

# An Introduction to Operating Digital Modes



The Columbia Amateur Radio Club  
[w4cae.com](http://w4cae.com)

# Why Digital Modes?

Mainly because they are fun!

- Computer Encode / Decode
  - For weak signal detection
  - Low bandwidth on some modes means your signal “gets out” better than with SSB
  - Mic shyness
  - Increases QRP/bad antenna viability
  - Data transfer (packet, e-mail, SSTV)
  - It’s fun!
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# So many to choose from:

- PSK variations
- RTTY (Radio Teletype)
- JT modes (weak signals)
- Feld Hell (Hellschreiber)
- MFSK
- Slow Scan TV
- Contestia
- DominoEX
- FSQ (Fast Simple QSO)
- IFKP
- MT63
- Olivia
- And more!

**KK4DSD's Opinion:** Start with PSK31 and RTTY. Both are “keyboard conversation” modes that are easy to get up and running, are well-documented, and are easy to use. Activity is easy to find for both modes.

Software to handle all these modes is in most cases, free and available for multiple operating systems. I suggest starting with “fldigi” as it is updated frequently by the author. You may have comparable luck with programs such as Digipan, WinWarbler or Digital Master, which is part of Ham Radio Deluxe.

# Types of Digital Modes: Operation

- Keyboard to keyboard “chatroom” style (PSK, RTTY)
- All modes can make use of macros -- pre-loaded text that you can send at the push of a button. For instance, the infamous RTTY “brag tapes” which list an operator’s gear. Macros are good for sending repetitive information. Some modes, such as JT65/JT9 are almost exclusively conducted via macros.
- Data: APRS, packet radio, mapping, weather data, e-mail, images
- Metadata: Automated spot/data collection ([pskreporter.info](http://pskreporter.info), [reversebeacon.net](http://reversebeacon.net))
- Many modes make use of a “waterfall” that visually represents signals. You “click to tune” on the signal. PSK relies on this method.

# Types of Digital Modes: Technology

This presentation is largely concerned with what we call the “sound card” modes, in other words, feeding your radio’s audio into a computer sound card, where it gets decoded by the computer.

You don’t need dedicated hardware for a particular mode, just a method to get audio in and out of your radio and computer. Packet modems, RTTY hardware, etc., is no longer needed as most computers, smartphones and tablets have the horsepower to decode any digital signal.

Some radios are equipped with USB sound cards (Kenwood TS-590) for digital modes. If your radio isn’t digital-ready, I suggest the use of a dedicated interface.

# Types of Digital Modes: Modulation

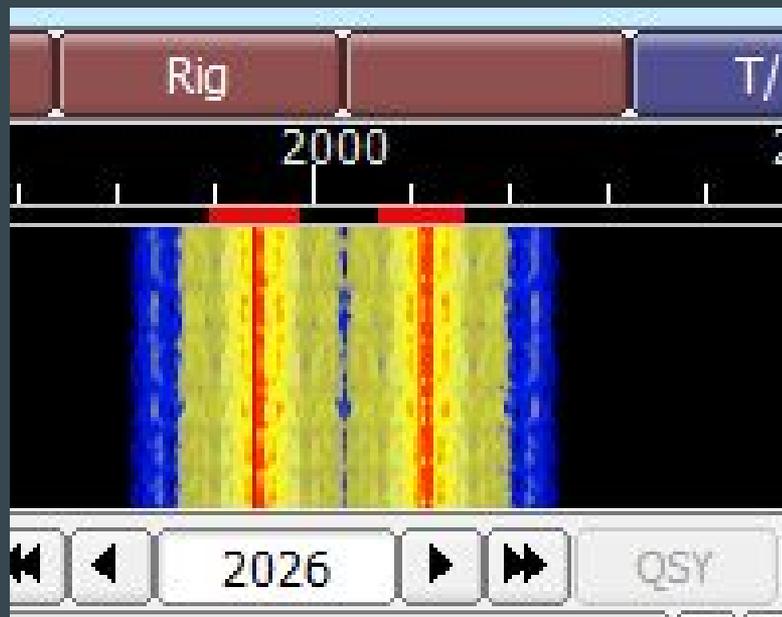
- Amplitude Shift Keying (ASK): Digital data as variations in the amplitude of a carrier wave (CW).
- Frequency Shift Keying (FSK): Digital information is transmitted through discrete frequency changes of a carrier wave.
  - Audio FSK: Frequency shifted by transmitted audio tone (describes most sound card modes)
  - Multiple FSK: Uses an alphabet of “M” tones
  - Binary FSK: Paired frequencies, 0 and 1 for space and mark
- Phase Shift Keying (PSK): Uses two phases 180 degrees apart
- And there are more beyond the scope of this presentation.

