

Getting Started With Digital Modes

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Introduction

- This presentation covers station and computer setup for the popular HF ham radio digital modes JT65, 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 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.
- The symbol rate is 31.25 baud.

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?

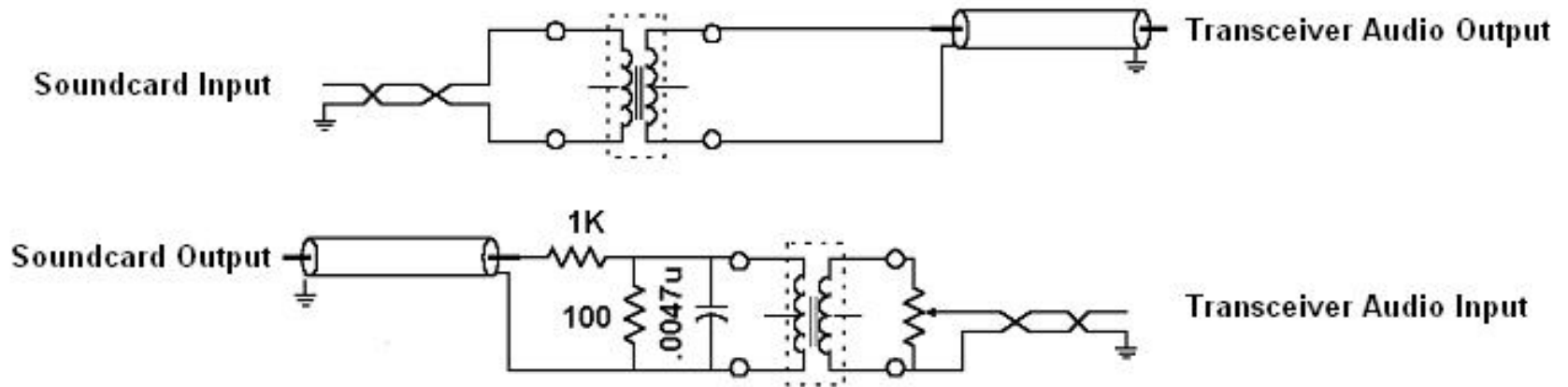
- The equipment needed to connect your rig to a computer is very modest, and can be homemade or purchased at low cost.
- The software needed is free or low cost.
- PSK₃₁ and JT65 modes work well with low power and simple antennas. RTTY is a popular mode for contests.
- Many hams use digital modes on HF, and contacts can be made anytime.
- Doesn't require good hearing by users.



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



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>

- Donner Digital Interface <http://www.donnerstore.org/>





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. WinWarbler and WSJT-X recommend setting the sound card to 16 bit, 48000 Hz (DVD Quality).



Software

- WinWarbler supports PSK₃₁ and RTTY on Windows. I use it with associated DXKeeper logging software, which allows me to easily confirm QSO via LoTW, eQSL, or paper/bureau. <http://www.dxlabsuite.com/>
- WSJT-X implements JT65 and JT9 for Windows, Linux, and Mac OS.
<http://physics.princeton.edu/pulsar/K1JT/wsjtx.html>
- Dimension 4 runs as a service on Windows to synchronize your computer's clock (required for JT65)
<http://www.thinkman.com/dimension4/>

Software (other choices)

- Ham Radio Deluxe is the most 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 sells for \$99.95. HRD uses QRZ XML callsign lookup, which costs \$29.95 per year. <http://www.hrdsoftwarellc.com/>
- JT65-HF (ongoing development discontinued) is the most popular software for JT65 on Windows. <http://jt65-hf.com/downloads/>



Software (other choices)

- Fldigi supports PSK₃₁, RTTY, and many less used digital modes for Windows, Linux, and Mac OS-X.
<http://www.w1hkj.com/>
- Several popular logging software packages support PSK₃₁ and/or RTTY:
 - Logger32 <http://www.logger32.net/index.html>
 - N1MM Logger <http://n1mm.hamdocs.com>
 - Amateur Contact Log <http://www.n3fjp.com/index.html>



Hardware Installation

- Typically sound card interface manufacturers provide decent install instructions:
- Tigertronic Signalink
http://www.tigertronics.com/sl_suprt.htm
- West Mountain Radio
<http://www.westmountainradio.com/content.php?page=support>



