QPSK31 versus BPSK31 on the VK – JA Circuit **August 2002**

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Peter Martinez G3PLX introduced the PC sound card version of BPSK31 in 1998 and this has now become the most popular digital mode on the HF bands. QPSK31 is the FEC version of BPSK31 but little is seen of this mode even though it demonstrates to be significantly superior to BPSK31. The author found himself discussing this curious situation with a regular sched partner Satoru JA1SCW on several occasions recently and this resulted in the conducting of a series of structured tests over a 3-week period. This test data now provides some perspective to the superiority of QPSK as worked over the JA – VK circuit. The results detailed below show that on 20 Meters, QPSK produces significantly fewer errors relative to BPSK as propagation disturbance (QSB flutter) increases. It has similarly been observed to be more robust than BPSK when QRM is present

Station setup:

VK3BGH [Graeme]	JA1SCW [Satoru]
Software: MixW2.06	Software: MixW2.06
PC: HP Omnibook P2, Win 98se	PC: Home-brew Celeron 500 Mhz, Win 98se
Sound Card: 16-bit SB Pro-compatible	Sound Card: SoundBlaster SB-16 (PCI)
Interface: Full isolation Home-brew	Interface: Full isolation Home-brew
TX/RX: Kenwood TS-430S	TX/RX: ICOM IC-756PROII
Antenna: 2 el Hi-Quad 10/15/20 at 50 feet	Antenna: 3 el Yagi 10/15/20 at 40 feet

Test setup:

The MixW2 multimode digital software was used by both stations and provided a QSO logging facility and extensive operating macros. These macros were used to set the mode changes, log the date and time and deliver the transmitted text. The popular RTTY test string - "The quick brown fox…" was used as a 5-line block in BPSK followed immediately by a 5-line block in QPSK – refer Table 1. These 2 text blocks were repeated 3 times in each direction at power levels of 50W, 25W, 10W and 5W. Tests were conducted over a 3-week period where conditions varied from light to heavy propagation disturbance.

Error measurement:

Errors were measured at the word level. Words were considered error free when they were faithfully reproduced, were unbroken by spaces, not run together and without garbage characters appended to them. Additional spaces between words, carriage returns or line feeds were not considered to be word errors for this exercise. See the example of error free word count in the text of Table 2 as received and printed by VK3BGH.

VK3BGH de JA1SCW 17 Jul 2002 13:13:46z
bpsk bp bp bp bp 5 5 5 watts
...
The quick brown fox jumps over a lazy dog.
The quick brown fox jumps over a lazy dog.
The quick brown fox jumps over a lazy dog.
The quick brown fox jumps over a lazy dog.
The quick brown fox jumps over a lazy dog.
...
Changing to qpsk qp qp qp qp
d
VK3BGH de JA1SCW 17 Jul 2002 13:15:05z
qpsk qp qp qp qp 5 5 5 watts
...
The quick brown fox jumps over a lazy dog.
The quick brown fox jumps over a lazy dog.
The quick brown fox jumps over a lazy dog.

The quick brown fox jumps over a lazy dog. The quick brown fox jumps over a lazy dog. ... Changing to bpsk bp bp bp bp VK3BGH (Graeme) de JA1SCW (Satoru) Now back to you to conclude the test tonight BTU VK3BGH de JA1SCW kn
Table: 1 Third sequence of BPSK and QPSK blocks at 5 watts 17.07.02 as sent by JA1SCW

VK3BGH de IA1SCW 17 J 2002 f3:13,46, bpsk bp bp bp bp 5 5 5 tts ... The quick bro- fojumps overa lazydog. Tt e uick brown fox jumps overa lazy dog. i he quick btowi fox 6uhps over a lazy dog The quick own ftx jumps eve a lazy dog. The quick brown fox :umcs over a laoty dog. ... Changing R qpsk qp qp qp qp eV BGH de JA1SCW 17 Jul 2002 13:15:05z qpsk qp qp qp qp 5 5 5 watto ... The quick brown fox jumps over a lazy dog. Th quick brown fox jumps over a lazy dog. The quick brown fox jumpr over a lazy dog. The quick brown fox jumps over a lazy dog. The quick brown fox jumps ove=e lazy aog. r... Changing to bpsk bp bp bp bp ii teTcVK3B z (Graemt e Jf1SCW (Satoru) Now back to yop to co nclude the teuo to neght ,TU VK3BGH de JA1SC kn i a	2 0 5 6 7 7 --- 27 total BP 9 8 8 9 6 --- 40 total QP Q/B ratio =1.48
Table: 2 Text from table 1 above as received and printed 17.07.02 by VK3BGH (Conditions: moderate propagation disturbance)	Error free words

Results:
Tables 3, 4 and 5 indicate the percentage of error free words for BPSK and QPSK as printed by each operator under 3 levels of propagation disturbance. There was not a single test power block where QPSK did not out-perform BPSK. Note the very significant advantage of QPSK under heavy propagation disturbance.

