unlikely to build two non-rotatable antenna systems such as these fixed on the same azimuth. However, a station containing both a stack and a multiplier Yagi might rotate these systems such that both are temporarily oriented in the same azimuth. What happens to their patterns?

Multiplier Yagi Fed

We start by examining impairments caused by the unused stack to the pat-

Table 1

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

Yagi loc		target #1										non-target							% sky < -15		
dist	dir	peak gain			median gain		minimum gain		largest		median gain		worst minor lobe			largest		dBi		feedpoint
λ	°	dBi	location	delta	dBi	e	dBi	delta	decr	incr	dBi	delta	dBi	location	delta	decr	incr		change	impedance
no stack		14.60	az 0° el 17°		12.66		8.84				-9.78		3.49	az 0° el 54°				25.0%		30.0 -j10.4
0.5	0°	12.15	az 0° el 19°	-2.45	10.74	-1.92	6.74	-2.10	-3.40	-0.17	-5.32	4.46	6.94	az 0° el 59°	3.45	-3.67	19.30	11.1%	-13.9%	34.6 -j1.0
1.0	0°	14.37	az 0° el 17°	-0.23	12.57	-0.09	8.86	0.02	-0.30	0.26	-10.35	-0.57	3.56	az 308° el 17°	0.07	-8.72	5.52	21.6%	-3.4%	30.1 -j10.1
2.0	0°	14.47	az 0° el 17°	-0.13	12.77	0.11	9.10	0.26	-0.45	0.38	-10.51	-0.73	3.15	az 0° el 53°	-0.34	-5.13	3.19	24.2%	-0.8%	30.0 -j10.3
4.0	0°	14.79	az 0° el 17°	0.19	12.75	0.09	8.65	-0.19	-0.31	0.26	-9.86	-0.08	3.29	az 0° el 53°	-0.20	-2.24	1.69	25.3%	0.3%	29.9 -j10.4
6.0	0°	14.73	az 0° el 17°	0.13	12.59	-0.07	8.66	-0.18	-0.20	0.17	-9.74	0.04	3.49	az 0° el 53°	0.00	-1.20	1.05	24.9%	-0.1%	30.0 -j10.4
8.0	0°	14.64	az 0° el 16°	0.04	12.65	-0.01	8.79	-0.05	-0.12	0.11	-9.74	0.04	3.54	az 0° el 54°	0.05	-0.75	0.61	24.8%	-0.2%	30.0 -j10.4
0.5	30°	14.14	az 348° el 17°	-0.46	12.09	-0.57	5.69	-3.15	-3.17	1.49	-7.29	2.49	6.92	az 308° el 17°	3.43	-10.62	13.64	14.6%	-10.4%	32.1 -j3.9
1.0	30°	14.74	az 357° el 17°	0.14	12.78	0.12	8.47	-0.37	-0.39	0.48	-10.60	-0.82	3.03	az 0° el 54°	-0.46	-7.94	5.19	24.5%	-0.5%	30.0 -j10.2
2.0	30°	14.92	az 0° el 17°	0.32	12.65	-0.01	8.45	-0.39	-0.48	0.36	-10.19	-0.41	3.28	az 51° el 17°	-0.21	-5.12	3.85	24.0%	-1.0%	29.9 -j10.4
4.0	30°	14.42	az 5° el 16°	-0.18	12.66	0.00	8.70	-0.14	-0.23	0.20	-9.77	0.01	3.44	az 358° el 55°	-0.05	-2.16	1.78	24.8%	-0.2%	30.0 -j10.4
8.0	30°	14.63	az 2° el 17°	0.03	12.65	-0.01	8.79	-0.05	-0.07	0.07	-9.76	0.02	3.52	az 358° el 54°	0.03	-0.68	0.66	24.9%	-0.1%	30.0 -j10.4
0.5	60°	14.71	az 351° el 17°	0.11	12.58	-0.08	6.46	-2.38	-2.40	1.53	-9.35	0.43	6.26	az 308° el 17°	2.77	-5.70	8.98	13.0%	-12.0%	30.9 -j10.7
1.0	60°	14.52	az 5° el 17°	-0.08	12.62	-0.04	8.73	-0.11	-0.42	0.38	-9.86	-0.08	3.57	az 308° el 17°	0.08	-4.30	4.83	23.6%	-1.4%	29.9 -j10.5
2.0	60°	14.69	az 358° el 17°	0.09	12.64	-0.02	8.76	-0.08	-0.11	0.12	-9.75	0.03	3.58	az 0° el 54°	0.09	-2.85	2.84	24.7%	-0.3%	30.0 -j10.4
4.0	60°	14.63	az 0° el 17°	0.03	12.66	0.00	8.82	-0.02	-0.04	0.04	-9.75	0.03	3.47	az 0° el 54°	-0.02	-0.88	0.91	24.7%	-0.3%	30.0 -j10.4
8.0	60°	14.61	az 0° el 17°	0.01	12.66	0.00	8.84	0.00	-0.01	0.01	-9.78	0.00	3.48	az 0° el 54°	-0.01	-0.26	0.25	24.9%	-0.1%	30.0 -j10.4
0.5	90°	14.09	az 340° el 16°	-0.51	11.14	-1.52	7.57	-1.27	-3.53	1.83	-8.76	1.02	8.25	az 308° el 17°	4.76	-7.65	10.57	18.9%	-6.1%	33.7 -j10.1
1.0	90°	14.69	az 6° el 17°	0.09	12.64	-0.02	8.51	-0.33	-0.47	0.40	-8.50	1.28	4.03	az 308° el 17°	0.54	-3.04	2.27	23.5%	-1.5%	29.9 -j10.4
1.5	90°	14.67	az 358° el 17°	0.07	12.65	-0.01	8.68	-0.16	-0.17	0.15	-9.75	0.03	3.44	az 308° el 17°	-0.05	-1.82	1.65	24.3%	-0.7%	30.0 -j10.4
2.0	90°	14.57	az 1° el 17°	-0.03	12.69	0.03	8.78	-0.06	-0.07	0.07	-9.75	0.03	3.54	az 1° el 54°	0.05	-1.19	1.06	24.8%	-0.2%	30.0 -j10.4
2.5	90°	14.63	az 0° el 17°	0.03	12.67	0.01	8.87	0.03	-0.04	0.04	-9.77	0.01	3.49	az 0° el 54°	0.00	-0.68	0.63	24.7%	-0.3%	30.0 -j10.4
0.5	120°	13.92	az 337° el 16°	-0.68	9.86	-2.80	5.33	-3.51	-5.80	2.42	-8.44	1.34	9.22	az 308° el 17°	5.73	-10.37	13.59	19.6%	-5.4%	34.7 -j15.7
1.0	120°	14.55	az 14° el 17°	-0.05	12.31	-0.35	7.94	-0.90	-1.70	1.53	-9.84	-0.06	5.37	az 308° el 17°	1.88	-6.75	6.14	24.3%	-0.7%	30.3 -j10.5
2.0	120°	14.94	az 358° el 17°	0.34	12.57	-0.09	8.23	-0.61	-0.61	0.51	-9.60	0.18	3.91	az 308° el 17°	0.42	-3.50	3.39	22.9%	-2.1%	30.0 -j10.4
4.0	120°	14.69	az 0° el 17°	0.09	12.68	0.02	8.78	-0.06	-0.12	0.14	-9.65	0.13	3.70	az 1° el 54°	0.21	-1.41	1.32	24.9%	-0.1%	30.0 -j10.4
8.0	120°	14.62	az 0° el 17°	0.02	12.67	0.01	8.82	-0.02	-0.04	0.03	-9.76	0.02	3.51	az 3° el 54°	0.02	-0.39	0.38	24.9%	-0.1%	30.0 -j10.4
0.5	150°	12.20	az 339° el 15°	-2.40	7.32	-5.34	-1.37	-10.21	12.20	-1.37	-3.04	6.74	9.61	az 51° el 17°	6.12	-12.52	17.65	5.3%	-19.7%	19.6 -j11.9
1.0	150°	13.62	az 27° el 18°	-0.98	10.01	-2.65	5.16	-3.68	-5.33	2.48	-5.92	3.86	8.50	az 51° el 17°	5.01	-13.23	11.95	8.5%	-16.5%	23.0 -j16.4
2.0	150°	15.52	az 15° el 17°	0.92	11.91	-0.75	5.91	-2.93	-2.95	2.21	-7.97	1.81	6.61	az 51° el 17°	3.12	-13.44	9.39	14.7%	-10.3%	29.0 -j13.2
4.0	150°	15.50	az 3° el 17°	0.90	12.41	-0.25	7.66	-1.18	-1.27	1.21	-9.60	0.18	5.04	az 355° el 52°	1.55	-10.53	6.54	21.0%	-4.0%	30.4 -j11.1
8.0	150°	14.78	az 6° el 17°	0.18	12.61	-0.05	8.94	0.10	-0.45	0.42	-9.77	0.01	4.11	az 0° el 53°	0.62	-3.40	2.70	24.6%	-0.4%	30.1 -j10.4
16.0	150°	14.69	az 1° el 17°	0.09	12.68	0.02	8.73	-0.11	-0.13	0.12	-9.76	0.02	3.67	az 0° el 54°	0.18	-0.84	0.84	24.7%	-0.3%	30.0 -j10.4
0.5	180°	12.83	az 0° el 14°	-1.77	9.52	-3.14	-0.84	-9.68	-9.68	-0.87	-3.25	6.53	8.41	az 180° el 75°	4.92	-10.58	21.65	7.6%	-17.4%	20.4 +j16.4
1.0	180°	9.51	az 0° el 14°	-5.09	5.00	-7.66	-2.93	-11.77	-11.79	-4.00	-1.98	7.80	9.44	az 180° el 15°	5.95	-12.81	17.70	5.3%	-19.7%	8.9 -j11.4
2.0	180°	11.30	az 0° el 13°	-3.30	7.79	-4.87	2.89	-5.95	-6.64	-0.38	-4.80	4.98	9.05	az 308° el 17°	5.56	-12.82	13.75	6.8%	-18.2%	24.2 -j21.0
4.0	180°	13.23	az 332° el 19°	-1.37	11.41	-1.25	7.01	-1.83	-3.17	2.18	-7.81	1.97	6.24	az 0° el 55°	2.75	-13.10	9.56	15.0%	-10.0%	32.5 -j12.4
8.0	180°	14.08	az 344° el 19°	-0.52	12.84	0.18	8.75	-0.09	-0.99	0.96	-10.06	-0.28	4.29	az 0° el 50°	0.80	-7.32	4.40	24.5%	-0.5%	30.3 -j10.3
16.0	180°	14.74	az 0° el 18°	0.14	12.71	0.05	8.73	-0.11	-0.28	0.28	-9.72	0.06	3.81	az 0° el 55°	0.32	-1.52	1.39	24.7%	-0.3%	30.0 -j10.4
20.0	180°	14.74	az 0° el 17°	0.14	12.66	0.00	8.66	-0.18	-0.20	0.18	-9.74	0.04	3.59	az 0° el 56°	0.10	-1.01	0.89	24.8%	-0.2%	30.0 -j10.4

