Amateur Radio Digital Modes

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Introduction

This presentation covers station and computer setup for the popular HF ham radio digital modes JT65, JT9, FT8, PSK31, and RTTY using a soundcard.
What is JT65?

- JT65A protocol was developed by Joe Taylor, K1JT in late 2003 for EME (earth-moon-earth) communications.
- JT65 uses 60 sec transmit/receive sequences and structured messages.
- Exchanges the minimum information needed for a QSO (Call Signs, Signal Reports, Grid Squares)
- Digital signal processing and redundancy allow up to 80% of the message to be lost and still be decoded correctly.
More about JT65

- During 126 intervals of 0.372 sec the waveform is one of 65 pre-defined tones.
- Bandwidth is 177.6 Hz.
- Accurate computer time (within 2 seconds) is required.
- Sound of JT65:
What is JT9?

- JT9 is similar to JT65 in that it uses 60 sec transmit/receive sequences and structured messages.
- The bandwidth of JT9 is 15.7 Hz, while the bandwidth of JT65 is 177.6 Hz.
What is FT8?

- Compared to the so called slow modes (JT9, JT65), FT8 is a few dB less sensitive but allows completion of QSOs four times faster. Bandwidth is greater than JT9, but about 1/4 of JT65A.
- Transmit/Receive sequence length: 15 seconds
- Bandwidth: 47 Hz
- FT8 stands for "Franke-Taylor design, 8-FSK modulation" and was created by Joe Taylor, K1JT and Steve Franke, K9AN.
- Recently I have heard more stations using FT8 than either JT65, JT9, or PSK31.
What is PSK31?

- PSK31 was developed by Peter Martinez, G3PLX in December 1998.
- Allows “real time” keyboard chat between two operators. Other stations see your typing immediately.
- “PSK” Phase Shift Keying modulates the phase of a carrier.
More about PSK31

- Typing speed is 50 wpm.
- Bandwidth is 62.5 Hz (about the same as 25 WPM CW).
- Uses varicode, frequently used characters are shorter than others.
- Sound of PSK31:
What is RTTY?

- After WW II, hams began using surplus radioteletype equipment.
- Allows “real time” keyboard chat between two operators. Other stations see your typing immediately.
- “RTTY uses a five-bit code (Baudot) to represent all the letters of the alphabet, the numbers, some punctuation and some control characters.
- At typical 45 baud each bit is 1/45.45 seconds long, or 22 msec
- Typing speed is 60 WPM.
More about RTTY

- Bandwidth is 250 Hz.
- The standard mark and space tones are 2125 Hz and 2295 Hz.
- RTTY can be sent using either FSK (on/off keying, typically from COM port or LPT port) or AFSK (audio from a sound card).
- Sound of RTTY:
Why use Digital Modes?

- The equipment needed to connect your rig to a computer is very modest, and can be homemade or purchased at low cost.
- The software needed is free or low cost.
- PSK31 and JT65 modes work well with low power and simple antennas. RTTY is a popular mode for contests.
- Many hams use digital modes on HF, and contacts can be made anytime.
What Equipment is Needed?

- HF Transceiver capable of SSB and monitoring of ALC (can be an older rig, or beginner rig).
- Computer running Windows, Linux, or Mac OS.
- Soundcard Interface between the computer and the transceiver (can be homemade, and some rigs such as Icom 7200 have built-in USB interface). RTTY is generated using AFSK (audio frequency shift keying).
- HF antenna (simple wire antenna or vertical is fine).
- Software (free or low cost software is available).
- Optional hardware: CAT (computer aided transceiver control)
Homemade Interface

Soundcard Input

Soundcard Output

Transceiver Audio Output

Transceiver Audio Input

audio transformers: 1:1, 600 ohm (e.g. Radio Shack 273-1374)

KK7UQ
Commercial Interfaces

- SignaLink USB
  http://www.tigertronics.com/slusbmain.htm
- Rig Blaster
  http://www.westmountainradio.com/rigblaster.php
- Unified Microsystems Sound Card Interface Kit
  http://www.unifiedmicro.com/sci6.htm
The Computer

- For Windows a minimum 1.5 GHz dual core processor with 3 GB memory is recommended. Same for Linux.
- An external USB sound card or second internal sound card is recommended to avoid sending OS sounds over the air, and to allow ham software to use computer speakers.
- 16 bit (or higher) sampling rate recommended for sound card. WSJT-X recommends setting the sound card to 16 bit, 48000 Hz (DVD Quality).
Software

- Fldigi supports PSK31, RTTY, and many less used digital modes for Windows, Linux, and Mac OS-X. http://www.w1hkj.com/
- NetTime synchronizes the PC clock with Internet time, which is necessary for JT65 and JT9. http://timesynctool.com/
Software (other choices)

