digital connection

BY DON ROTOLO,* N2IRZ

Introducing "RSQ" Digital Signal Reports

I often marvel at the signal reports given, especially during contests. Everyone is 59 or 599, even if there is obvious difficulty in copying the other station. This is not meant as a disparaging comment about contesters. QSO rate is critical, so they don't really have the time to carefully measure the other station's signal and then give (and record) an accurate report. However, in casual ragchews an accurate signal report can be helpful to the other ham's understanding of his/her own station's performance. Those of you who have worked me know that I tend to give out honest signal reports, and rarely are stations really 59 at my receiver.

On PSK 31, however, I do not actually listen to the signal. Not only does it drive my family crazy (remember, I'm in the middle of the family room here), I really don't get any useful information out if it. RST (Readability, Strength, Tone) reports have little or no meaning here, so other than a careful reading of IMD, how can we let the other station know how well he is doing? We could tell him that he has hot audio, but how does one code that onto a QSL card?

The answer is given by a team of hams who wrote an article for Australia's *Amateur Radio* magazine last August. *CQ*'s eagle-eye editor, W2VU, who reads even more voraciously than I do (a feat indeed), saw that article, which describes a new method of reporting signals in the PSK31 world—RSQ.

The following discussion is based entirely upon that article, which was published under Graeme Harris, VK3BGH's byline, with acknowledgement given to the rest of the team (Bob, K6MBY, Ian, GM4KLN, and Milton, W8NUE). My goal in passing along this information is to encourage the RSQ system's adoption and use in the PSK31 world.

RSQ stands for Readability, Strength, Quality, and the method discussed offers specific scales and standards for each number, as shown in Table I. Of course, the scale is somewhat subjective, but nonetheless we can start giving out much more meaningful reports if we use this sensible method.

Readability is the percentage of text that is properly decoded. 100% is easy to recognize, but remember that we can still understand a message even if a large number of characters are missing. *Strength* is a visual measure of the strength of the waterfall trace. I don't find my radio's S-meter to be particularly useful, especially in the presence of multiple signals in the passband, while the system sensitivity (and therefore relative brightness of displayed traces) is fairly constant. *Quality* is a measure of the number of visible sidebands to the main signal. I want to emphasize that the goal is *no sidebands at all!*

*P.O. Box 114, Park Ridge, NJ 07656
e-mail: <n2irz@cq-amateur-radio.com>

As with the accurate use of RS and RST reports, if RSQ reports are consistently used and become a natural part of most PSK31 QSOs, we all will benefit. PSK31 and its related cousins are ultra-low bandwidth modes, allowing dozens of QSOs in a very small slice of spectrum. Amateurs have always prided themselves on their ability to understand and seek the best possible technical performance from their stations. A well-adjusted station (technically, not psychologically) doesn't occupy more spectrum than necessary, allowing others to enjoy the great natural resource of radio as well. Your signal also goes farther on less power— the RF in those sidebands is absolutely wasted—and maybe that will give you the edge in your next QSO with that rare one.

I hope to have the privilege of activating WW2CQ/62 on 40-meter PSK31 around the time you'll be reading this, and you absolutely can expect to receive an accurate RSQ report from me. Come on out, get on the air, and have some fun watching me type in real time!

For more information on the RSQ system, visit <http://www.psb-info.net>.

How's Your Signal?

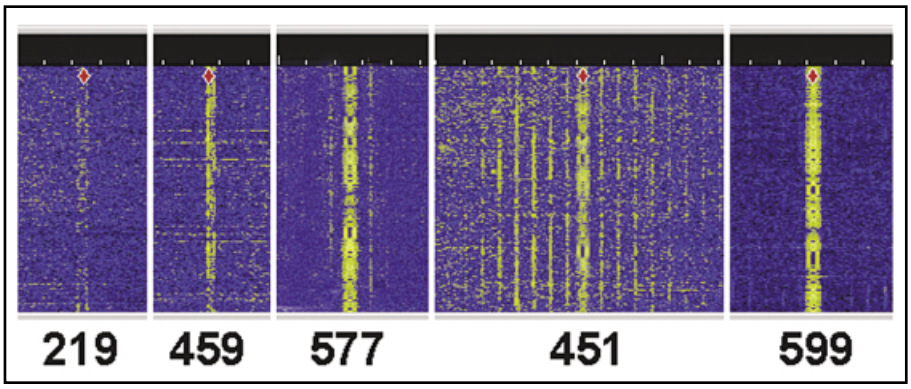
Are you sending a good, clean signal? That's been a fair question for radio amateurs since the days of spark. We all know that a properly adjusted transmitter produces a spectrally clean signal, which also happens to sound quite good to the ears. An overdriven transmitter, whether at audio or RF, produces distortion and unnecessarily widens the transmitted signal, causing interference to others on the band while making for a less understandable signal.