Additional Software

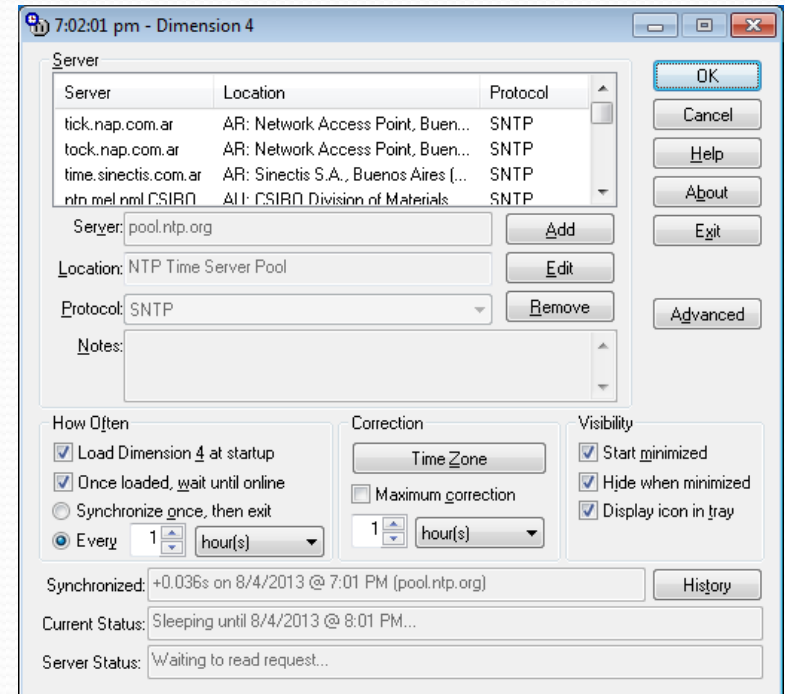
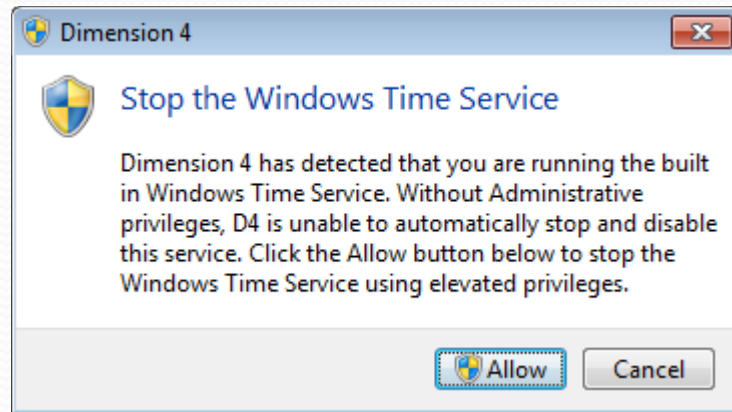
- When operating JT65, the helper application JT-Alert <http://ham-apps.com/> interfaces with either WSJT-X or JT-65HF and provides audio and visual alerts for:
 - Your Callsign decoded (someone calling you).
 - CQ & QRZ.
 - Wanted Callsign.
 - Wanted Grid (by Band).
 - Wanted US State (by Band).
 - Wanted DXCC (by Band).
 - Wanted CQ Zone (by Band).

Software Installation

- Installation instructions are available online:
- WinWarbler (DXLab) <http://www.dxlabsuite.com/>
- WSJT-X has a detailed User's Guide
<http://physics.princeton.edu/pulsar/K1JT/wsjtx.html>

Dimension 4 Install

- Dimension 4 (or equivalent) is needed on most computers when operating JT65 so that the computer time is within a second of the other ham's computer time.





Additional Help

- Besides talking with folks at your local ham radio club, you can get help online. There are forums and groups for DXLab (WinWarbler), JT65, HRD (Ham Radio Deluxe), etc.
- <http://groups.yahoo.com/group/dxlab/>
- <https://groups.google.com/forum/#!forum/jt65-hf>
- <http://forums.hrdsoftwarellc.com/>

WinWarbler

WinWarbler 7.7.4 for AF5FH @ 2013-08-04 21:21 Z [CC,DXK,PF]

QSO Info (Receive Pane 1) started @ 04-Aug-2013 21:20:50

Call ? W6MSB/W7 rst S 599 rst R 599 Name Mark DXCC K Begin Log X
QSL Via CQ ITU QTH Greenough Mt Cont NA End Spot
Buro Grid DN36gv ARRL State MT County