Table 2

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

Yagi loc		target #1									non-target							% sky < -15			
dist	dir	peak gain			median gain		minimum gain		largest		median gain		worst minor lobe			largest		dBi		feedpoint impedance	
λ	°	dBi	location	delta	dBi	e	dBi	delta	decr	incr	dBi	delta	dBi	location	delta	decr	incr		change	top	bottom
no mult Yagi		15.76	az 0° el 15°		13.87		10.09				-15.00		-4.88	az 0° el 48°				47.2%		26.7 -j7.8	27.7 -j8.1
1/2	0°	11.31	az 0° el 67°	-4.45	5.55	-8.32	(floor)	—	-26.31	-4.60	-6.86	8.14	11.31	az 0° el 67°	16.19	-6.40	26.31	9.7%	-37.5%	32.7 -j4.0	35.5 -j4.7
1	0°	10.93	az 0° el 12°	-4.83	6.60	-7.27	0.45	-9.64	-11.53	-3.67	-2.73	12.27	8.76	az 0° el 62°	13.64	-4.56	23.76	4.8%	-42.4%	15.2 -j2.5	26.7 -j5.4
2	0°	13.12	az 0° el 12°	-2.64	9.18	-4.69	5.43	-4.66	-6.57	-0.99	-6.40	8.60	5.05	az 0° el 52°	9.93	-8.76	19.64	10.8%	-36.4%	22.5 -j13.3	23.4 -j9.2
4	0°	14.71	az 0° el 13°	-1.05	12.53	-1.34	8.77	-1.32	-2.44	2.38	-10.65	4.35	1.49	az 0° el 56°	6.37	-10.03	13.57	19.2%	-28.0%	27.6 -j8.6	28.0 -j9.9
6	0°	15.09	az 0° el 13°	-0.67	13.74	-0.13	10.22	0.13	-1.20	1.37	-12.99	2.01	-1.97	az 0° el 47°	2.91	-9.24	9.14	28.9%	-18.3%	27.0 -j7.8	28.1 -j8.4
8	0°	15.21	az 0° el 13°	-0.55	14.09	0.22	9.13	-0.96	-1.04	0.81	-14.40	0.60	-2.33	az 0° el 50°	2.55	-7.41	6.14	37.0%	-10.2%	26.8 -j7.8	27.9 -j8.1
16	0°	15.72	az 0° el 13°	-0.04	13.80	-0.07	10.08	-0.01	-0.26	0.24	(floor)	—	-4.31	az 0° el 50°	0.57	-2.34	2.59	46.9%	-0.3%	26.7 -j7.8	27.7 -j8.1
24	0°	15.83	az 0° el 15°	0.07	13.85	-0.02	10.01	-0.08	-0.12	0.12	(floor)	—	-4.73	az 0° el 47°	0.15	-1.52	1.53	47.4%	0.2%	26.7 -j7.8	27.7 -j8.1
28	0°	15.81	az 0° el 15°	0.05	13.87	0.00	10.15	0.06	-0.09	0.10	(floor)	—	-4.69	az 0° el 49°	0.19	-1.07	1.14	47.4%	0.2%	26.7 -j7.8	27.7 -j8.1
32	0°	15.77	az 0° el 15°	0.01	13.86	-0.01	10.06	-0.03	-0.07	0.07	(floor)	—	-4.72	az 0° el 48°	0.16	-0.80	0.86	47.4%	0.2%	26.7 -j7.8	27.7 -j8.1
1/2	30°	11.36	az 320° el 17°	-4.40	8.42	-5.45	0.09	-10.00	-12.68	-1.72	-7.69	7.31	8.94	az 357° el 66°	13.82	-8.40	23.94	16.1%	-31.1%	23.8 -j9.5	26.1 -j10.7
1	30°	14.35	az 332° el 16°	-1.41	11.48	-2.39	5.57	-4.52	5.92	2.39	-6.80	8.20	5.42	az 354° el 59°	10.30	-8.93	20.34	10.4%	-36.8%	22.3 -j9.0	23.9 -j9.8
2	30°	16.30	az 345° el 16°	0.54	13.35	-0.52	6.98	-3.11	-3.14	2.18	-10.13	4.87	1.18	az 12° el 51°	6.06	-10.01	14.61	22.9%	-24.3%	25.9 -j9.4	26.7 -j8.5
4	30°	16.47	az 356° el 15°	0.71	13.63	-0.24	8.81	-1.28	-1.35	1.20	-12.83	2.17	-1.31	az 1° el 51°	3.57	-8.52	10.53	29.4%	-17.8%	26.9 -j8.1	27.7 -j8.6
8	30°	15.84	az 6° el 15°	0.08	13.80	-0.07	9.86	-0.23	-0.41	0.42	(floor)	—	-3.77	az 353° el 50°	1.11	-4.76	5.19	44.3%	-2.9%	26.7 -j7.8	27.7 -j8.1
16	30°	15.81	az 358° el 15°	0.05	13.88	0.01	10.01	-0.08	-0.12	0.11	(floor)	—	-4.55	az 358° el 58°	0.33	-1.55	1.65	47.3%	0.1%	26.7 -j7.8	27.7 -j8.1
20	30°	15.79	az 2° el 15°	0.03	13.88	0.01	10.08	-0.01	-0.08	0.08	(floor)	—	-4.69	az 356° el 48°	0.19	-1.12	1.15	47.3%	0.1%	26.7 -j7.8	27.7 -j8.1
24	30°	15.79	az 0° el 15°	0.03	13.88	0.01	10.06	-0.03	-0.05	0.05	(floor)	—	-4.76	az 1° el 48°	0.12	-0.83	0.81	47.2%	0.0%	26.7 -j7.8	27.7 -j8.1
1/2	60°	14.10	az 18° el 14°	-1.66	11.19	-2.68	6.06	-4.03	-6.59	1.00	-9.26	5.74	5.06	az 300° el 15°	9.94	-9.36	19.01	19.3%	-27.9%	27.3 -j12.3	30.1 -j12.4
1	60°	15.55	az 347° el 15°	-0.21	13.58	-0.29	9.14	-0.95	-1.68	1.58	-13.08	1.92	14.01	az 333° el 16°	18.89	-8.42	12.08	28.6%	-18.6%	27.2 -j7.9	27.8 -j8.1
2	60°	16.02	az 1° el 15°	0.26	13.77	-0.10	9.65	-0.44	-0.47	0.37	(floor)	—	-3.62	az 300° el 15°	1.26	-5.39	5.47	43.4%	-3.8%	26.7 -j7.8	27.7 -j8.1
4	60°	15.82	az 0° el 15°	0.06	13.86	-0.01	10.06	-0.03	-0.11	0.12	(floor)	—	-4.68	az 353° el 48°	0.20	-1.87	1.79	46.8%	-0.4%	26.7 -j7.8	27.7 -j8.1
8	60°	15.77	az 0° el 15°	0.01	13.87	0.00	10.08	-0.01	-0.02	0.03	(floor)	—	-4.85	az 3° el 48°	0.03	-0.48	0.49	47.3%	0.1%	26.7 -j7.8	27.7 -j8.1
1/2	90°	14.84	az 15° el 15°	-0.92	12.75	-1.12	8.50	-1.59	-3.03	1.51	-12.15	2.85	2.61	az 59° el 15°	7.49	-10.12	13.77	30.0%	-17.2%	29.3 -j7.2	30.7 -j6.6
1	90°	15.80	az 356° el 15°	0.04	13.83	-0.04	9.79	-0.30	0.46	0.40	(floor)	—	-3.79	az 59° el 15°	1.09	-4.86	5.21	42.9%	-4.3%	26.7 -j7.8	27.6 -j8.1
1 1/2	90°	15.81	az 0° el 15°	0.05	13.84	-0.03	9.99	-0.10	-0.14	0.12	(floor)	—	-4.54	az 59° el 15°	0.34	-1.99	2.27	46.4%	-0.8%	26.7 -j7.8	27.7 -j8.1
2	90°	15.73	az 358° el 15°	-0.03	13.89	0.02	10.06	-0.03	-0.05	0.06	(floor)	—	-4.74	az 59° el 15°	0.14	-1.24	1.40	46.9%	-0.3%	26.7 -j7.8	27.7 -j8.1
2 1/2	90°	15.78	az 0° el 15°	0.02	13.88	0.01	10.11	0.02	-0.03	0.04	(floor)	—	-4.78	az 0° el 48°	0.10	-0.97	1.11	47.2%	0.0%	26.7 -j7.8	27.7 -j8.1
4	90°	15.76	az 0° el 15°	0.00	13.87	0.00	10.09	0.00	-0.01	0.01	(floor)	—	-4.91	az 0° el 48°	-0.03	-0.40	0.42	47.4%	0.2%	26.7 -j7.8	27.7 -j8.1
1/2	120°	15.36	az 9° el 15°	-0.40	13.45	-0.42	7.61	-2.48	-2.51	1.48	-10.91	4.09	0.94	az 59° el 15°	5.82	-8.90	12.07	20.7%	-26.5%	27.3 -j8.9	28.2 -j8.6
1	120°	15.72	az 357° el 15°	-0.04	13.83	-0.04	10.00	-0.09	-0.27	0.24	(floor)	—	-4.77	az 59° el 15°	0.11	-2.77	3.61	47.7%	0.5%	26.6 -j7.9	27.7 -j8.1
2	120°	15.81	az 0° el 15°	0.05	13.84	-0.03	10.07	-0.02	-0.07	0.07	(floor)	—	-4.82	az 358° el 48°	0.06	-2.39	2.11	45.5%	-1.7%	26.7 -j7.8	27.7 -j8.1
4	120°	15.78	az 0° el 15°	0.02	13.88	0.01	10.08	-0.01	-0.03	0.03	(floor)	—	-4.91	az 1° el 48°	-0.03	-1.10	1.31	47.1%	-0.1%	26.7 -j7.8	27.7 -j8.1
8	120°	15.76	az 0° el 15°	0.00	13.87	0.00	10.09	0.00	-0.01	0.01	(floor)	—	-4.89	az 0° el 48°	-0.01	-0.41	0.50	47.3%	0.1%	26.7 -j7.8	27.7 -j8.1
1/2	150°	15.39	az 6° el 15°	-0.37	13.45	-0.42	8.20	-1.89	-1.97	0.85	-8.50	6.50	-0.60	az 236° el 18°	4.28	-9.99	13.61	13.6%	-33.6%	25.3 -j3.0	25.8 -j2.5
1	150°	15.77	az 0° el 15°	0.01	13.84	-0.03	9.98	-0.11	-0.15	0.11	(floor)	—	-4.60	az 59° el 15°	0.28	-0.92	1.51	48.5%	1.3%	26.7 -j7.8	27.7 -j8.0
2	150°	15.74	az 0° el 15°	-0.02	13.87	0.00	10.12	0.03	-0.07	0.06	(floor)	—	-4.90	az 0° el 48°	-0.02	-1.51	2.08	47.0%	-0.2%	26.7 -j7.8	27.7 -j8.1
4	150°	15.77	az 0° el 15°	0.01	13.86	-0.01	10.09	0.00	-0.04	0.05	(floor)	—	-4.84	az 1° el 48°	0.04	-0.79	1.25	47.0%	-0.2%	26.7 -j7.8	27.7 -j8.1
8	150°	15.75	az 0° el 15°	-0.01	13.88	0.01	10.09	0.00	-0.01	0.02	(floor)	—	-4.90	az 0° el 48°	-0.02	-0.33	0.33	47.3%	0.1%	26.7 -j7.8	27.7 -j8.1
16	150°	15.76	az 0° el 15°	0.00	13.87	0.00	10.09	0.00	-0.01	0.01	(floor)	—	-4.88	az 0° el 48°	0.00	-0.09	0.08	47.2%	0.0%	26.7 -j7.8	27.7 -j8.1
1/2	180°	14.62	az 0° el 15°	-1.14	12.89	-0.98	8.99	-1.10	-1.29	-0.61	-9.31	5.69	4.78	az 184° el 84°	9.66	-7.82	19.78	14.9%	-32.3%	19.6 -j0.9	19.7 +j0.1
1	180°	15.86	az 0° el 15°	0.10	13.95	0.08	10.08	-0.01	-0.04	0.11	(floor)	—	-5.44	az 59° el 15°	-0.56	-2.54	2.23	54.2%	7.0%	26.8 -j7.8	27.8 -j7.9
2	180°	15.84	az 0° el 15°	0.08	13.87	0.00	9.98	-0.11	-0.14	0.12	(floor)	—	-4.49	az 59° el 15°	0.39	-1.78	1.23	47.9%	0.7%	26.7 -j7.8	27.7 -j8.0
4	180°	15.70	az 0° el 15°	-0.06	13.82	-0.05	10.09	0.00	-0.08	0.15	(floor)	—	-4.93	az 59° el 15°	-0.05	-0.41	1.06	46.9%	-0.3%	26.7 -j7.8	27.7 -j8.1
8	180°	15.75	az 0° el 15°	-0.01	13.89	0.02	10.10	0.01	-0.04	0.04	(floor)	—	-4.82	az 0° el 48°	0.06	-0.42	0.22	47.7%	0.5%	26.7 -j7.8	27.7 -j8.1
16	180°	15.77	az 0° el 15°	0.01	13.88	0.01	10.10	0.01	-0.01	0.01	(floor)	—	-4.87	az 0° el 48°	0.01	-0.19	0.11	47.4%	0.2%	26.7 -j7.8	27.7 -j8.1
20	180°	15.76	az 0° el 15°	0.00	13.87	0.00	10.09	0.00	-0.01	0.01	(floor)	—	-4.88	az 0° el 48°	0.00	-0.12	0.07	47.3%	0.1%	26.7 -j7.8	27.7 -j8.1

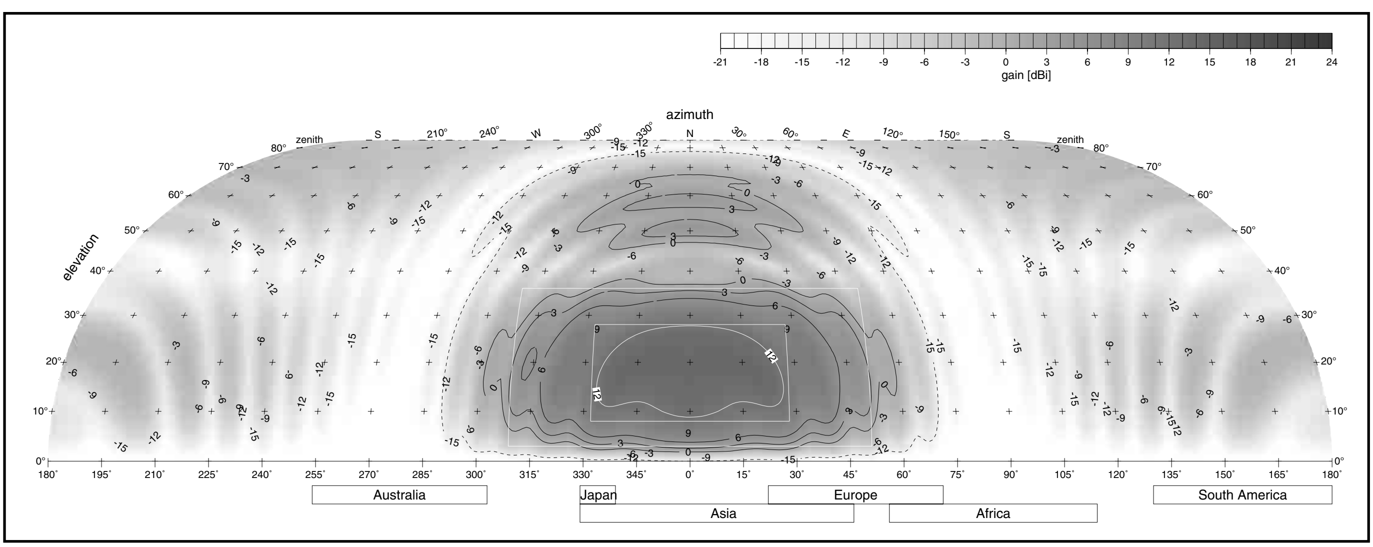

Figure 1—Gain pattern of the multiplier Yagi when it stands 8λ directly behind the stack. Both antennas point toward 0° azimuth. Parasitic re-radiation by the stack modulates the Yagis pattern with a rippled pattern of constructive and destructive interference.

tern of the multiplier Yagi. The feedpoints of the stack's Yagis are short-circuited.