# Digital Mode Characteristics

Type	Mode	Symbol Rate		Width (Hz)	Error Correct	Duty Cycle	ITU	
		(Baud)	WPM				Designation	Coding
ASK	CW-100	50	100	200	No	44%	200H0A1A	Morse
ASK	CW-20	10	20	50	No	44%	50H0A1A	Morse
ASK	FELD-HELL	123	25	350	No	22%	350HA1B	None
FSK	RTTY-45	45	60	270	No	100%	270HF1B	Baudot
FSK	RTTY-75	75	100	370	No	100%	370HF1B	Baudot
MFSK	Contestia 8-250	31	30	250	Yes	100%	250HF1B	ASCII-128
MFSK	DominoEX11	11	80	262	Yes/No	100%	262HF1B	ASCII-256
MFSK	JT65							
MFSK	MFSK8	8	36	316	Yes	100%	316HF1B	ASCII-256
MFSK	Olivia 8-250	31	15	250	Yes	100%	250HF1B	ASCII-128
MFSK	THOR11	11	40	262	Yes	100%	262HF1B	ASCII-256
MFSK	THROB2	2	20	72	No	80%	72H0F1B	44 Chars
OFDM	MT63-500	5	50	500	Yes	80%	500HJ2DEN	ASCII-128
PSK	BPSK-31	31	50	62	No	80%	63H0G1B	ASCII-256
PSK	BPSK-63	63	100	125	No	80%	125HG1B	ASCII-256
PSK	QPSK-31	31	50	62	No	80%	63H0G1B	ASCII-256
PSK	QPSK-63	63	100	125	No	80%	125HG1B	ASCII-256

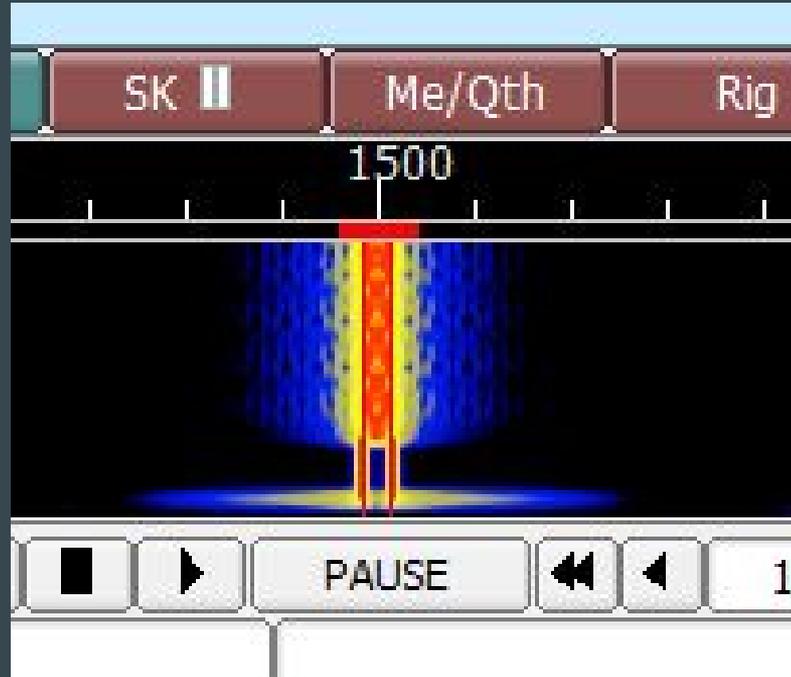
# Radio Teletype (RTTY)

- Keyboard to Keyboard
- 5 bit Baudot-Murray code represents letters (uppercase), numbers and punctuation (00100 = space, 00001 = E etc., using shift and space)
- 45 baud (most common version) corresponds to a typing speed of 60 WPM.
- No error correction
- AFSK emulation with sound card
- Most popular digital contesting mode.



# PSK31

- Binary phase shift keying
- ASCII-256 (upper and lowercase characters - Fact: lowercase letters send faster than uppercase)
- Narrow bandwidth: Less than CW, up to 80 PSK31 signals will fit in the same bandwidth as one SSB signal.
- Doesn't need a lot of power, 20W max!
- Multiple QSO decode
- Popular and easy to use



# Digital Mode Frequencies

Band	Digital	PSK	JT65
10 Meters	28.110–28.125	28.120	28.076
12 Meters	24.920–24.930	24.920	24.920
15 Meters	21.060–21.090	21.070	21.076
17 Meters	18.100–18.110	18.100	18.102 18.106
20 Meters	14.065–14.090	14.070	14.076
30 Meters	10.130–10.145	10.142	10.139 10.147
40 Meters	7.030–7.040 7.060–7.080	7.035	7.039 7.076
80 Meters	3.575–3.585 3.620–3.640	3.580	3.576