Xcvr Freq
RX 14,070.000
TX 14,070.000
Config Help

W6MSB/W7 de AF5FH
RST: 599 599
Name: Jim Jim
QTH: Albuquerque, New Mexico
Grid: DM65sc DM65sc
Mark, I copy you 100%
how copy?
btu Mark W6MSB/W7 de AF5FH kn
eAF5FH de W6MSB/W7 73 Jim and thanks for QSO. Hope to cu agn during portable ops in Montana, and agn at home
oTH in CA. QSL 100% info QRZ.com.
AF5FH de e te et
W6MSB/W7 de AF5FH
qsl via eQSL andLoTW OK
Thanks for this PSK31 QSO Mark, 73 and good DX!
W6MSB/W7 de AF5FH sk sk

Macros: psk sample
alt F5 alt F6 alt F7 alt F8 ALT alt F9 alt F10 alt F11 alt F12
alt sh F5 alt sh F6 alt sh F7 alt sh F8 alt sh F9 alt sh F10 alt sh F11 alt sh F12

Operating Mode
 CW PSK31
 Phone PSK63
 RTTY PSK125

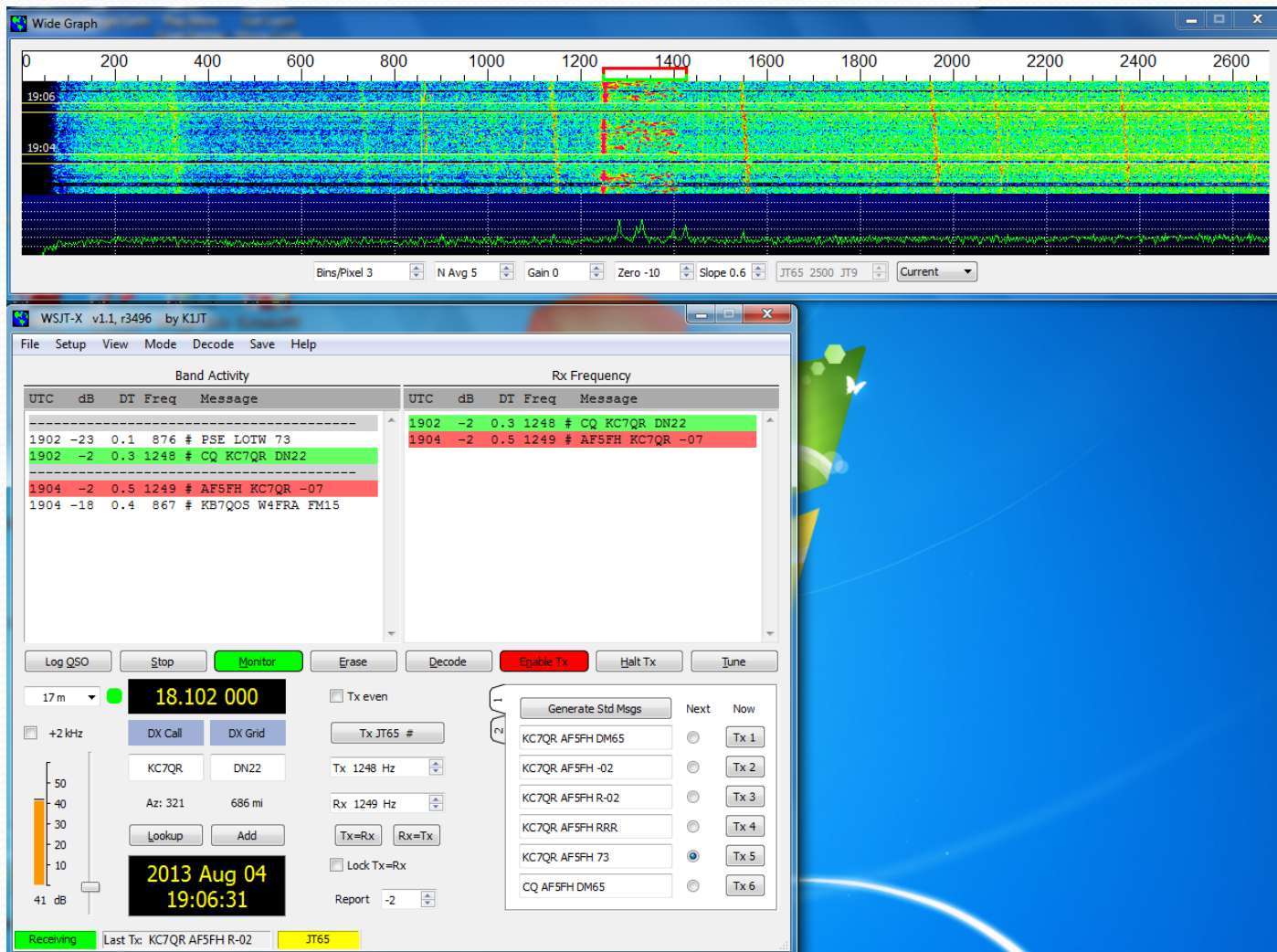
Receive Channel 1 (BPSK31 USB)
Freq: 14,071.677 9 86
 AFC BBD
IMD X
Opt 25 i p: ~

