

RSQ - An Improved Signal Reporting System for PSK

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Narrow band digital modes have become more popular on the HF bands in recent years and have seen an increase in more casual keyboard style QSO's. Today, PSK31 leads the way with keyboard chatting, RTTY remains popular, and an increasing number of other PC sound card based digital modes are seen on the bands. This article suggests that Readability, Signal Strength and Tone (RST) no longer provides a meaningful signal report for these newer modes and is particularly unsatisfactory for PSK. An improved signal reporting process is now needed to keep pace with the evolving digital revolution in Amateur radio, and the popular PSK modes are seen to provide an opportunity to springboard a change.

"Your report is 5 and 9 OM - please repeat name and QTH" !!

There seems little value in receiving a 59 or 599 report when the other station is obviously struggling to hear you. Despite the lack of meaning in such reports for SSB and CW, a further situation exists for PSK where the traditional RST format is clearly inadequate to describe the error content of received text, signal strength on a busy band, or quality of the actual transmission itself. A particularly unhelpful aspect is where operators with poor quality transmissions receive T9 reports as a matter of course even though their signals are broad and distorted with the potential to QRM adjacent QSO's.

So what really constitutes a readability of 3, 4 or 5 for PSK text decoding on your screen? How do you interpret signal strength when there are several other signals within your passband or when a local station has pinned your S meter? And what is a meaningful and reliable measure for the quality of a transmitted PSK signal? These are the questions that have been the basis of most debate since PSK31 was introduced in 1998. Various solutions have been proposed but unfortunately none have produced any serious new direction for change.

Late 2002, a small group of operators decided to propose a new signal reporting system for PSK and assemble a website in support of its implementation. "PSB" (Print, Strength, Bandwidth) reporting was developed, advertised and used on-air by the development team, during which time it also underwent peer review via a list of dedicated mailing subscribers and the PSK31 group site at Yahoo.

"RSQ" (Readability, Strength, Quality) is a subsequent development of the PSB system. It provides the same improved reporting outcome as PSB and uses terminology more closely aligned to that of traditional RST.

Just as RST describes the **tone** of a CW signal in terms of the presence of unwanted modulation heard as *hum, key clicks, chirping* etc, so RSQ describes the **quality** of a PSK signal in terms of the presence of unwanted modulation observed as additional *unwanted sidebands*. This is the most significant departure of RSQ from traditional RST.

RSQ Reporting Table

Readability is the percentage of decipherable text.

Strength is a visual measure of the waterfall trace.

Quality attempts to describe visible unwanted sidebands.

READABILITY		
R5	95%+	Perfectly readable
R4	80%	Practically no difficulty
R3	40%	Considerable difficulty
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 unwanted sideband pairs
Q7	One barely visible pair
Q5	One easily visible pair
Q3	Multiple visible pairs
Q1	Splatter over much of the spectrum

S meters measure the average strength of all signals in the receiver passband. So for regular situations where multiple signals are present, and narrow band IF filtering is not applied, then a visual measure of waterfall trace or spectrum amplitude is more meaningful for the strength of the decoding signal.

When viewing the quality of very strong signal traces, well-suppressed additional sidebands may be seen above the noise floor. In this case, an inter-modulation distortion (IMD) reading may assist in determining their status. If the IMD reading is about -25db or better, then any additional sidebands can be assumed as below the interference threshold, disregarded, and a Q9 report given. If the IMD reading is about -20db or worse, then the additional sideband modulation is undesirable, may cause interference to other stations, and an appropriate value from the quality table can be applied to the report.

PSK software usually provides the facility to measure IMD, however many operators are unaware of the limitations of its practical use. The measurement of very strong signal IMD mentioned above is reliable providing the measurement is taken when the signal is at idle as occurs during a pause at the keyboard or during the brief tail at the end of each PSK transmission – and even then, only after careful adjustment of receiver gain settings.