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

To identify the minor lobes, a range of ±51° in azimuth and 8 and 28° in elevation (representing the -11 dB points on the main beam) was excluded from the non-target zone statistics. This exclusion prevented the sides of the main beam from obscuring information about the behavior of the pattern outside the main beam.

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

• Location of the multiplier antenna relative to the stack; e.g., 1 λ at 0° means the multiplier antenna stands one wavelength in front of the stack. Both the stack and multiplier Yagis point to 0° azimuth.

• Peak gain of the multiplier antenna, its azimuth and elevation, and the impairment to peak gain (change in peak gain caused by the presence of the unused stack).

• Median gain over the target zone, and the impairment to median gain.

• Minimum gain within the target zone, and the impairment to that minimum gain. Since no antenna fills a target zone uniformly, we want to know if impairments exist to the least well-served part of the target.

• Largest spot increase in gain, and largest spot decrease in gain, within the target zone. "Spot gain" refers to the gain in a specific direction (azimuth and elevation). A significant change in the gain in any one direction would be an undesirable interaction, even if the overall pattern averaged out to the same level of gain.

• Median gain outside of the main beam, and impairment to that median gain. A well-designed antenna has little sensitivity outside of its main beam; any increase in median gain indicates impaired performance. An entry of "floor" here means the median gain is less than the floor threshold of -15 dBi.

• Worst (highest gain) minor lobe outside the main beam, its location and the impairment (increase in gain of the worst minor lobe).

• Largest spot increase in gain, and largest spot decrease in gain, outside the main beam.

• Portion of the sky hemisphere with gain of < -15 dBi (quiet regions of reduced QRM and QRN), and impairment to that portion.

• Feedpoint impedance.

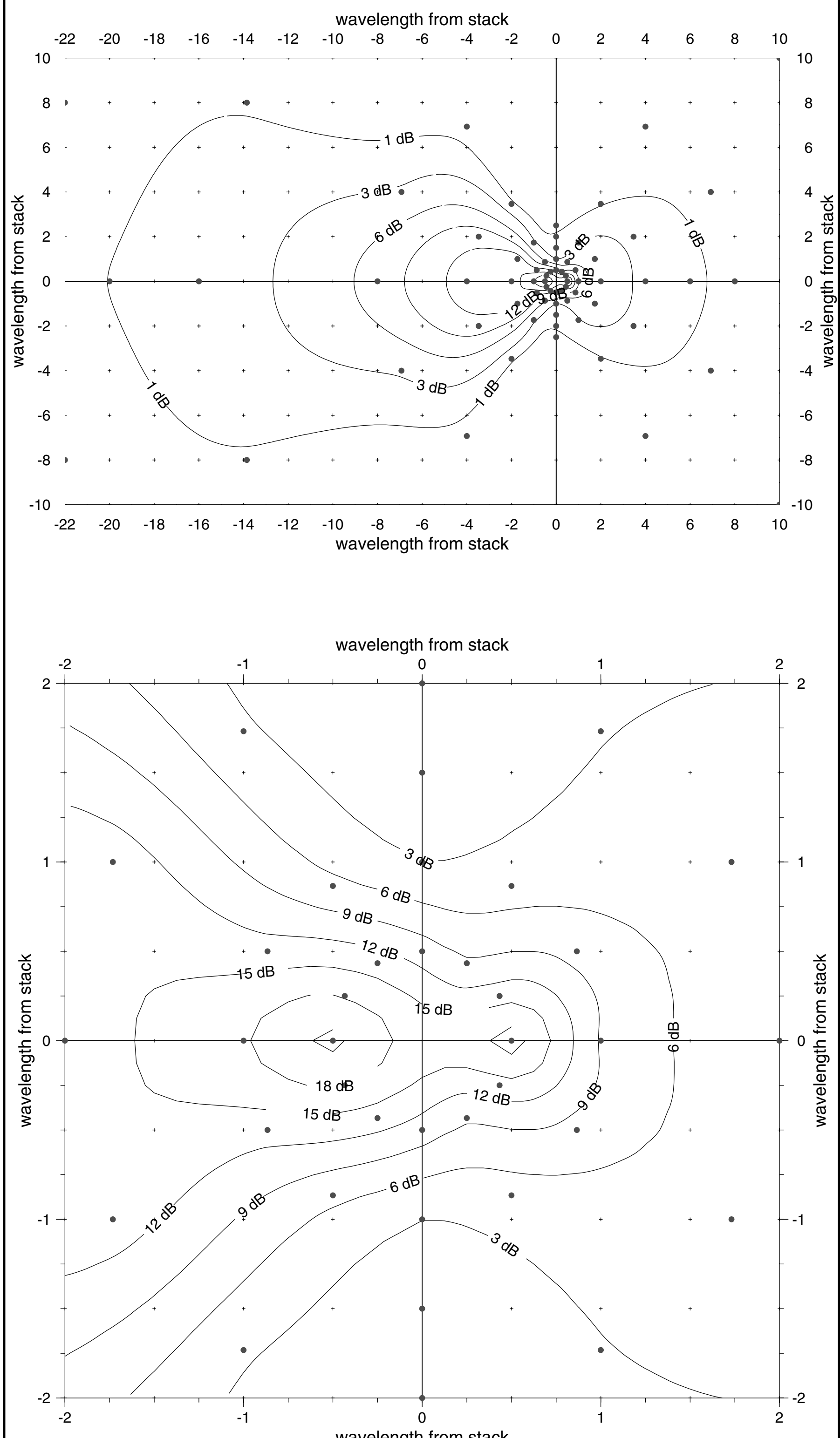

Figure 2—Maximum absolute variation in spot gain in any direction for the multiplier Yagi due to the presence of the stack. The stack stands at the origin of the coordinate system. Dots indicate calculated locations for the multiplier Yagi relative to the stack. Both antennas point toward 0° azimuth.

Implication Of Design Objectives

Each station designer must choose his design objectives. Let's examine the implications of choosing three different, increasingly strict, thresholds for tolerable impairments between a stack and a multiplier antenna:

• No impairment within the target zone exceeding -1 dB, but accept any degree of impairment outside the main beam.

• No impairment to the median gain outside the mean beam exceeding -1 dB, and no variation in spot gain by more than -6 dB (an S-unit).

• No variation in spot gain at any point in the pattern exceeding -1 dB.

Careful study of Table 1 reveals that all impairments vary in a coordinated fashion, rising and falling together. But while impairments to the main beam rapidly dwindle in significance as spacing between the antenna systems increases, the antenna pattern outside the main beam can remain impaired at greater distances.

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

Figure 1 shows continued pattern impairments in this alignment at a separation of 8 λ. The ripples reveal parasitic reradiation from the unused stack's Yagis. This separation nearly achieves our second design criterion: the median gain outside the main beam varies less than a dB from a multiplier Yagi standing alone. But certain directions outside the main beam show gain decreases over –7 dB or gain increases over 4 dB. To achieve the third criterion in this alignment requires an enormous separation of 20 λ!

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

Table 1 shows the variation in spot gain outside the main beam represents the most sensitive detector of pattern impairments. Figure 2 maps out this variation as a function of the relative location of the two antenna systems. The X and Y axes represent distances to the multiplier Yagi from the stack, which stands at the origin in the center of the figure. The contours represent constant values for the largest spot gain variation (either negative or positive). Both antenna systems point to the right.

Azimuthal Beam Stretch

The tabular data also reveals one other form of interaction. Figure 3 illus-

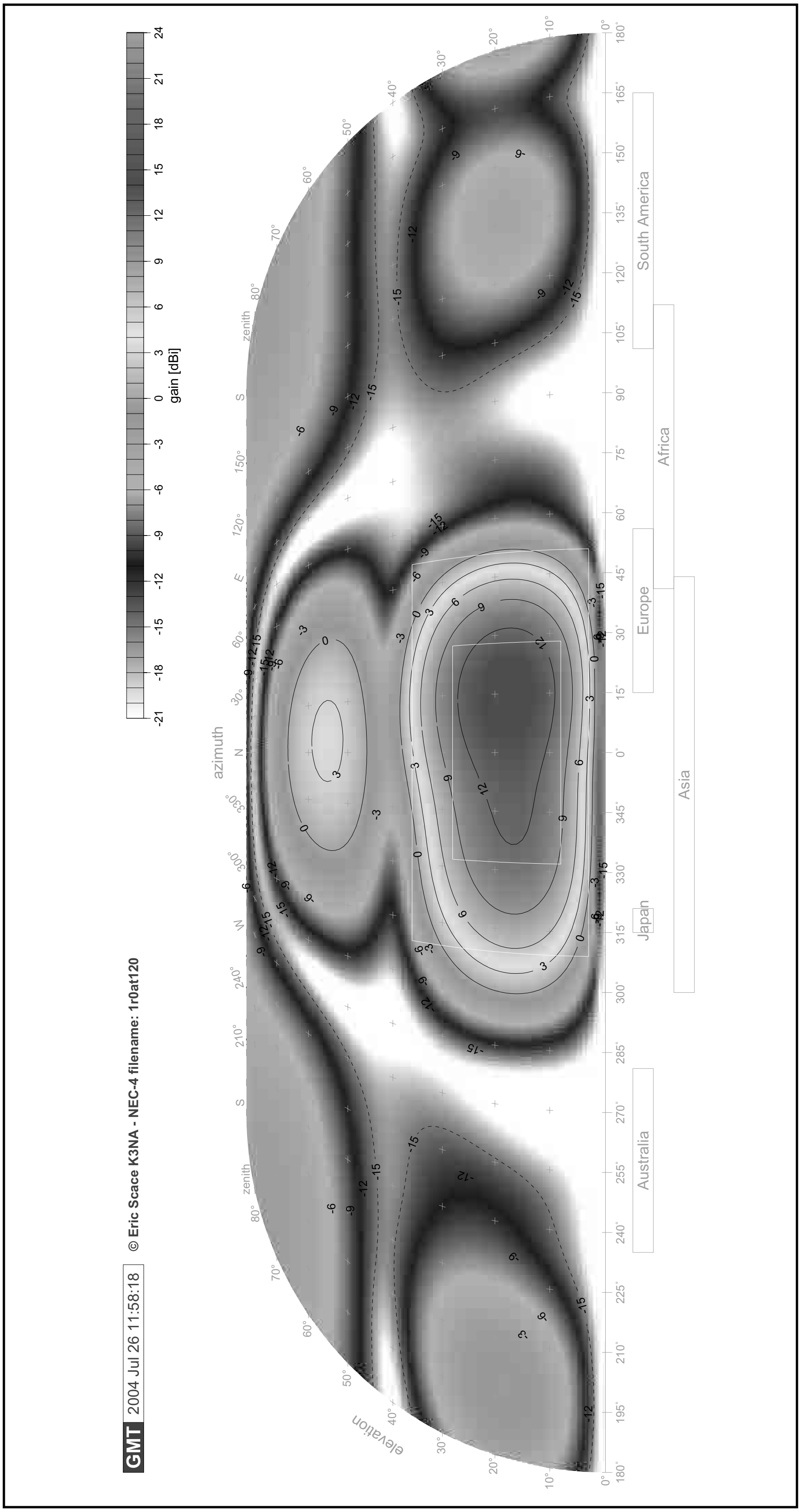

Figure 3—Gain pattern of the multiplier Yagi when it stands 1λ behind and to the right of the stack. Both antennas point toward 0° azimuth. The parasitic reradiation by the stack stretches out the multiplier Yagi main beam, forcing the point of peak gain to shift 14° in azimuth from the intended direction (0°).

trates the multiplier Yagi's pattern when that Yagi stands 1λ behind and to the right of the stack. Main beam distortion forces the peak gain 14° to the right of its normal position in azimuth. Look for variations in azimuth in the table to identify beam stretch. In some situations, gain at the center of the target zone falls -3 dB due to stretch; in other words, the main beam isn't pointing in the direction indicated by the rotator!

Stack Fed

Having examined impairments when feeding the multiplier Yagi, now reverse the roles and feed the stack. The multiplier Yagi's feedpoint is now short-circuited. Table 2 itemizes pattern impairments to the stack.

