

# Digital Mode Primer – PSK – Adapted From Information on BPSK31.com and Other Sources

## ✓ About PSK

PSK is a digital communication mode for amateur radio. It is one of many, but probably the most common and easy-to-use digital mode as a PSK station needs only to consist of an SSB transceiver, an antenna, and a soundcard equipped PC or an external Soundcard Interface. PSK is very well supported and there is PLENTY of information on the internet about hardware interfaces, software, basic set up, and operation.

## ✓ Brief history of PSK

PSK was created by Peter Martinez, G3PLX, in the mid-'90s. In the early stages, PSK signals were sent using specialized hardware devices. However, in 1999, Peter released software that allowed PSK to be sent and received using a computer soundcard. Due in part to the widespread availability of such a setup, PSK31 has become one of the most popular digital modes in amateur radio.

## ✓ How PSK31 Works

PSK31 signals consist of changing audio tones to convey the transmission content. Individual characters are represented by a binary sequence of 1's and 0's, the sequence being determined by a system called Varicode. The number of bits per character varies based on how commonly the letter is used, an "e" being represented by 11, thus achieving greater transmission speed.

The bits, 1's and 0's, are transmitted by phase-shifting an audio tone, hence the name Phase Shift Keying (PSK). The 31 in PSK31 refers to the speed at which data is sent; in this mode, at about 31 bits-per-second. (31.5 baud)

PSK31 achieves its weak-signal performance as a result of two factors. First, a PSK31 signal is narrow, being about 31 Hz wide. Second, the structure of Varicode allows the receiving computer to anticipate the times for each data bit. These factors combine to make PSK31 one of the most popular and high performance digital modes.

## ✓ What's the "b" in BPSK31?

The "b" in BPSK31 stands for binary. This refers to the most common form of PSK31, which sends two channels of data with a transmission. There is also another flavor, QPSK31, which adds two additional channels for error correction, but while it too is very accurate, it is not as widely used as BPSK31.

## ✓ Modes – Lots of options

There are multiple ways to do phase shifting using audio tones. There are MANY other digital modes besides PSK31. Most of the popular digital mode software supports all the major modes and you can select Olivia, RTTY, MT63, MFSK, Domino modes which are also popular in some areas. But PSK31 is by far the most used. PSK125 is a faster version of PSK that you sometime will see as a slightly "wider" signal on the waterfall when conditions are favorable. There is a lot of development and experimentation going on and new modes emerge regularly. JT65 is one of the latest.

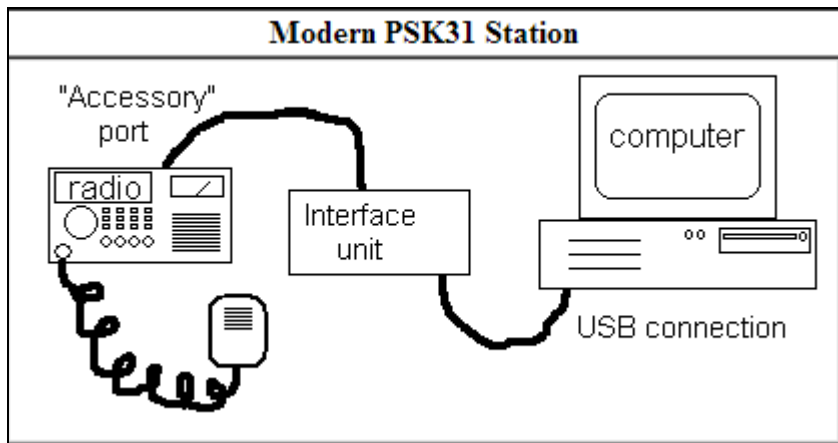
To hear what the various digital modes sound like when you hear them over the radio or look like on the Waterfall, go to <http://www.w1hki.com/FldigiHelp-3.21/Modes/index.htm> or <http://wb8nut.com/digital/> where you can select many different digital sound and waterfall examples. If you turn on "RSID" (Reed-Solomon Identification) some software will actually tell you what modes and frequencies you're seeing on the waterfall.

Depending on band conditions, you may find yourself moving from one mode to another to take advantage of error correction or weak signal decoding characteristics of other digital modes. When conditions are good you can use faster modes. When conditions deteriorate you have to use slower modes to allow for error correction or more “noise tolerant” signal decoding.

### ✓ PSK Station Setup

A basic PSK station should consist of the following components:

- HF SSB Transceiver and Antenna
- Soundcard-equipped PC or (optional) Soundcard Interface (Signalink, Rigblaster, Donner Digital Interface, and others)
- Digital Mode Software



(Diagram courtesy of N1KM's PSK Elmer Page at <http://www.mymorninglight.org/ham/psk.htm>)

### ✓ Signalink Soundcard Interface

About \$100. Connects to your PC (USB or Serial versions) and Radio (data/accessory port or Microphone connector). Read the instructions about jumpers and set up for your rig.