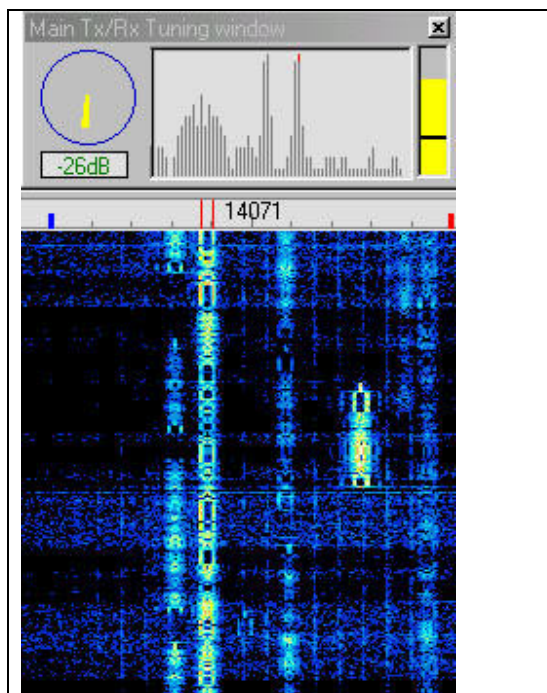
It is therefore suggested that IMD readings only be given to the other operator when requested, and then only as a supplementary report. The following explanation is given by Howard (Skip) Teller KH6TY who developed the first panoramic PSK31 transceiver and Digipan software: *"IMD is the measurement of the first pair of unwanted sidebands to the desired ones, and if the signal to noise ratio is not around 26 db, you will start to measure the noise instead of the unwanted sidebands, which will be under the noise threshold. Also, if there is any distortion in the receiver, you create a false IMD reading. Whenever I measure a station's IMD, I have to be sure the S/N is good, and then I reduce the RF gain of my transceiver until the IMD stops falling and starts rising. At this point, I believe I have almost eliminated IMD caused by the receiver distorting the signal"*.

Good quality BPSK31 transmission

The image below shows a range of signals, with the chosen signal highlighted by the two parallel lines at the top center of the waterfall display. The clean profile of this signal is evident from the display.

This trace would rate a **Q9** report according to the RSQ reporting table.

There are a total of 6 traces to be seen in this waterfall display with some only just visible, and most occupying the normal bandwidth of approx 60hz. However, the short trace to the centre-right is starting to exhibit an additional unwanted sideband pair.



Poor quality transmission

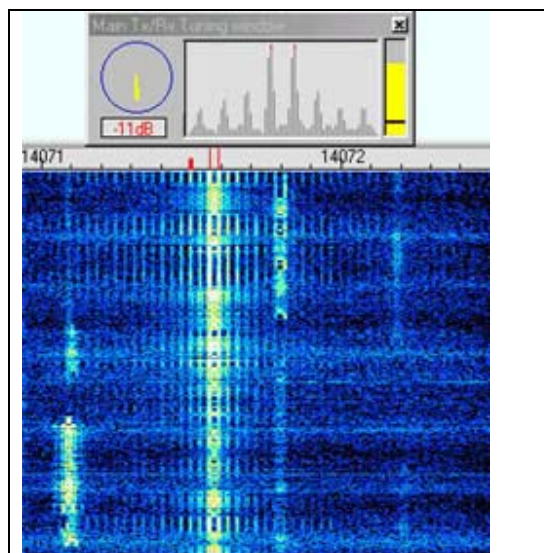
This image demonstrates a bad signal, unfortunately all too commonly seen! The signal is generating multiple sidebands, taking up more bandwidth than necessary, and causing interference to fellow amateurs.

The spectrum display clearly shows the multiple signals emitting from this station.

This trace would rate a **Q1** report.

There are 4 traces in this display and the traces on either side of the poor signal are being subjected to its multiple sideband QRM.

Any DX traces within 100 to 200hz of the poor signal would be difficult to decode and the gross distortion of this signal would also be quite audible.



Further information about the RSQ scheme can be found at the <http://www.psb-info.net/> website which also outlines the original PSB report and supporting information. Here you will find a station setup checklist to assist operators to achieve a clean PSK signal and a PSK31 signal modeling treatment as a basis for that checklist. Colour screen shots and audio clips of a range of signal traces of differing quality are also provided for reference.

Since PSK IMD readings are difficult to reliably measure at the receiving end, a simple test bed has been described to allow operators to measure the IMD and bandwidth of their own transmitted signals. There are also pages for News, Future Plans and links to information on digital mode sound card interfaces and related topics.

The website was revised November 2003 to make the reporting process independent of the PSK baud rate and to introduce the new RSQ development. Operators have the option to mention the site URL for reference and further information when providing RSQ reports.

The format of the 3 data elements of an RSQ report continue to satisfy the traditional RST requirements for manual and computer logs, QSL cards and PSK software. RSQ is not recommended however for chasing elusive DX or regular contesting until wider acceptance is achieved.

RSQ can improve the value of PSK signal reports and help reduce excessive bandwidth and distortion. The reporting process is intuitive and provides more useful information for stations wishing to better understand the overall status of their signal.

This article has described RSQ as an attempt to improve signal reporting for the various PSK modes, and offers it as an alternative to the traditional RST report. Your comments on this proposal and the best way to promote it would be appreciated. Please provide feedback to <http://www.psb-info.net/Feedback.html>

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