

DIGITAL HAPPENINGS #2

By W0NAC ("Matt")

Hello again everyone. Gee, but this last month passed by in a flash! When one gets to be my age it seems like the months and years not only pass by very fast, but that the rate is accelerating! Have you ever noticed this? Well, I shouldn't complain. The Lord has taken real good care of me over the years. On with digital happenings....

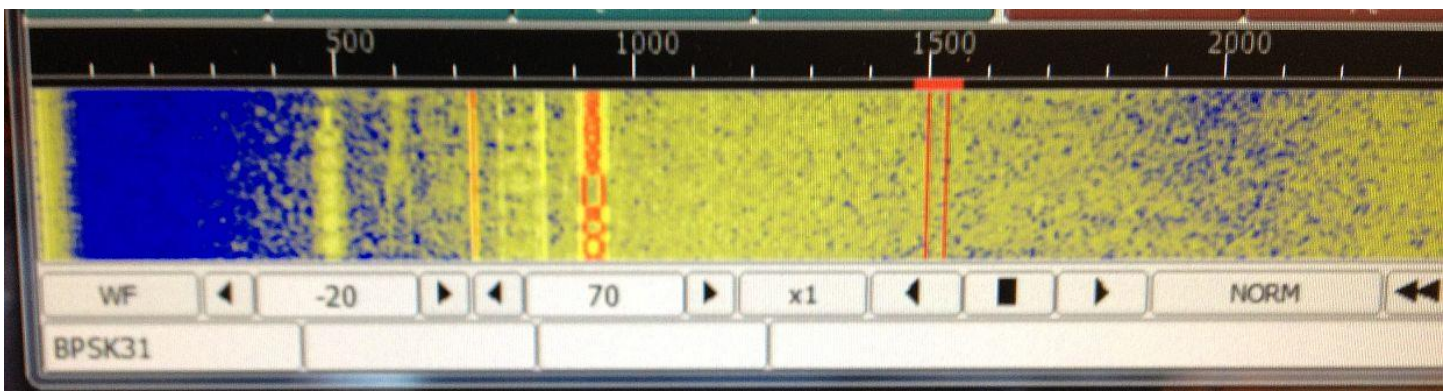
HOW TO TUNE AND DECODE DIGITAL SIGNALS

There are several things you need to know before we get into specifics. Every digital mode I have ever used (or know about) requires that your transceiver be set to Upper Side Band (USB) even on 40M and below. Yes, this goes against the standard convention, but it is the convention digital operators observe. Lower Side Band could be used equally well, but if you use it you will not copy anything, because everyone else is using USB.

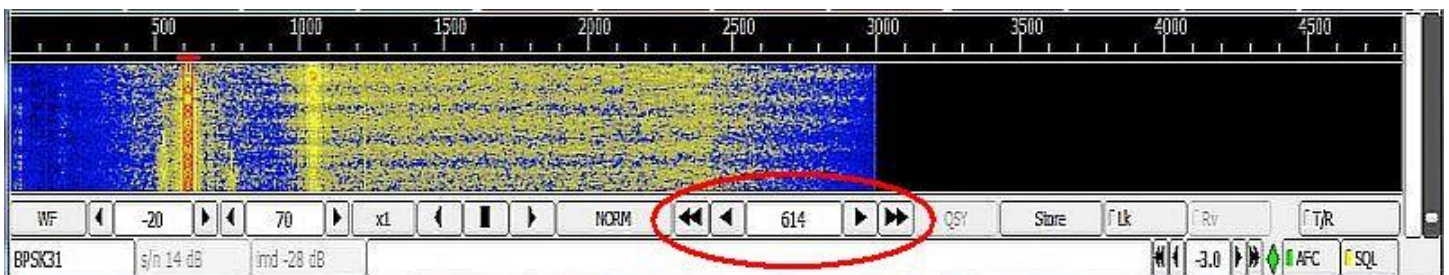
Next, you need to know how digital signals are generated. If one applies a pure 1000Hz (.001 MHz) sine wave audio tone into the mike input of a transceiver set to USB and with 14.070 MHz set on the dial, a pure CW signal will be output with a frequency of 14.070 MHz + .001 MHz = 14.071 MHz. Of course, digital signals usually use multiple tones and apply other complex modulation techniques, but the same principle applies. In fact, many manufacturers of modern transceivers use this same technique to generate their CW signals. Creators of almost all digital modes use either the sound card in your computer or a sound card in your interface box. They simply modulate the output of the sound card according to the scheme for the digital mode you are using. The modulated sound card output is then fed into the transceiver audio input. Like the CW example, the RF signal produced is offset above the transceiver dial setting in varying amounts according to the audio frequencies of the modulated audio tones. This is (I hope!) a simple explanation of what is a very complex process.