The stack's pattern displays somewhat greater sensitivity to the presence of the multiplier Yagi than vice versa. In the most extreme configuration, with the multiplier Yagi standing in front of the stack and in the stack's main beam, the multiplier Yagi must stand 30λ away to meet our most stringent impairment design criterion—rather impractical for most contesters. When out of the main beam or behind the stack, that most stringent impairment objective can be met with about 4λ spacing. See Figure 4 for the map of impairment to spot gain outside the main beam vs. location.

Azimuthal beam stretching also occurs when the multiplier Yagi stands forward and to one side of stack.

Impedance And Impairment

Feedpoint impedance varies but little, even for closely spaced antennas with significant pattern impairments. In most directions the multiplier Yagi must be located within 1λ of the stack before a variance of more than 1Ω occurs—quite close, considering these Yagis have booms of 0.67λ! One cannot rely solely on impedance irregularities to indicate that antenna patterns have been disturbed.

The data also indicates that a significant variation in impedance indicates a major pattern disruption. If your antenna's impedance changes significantly when rotating the antenna, you should examine your antenna field for undesired interactions. Such impairments might arise from the location and orientation of other antennas, as illustrated here. Other metallic objects also may introduce impairments; e.g., resonant guy wire segments or harmonically related, insulated antenna elements and parts.[6]

Next step

This part and the previous article in this series, taken together, have examined two cases: antenna systems pointed at right angles, and pointed to the same azimuth. Next time we will look at these two systems pointed in opposite directions. Taking these three cases together will allow us to draw conclusions about acceptable minimum spacing for rotatable antennas on the same band.

Notes:

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

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

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

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

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

[6]Weber, Dick K5IU, "A Guy-Wire-Interaction Case Study", *QEX,* 2002 Nov/Dec, pp. 42–48; ARRL, Newington CT USA.

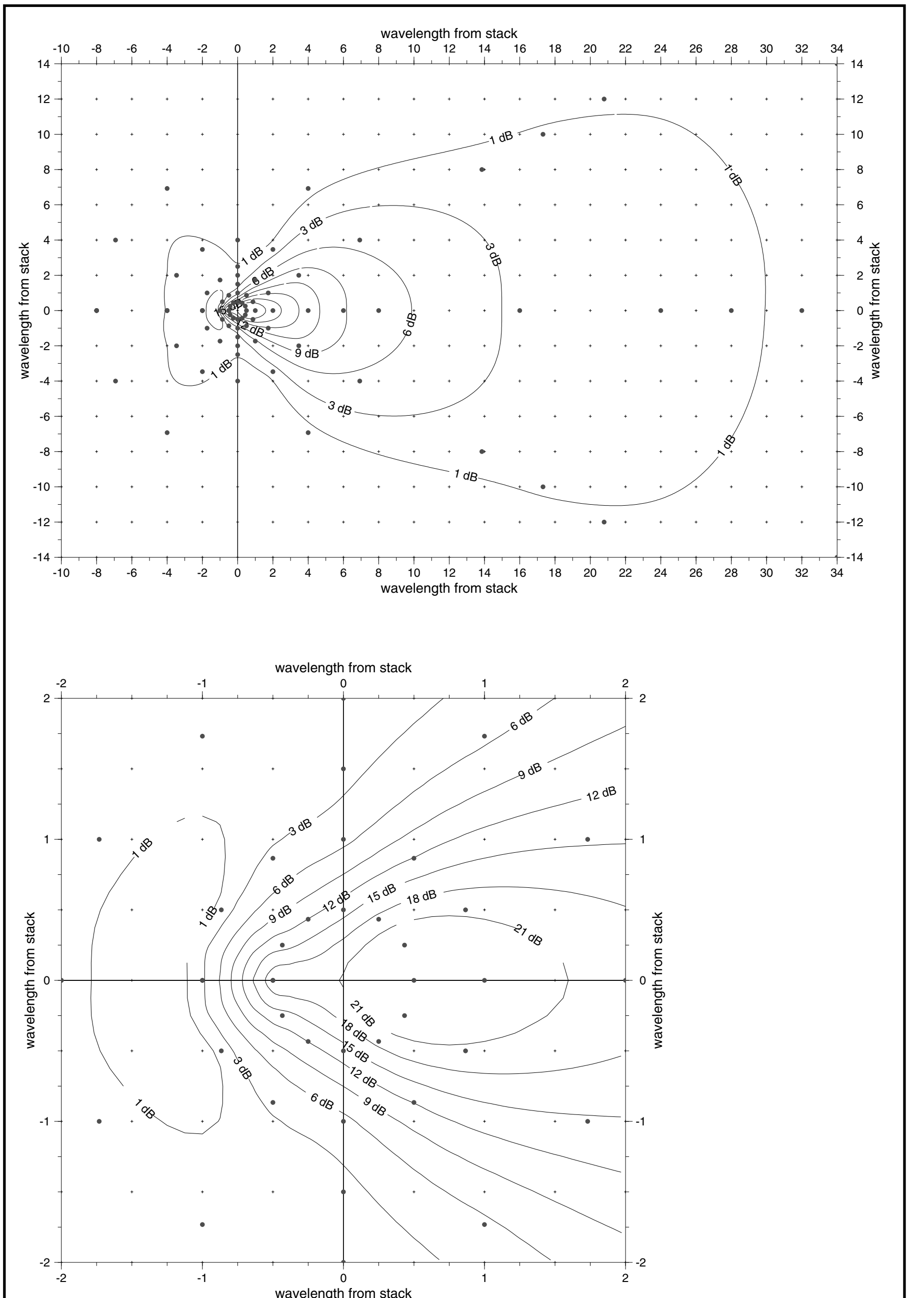

Figure 4—Maximum absolute variation in spot gain in any direction for the stack due to the presence of the multiplier Yagi. The stack stands at the origin of the coordinate system. Dots indicate calculated locations for the multiplier Yagi relative to the stack. Both antennas point toward 0° azimuth.

A Simple Modification to the Top Ten DX Doubler

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Last year I replaced the much-modified rat's nest of wires used to control my two-radio setup with a Top Ten Devices DX Doubler.[1] This box performs all of the control functions needed to switch transmitting and receiving signals to and from the radios. In the receive mode, it provides three choices for headphone control. Its "Auto" mode connects both ears to the radio selected by your logging program, while its "PTT" mode connects one ear to each radio while listening but connects both ears to the non-transmitting radio while transmitting. Many people find this latter mode useful in forcing one to listen to the second radio. I use this as my default mode of operation. The third mode lets the operator manually select which radio to listen to.

However, at times I find listening to loud signals on the second radio to be distracting. For example, I don't like hearing HC8N blasting through on my right ear while I am trying to pull a weak signal out of the noise on the run radio on the left ear. I could reach up and switch the DX Doubler to the "Auto" mode, but I don't want to move my hands from the keyboard to do that. This seemed an ideal opportunity for a no-cost, no-holes modification.

The DX Doubler's schematic shows that switch S2 selects the chosen mode by grounding different pins of IC U5. However, selecting "PTT" doesn't connect anything to anywhere. That is, when in the "PTT" mode, neither "Auto" nor "Manual" is grounded. By connecting a temporary connection between the "Auto" terminal of S2 and ground, a footswitch can let the operator use the desirable "PTT" mode as the default while momentarily selecting the "Auto" mode when needed. As long as one steps on the footswitch, the "Auto" mode is selected. On releasing the footswitch, the normal two-radio "PTT" mode is available.

I chose to use the rear panel "Key" RCA jack, J7, for my no-holes modification. *TRLog* and the DX Doubler provide both computer generated messages and the seamless use of my external keyer paddle. Thus, the "Key" jack is superfluous in my station. The "PTT" jack, J8, could be pressed into service if you don't intend to use a footswitch to provide a traditional PTT function. I merely removed the wire from the center pin of J7, taping the bare end for return-to-new state when the unit is sold at my Silent Key auction. A short piece of insulated wire is connected between the center pin of J7 to the bottom lead of S2. I used solid wire from old telephone cable to make this connection. It is quite easy to loop an eye of solid wire around the bottom lead of S2 before soldering. That's the entire modification. Just connect your footswitch to the "Key" connector.

By the way, I have an all Ten-Tec station. Judging by complaints on various contest-related reflectors, some people seem quite distressed that Ten-Tec radios have not provided a PTT mode of CW operation. In particular, the PTT connection on a Ten-Tec radio is in parallel with the rig's key jack. Thus, the desirable hang time for effective use of the DX Doubler's PTT mode is not available directly from the radio. However, *TRLog*, and many other logging programs, already provide a PTT output to control sluggish linear amplifiers. This PTT signal is available on the cables from J2 and J3 to the radios. I merely took the unused PTT lead on the Top Ten rig cable and connected it back to the PTT RCA jacks (J4 and J5) on the back of the DX Doubler. Now everything works perfectly, whether using the pre-recorded messages or the paddle. NCJ

[1]H. Ward Silver, NØAX, *NCJ* Reviews: Top Ten Devices' DX Doubler, *National Contest Journal*, March/April 2002, pp. 14-15.

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NCJ Station Profile — K8CC

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Only days after the NT1Y station profile in the January/February 2004 *NCJ* hit the stands, the antenna shown on the cover succumbed to New England ice. The behind-the-scenes armchair analysis of the failure was exciting to watch and read, and when there was nothing left but the shouting, one thing was for sure: as hams have said for generations, *this antenna must have been big enough!*

Congratulations to Bill and his crew, notably Scott, W4PA, for a great showing on their maiden voyage. Scott appears to be the top single-combat warrior in the 2003 CQWW CW with a convincing victory from NT1Y in Single-Op All-Band High-Power.

The Black Hole

This month the Hardware Addict turns his attention toward that part of the country that gets no respect: the Black Hole. K8CC is an HF Multi-Multi station that has been intact for almost 15 years. Owner/builder Dave Pruett is a true hardware addict. The story of K8CC covers a lifetime of learning at many different stations culminating in the building of his own, where the learning, and now teaching, continues today. As a side note, Dave was the *NCJ* Editor from the November/December 1984 issue through the May/June 1987 issue.

Young Hardware Addict

The Ham Radio column in *Popular Electronics* magazine first got Dave interested. Columnist Herb Brier, W9EGQ, published station reports sent to him, usually from Novices or new Generals. "I was fascinated reading about the different types of station setups people used. See, I was a 'Hardware Addict' even then!"

In 9th grade, Dave met Rick Bernard, WA8RRR, his original Elmer. Rick was already licensed and helped Dave and two others get licensed in 1969. "Ham radio was a big part of our high school years. After college, Rick and I continued to compete against each other with our 100-watts-and-wires stations, usually in SS. We're still friends almost 40 years later and still occasionally contest together."

Dave's Novice call was WN8DCR. Scarcely two months later, he upgraded to WB8DCR bypassing the Advanced exam. In 1976, Dave upgraded to Amateur Extra and a year later, he landed K8CC in that first big round of short call signs. "I remember sitting on 3830 while people debated preferred callsigns in the original 'vanity callsign' opportunity."

The Formative Years

When he went away to college, Dave acquired the call WB5YEM. "I went off to a small college in Arkansas in 1976, which just happened to be in the town where Stan, WA5RTG (now K5GO), and his dad John, W5DRW (later N5DX, now a Silent Key, but now the call sign of Stan's son Kevin), lived. Their station was my first exposure to big hardware and serious contesting. Stan opened my eyes to 3830 KHz, which, back in the seventies was active most evenings with contesters chatting. Stan and I have maintained our friendship over the years and have advised each other on building our big stations."

Dave credits an impressive list of station builders who influenced his Big Station plans—among them: N4AR, K3LR and local friend W8UA. "I got to join the N4AR team for Worldwide CW from 1982 to 1984. Operating from that huge station with all of its hardware really fills you with ideas." Dave also operated from K3LR (when the station was actually located at the AF3P QTH) back in the city lot days in 1984-85. "This showed me what could be done even with a small lot when good design is applied and the details are attended to."

"I've had the opportunity to visit, and in some cases operate from, many legendary or well-known stations over the past 20 years. I've operated from places like G3MXJ, K3LR, K3MQH (VHF), K8AZ, N4AR, N5AU and W3LPL. In my travels (often on road trips for Chrysler), I've visited stations like K1CC, K1GQ, K1KI, K1OX, K1TO, W1AW, K4OJ/W1CW/W1YL, K4XS, WC4E, N4ZZ, W4AN, K5ZD, K5LZO, K5RC, NR5M, W5XZ, K6NA, K6UA, N6TR, W7RM, W9RE and W9ZRX. A lot of these visits resulted in valuable hardware lessons learned."

Building K8CC

"K5GO was the person who first gave me the vision to think about owning a big station. I finished college and moved back to Michigan permanently in 1982. I bought this property (5 acres) in 1983, with the explicit purpose of building a contest station. We started building the house in 1985, and finished in 1986. One month later, 100 feet of 25G was in the air with monobanders for 20/15/10 and a 40 rotary dipole and low band wires."