- Ham Radio Deluxe is a popular software for PSK31 on Windows. It also supports RTTY and many less used digital modes. Version 5.24-38 is the last free version. The current version 6.4 sells for $99.95. [https://www.ham-radio-deluxe.com/](https://www.ham-radio-deluxe.com/)

- Tigertronics lists a variety of software that can be used with their SignaLink [http://www.tigertronics.com/sl_soft.htm](http://www.tigertronics.com/sl_soft.htm)
Several popular logging software packages support PSK31 and/or RTTY:

- Logger32 [http://www.logger32.net/index.html](http://www.logger32.net/index.html)
- N1MM Logger [http://n1mm.hamdocs.com](http://n1mm.hamdocs.com)
- Amateur Contact Log [http://www.n3fjp.com/index.html](http://www.n3fjp.com/index.html)
Hardware Installation

- Sound card interface manufacturers provide install instructions:
  - Tigertronic SignaLink
    [http://www.tigertronics.com/sl_suprt.htm](http://www.tigertronics.com/sl_suprt.htm)
  - West Mountain Radio
Additional Software

When operating JT65, the helper application JT-Alert [http://hamapps.com/](http://hamapps.com/) interfaces with either WSJT-X or JT-65HF and provides audio and visual alerts for:

- Your Callsign decoded (someone calling you).
- CQ & QRZ.
- Wanted Callsign.
- Wanted Grid (by Band).
- Wanted US State (by Band).
- Wanted DXCC (by Band).
- Wanted CQ Zone (by Band).
Software Installation

- Installation instructions are available online:
  - Fldigi [http://www.w1hkj.com/beginners.html](http://www.w1hkj.com/beginners.html)
Additional Help

Besides talking with folks at your local ham radio club, you can get help online. There are forums and groups for Fldigi, WSJT-X, JT-Alert, etc.

- http://groups.yahoo.com/group/win-fldigi/
- https://groups.yahoo.com/neo/groups/wsjtgroup/info
- https://hamapps.groups.io/g/Support
Fldigi
Soundcard Level Set

- Right-click the white colored speaker icon located in the lower-right corner of your desktop and select "Recording Devices" from the pop-up menu.

- In the new window that opens, click one time on the "Microphone - USB Audio Codec" sound card to select it and then click the "Properties" button.

- In the Properties window that opens, click the "Levels" tab.

- Right-click the percentage display to the right of the Level slider and then select "decibels".

- Lower the Level slider to "0db" or as close as you can. This is "-0.4db" in Windows 7. It might be slightly different in Vista, Windows 8 and 10, but in any case, the closest value to 0db will work just fine. Note that you can use the left/right arrow keys to move the slider once you've clicked on it. This might be easier than using your mouse.

- Click OK, then click OK on the Recording Devices window.
Tuning Up

- Too much audio output from your soundcard will distort your signal. Typically, we set RF Power output from the transceiver to 100%, and adjust audio output from soundcard to achieve desired power output. ALC should be zero. Make sure that speech compression is off. Make sure microphone is turned off.

- With my vertical antenna, typical power output for JT65 is from 10 to 25 watts; PSK31 is from 20 to 40 watts; RTTY from 50 to 70 watts. Your power output will vary depending upon the efficiency of your antenna.
Receiver Settings

- For PSK31 and JT65, set your receiver AGC (automatic gain control) off if possible, otherwise set to slow.
- Turn the RF gain down to prevent overload of the sound card input and/or distortion.
- I have found that NB (noise blanker), NR (noise reduction) are best left turned off.
- Setting receiver filter to narrow, and using any notch filter capability is very helpful when working weak signals.
Suggested Operating Frequencies

<table>
<thead>
<tr>
<th>FT8</th>
<th>JT65</th>
<th>PSK31</th>
<th>RTTY</th>
</tr>
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<tbody>
<tr>
<td>3574 kHz</td>
<td>3576 kHz</td>
<td>3580 kHz</td>
<td>3580 to 3600 kHz</td>
</tr>
<tr>
<td>7074 kHz</td>
<td>7076 kHz</td>
<td>7035 kHz, 7070 kHz</td>
<td>7080 to 7100 kHz</td>
</tr>
<tr>
<td>14074 kHz</td>
<td>14076 kHz</td>
<td>14070 kHz</td>
<td>14080 to 14100 kHz</td>
</tr>
<tr>
<td>21074 kHz</td>
<td>21076 kHz</td>
<td>21070 kHz</td>
<td>21080 to 21100 kHz</td>
</tr>
<tr>
<td>28074 kHz</td>
<td>28076 kHz</td>
<td>28120 kHz</td>
<td>28080 to 28100 kHz</td>
</tr>
</tbody>
</table>

Hope to see you on the HF Digital Bands!