When digital signals are received, they are usually displayed on what is called a waterfall. This is a moving display that constantly scrolls downward at a slow rate. The waterfall typically has a scale of say 0 to 3500 Hz so you can see what offset the person sending is using. But remember that the output of all sound cards is typically limited to 200 Hz on the low side and maybe 2500 Hz on the high side. The output level rolls off rapidly if you try to make the sound card produce a signal outside this pass band. Below is a photo of what a waterfall display looks like on my computer using FIDigi and set for PSK-31. Please note the partial offset scale showing from 0 to ~2300 Hz+. There are several PSK signals on the waterfall, but the strongest one is at about 925 Hz on the offset scale. You can tell that this is a PSK-31 signal because of its width (~40 Hz) and that it has a warble-like sound that is unique.

All screen shots were either taken with a camera or captured direct while running FIDigi on my computer. Also, all instructions are tailored for FIDigi software. Other software may operate in a similar way, but there will be some differences. You will need to consult the manual for your particular software if it is not FIDigi.



To tune into this signal you need to move the vertical tuning band (the red band at about 1500 Hz offset) to the left until it is exactly centered over the desired signal. You do this by placing the mouse cursor anywhere in the waterfall. When you do, a yellow tuning bar appears on the waterfall and tracks your mouse pointer. Just move this yellow bar by moving the mouse left or right until it covers the signal track. Then press the left mouse button momentarily. The red tuning band then moves to match where you have placed the yellow bar. You can also move the red band left or right by placing your mouse pointer anywhere on the band itself and then push and hold the left mouse button. While holding the left mouse button down, drag the red band to where you wish it to be by moving your mouse and then release your left mouse button to leave it there. If you have done this accurately, your software will decode the text and start displaying it on your receive screen. The following shows a PSK-31 signal that has been properly tuned. Note that the small red bar just below the offset scale is centered exactly over the signal.



Some digital modes are more critical about tuning than others. MFSK-16, for example, will not print out unless it is tuned within a few Hz. If you need finer control of tuning, most software has fine and coarse tuning arrows which move the tuning band left or right in small amounts. For example, the fine tuning arrows in FIDigi moves the tuning band 1 Hz at a time in either direction. The coarse tuning arrows move it left or right by 10 Hz each time you click on them. Also, most software programs have a small box displaying the exact offset of the red tuning bar (these features in FIDigi are circled in red on the screen shot). Actually, the red tuning bar sets **both** the transmit offset and the receive offset. Both the transmit and receive offsets move together unless you lock your transmit offset. If the transmit offset is locked, you can then move your receive offset higher or lower. In the SSB mode this is more commonly called RIT or Receiver Incremental Tuning.

An excellent description of almost all the digital modes used all over the world can be found at this link maintained by G4UCJ: http://hfradio.org.uk/html/digital_modes.html. All of these modes (except ROS which is not authorized yet for American amateurs) can be used by county hunters, but to date I have only heard

county hunters using PSK-31, PSK-63, MFSK-16, OLIVIA, CONTESTIA 8/500, THROB-4, JT-65, and RTTY modes. G4UCJ keeps his site very current and it contains a wealth of information. You can even listen to samples of what the various modes sound like. I highly recommend that you spend time on his site. You can learn a lot!

Now that you know how to tune a digital signal, let's go through a practical example of how you would find and tune to the signal of a mobile station running counties using digital modes. The mobile almost always needs spotting so that others can know what mode and sub mode they are using and their band and frequency. A typical spot might be as follows:

<u>Spotter Call</u>	<u>FQ (KHz)</u>	<u>Mobile Call</u>	<u>Comments</u>
W0NAC	14074.3	W0NAC/N0LXJ	Gilpin/Clear Creek, CO [PSK63]

The spot tells you all you need to know about finding us. First, you can see that we spotted ourselves (probably using wide area data coverage and our internet browser). Next you know that we are operating on the 20M band and that we are putting out the county line of Gilpin and Clear Creek, CO using PSK-63. (The mode has to be typed in as PSK63, not PSK-63 because the site we use translates dashes into something else).