Set the audio controls on your PC to use the USB Audio Codec for Playback and Record.

You'll need to determine what COM port your PC is using so you can set the PSK software so it knows which COM port to talk to the Signalink sound card interface.

Set TX and RX knobs to ~9 o'clock to start. DLY or transmit delay should be set to off or full counter clockwise.

### ✓ Digital Mode Software

<http://www.w1hki.com/index.htm> - Navigate to the Download page. You only need FLDIGI, but you can also “play” with FLRIG for radio control, FLMSG for forms transmit and receive, and others.

Always selected the “defaults” for location of files and accessory apps so the modules know where to find companion apps and directories.

FLDIGI is the Georgia ARES Standard although some prefer to use HRD, DM780 or other apps. The advantage of FLDIGI is its companion applications – FLMSG, FLRIG, and others. FLDIGI for example can be set automatically detect that you are receiving a “form” transmission and “call” FLMSG to decode the form and display it upon receipt.

To configure FLDIGI, simply set your operator information, Com ports used by the soundcard interface, and user preferences based on the radio you’re operating. Just about everything else is a user preference.

#### ✓ **PSK31 Frequencies in MHZ – Generally Requires a General Class License or Above**

1.838

3.580

7.035 to 7.070

10.140

14.070 – Very high traffic. Lots of opportunity for contact.

18.100

21.080 (although most activity can be found 10 kHz lower)

24.920

28.120

#### ✓ **PSK31 Operation**

Remember to tune the transmitter, especially if you bounce from band to band. This will prevent damage to the transmitter and guard against messy, distorted signals. Most PSK31 software packages have a testing / tuning feature for this purpose or you can set up a “Test” macro.

Another thing to watch is the ALC (automatic leveling control) meter on the radio. Adjust the audio level until the ALC meter **always** reads at 0. If the audio level is too high, the ALC controls in the transmitter will kick in, and the result will be a distorted PSK31 signal (splatter).

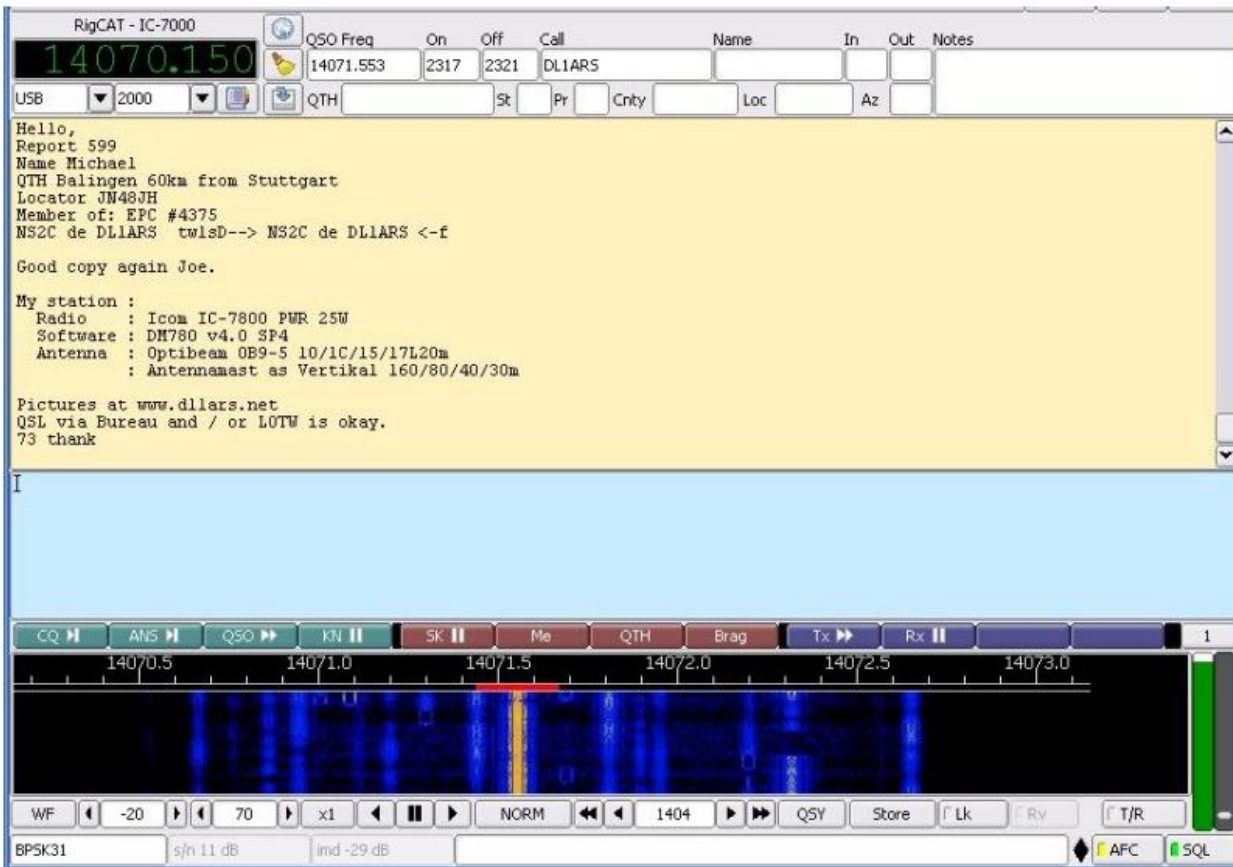
Try not to “overdrive” your signal. You don’t need as much power to transmit digitally as you do with voice. 30-50 watts is about all you need. It’s not uncommon to talk with Europe, South America, and other places with 30 watts or less. You can also receive signals you can’t hear through the audio noise level and may even be very faint on the waterfall - -but you can still communicate effectively with them!