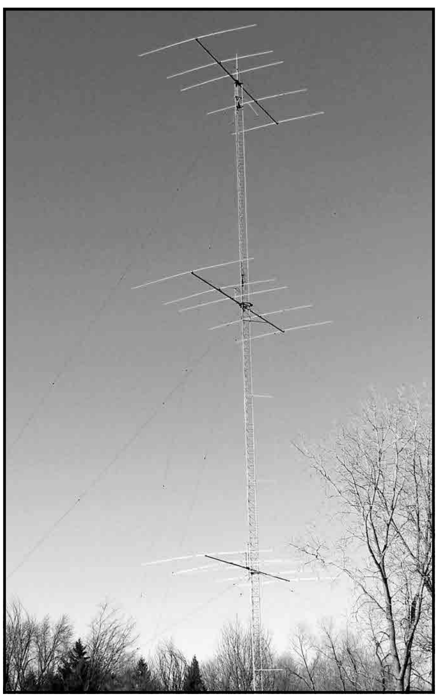
With this station, Dave entered his first serious Single-Op all-band high-power effort in CQ Worldwide in 1986. "N4AR gave me some sobering advice; he said 'Dave, keep in mind that no matter what antennas you put up in the future, you'll never be more than 6 dB louder than you are now.'"

The ops at K8CC for 2003 ARRL DX CW: (l to r) John, K8JM; Mark, NU8Z; Dave, K8CC; Don, WX3M; Mike, WD8S.

The K8CC antenna farm—all on 5 acres.

The amplifier racks at K8CC. Lots of watts here!

The main operating position at K8CC.



The 15-meter tower—a stack of 5-element monobanders.

In 1987, two more towers went up with rotatable Yagis on 40 through 10 meters and K8CC began hosting multi-ops. The fourth tower went up in 1990 and that tower configuration stabilized for about 10 years. In 2001, K8CC sprouted a fifth tower for VHF antennas.

"Almost all of the HF Yagis are homebrew. The 3L 40 is noteworthy in that it was designed prior to the availability of mechanical analysis tools. It was built out of junk aluminum and pieces of old CB beams, yet other than an infant failure in the gamma match, it has been trouble free for 14 years.

"One problem we have is not enough room for really effective low band receiving antennas. The lot is 440 x 500 feet, and any Beverages strung on the property seem to be negatively affected by the towers. Behind my property is a 100-acre cornfield owned by a dairy farm on which we've been known to surreptitiously install semi-temporary Beverages."

One thing that is significant, while perhaps not unique, to the design of K8CC is that the station can be run in most any category with only a few adjustments to the station layout. The main desk has two operating positions that are used for multi-single and multi-two operations. A second rig can be added to one position for SO2R. There are four other radio tables in the shack with eight more operating positions that can be activated for multi-multi simply by moving some coax and rotator cables.

K8CC has always been near the forefront of hardware technology. "My first two-radio operation was in 1981 CW SS. The following year K5GO and I developed 'auto receiver switching' based on some things K3LR and others were doing. Arguably, these were early implementations of what we now know as SO2R. K8CC has had fully automated band switching since 1989 with homebrew predecessors to Six Packs and Top Ten boxes. The last K8CC paper log was used in 1988, with first *CT* then later *NA* software. We recently uploaded 248K+ QSOs to the ARRL's Logbook Of The World, which represents almost every contest QSO made from this QTH since 1986."

Training the Next Generation

From the beginning, Dave's station was designed for multi-op contesting. "While I like single-op myself at times, I really enjoy the camaraderie that comes from a multi. While I try to attract the best ops I can so we can put on a serious, competitive effort, we never turn away new contesters. We integrate them into our contest operations, or we have also occasionally hosted 'training multis' where we expressly pair new ops with experienced hands to teach and learn. We also occasionally host newcomers doing single-op themselves.

"I like to see the station used by guys who have little or no station of their own. With deed and antenna restrictions these days, for many people antennas like mine are just not possible. I love for them to see what is possible."

A Mad Influence

"One big part of my contesting experience has been my 21 year membership in the Mad River Radio Club." Dave says the MRRC has been a source of camaraderie, support and guest operators over the years. "Every contester should belong to a contest club, if possible."

The Last Word

I asked Dave what gem of wisdom would make a fitting end to his story. "I can't help but say how thankful I am for Amateur Radio and for contesting. Being a contester is like being a part of a fraternity, and it never ceases to amaze me how you can meet a fellow contester for the first time and have an instant connection. I'm also reminded of those contesters we've lost recently. N8SM, K4OJ and W4AN were all personal friends of mine, and their loss causes me to pause and appreciate the many amateur friends I've made over the years who have encouraged me, helped me build, or operate K8CC."

DX Contest Activity Announcements

Bill Feidt, NG3K

RSGB IOTA Contest (July 24-25, 2004)

Call	***Entity***	***IOTA***	***Operators***
CT9X	Madeira	AF-014	CT1EPV, CT1AGF, CT3FN, CT3EE, CT3MD, DJ2VO, G3KHZ, HB9EBV, VA2AM
E21EIC/P	Thailand	AS-107	E21EIC
IC8OZM	Italy	EU-031	IK8UND, IK8HCG, IC8OZM, IK8TEO
JM1PXG/6	Japan	AS-047	JM1PXG
LZ1KSL	Bulgaria	EU-181	LZ1KSL team
M8C	England	EU-011	GØVJG, G4BUO, 2EØATY, M3CVN
MJØDLQ/p	Jersey	EU-009	ON4ASG, ON4AVA, ON4ON, ON5SY, ON6CX, ON7PQ, ON7XT
MMØCWJ/p	Scotland	EU-111	MMØCWJ
SM1T	Sweden	EU-020	SM1TDE
SMØELV/5	Sweden	EU-177	SMØELV
VY2/W1MO	Canada	NA-029	W1MO
XU7ACV	Cambodia	AS-133	ES1RA

Thanks to: E21EIC, ES1RA, G0VJG, IK8UND, JM1PXG, LZ4BU, MM0CWJ, ON9CGB, OPDX, SMØELV, SM1T, W1MO.
See **www.ng3k.com/Misc/iota2004.html** for further details.

CQ/RJ Worldwide DX Contest, RTTY (September 25-26, 2004)

Call	***Entity***	***Class***	***Operators***
VP2E	Anguilla	SO	KU4J

Thanks to: KU4J. See **www.ng3k.com/Misc/cqr2004.html** for further details.

CQ World Wide DX SSB Contest (October 30-31, 2004)

Call	***Entity***	***Class***	***Operators***
4XØWV	Israel	M/S	KC8FS, WA8WV
7P8Z	Lesotho	SOAB HP	ZS4TX
FS/AH8DX	St Martin	SOAB	AH8DX
J49Z	Crete	M/S	I2WIJ, IK8UND, IK8HCG
LZ9W	Bulgaria	M/M	LZ Contest Team
PJ4/T93M	Neth Antilles	SOAB HP	T93M
PJ7/K7ZUM	Sint Maarten	SOAB	K7ZUM
VK9XD	Christmas	SOAB	VK2CZ

Thanks to: AH8DX, IK8UND, K7ZUM, KC8FS, LZ2CJ, T93M, VK2CZ, ZS4TX.
See **www.ng3k.com/Misc/cqs2004.html** for further details. NCJ

Contesting for Fun

Brian Kassel, K7RE

Bob, N4BP, and I have been making budget DXpeditions to Freeport on Grand Bahama Island each February for the past four years. We both hold Bahama licenses. Bob is C6AKQ and I'm C6ALK. On another trip to the island, Bob and his fellow operators discovered a group of rental apartments under a 160 foot unused tower. They introduced themselves to the owner and discussed some possible commercial uses for that naked tower, and at the same time relayed their interest in a future ham operation there. After all, a naked tower in a rare DX location is something contest hams dream about. On their return home, several emails crossed back and forth resulting in a plan to rent an apartment and use the tower for the ARRL DX CW Contest this year. Bob, Kevin, K4PG/C6APG, and I would be the participants.

On previous visits, we had gotten every detail down pat, as we had had always operated from the same location. We had never operated from this particular location on the island and had only eyeballed the tower and site very quickly, so we had to come up with many possible methods of mounting our antennas, allowing for enough feed line, etc. We sensed Murphy was at our heels on this trip.

Bob and I left Port Everglades on February 17 for Freeport on the new "CAT" ferry that had just begun a daily crossing this past November. Kevin had recently begun a new job and could only join us for three days. The CAT turned out to be a wonderful mode of transportation, one advantage being a considerably lower fare. Although seas were 9 to 11 feet in the Gulf Stream, the ride was quite smooth for the most part. We arrived at the dock in Freeport at 6 PM and waited about a half an hour on board while the baggage was unloaded. Customs was a snap and our taxi arrived at the apartment complex at about 7:30 PM.

Since it was already dark, we would have to wait until the next morning to erect antennas. We unpacked, had a leisurely meal of Lipton flavored rice (this really was a budget operation!) and got to sleep fairly early. I became impatient, though, and strung a wire around the bedroom to listen on 30 meters with my K2. Having come from western South Dakota, just outside the northern propagation hole, I spent several hours marveling at how many nice sounding European stations there were on the band. It seemed to me like a 30 meter propagation paradise.

Wednesday morning we first set up our stations in the control room beneath the tower. The building had been used only for storage for several years, so it was necessary to clear space for our equipment. My station consisted of my Elecraft K2/100 driving an Ameritron AL-500M. I also had an MFJ 901B tuner to cover the WARC bands for pre-contest operation. Bob's station was an ICOM IC-706MKII and AL-811H. During the packing, he had left his LDG AT-11 autotuner behind, but the AL-811H's pi-network did a good job of matching the 80 meter dipole on most bands.

Now we were ready to tackle the antennas. I had measured out a 160 meter dipole and constructed a coaxial balun on 4 inch PVC tubing to feed it. This antenna went up first at about 110 feet. It was originally planned to be near the top of the 160 foot tower, but that morning began with a very stiff breeze. By the time Bob reached the 110 foot level, the unguyed tower had quite a bit of sway! Next, Bob's 80 meter dipole was secured at the 80 foot level with another coaxial balun, this one just an air-wound coil of coax. I tied out the ends of the dipoles (160 meter ran roughly east to west, 80 meter ran north to south) while Bob ran the RG-58 down the sides of the tower. All antennas but one leg of Bob's 80 meter dipole were contained on the property while that leg crossed the road to a vacant lot. My 160 meter dipole needed about a foot trimmed from each end. Pretty darn close, all things considered. Normally I would not have been concerned at all about the slight improvement in SWR, but the ALS-500M is very particular about SWR, and quickly reduces power above a 1:1 match. I wanted to be able to run the full maximum of 250 W allowed at C6A.

Bob's 80 meter dipole, which had been used for four years on the roof of the Bell Channel Inn, came up electrically short. He had never had the antenna so high. Bob found a three foot length of telephone cable lying on the shack floor adjacent to very dead small lizard, spliced it into one end, and obtained a perfect 1:1 SWR just above the band edge. At that point, we took a break from the antenna work and spent the rest of the day making QSOs. I was on 30 meters and Bob was on RTTY. Kevin's 3 element 10 meter Yagi (borrowed from N4GM) went up the next day. Although the beam was to go up only fifty feet, it turned out to be the toughest to erect. Bob found a wood dowel beneath the tower about twice as long as the boom and U-bolted it to the boom. I held it away from the tower with a piece of nylon string while Bob hoisted it up to its final position. The trick was to get the free end of the dowel through the tower, and it was finally clamped to the tower with the beam reasonably horizontal and facing 320 degrees.

For the next two days we played radio. In some ways this is more fun than the contest proper. We avoided making CW stateside contacts on 10/80/160 so as to maximize our score during the weekend. Bob did get on 80 meters on two nights, but only worked N4GM stateside with the other 80 plus QSOs being mostly Europeans. Bob also made just over 100 RTTY contacts, again mostly EU. Bob became very frustrated at times. It seems that RTTY is nearly impossible from C6A. The European operators don't seem to understand that the computer cannot copy ten signals all the same strength on the same frequency. He would pick up a prefix, struggle through the QRM, pick up a letter or two of the suffix, and then sometimes pull out a complete call. The rest of the pack would simply not wait, even after a complete call was pulled out! Working split helped to some extent, but the Europeans were very adept at finding where he was listening and again endlessly threw in their calls even when asked by Bob over and over not to. Several times, he gave up in disgust and went back to CW, where at least his brain was able to distinguish calls. A summary of our ARRL DX CW contest activity follows:

C6AKQ/N4BP (SB80): 1456 Qs and 59 Mults for 257,535 points (new world record!).

C6ALK/K7RE (SB160): 858 Qs and 57 Mults for 146,718 points (new world record!).

C6APG/K4PG (SB10): 604 Qs and 56 Mults for 100,968 points.

All in all, it was a very successful operation, laying to rest our nervousness at trying a complete departure from our previous four years. The K2 DSP option really helped on many noisy QSOs on 160 meters. I have used other DSPs in the past, but this one was far better than any others that I have tried, especially from the noise reduction standpoint. Murphy didn't seem willing to attack our little mini DXpedition this time out.

We are already discussing plans for next year. We have our own records to break, and maybe a few more to establish on other bands and modes. Like many who have this contesting thing in their blood, there is no rest for the weary. NCJ

Propagation

Carl Luetzelschwab, K9LA

The WRTC2006 competition will be in Florianopolis, the capital of the Santa Catarina State in southern Brazil, in July 2006.