To tune us in you would set your software to send/receive using PSK-63 Mode/Sub mode. Next, you would set your transceiver frequency to 14.0730 (most of the time you use 1 KHz increments here). Then you would set your offset to +1300 Hz. If propagation is right, you should see our trace near where you have set the offset. Move the tuning bar until our signal starts decoding, and you are ready to work us.

Another example:

<u>Spotter Call</u>	<u>FQ (kHz)</u>	<u>Mobile Call</u>	<u>Comments</u>
W0NAC	7072.6	NX4W	Camden/Glynn, GA [CONTESTIA 8/500]

Here you would set your Mode/Sub mode to CONTESTIA 8/500 using the mode drop down selections. Then you would set your transceiver dial to 7062.0 and your offset to +600 Hz. All else being right, you should be able to print Lloyd on his county line in GA. Please note that this mode has a bandwidth of 500 Hz so your tuning bar will expand to 500 Hz wide also. Also note that for all modes except JT-65, the **center** of the tuning band is used in measuring the offset.

Next month I will go into more detail on how to adjust your transmitter so that it puts out a clean signal. If you wish to begin right away, heed the following cautions:

- 1) Your transceiver should be set to 100% power, then control the actual output by adjusting the level of the audio going into the transceiver from the sound card.
- 2) Have your transceiver set so you can see ALC action as well as power output.
- 3) Start with the audio drive set to 0

4) If you are using a transceiver rated at 100 Watts PEP SSB, then don't drive it higher than ~40 Watts. Remember almost all digital modes operate with a duty factor very close to 100%. In other words digital modes are like operating CW with a brick on the key!

5) As you gradually increase audio drive with the transmitter on (into a dummy load of course), watch for any ALC action. When it does show a bit, back off on the audio drive slightly until it just disappears.

If you observe these cautions faithfully, you are almost guaranteed to have a clean signal.

Now back to receiving. Here are some tips for better operation:

1) Use NO signal processing (this includes compression) on either transmit or receive. However, sometimes a little bit of noise reduction will help pull out weak signals and can be used safely in small doses for receiving. The idea here is to keep your transceiver operating as near linear as possible to reduce spurious sidebands on your signal.

2) The noise blanker can usually be used without any problems, but it is better left OFF if you don't need it.

3) If you can control your receiver pass band, you can use it to reduce overall noise. You can even use a narrow CW filter, especially when operating PSK, to reduce overall noise coming in. However, you must be operating USB. Many transceivers will not allow you to switch in the CW filter when operating SSB. If this is the case with your transceiver, there are ways to get around this, but they are beyond the scope of this article.

4) Find and use the fine tuning arrows. You will probably find that your mouse is harder to control when trying to move the cursor very small distances.

5) Adjust your waterfall so that only a little noise displays. The noise will show as granular white specks drifting down the waterfall. Having only a little noise showing is probably the most sensitive setting for decoding other signals.

6) Learn as much as you can about macros. You need to know how to create new ones, modify older ones, and the techniques for using them. You also need to know how you can imbed macros into your overall operation.

7) Study your manuals and know your equipment inside and out. Your pleasure in operating will be greatly enhanced if you do. You learn digital techniques just like you eat an elephant – one bite at a time!

DIGITAL ACTIVITIES LAST MONTH

I helped two people last month. W9SUQ (Larry) is now getting his feet wet on digital operations. We worked together to set up his TS-2000, Signalink USB interface, and his computer (using FIDigi) for software. His XYL (Rose) is pretty much housebound now. Larry is also at home almost every day since he is her primary caregiver. I hope that operating digital will help him to do something new and challenging while he is spending

most of his time at home. If you are also housebound or just a little tired of the same old things, operating digital will help you break out of any rut you are in and also exercise your brain. As we get older, we not only need physical exercise, but brain exercise as well.

I also helped K4PBX (Jim) get going on JT-65 (he was already active on other modes). I then gave him his first contact using JT-65. Lots of fun for both of us! I'll be describing the JT-65 mode in a later article.

I will be happy to help anyone get started. Just email me or call me on the phone. My email is w0nac@comcast.net and my phone number is 303-799-3658. Call any time.