Light propagation disturbance
3rd August 2002

Error Free Words Recorded by VK3BGH		
Xmit Pwr	**BPSK31**	**QPSK31**
50W	96.3%	98.5%
25W	81.5%	88.9%
10W	88.9%	100.0%
5W	77.8%	96.3%
Average	**86.1%**	**95.9%**

Error Free Words Recorded by JA1SCW		
Xmit Pwr	**BPSK31**	**QPSK31**
50W	95.6%	98.5%
25W	89.6%	96.3%
10W	85.9%	99.3%
5W	84.4%	97.8%
Average	**88.9%**	**98.0%**

Table 3

Moderate propagation disturbance
17th July 2002

Error Free Words Recorded by VK3BGH		
Xmit Pwr	**BPSK31**	**QPSK31**
50W	49.6%	86.7%
25W	31.9%	85.9%
10W	40.7%	88.1%
5W	64.4%	93.3%
Average	**46.7%**	**88.5%**

Error Free Words Recorded by JA1SCW		
Xmit Pwr	**BPSK31**	**QPSK31**
50W	54.1%	66.7%
25W	47.4%	78.5%
10W	37.0%	79.3%
5W	56.3%	95.6%
Average	**48.7%**	**80.0%**

Table 4

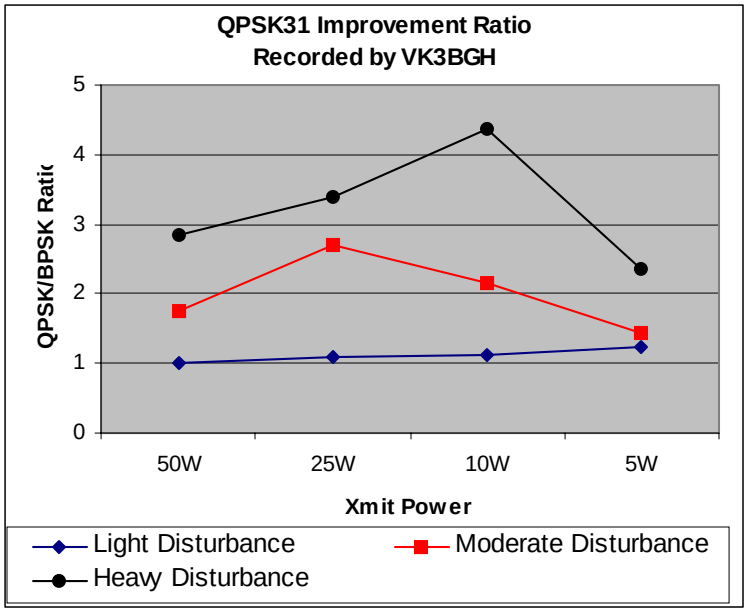
Heavy propagation disturbance
24th July 2002

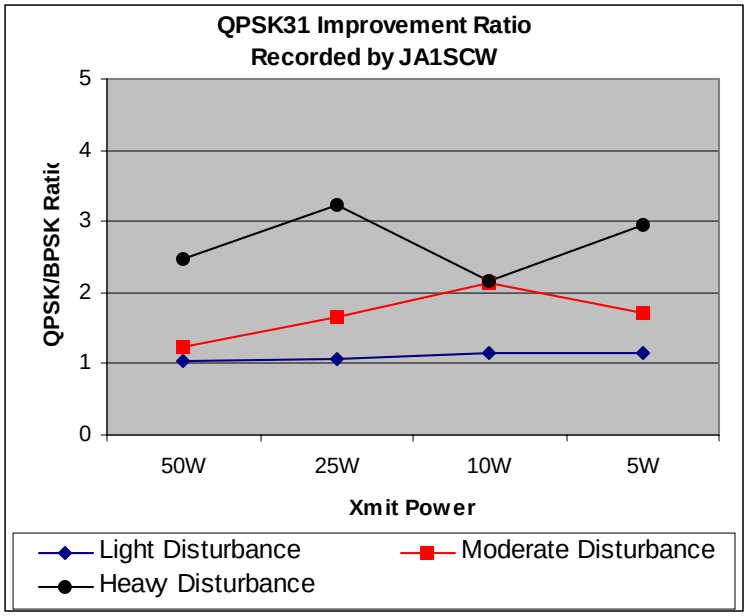
Error Free Words Recorded by VK3BGH		
Xmit Pwr	**BPSK31**	**QPSK31**
50W	28.1%	80.0%
25W	13.3%	45.2%
10W	8.1%	35.6%
5W	23.0%	54.1%
Average	**18.1%**	**53.7%**