With that announcement, the fifth WRTC event has been set in motion. Although WRTC2006 is still two years away, let's take a high-level look at what the competitors can expect for propagation in July 2006 from PY5 (28° S latitude, 48° W longitude). We'll do this by dividing it into *Good News* and *Bad News*. We'll start with the Bad News.

Bad News #1—It's no secret that Cycle 23, which started in October 1996 and peaked in April 2000 (with a nice secondary peak in November 2001), is in its decline. Figure 1 shows the predicted progress of Cycle 23.

WRTC2006 will be held pretty much at solar minimum, which should occur in late 2006 or early 2007. Thus our first-pass expectation is that 15 meters and 10 meters might not be too productive.

Bad News #2—If sunspot minimum isn't enough, the ratio of oxygen atoms (good for electron production) to molecular nitrogen and oxygen (good for electron loss) is lower in the summer months. This will give lower MUFs (maximum usable frequencies) in the Northern Hemisphere. This is another problem for propagation to the major contest population areas of North America, Japan, and Europe on 15 meters and 10 meters.

Bad News #3—The short path to Japan skirts the northern auroral zone. Figure 2 shows this.

The short path from PY5 to JA is quite long, too—it's roughly 19,100 km. That won't help the signal strength of the 100 W competitors (assuming no amps are allowed). One might counter this by noting that JA is near the antipode of PY5—the antipode of PY5 is only 900 km south of JA. But realizing that the Earth is not a perfect sphere and that the ionosphere is different along all paths to the antipode suggests that antipodal focusing may not be as big a player as some believe it to be.

I think that's enough Bad News. Now let's look at the good news.

Good News #1—Figure 2 also shows that the short paths to North America and Europe are under 11,000 km (from the fact that the distance from PY5 at the center of Figure 2 to the outer circumference is halfway around the world—20,000 km). More importantly, the short paths shouldn't be affected too much by geomagnetic field activity since they don't get near the northern auroral zone. In North America, the competitors may have more problems with VEs than W/Ks if the geomagnetic field is disturbed.

Good News #2—Speaking of geomagnetic field activity, the quietest time of a solar cycle is around solar minimum. Thus the probability is low that the short path to JA will suffer due to geomagnetic field activity. This also means the short paths to VE might not be too bad, either.

Good News #3—QRN from local thunderstorms shouldn't be too much of a problem for the competitors, since July is winter in the Southern Hemisphere. A look at the worldwide thunderstorm activity map for July in the USAF Handbook of Geophysics confirms this.

Good News #4—With the short path to JA at 19,100 km, it is possible that the long path to JA will offer some openings. Perhaps the long path will be open and the short path will be closed. The competitors will need to consider this likelihood.

Good News #5—The short paths from PY5 to the three major contest population areas (NA, JA, and EU) go through the robust equatorial ionosphere. Even though WRTC2006 will be at solar minimum, the late afternoon and early evening equatorial process of **E x B** electron drift will create tilts in the ionosphere on both sides of the geomagnetic equator with higher-than-normal electron densities in these areas. This will make it possible to launch chordal hops out of PY5 to take advantage of trans-equatorial propagation. This will still require help from a sporadic E-hop or a normal F-hop on the northern end, but at least there's some hope of 15 meter and 10 meter propagation.

Thus with a bit of luck 15 meters and 10 meters may be more productive to NA and EU than expressed in Bad News #1 and #2. For example, the monthly median MUF from PY5 to EU is predicted to be around 30 MHz in July 2006, even though the smoothed sunspot number is very low. That says 10 meters, along with 15 meters, just may turn out to be important players in WRTC2006. The competitors will have to keep an eye on these bands.

All of the above bad news and good news begs the question "Will WRTC2006 from low latitude PY5 at solar minimum be tougher than WRTC2002 from high latitude OH just after solar maximum?" I have my opinion, but for now let's just say "they're going to be different." When WRTC2006 is over, it'll be interesting to compare the competitor's logs from 2002 and 2006.

When you think about it, this is what makes WRTC so interesting for the competitors—the varied conditions. I think a good knowledge of propagation from PY5 will be an important factor in determining the winners.

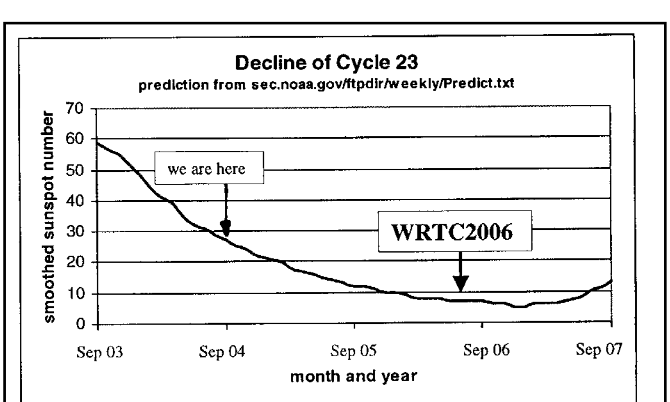
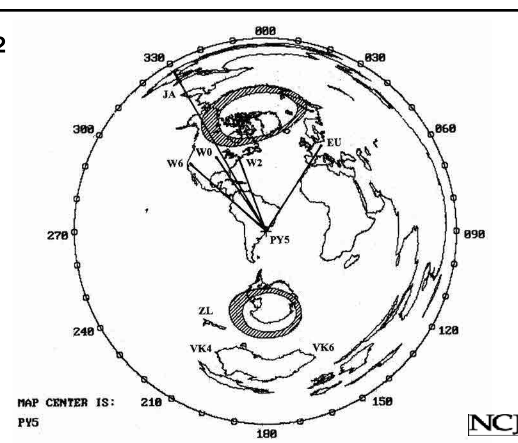


Figure 1

Figure 2



Contest Calendar

Bruce Horn, WA7BNM

Here's the list of major contests of possible interest to North American contesters to help you plan your contesting activity through December 2004. 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 call book address, or via e-mail to **bhorn@hornucopia.com**. Good luck and have fun!

September 2004

All Asian DX Contest, Phone	0000Z, Sep 4 to 2400Z, Sep 5
Russian RTTY WW Contest	0000Z-2400Z, Sep 4
AGCW Straight Key Party	1300Z-1600Z, Sep 4
DARC 10-Meter Digital Contest	1100Z-1700Z, Sep 5
MI-QRP Labor Day CW Sprint	2300Z, Sep 6 to 0300Z, Sep 7
ARS Spartan Sprint	0100Z-0300Z, Sep 7
YLRL Howdy Days	1400Z, Sep 8 to 0200Z, Sep 10
WAE DX Contest, SSB	0000Z, Sep 11 to 2359Z, Sep 12
CIS DX Contest, RTTY	1200Z, Sep 11 to 1200Z, Sep 12
ARRL September VHF QSO Party	1800Z, Sep 11 to 0300Z, Sep 13
North American Sprint, CW	0000Z-0400Z, Sep 12
Tennessee QSO Party	1800Z, Sep 12 to 0100Z, Sep 13
ARCI End of Summer PSK31 Sprint	2000Z-2400Z, Sep 12
ARRL 10 GHz and Up Contest	0600 local – 2400 local, Sep 18 and 0600 local – 2400 local, Sep 19
Scandinavian Activity Contest, CW	1200Z, Sep 18 to 1200Z, Sep 19
Collegiate QSO Party	1200Z, Sep 18 to 0400Z, Sep 19
Med. Islands Award Contest	1200Z, Sep 18 to 1200Z, Sep 19
South Carolina QSO Party	1300Z, Sep 18 to 2100Z, Sep 19
QRP Afield	1500Z, Sep 18 to 0300Z, Sep 19
Washington State Salmon Run	1600Z, Sep 18 to 0700Z, Sep 19 and 1600Z-2400Z, Sep 19
QCWA QSO Party	1800Z, Sep 18 to 1800Z, Sep 19
North American Sprint, SSB	0000Z-0400Z, Sep 19
144 MHz Fall Sprint	1900 local – 2300 local, Sep 20
CQ Worldwide DX Contest, RTTY	0000Z, Sep 25 to 2400Z, Sep 26
Scandinavian Activity Contest, SSB	1200Z, Sep 25 to 1200Z, Sep 26
Texas QSO Party	1400Z, Sep 25 to 0200Z, Sep 26 and 1400Z-2000Z, Sep 26
Alabama QSO Party	1800Z-2400Z, Sep 25
Fall QRP Homebrewer Sprint	0000Z-0400Z, Sep 27
222 MHz Fall Sprint	1900 local – 2300 local, Sep 28

October 2004

TARA PSK Rumble Contest	0000Z-2400Z, Oct 2
Oceania DX Contest, Phone	0800Z, Oct 2 to 0800Z, Oct 3
EU Autumn Sprint, SSB	1500Z-1859Z, Oct 2
California QSO Party	1600Z, Oct 2 to 2200Z, Oct 3
UBA ON Contest, SSB	0600Z-1000Z, Oct 3
RSGB 21/28 MHz Contest, SSB	0700Z-1900Z, Oct 3
ARS Spartan Sprint	0100Z-0300Z, Oct 5
YLRL Anniversary Party, CW	1400Z, Oct 6 to 0200Z, Oct 8
432 MHz Fall Sprint	1900 local – 2300 local, Oct 6
Makrothen RTTY Contest	0000Z-0800Z, Oct 9 and 1600Z-2400Z, Oct 9 and 0800Z-1600Z, Oct 10
Oceania DX Contest, CW	0800Z, Oct 9 to 0800Z, Oct 10
EU Autumn Sprint, CW	1500Z-1859Z, Oct 9
Pennsylvania QSO Party	1600Z, Oct 9 to 0500Z, Oct 10 and 1300Z-2200Z, Oct 10
FISTS Fall Sprint	1700Z-2100Z, Oct 9
North American Sprint, RTTY	0000Z-0400Z, Oct 10
10-10 Int. 10-10 Sprint	0001Z-2359Z, Oct 10
UBA ON Contest, CW	0600Z-1000Z, Oct 10
YLRL Anniversary Contest, SSB	1400Z, Oct 13 to 0200Z, Oct 15
JARTS WW RTTY Contest	0000Z, Oct 16 to 2400Z, Oct 17
Microwave Fall Sprint	0600 local – 1300 local, Oct 16
Worked All Germany Contest	1500Z, Oct 16 to 1459Z, Oct 17
Asia-Pacific Fall Sprint, CW	0000Z-0200Z, Oct 17
RSGB 21/28 MHz Contest, CW	0700Z-1900Z, Oct 17
W/VE Islands QSO Party	1600Z, Oct 23 to 2359Z, Oct 24
FISTS Coast to Coast Contest	0000Z-2400Z, Oct 24
CQ Worldwide DX Contest, SSB	0000Z, Oct 30 to 2400Z, Oct 31
10-10 Int. Fall Contest, CW	0001Z, Oct 30 to 2359Z, Oct 31
ARCI Fall QSO Party	1200Z, Oct 30 to 2400Z, Oct 31

November 2004

ARS Spartan Sprint	0200Z-0400Z, Nov 2
IPARC Contest, CW	0600Z-1000Z, Nov 6 and 1400Z-1800Z, Nov 6
Ukrainian DX Contest	1200Z, Nov 6 to 1200Z, Nov 7
ARRL Sweepstakes Contest, CW	2100Z, Nov 6 to 0300Z, Nov 8
NA Collegiate ARC Championship, CW	2100Z, Nov 6 to 0300Z, Nov 8
IPARC Contest, SSB	0600Z-1000Z, Nov 7 and 1400Z-1800Z, Nov 7
High Speed Club CW Contest	0900Z-1100Z, Nov 7 and 1500Z-1700Z, Nov 7
DARC 10-Meter Digital Contest	1100Z-1700Z, Nov 7
WAE DX Contest, RTTY	0000Z, Nov 13 to 2359Z, Nov 14
JIDX Phone Contest	0700Z, Nov 13 to 1300Z, Nov 14
OK/OM DX Contest, CW	1200Z, Nov 13 to 1200Z, Nov 14
LZ DX Contest	1200Z, Nov 20 to 1200Z, Nov 21
All Austrian 160-Meter Contest	1600Z, Nov 20 to 0700Z, Nov 21
ARRL Sweepstakes Contest, SSB	2100Z, Nov 20 to 0300Z, Nov 22
NA Collegiate ARC Championship, SSB	2100Z, Nov 20 to 0300Z, Nov 22
RSGB 2nd 1.8 MHz Contest, CW	2100Z, Nov 20 to 0100Z, Nov 21
CQ Worldwide DX Contest, CW	0000Z, Nov 27 to 2400Z, Nov 28

December 2004

ARCI Topband Sprint	0000Z-0600Z, Dec 2
ARRL 160-Meter Contest	2200Z, Dec 3 to 1600Z, Dec 5
TARA RTTY Melee	0000Z-2400Z, Dec 4
CIS DX Contest, CW	0000Z-2400Z, Dec 5
ARCI Holiday Spirits Homebrew Sprint	2000Z-2400Z, Dec 5
ARS Spartan Sprint	0200Z-0400Z, Dec 7
ARRL 10-Meter Contest	0000Z, Dec 11 to 2400Z, Dec 12
MDXA PSK DeathMatch	0000Z, Dec 18 to 2400Z, Dec 19
OK DX RTTY Contest	0000Z-2400Z, Dec 18
RAC Winter Contest	0000Z-2400Z, Dec 18
Croatian CW Contest	1400Z, Dec 18 to 1400Z, Dec 19
Stew Perry Topband Challenge	1500Z, Dec 18 to 1500Z, Dec 19
DARC Christmas Contest	0830Z-1059Z, Dec 26

Contest Tips, Tricks & Techniques

By Gary Sutcliffe, W9XT
w9xt@qth.com

There has been a lot of discussion the last few years regarding the aging of contesters and the ham population in general. The ARRL published the results of their 2003 *QST* Reader Survey in the June 2004 *QST*. Compared to the 1991 survey, the average age of ARRL members has gone from 52 to 59 and the average length of being licensed has gone from 18 to 25 years.