If you do contact someone with a messy signal, do not give them an automated (macro) signal report of 599 – an easy 595 will let them know to adjust their audio drive.

Next, tune your radio to a common PSK31 frequency like 7.070 or 14.070 MHz . Make sure your radio is set to SSB mode on the upper sideband (USB). You will not have to change frequencies after that, since PSK31 signals are so narrow (31 Hz), all the transmissions will be picked up by the receiver without changing frequencies. It is then up to the software, not the radio, what signal(s) to decode.

Fire up your favorite your favorite PSK31 software. Most packages will have a “waterfall” display where you will see all the signals from the receiver.

In most software packages, you can click on or move a marker (usually a pair of vertical lines) to a signal to begin decoding the transmission. If you’re line up on the frequency and set to the correct mode, you should begin decoding the signal in a few seconds.



✓ **Conversation**

Digital mode QSO's are not unlike most others on voice except you type your outgoing message into the "TX" section and you receive decoded transmissions in the "RX" section. The first transmission is usually a CQ call. This is similar to CW, like this:

**CQ CQ CQ de WA4EOC WA4EOC WA4EOC CQ CQ CQ de WA4EOC WA4EOC WA4EOC K**

This basically means that WA4EOC is calling for someone to contact. The "K" at the end of the transmission means "over," signifying that the other station may begin transmission. Typically, the next transmission would be something like this:

**WA4EOC WA4EOC WA4EOC de OTHERCALL OTHERCALL OTHERCALL WA4EOC WA4EOC WA4EOC de OTHERCALL OTHERCALL OTHERCALL pse K**

After that, the conversation proceeds with the station transmitting back and forth following this format:

**OTHERCALL de WA4EOC (rest of message) BTU OTHERCALL de WA4EOC kn**

The "BTU" stands for "back to you" and is optional. "KN" means only the station I'm talking to should reply. "pse" is "please".

Finally, at the end of the conversation, both stations end their last with "sk" instead of "k" to signify the end of their final transmission ("sk" stands for silent key).

## ✓ **Macros**

If you're not a fast or accurate typist, one of the advantages of most PSK software is the ability to create MACROS for common QSO exchanges. An operator can set up macro "buttons" to send CQ's, acknowledge CQ's, "Brag", and do the sign off including updating the operators log book. The macros will automatically insert their call, your call, bragging information, and automatically update your logbook if you want to. You can literally do entire conversations by clicking on macro buttons. Our 130+ Field Day contacts were literally 3 or 4 macro buttons pushed at the right time. Many PSK nets are run entirely using macros.

## ✓ **Nets**

Georgia ARES Digital Net - Sunday afternoons @ 21:00 or 21:30 UTC – 3.583 Mhz. Usually centered around 1000 on the waterfall.

NW Georgia ARES Digital Net – Tuesday nights @ 7:30 – 3.583 Mhz. Usually around 1000 or 1500 on the waterfall.

## **Common Issues**

Wrong Com Port Selected in software

Wrong sound device selected – USB Audio Codec if using External Soundcard Interface

Sound levels on PC or External Interface set too high/low

Ground wave/multi-path interference

Software "hangs"

## ✓ **Links**

FLDIGI - <http://www.w1hkj.com/index.htm>

Software Download page: <http://www.w1hkj.com/download.html>

<http://www.wb8nut.com/digital/> - Great collection of information about lots of digital modes including PSK.

## ✓ **If You Need Help**

**Don't be afraid to ask! Post questions on our club Yahoo Groups page, bring up your question during a meeting, ask during the weekly club net, or put out a call on the local repeater. Most HAMS will be more than happy to help if they know you need help!**

## ✓ **Credits**

The information in this document is a collection, merge, and adaptation of information obtained from multiple sources including:

Jacob Gillespie, KD5TEN and BPSK31.com

J. Duffy Beischel, WB8NUT

Bob Johnston, KK4LAC whose station would not be operating without the generous help of Juan Quiroga – WW4WX,

Tom Olley – KG4VUB, Frank Dean – K4SJR!

And a few other digital modes instructional documents on various local club web sites where the author was not identified.