Error Free Words Recorded by JA1SCW		
Xmit Pwr	**BPSK31**	**QPSK31**
50W	26.7%	65.9%
25W	18.5%	60.0%
10W	4.4%	9.6%
5W	11.9%	34.8%
Average	**15.4%**	**42.6%**

Table 5

The ratio of error free words (QPSK/BPSK) is graphed below. This further illustrates the benefit of QPSK as propagation disturbance increases and also tends to show this to be relatively independent of typical power levels used by DX operators.





Conclusions:

QPSK31 has been demonstrated to be clearly superior to BPSK31 over the VK3 - JA DX path under adverse conditions. Casual contacts between VK3 and the USA have also produced similar results in favour of QPSK. There does now appear to be a case for QPSK to become the default PSK mode but this is unlikely to be accepted until the QPSK benefits are more widely recognised by PSK operators.

Recent contact with Peter Martinez G3PLX regarding these tests indicates that he is of the same opinion regarding the superiority of QPSK. Peter advised that he uses QPSK in preference to BPSK whenever in QSO with his regular sched partner. He said he originally made BPSK the default mode because it is easier for beginners to use. This is because BPSK requires half the frequency stability required by QPSK, will work with either LSB or USB modulation and doesn't have the 800MS QPSK FEC delay between overs. He also believes that most operators when they try QPSK do so under good local conditions and see little or no improvement for their effort and then return permanently to BPSK. Peter indicated he is keen to see data similar to that presented here published to the PSK community so that users are encouraged to try and prove for themselves the real value of QPSK. This is what JA1SCW and the author had in mind at the outset when we undertook these tests.

In reality, I have not observed any QPSK frequency stability problems with my 20-year-old TS-430S transceiver or noticed the 800MS FEC delay between overs. What I do notice however is the huge reduction in print error when changing from BPSK to QPSK under adverse conditions. It is now hoped that existing BPSK users might look again at the value of QPSK for DX contacts. For those who have not tried PSK31 or any of the many other soundcard modes there is much information and support available these days within the EMDRC and on the web.

No attempt has been made to cover the technical aspects of the PSK modes as this is abundantly available elsewhere. A good sample of useful reference material is covered in the list below. Many of the web sites have links to further information re trouble shooting and alternative software. Software for PSK is available to run on almost any computer from DOS based 286 machines upwards.

The references are primarily aimed at PSK31 but also include many of the other sound card modes now available. A PC, sound card, transceiver and simple interface are the hardware requirements. Software – much of it free, is available to operate several or all of the following digital modes: CW, RTTY, AMTOR (FEC), PACKET, PACTOR (Receive only), **BPSK31, QPSK31**, FSK31, MFSK, THROB, MT63, HELLSCHREIBER, FAX (Receive only), SSTV.

I can provide a hard copy of any of this reference information to any members who don't have access to the Internet. Feel free to contact me by e-mail.

References:

Gibbs, A. (VK6PG). PSK31 – The easy way.
AR March 2000 P36.

Martinez, P. (G3PLX) White Paper on PSK31.
http://www.psk31.com/g3plxarticle.pdf

Martinez, P. (G3PLX) PSK31 Fundamentals and Setup
http://home.teleport.com/~nb6z/psk31.htm

Holbert B. (W5BBR) Sound card interface for RTTY, PSK31 and SSTV
http://www.w5bbr.com/soundbd.html

Clint Hurd (KK7UQ) Sound Card Interface Manual (Lots of info inc trouble shooting)
http://www.waypoint.com/users/~discobay/manual.htm

Nick Fedoseev (UT2UZ) Digipan Software Free-Ware (recommended PSK31 software to start with)
http://www.digipan

Nick Fedoseev (UT2UZ) MixW2 Software Home page
http://www.mixw.net/