This survey was taken from ARRL members, so it may not be a precise picture of the overall ham population. Younger, newly licensed amateurs are probably less likely to be ARRL members than older hams, which would skew the average age to the high end.

W8NF challenged me in my request for material in preparing this column. Dave mentions a 1974 article stating the average age of licensed hams was 61, which would result in a slight lowering of the average age over the last 30 years. He notes that it is difficult to be active in ham radio with children and a career as one reason that the average age is high. Dave does feel that the average age of contesters is on the rise.

Whether the average age of hams and contesters is going up or going down, every one of us will hopefully be contesting well into our senior years, and sooner or later will have adjustments to their contesting due to the effects of age and changing life styles.

Operating Changes

Some operators mentioned a loss of competitive drive after years of contesting. AA4NU says he tends to operate more for the pure sport of contesting. Billy goes on to say that he worries less about what he was unable to get up and running to improve his shot at winning.

Several readers, including K9ZO and W1WEF, mentioned losing the will or ability to operate long contests. KJ9C says after being licensed for 43 years he favors contests of 24 hours, or longer ones if they have forced off-times.

Ted, K1BV, enjoys contests as much as he did when he was younger, but only operates as long as conditions are decent.

K5ZD still operates many contests like he used to, but as he gets older he finds he has less time to operate seriously. Although he can be found working many contests, he now only operates 2-3 contests seriously each year. Randy finds this frustrating, noting, "Contesting doesn't really have much to offer someone who wants to be competitive, but is unable to play for the win."

Now that he is retired, Dan, W8CAR, finds he has more time to operate the radio. Offsetting that, he travels more often, which conflicts with contests he would otherwise operate.

Dan goes on to say that he has less stamina than he used to and is intent on getting in better shape. He has taken up tennis and works out at a gym a few times a week. He is also working on losing some weight. Dan feels this is helping him offset the effects of additional years and plans to be in the game for several more solar cycles.

W8NF uses a large monitor set at low resolution to aid his poor eyesight. Dan is not yet 50, and was born with poor eyesight, but his tip may be useful to those with impaired vision.

Since writing my last column, I had an eye exam and was prescribed reading glasses for close work, a concession to being within a few weeks of hitting the big 5-0 myself. Besides seeing the computer terminal better, I find them very helpful in working on equipment. It is a cruel joke of life that electronic components are getting smaller at the same time my eyes are starting to deteriorate, making it exponentially more difficult to work with tiny parts as time goes by!

Station Changes

After years spent building a station, most readers have commented that their focus has gone or they expect to go from a "build" to a "maintain" mode.

K1BV retired in 2002 and moved to a new home. One compromise he made when setting up his station was settling for a 60-foot tower instead of one 80 feet tall. Ted figures the shorter tower will be easier to climb.

AA4NU suggests modern tools like antenna and terrain-modeling software can help in decisions concerning the best return for added complexity. Essentially with proper attention to details, a smaller, more maintainable system can be as or more effective than a larger, improperly designed system. AA4NU is also a believer in the KISS (Keep It Simple, Stupid) principle.

Although he has been licensed since 1961, K9AY didn't contest for the first 25 years and feels he is still in the learning mode. Gary will soon be building a new house and station. His plans include a single large tower and several smaller ones. The smaller ones will be crank up towers, leaving a single tower that needs climbing. The area inside the shack will be developed for multi-single and multi-two operating for times when he does not want to contest by himself.

Another of Gary's plans is to use a combination of direct buried and buried conduit for coax and control cables. Gary expects this to be more reliable and thus require less maintenance.

With a similar tower plan to K9AY, W8CAR recently poured a base for a 55-foot crank up/tilt-over tower. Two smaller tilt-over towers are in the planning stage. Dan does not want to climb towers in the future.

W7DRA suggests one low-maintenance contest secret. It is called a plane ticket!

Apparently, the youngster of the readers responding to this topic is WM5R who is 31 years old and is still on his first solar cycle with only 8 years experience. Ken looks forward to being financially able to own his own towers and antennas.

Thanks to AA4NU, K1BV, K5ZD, K9AY, K9ZO, W1WEF, W7DRA W8CAR, W8NF and WM5R for their comments on this subject. Thanks also to Carl, K9LA, for suggesting this topic.

Band specialization: Do you specialize in contesting on your favorite band, either at your home station or as part of multi-op efforts? What band is your favorite? What contests and band combinations do you do single band efforts in? What do you like about it and what special tricks apply to your band? Do you change which bands you specialize over the course of a sun spot cycle?

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

Jon K. Jones, NØJK
n0jk@hotmail.com

The 2004 June VHF QSO Party

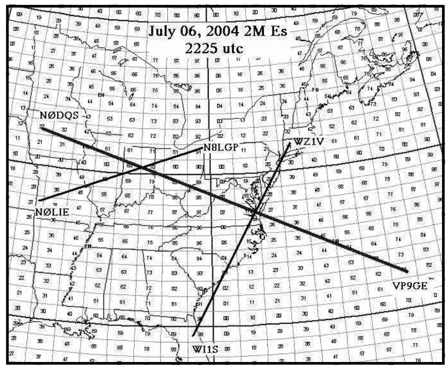
The E_s propagation on 6 meters in the 2004 edition of the ARRL June VHF QSO Party "was good with 300+ Qs and 108 grids, but not as good as last year" reported Jerry, WB9Z. I think Jerry summed it up pretty well—fair to good conditions, but not nearly as good as last year. Maybe we were a little spoiled with the widespread E_s, including 144 and even 222 MHz E_s in the 2003 June contest. In some ways, 2004 reminded me of 2002 (I even operated from the same spot in EM08). Others, such as K1TEO, found the conditions on 6 meters to be "a total disappointment with a total of only 32 E-skip QSOs and 15 grids. I kept waiting and waiting in vain for it to open up!"

I noted some E_s on 6 meters at the start of the contest to W7 for about 30 minutes, and then the band died. Saturday evening the 6-meter band opened for a fair opening to W4, with EM60s, EM70s, EM80s and EM90s coming in pretty well.

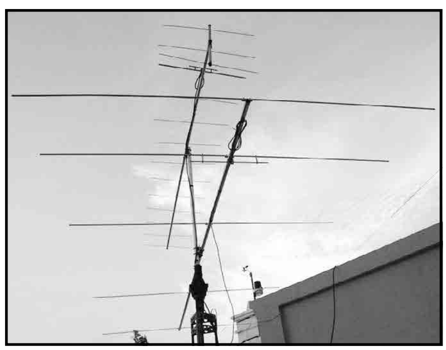
I heard ZF1DC in EK99 in the Cayman Islands several times, but they were weak. Since I was a single-op QRP portable with 10 W and a 2-element Yagi, I did not have much hope of working ZF1DC. ZF1DC is in the "E_s void" at 2,600 km, which is the gap between single and double hop E_s and a difficult distance to work from Kansas on 6 meters. Their signal was weak and fluttery, but I wanted a DX contact with ZF in the log. They finally rolled up on a QSB peak and my persistence along with David's good ears paid off. I put ZF1DC in the log at 0149 UTC June 13.

Scores, for even the top stations, were down considerably from last year. On a relative basis, the stations in Texas, Florida and further south to the Cayman Islands did better than most areas on 6 meters. I have observed this pattern over the years. During down years for E_s, stations located in the southern tier will do better on 6-meter E_s than other parts of the country. This is due in part to E_s occurring more frequently (on a statistical basis) further south.

There is always an exception to the rule. This year it was K8GP in FM08. They posted a 6-meter line score of 902 QSOs and 171 grids! The "Grid Pirates" may have the highest 6-meter score for the June 2004 contest. How did they do it? Great operators, an outstanding high location on Spruce Knob in West Virginia and a quiet operating site helped K8GP make the most of the marginal E_s and scatter openings. I noted K8GP was one of the few stations I heard out of the W3/W8 area, and they had a solid E_s signal on 6 meters. On Saturday evening, K8GP heard my 10 W on the first call and copied my grid information without a repeat. Other big stations seemed to have trouble hearing me. When I finally got their attention it took multiple tries to get my grid across (some never could hear me, and others mangled the grid). If you extrapolate this over the contest, perhaps K8GP was able to work and log more of the little pistol stations than their competition. Another pattern I have observed is that during marginal E_s, the stations heard most often are those running power and located at high elevations.



VP9GE was heard by NØDQS in Iowa on *2 meters* during the big E_s opening July 6.



VP9GE's 6 and 2-meter Yagis.

I contacted Gene, W3ZZ, one of the ops at K8GP, about this and here are some of his comments…

"Spruce is the highest point between Mt Washington in New Hampshire and the VA/NC border, but it is only about 100-400 feet higher than the highest points nearby. Its major advantage is that it is *very* quiet—no ac within 10 miles. No water anywhere at the site, either. It is very remote—the DC area is anywhere from 110 to 150 miles away. That reduces man-made noise and interference, although not from neighbors like W4IY L/M who is less than 15 miles away.

"Spruce has two interesting features. It is large mountain with a summit that is rather flat like a mesa. I would estimate that in all directions we have at least 7-10 wavelengths (120-200 feet) before it starts going down for real. Secondly, Spruce is well known for all the skip you can work on what sounds like a dead band. I call these openings, for want of a better term, "mini-E." This involves one to three stations worked 700-1200 miles away in a given a minute or two, then nothing. These do not sound like scatter; they sound like E_s, but it doesn't last. If you react fast enough you can work a lot of stations this way."

Another reason mentioned by Gene for K8GP's success on 6 meters is their antennas. K8GP uses the 3CI C5 Yagi. It is a K1JX designed antenna—a 5-element Yagi on a 12-foot boom.

"Without question the C5 works better than almost any other antenna with a 12 foot boom. I think Mike Stahl has an antenna of similar size that no doubt is good, but I don't think there is anything better than what we have at K8GP. We have a broad pattern and are able to look in three directions with gain at once—four directions if we have three buses working. I think that is advantageous over long, narrow beamwidths—no matter how well those big Yagis work."

Based on Gene's comments, it is probably similar to using Moxons for 6-meter portable work. A good contest antenna for 6 meters may be one with gain, but a broad pattern. We'll have more discussion from Gene on how K8GP and other top VHF stations set up their successful stations in future columns.

Finally, I had an opportunity to listen to the CQ WPX VHF Contest from Munich, Germany. The 6-meter band was dead, but I confess to spending some time in their famous Bier Gartens, so I may have missed an opening! I heard there were some good openings in the States and I hope you all did well.

NCJ

Software for Contesters

Pete Smith, N4ZR
n4zr@contesting.com

It's always a little awkward, in a new setting, knowing how much to say by way of introducing yourself. So here I am writing a new column for *NCJ*, and I suspect a lot of folks are wondering, "Why him?"

Well, first off, I volunteered. But I've also been kicking around in the world of ham radio computing for a long time. The first piece of software I ever wrote, in about 1983, was a dupe-checking routine for the Timex-Sinclair 1000. Remember those? They had an add-on RAM module that plugged into a port on the back and had a nasty habit of coming loose just after you'd finished programming something, but before you saved it to an audio cassette.

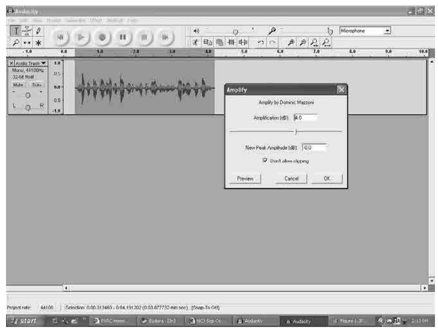
That first effort was followed, in 1985 or so, by a complete contest logger on the RadioShack TRS-80 Model 100, and a year later, by a version for the Commodore 64. Both were fairly unusual for the time because they sent CW as well as performing logging functions. Imagine trying to cram logging, CW, dupe checking and useful multiplier tracking for CQWW into 32K of user memory space.

I sold maybe 100 of *The Contester III*, as it was called, before I called it quits in 1991. *CT* had appeared on the market, and it was clear that the IBM PC platform had advantages that a C-64 could never match. I couldn't afford one of those (imagine!) and that was that.