I have again included Table 1 which has been updated from last month as several new calls were added. If I have left anyone off the list you have my sincere apology! Just drop me a quick email and include your stats, if you know them, and I will be pleased to add you to the list. Conversely, if you are on the list and feel that you don't belong, please also drop me an email and I will remove you.

Table 1 - Active Digital County Hunters Award Status

#	CALL	NAME	STATUS* (M,F,I)	USA - DIGITAL Counties (of 3077)	(1 MODE)	(2 MODES)	FIVE MODE COUNTIES (3 MODES)	(4 MODES)	(5 MODES)
1	AA8R	Randy	F	1000+	-	-	-	-	-
2	AC0B	Cliff	F	-	-	-	-	-	-
3	AD1C	Jim	F	-	-	-	-	-	-
4	K0DEQ	Bill	F	-	-	-	-	-	-
5	K0PVW	Rob	F	-	-	-	-	-	-
6	K0WJ	Lou	F	-	-	-	-	-	-
7	K4PBX	Jim	F	-	-	-	-	-	-
8	K5GE	Gene	F	-	-	-	-	-	-
9	K5SF	Dick	F	-	-	-	-	-	-
10	K7REL	Tom	F	-	-	-	-	-	-
11	K8QWY	Ed	F	-	-	-	-	-	-
12	K8ZZ	Ed	F	-	-	-	-	-	-
13	KC3X	Hollis	F	-	-	-	-	-	-
14	KC6AWX	Bob	F	-	-	-	-	-	-
15	KD5YUK	Billy	F	-	-	-	-	-	-
16	KD7KST	Bill	M/F	1792	-	-	-	-	-
17	KG5RJ	Gregory	F	-	-	-	-	-	-
18	KM1C	Bill	F	-	-	-	-	-	-
19	N0KV	Barry	M/F	-	-	-	-	-	-
20	N0LXJ	Sharon	M/F	1298	3077	2192	1105	346	138
21	N1API	Al	F	-	-	-	-	-	-
22	N3HOO	Ed	F	-	-	-	-	-	-
23	N4JT	Jim	F	-	-	-	-	-	-
24	N5MLP	Ron	M/F	-	-	-	-	-	-
25	N6PDB	Dennis	F	-	-	-	-	-	-
26	N8CIJ	Dick	F	-	-	-	-	-	-
27	NA8W	Darl	F	-	-	-	-	-	-
28	NF0N	Mike	F	-	-	-	-	-	-
29	NN9K	Pete	F	-	-	-	-	-	-
30	NT2A	Gene	F	-	-	-	-	-	-
31	NU4C	Paul	F	-	-	-	-	-	-
32	NW6S	Jim	F	-	-	-	-	-	-
33	NX4W	Lloyd	M/F	-	-	-	-	-	-
34	W0NAC	Matt	M/F	1694	3077	2755	1814	809	215
35	W0QE	Larry	F	-	-	-	-	-	-
36	W4IHI	Gary	F	-	-	-	-	-	-
37	W4YDY	Dave	F	-	-	-	-	-	-
38	W6RK	Risto	F	-	-	-	-	-	-
39	W6RLL	Joe	F	-	-	-	-	-	-
40	W7IN	Larry	F	-	-	-	-	-	-
41	W7QQ	Bill	M/F	-	-	-	-	-	-
42	W9SUQ	Larry	F	-	-	-	-	-	-
43	WA4UNS	Doug	F	-	-	-	-	-	-
44	WA7JHQ	Sterling	F	-	-	-	-	-	-
45	WB0M	Jeff	F	-	-	-	-	-	-
46	WB2ABD	Paul	F	-	-	-	-	-	-
47	WD4OIN	Jack	F	-	-	-	-	-	-
48	WQ7A	Terry	F	-	-	-	-	-	-
49	WY4D	Bennie	F	-	-	-	-	-	-

Next month I plan on discussing “How to adjust your rig for a clean signal” plus one other topic that anyone suggests. If no one has any suggestions, the second topic will be on “Other Interesting modes (JT-65)”

Future topics in the coming months include –

“How to ‘put out’ counties mobile using digital modes”

“How to operate as a mobile OM/YL team using digital modes”

“How to fine tune your Interface”

“How to use macros with specific examples”

So long for this time.....Please email me with your comments/suggestions at w0nac@comcast.net and please don't forget to send me your counties worked status on the **USA – Digital** and **5 Mode Awards** so I can update the Digital County Hunter list again next month.

Thanks and 73's

Matt – W0NAC