These issues apply to all types of transmission—FM, AM, SSB, and even CW. Overdriving is not the only possible problem, of course (CW has its key clicks and phone can have hum), but it's sadly one of the more common ones. In the digital world we tend to see fewer problems, since many digital modes strongly depend upon a lack of distortion for good performance.

Pushing the Limits

Has anyone ever tried to make a VHF packet connection with "hot" audio, hitting up against the radio's deviation limiter? You can decode the other stations just fine, but they never acknowledge your transmissions. Listening on another receiver, it sounds like a harsh static burst instead of an almost musical "braaap." The point is that most digital modes are not tolerant of distortion, so if you want to get it working, you have to adjust your transmit chain properly.

Some of the more modern modes, designed to be extraordinarily robust in the relatively noisy HF



Five different PSK31 signals on the air, as seen on the waterfall display of DigiPan 1.6d. Note the RSQ reports I added beneath each of the signals, and how the Readability can be high even if the Strength is low, and Quality should be (and usually is) high. It took quite a bot of searching to find those two low-quality signals!

The K4ABT RASCAL sound-card interface. It is an inexpensive and relatively simple device, using good isolation transformers and ferrite beads to avoid feedback issues. Note the transmit audio level adjustment potentiometer inside the small hole. For more information, go to <www.packetradio.com>.

radio environment, are much more forgiving of distortion. As the science of digital communications advances, the developers of new protocols for HF often try to enhance the ability of their protocol to survive the vagaries of the HF communications channel, while maintaining throughput and spectral efficiency. This means that on a good HF channel, your transmitted signal can be downright *awful* and still be understood at the other end. However, that's no excuse for a dirty signal.

When I operate, I generally use a digital keyboard mode. My station is located at the computer in the family room, so if I were to operate phone, I'd be disturbing the rest of the family. If you hang out around 7075 kHz long enough—say, an hour when the band is open—you'll come across PSK31 signals that look like a freshly plowed farm field (lots and lots of little parallel grooves stretching off to the distance). Those sidebands—often only one set, and sometimes dozens—are distortion, pure (impure?) and simple. The cause is a too high setting of the transmit audio.

Even with such significant overmodulation, splattering across kilohertz of spectrum for a 31-Hz wide signal, it's rarely a problem to decode the signal. As far as the fellow at the transmitting end is concerned, he (or she) is able to both send and receive, and so he does not know there is anything wrong with his signal *unless someone tells him!*

For some folks, though, telling another operator that there is something wrong with his signal is a daunting task. First, you have to try to avoid judging the other operator, sounding accusatory, or saying anything that will put him on the defensive. Some folks are happy when you let them know "their breath stinks," while others take great offense. I try to first engage them in a QSO—making the contact after their current QSO is over—and once we're "talking," I casually mention that their output audio is "hot." Then I ask how mine looks, and suggest that maybe we can try adjusting it.

Assuming they don't immediately terminate the QSO, or otherwise indicate hostility, I then try to explain how simple the adjustment is, how exactly to do it, and get them to try turning it down a bit. Some folks literally do not want to hear it and others have a hard time understanding even simple directions, but the majority end up making the simple adjustment and cleaning up their signal tremendously.

Simple Adjustments

This is what I often tell the other operator when it comes time to adjust the transmitter drive: If you are using DigiPan software, the adjustment is accessed through the Configure/Transmitter Drive menu. If you are using some other software, you can either read the setup instructions, or just open up the advanced volume controls by double-clicking the little speaker icon in the system tray (this applies to Windows®, of course. I don't know the equivalent setup on a Mac, but I cannot imagine it being much different). Many sound-card interface adapters, such as the K4ABT RASCAL I'm using, also have an adjustment potentiometer on them, which you can use instead.

Simply adjust the Wave output slider down. If I see a lot of sidebands, I tell them to drop it by half of what they have set it to, or more; otherwise I recommend dropping it by one-fourth. Once they have reached the one-third point on the wave slider, I ask them to go to the master volume slider instead. If possible, you don't want any of the controls very close to their upper or lower limits, since adjustments tend to get touchy there.

In DigiPan there is a little number at the bottom of the screen which gives the IMD (inter-modulation distortion) measurement. A measurement of –25 dB or

lower is considered excellent, and anything in the –22 dB or lower range is probably fine. On the other hand, valid IMD readings in the teens or single digits indicate a serious problem. However, this measurement isn't always a reliable indicator of the other station's transmit performance, since you have to be aware of the conditions under which this measurement is valid.

First, you have to be measuring an unmodulated (idle) carrier. Measurements taken while the other station is sending data are meaningless (and DigiPan doesn't even display them). Second, the receive audio chain in your station needs to be properly and carefully adjusted to avoid errors caused by the IMD performance of the receiver. You are measuring the first pair of sidebands as compared to the desired signal, so signals that are weak will cause you to measure more noise than expected, making for erroneous readings. That means you need a good, strong signal (but not overloading) to measure. Then adjust the receiver's RF gain down until IMD just starts to rise instead of fall. At that point, much of the receiver's IMD has been adjusted out, leaving a reasonably accurate measurement of the other station's signal. Note that readjustment is necessary for each signal measured.