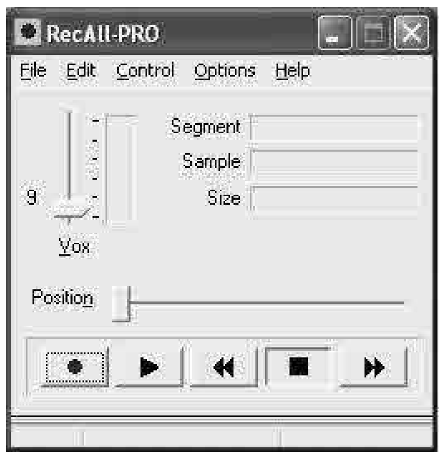
I've stayed interested in ham applications of software ever since, writing a column for the late, lamented *Radiosporting,* as well as occasional articles for *NCJ*, and spending a lot of time exploring software for antenna modeling, propagation prediction and lots of other ham applications. In this column, I hope to feature some of the free and low-cost software that is available out there, and encourage you to see how these programs can bring added convenience, information and just plain fun to your contesting experience.

Audio Recording Software

For this first column, I want to write a little about digital audio recording. Now that inexpensive sound cards abound and are installed in virtually every computer, hardware devices to automate canned CQs and other repetitive messages in contests are almost obsolete. Most logging software includes the capability of recording and playing back voice messages through a sound card. This in turn has introduced us to the annoyance of playing with level controls in the sound card mixer software, trying to get the playback levels of all the canned messages equal and as close to the live voice as possible.



Screen shot of the "Amplify" feature in *Audacity.*



Screen shot of *RecAll.*

Enter *Audacity,* a freeware *Windows* audio editor available from **audacity.sourceforge.net/**. *Audacity* is a classical open-source software project involving a team of developers from the US and Europe, coordinated over the Internet and hosted on Sourceforge. Version 1.2.1 of the software has just been released.

Audacity has many nice features, but what makes it special for our purposes are a few capabilities that I haven't found (at least together) anywhere else. The first is a mixer that is fully integrated into the program; no more jumping back and forth to the cumbersome audio mixer utility that comes with so many sound cards and motherboards. Also included is an audio compressor that can provide a custom-tailored amount of compression while not clipping the audio signal.

The feature that I find the most useful is called, simply, "Amplify." Found on the Tools menu, it lets you easily and quickly modify all of your voice messages to exactly the same peak level, all without clipping. This way, you can retain the dynamic range of your recordings (not bringing up white noise or hum in quiet periods, as compression can) and yet provide exactly the same peak level of audio drive to your transceiver, whether the recording is a long CQ or a quick "5905."

The second piece of audio recording software this month is *RecAll*, from Sagebrush Software (**www.sagebrush.com/recall.htm**). This one is not free—it costs $14.95—but a 30-day full-capability free trial is available. I often used *RecAll* to record contests when I was using a *DOS* contest program that didn't have built-in recording capability. I should add that it probably won't work well to run *RecAll* on the same computer with a *DOS* contest logger, even when the logger is running in a *Windows DOS* window, because those programs don't tend to time-share well. Test first!

There are a couple of neat things about *RecAll*. First, it has a VOX capability with an adjustable threshold, so that you can be sure that it doesn't just sit there, filling up endless megabytes of disk space with silence if you are recording something off the air and forget to turn *RecAll* off along with your radio. A screenshot of the program illustrates how tiny and simple the user interface is, but there's a surprising amount of power behind that simple façade. For example, the sound card mixer is available from the Options menu, and a wide range of recording rates and options are available so that you can tailor the size and quality of your recordings to meet your needs—for example, to record an entire 48-hour contest in a file that will fit in one CD.

On playback another very useful feature is available. *RecAll's* files incorporate a time-stamp. You can use the slider to find the right approximate section of the recording that you want to listen to, and then use the fast forward and rewind buttons, with and without the shift key, to move forward and backward a minute or a second, respectively. Using this facility, I found it easy to locate a given QSO in a 48-hour CQWW recording. You do have to make the mental conversion from UTC, unless your logging computer is set on UTC rather than your local time, because *RecAll* only knows about the time on the computer. NCJ

NCJ Snapshots

Trey N5KO Elected to the CQ Contest Hall of Fame

Trey N5KO was inducted into the CQ Contest Hall of Fame at the Dayton Dinner this year. Trey is a former NCJ Editor (September/October 1993 through November/December 1994 under his previous call WN4KKN). Ramon, XE1KK provided a copy of the nomination to NCJ, and here it is. Congratulations, Trey!

March 9, 2004

Mr. Bob Cox, K3EST
CQ Hall of Fame
k3est@cqww.com

Dear Bob,

This is a Latin-American multinational nomination of Trey Garlough, N5KO/HC8N, for CQ Contesting Hall of Fame.

He is a life member of the American Radio Relay League, member of Quito Radio Club and Northern California Contest Club and founding member of the Boring Amateur Radio Club and Galapagos Radio Sociedad.

A ham radio Internet pioneer, he was the creator of many Internet mailing lists including CQ-Contest@Contesting.com and 3830@Contesting.com. He was also a founding member of Contesting.com and eHam.net web sites. Trey continues to provide web hosting, Internet mailing list services and technical guidance to scores of amateur radio contesting and public service organizations.

He is a former Editor (1993-1994) and CW Sprint Editor (1989-1993) of the National Contest Journal, and was a Team World (1966) and Team USA (2002) selection to the World Radiosport Team Championship.

He unselfishly has given his time to some less notorious activities that still have an impact on the way we contest today, as he was the leader of the collaboration between contest sponsors and logging program authors that resulted in the creation and adoption of the Cabrillo Format. N5KO also has been a key contributor in the conversion from paper log to electronic log processing for numerous contests, including all ARRL and CQ events.

As an operator, he won the 1976 ARRL Novice Roundup, was USA National champion (CW Sweepstakes) three consecutive years (Top Ten 10 times) and has placed in the Top 10 of the CW Sprint 15 times.

He has placed in the Top Ten single op all band in CQWW CW nine times from the southern hemisphere. This includes his overall victory in 1999, which was notable in the following respects: 1. world record, 2. only CW world champion from southern hemisphere in past 30+ years, 3. only CW world champion from Pacific Ocean in past 30+ years, 4. first single op to achieve 7000 QSOs in a 48-hour CW contest.

As an operator, N5KO has achieved 15 World #1 results in CQWW (nine world records) and 10 World #1 results in WPX (eight world records), many of them as multioperator with new and experienced contesters.

Trey is not an American coming south looking only for QSOs; he is a man who learned how to speak our language because of radio, an amicable competitor, a colleague always willing to share, a patient Elmer and above all a good friend.

In many ways, he is one of us and this is why the Latin-American contesters and DXers present Senor Trey Garlough to the CQ Contesting Hall of Fame.

Arturo Gargarella, LU6ETB; Atilano Oms, PY5EG; Ramon Santoyo V., XE1KK; Radio Club Quilmes; Araucaria DX Group.

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The N8NR Contest Station Near Greenville, Ohio

N8NR is truly out in the middle of nowhere in rural Ohio. That usually means a quiet location–except when a distant noise source starts up, which requires an effort to track it down.

Bob has three tall towers, as seen in the accompanying photo. The tower in the middle sports stacked monobanders for 20 and 15 meters, with the top ones rotatable and the lower ones fixed on Europe.

The left-most tower has a rotatable 2-element 40-meter Yagi and a 5-element 10 meter Yagi. Lower on the tower are two 5-element 10-meter monobanders fixed on Europe. The right-most tower has a Mosley multibander and VHF antennas.

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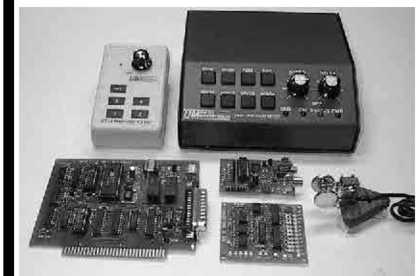

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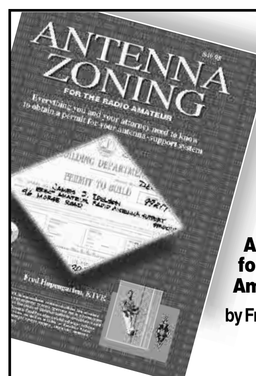

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by Fred Hopengarten, K1VR

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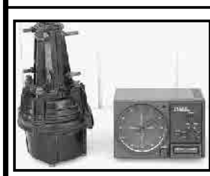

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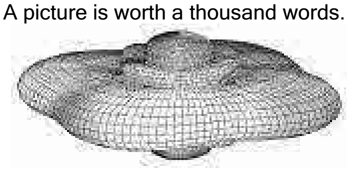

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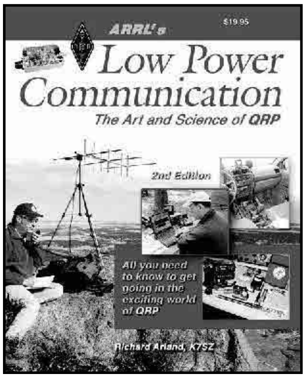

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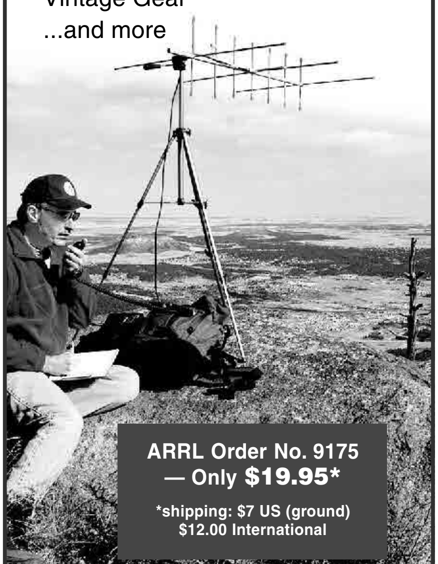

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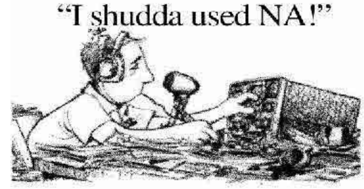

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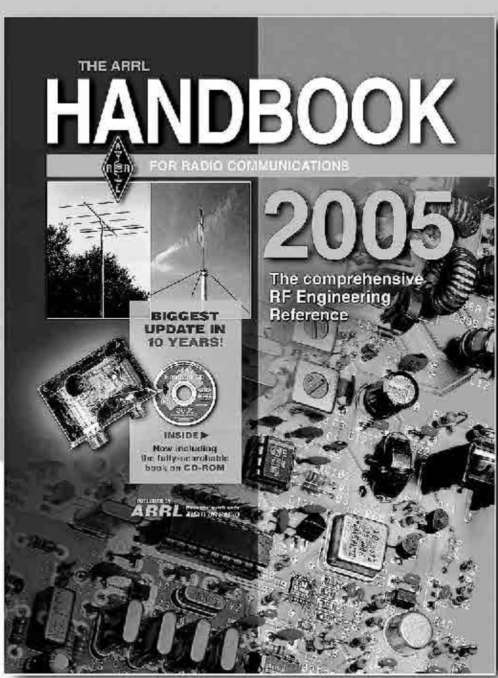

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Triple Band Stack Registers Memorizes the last 3 used frequencies – quick recall for band hopping, provides the ultimate in multi-mode flexibility.

DUAL RECEIVER CONTROLS

Digital Voice Recorder Controls Simple record and play controls for the internal DVR. Great for quick recording and playback of a call, great for reducing the number of broken calls in your log.

Dual VFO Tuning Knobs Independent tuning knobs for each receiver. There's no mistake about which receiver you are adjusting, as the size difference allows for "no-look" operation!

DUAL RECEIVER CONTROLS

Gentlemen, start your engines. *All four of them!*

Power your way to front of the pack with Icom's new IC-7800. Cutting edge digital meets the best of world class analog, resulting in an amazing 110dB of receiver dynamic range and a *+40dBm IP3 in the HF bands!* But that's not all. The '7800 has two identical, independent receiver circuits. Receive two different bands simultaneously on different antennas, with no adverse effects from one receiver to the other – take your band hopping and contesting to the next level! There are four 32-bit floating point DSP units with 24-bit AD/DA converters, one each for the main RX, second RX, TX, and spectrum scope, to accelerate data processing to whiplash speeds! Newly designed power amplifiers provide a powerful 200W of output power at full duty cycle and low transmit IMD. So what are you waiting for? Make your move. See your authorized Icom dealer!

Dual Receive Controls Separate key receiver controls are available for each receiver. Controls for volume, RF gain, and DSP controls, the '7800 also has independent controls for the Digital Twin PassBand tuning as well as the 70 dB Manual Notch filters. Whether in a contest, or just hopping around the bands, easy access to receiver controls such as volume, RF gain, and AGC adjustments are at your fingertips.

Dual Digital Twin PassBand Tuning Only Icom brings you Digital Twin PassBand tuning. Adjustments can be made for each receiver without affecting the other receiver.

Independent Digi-Sel Controls Incorporated into the IC-7800 is a newly designed digital pre-selector, with separate controls for each receiver.

Independent Auto Tune Automatically zero beat your CW or AM carrier signals. The '7800 makes sure you're right on the proper frequency for these modes. Each receiver has a separate control.

Independent AGC Settings Multiple AGC settings for each receiver. On-the-fly adjustment for either preset AGC settings, or a completely variable AGC control.

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