# Tips and Tricks

Finding digital modes on the airwaves and how to work them

- Google is your friend. If you're wondering where to find PSK action on 40 meters, Google it.
  - Most digital mode action is centered around specific frequencies, making them easier to locate. For instance JT65 is commonly found at 14.076, PSK is lower, at 14.070.
  - Study up on QSO format and etiquette. Each mode has some quirks.
  - Listen and decode a few modes to get familiar with how the mode works. You don't even need special hardware to do this: Use your computer's built-in mic.
  - Almost all digital modes are upper sideband (RTTY is usually LSB).
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# Hardware

You need a way to get audio in and out of your computer. This can be as simple as a pair of audio cables, but you will get best results with a dedicated audio interface.

Each radio is different so you'll need to do research on the proper cables and radio setup for digital work. You may even need to construct your own cable in some cases.

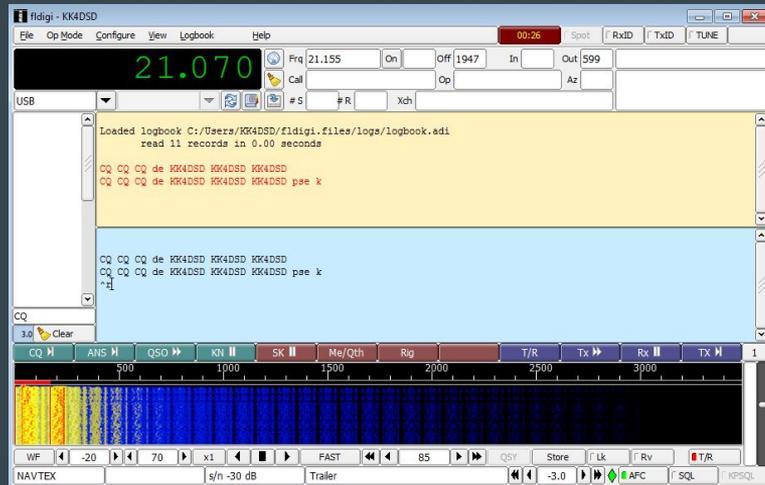
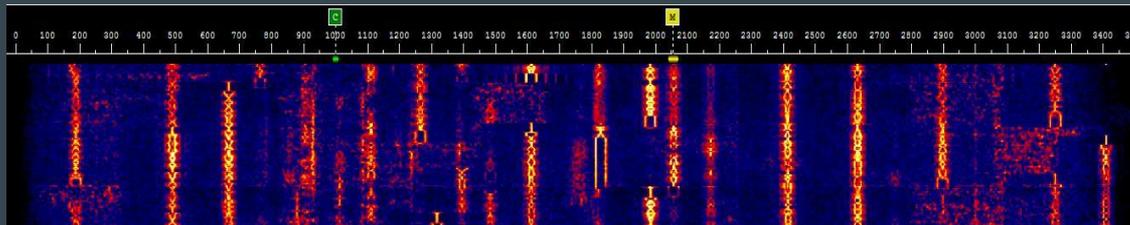
We'll be using a Tigertronics Signalink and a Yaesu FT-817 for the purposes of this demonstration.



**Demo: Signalink + Yaesu FT-817**

# Software

- Fldigi (<http://www.w1hkj.com/>) The Swiss Army Knife of digital modes, with versions for all operating systems.
- WSPR
- Digital Master (Ham Radio Deluxe)
- WinWarbler (DX Labs)
- DigiPan (<http://www.digipan.net/>)  
Easy to use!
- RMS Express (send e-mail)
- MMTTY (best RTTY program!)
- WSJT-X, the JT modes
- MixW



# Video: 20m PSK QSO



# Next Steps: More resources online

## Essential reading/watching:

- Randy, K7AGE's intro to PSK31 - <https://www.youtube.com/watch?v=6bfCsbbxh1M>
- ARRL's Digital Modes resource page - <http://www.arrl.org/digital-data-modes>
- Digital Modes Samples - <http://www.kb9ukd.com/digital/>

## Software:

- Fldigi: <http://www.w1hkj.com/>
- Digipan: <http://www.digipan.net/>
- MMTTY: <http://hamsoft.ca/pages/mmtty.php>
- WSJT-X: <http://physics.princeton.edu/pulsar/kljt/wsjtx.html>
- MixW: <http://mixw.net/>
- WinWarbler: <http://www.dxlabsuite.com/winwarbler/>
- Ham Radio Deluxe: <http://ham-radio-deluxe.com/>

# Questions?

Portions of this presentation were taken from “Radio in the Digital Age” by Steven F. Goldberg, W3SFG