Technology on the Move

In last December's column, I mentioned that I would also be reporting on some tests performed by Rick Muething, KN6KB, on the performance and efficiency of some HF modes. Rick undertook these measurements as part of his presentation at the ARRL/TAPR Digital Communications Conference last September in Des Moines, Iowa. His paper describes these measurements in the context of a new digital HF mode called SCAMP, which he and others were developing.

The reason for developing SCAMP (Sound Card Amateur Message Protocol) is to create an alternative to relatively expensive PacTOR equipment. WinLink 2000 requires an error-free data mode for transporting data over HF, and right now PacTOR is about the best there is. SCAMP incorporates many of the features of PacTOR, with the result that a similar spectral efficiency and data throughput on real HF channels is seen. Testing is well under way, with the first transcontinental QSO occurring on December 4, 2004 as reported at <http://www.arrl.org/news/stories/2004/12/07/6/?nc=1>.

Since I'm out of space for this month, I won't be presenting Rick's findings. The topic of PSK signal quality is simply too important to shortchange. In the near future I promise to cover the new SCAMP mode in detail, once it becomes available outside the beta-testing team.

Also, last November I participated in a conference call with some of the folks from SkyPilot Network Inc. about their unique and exciting deployment of WiFi (802.11) technology to create what is essentially a Wide-Area Network (WAN), much like what packet was in the early 1990s—except at megabit speeds. This technology could be exactly what the HSMM folks are looking for. The equipment is quite inexpensive for commercial gear and could easily be afforded by larger clubs. However, for the rest of us, I see some potential for hams to re-use what we already know and have to replicate the system, perhaps even making interoperable equipment, to build what we've all been waiting for. I'll go into more details of the system in a future column, but for now, visit <www.skypilot.com>.

Readability (% of text)

R5	95%+	Perfectly readable
R4	80%	Practically no difficulty, occasional missed characters
R3	40%	Considerable difficulty, many missed characters
R2	20%	Occasional words distinguishable
R1	0%	Undecipherable

Strength

S9	Very strong trace
S7	Strong trace
S5	Moderate trace
S3	Weak trace
S1	Barely perceptible trace

Quality

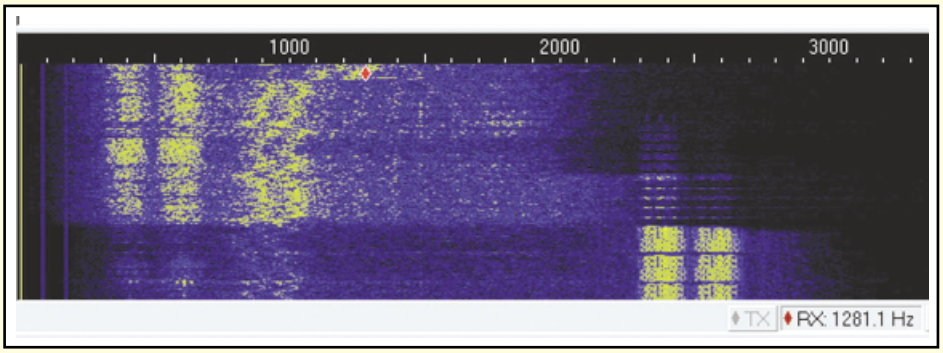
Q9	Clean signal, no visible sidebar pairs
Q7	One barely visible pair
Q5	One easily visible pair
Q3	Multiple visible pairs
Q1	Splatter over much of the spectrum

Table I– RSQ standards.

It's a good feeling to have more ideas to write about than I have column space, but I still want to hear from you, the readers. I find that receiving a letter or e-mail from a reader is the highlight of my day, and especially so when someone tells me about an idea for a column he or she would like to see. While I try to cover topics varied enough to interest at least a fair number of the readership, perhaps there's a favorite topic you haven't seen covered yet. Let me know. Until next time . . .

73, Don, N2IRZ

Interference, AGC and IF Shift



In my December column I mentioned how many have experienced "interference" from a PacTOR robot coming up on or near a PSK31 QSO, wiping it out. Bill Gerth, W4RK, the Emergency Coordinator for the Wil-liamson County (TN) ARES, wrote to mention that the WinLink 2000 PacTOR frequencies are chosen to avoid the PSK segments, and reminded me of something I had forgotten to mention—IF shift. Whenever a relatively loud (or wideband) signal comes up in the radio's passband, the Automatic Gain Control (AGC) will decrease the receiver gain to avoid overload. This causes any less powerful signals to fade into the noise, possibly disrupting a QSO. The simple solution is to either use your IF shift to put the loud signal outside the passband, or tune the radio for the same effect, thus eliminating the AGC compression. The accompanying picture shows what happened when I shifted the IF passband down in frequency to eliminate the loud signal at the right. See how the signals to the left just pop out of the noise? The vertical scale is about 30 seconds.