Transmit (BPSK31 USB)
Freq: 14,071.677 net ch 1 split tune ID
QSO F1 F2 F3 F4 Esc
Set Freq Start CW ID Stop Abort

Tuning Display
Vert height 1.0
Horiz zoom 1
Horiz pan

14070 14071 14072 14073

WSJT-X



Ham Radio Deluxe

The screenshot displays the Ham Radio Deluxe software interface during a QSO. The main window is titled "IC-7200" and shows a frequency of 14.070.000 MHz. The interface is divided into several sections:

- Top Panel:** Includes a menu bar (File, Edit, View, QSO, Browser, Logbook, SSTV, SuperSweeper, World Map, Tools, Window, Help) and a toolbar with icons for QSO, SuperSweeper, Radio, Soundcard, Waterfall, HRD, Logbook, and Program Options. A digital display shows the time 15:45:31.
- Left Panel:** Contains controls for the IC-7200 radio, including a large frequency display (14.070.000), a signal strength indicator (S4), and buttons for TX and DATA-ON. It also shows Mode (USB) and Filter (FL1).
- Center Panel:** Features an "Add Log Entry" form with fields for (F2) Start (15:43), (F3) End (15:45), (F5) Call, Name, QTH, Locator, Country, Frequency (14.070.000), Band (20m), Mode (PSK31), Sent (599), and Rcvd (599). There are also buttons for Add (F7) and Reset (F4).
- Right Panel:** Contains a "Tags" section with expandable categories: "About Me" (Callsign: AFSFH, Name: Jim, Age: 55, Locator: DM65sc, QTH: Albuquerque, NM, E-Mail, HomePage: http://www.qrz.com, Clubs), "My Equipment" (Radio: Icom IC-7200, Antenna: Hy-Gain AV640 vert, Power: 30 watts, Computer, Interface, Accessories), "Other" (Temperature, Weather, Other1-4), and "Computer" (Mode: BPSK-31, Program: DM780 v5.24.0.38, ProgramFull: Digital Master 780 v). Below this is a text window showing a QSO transcript.
- Bottom Panel:** Features a "Waterfall" display showing a spectrum from 100 to 3000 kHz. The current frequency is 1197 kHz. The display shows a strong signal at the current frequency. Below the waterfall is a status bar with "Ready", "CPU: 2%", "Audio: 42%", and "Overload".

The QSO transcript in the right panel shows the following text:

anyway, another suggestion would be to see if there is a Yahoo Group for the antenna tuner you are using, and post a question there also could try the forums on eHam or QRZ
I have gotten some helpful hints when I ask questions on eHam
KI6NOX de AFSFH 73 Richard and thanks for PSK31 QSO 462 on 20m.
KI6NOX de AFSFH sk
AFSFH Jim de KI6NOX
Yes, I see you are closing out sok
ending
Yes loose connections are a killer -- will check
Thank you very much
Thank you AFSFH Jim for the nice QSO
My best to you and your family
Logged on local 8/4/2013 08:43 Pacific Daylight Time and ZULU 2013-08-04 15:03Z
eQSL is OK
With this TX I will c
over and out CL

Below the transcript, there is another section of text:

and found a loose connection at the coil/trap for 20 meters
all other bands were fine
anyway, another suggestion would be to see if there is a Yahoo Group for the antenna tuner you are using, and post a question there also could try the forums on eHam or QRZ
I have gotten some helpful hints when I ask questions on eHam
KI6NOX de AFSFH <add-log>73 Richard and thanks for PSK31 QSO 462 on 20m.
KI6NOX de AFSFH sk <stop>

JT65-HF

JT65-HF Version 1.0.9.3 [AF5FH QRV]

Setup Rig Control Raw Decoder Transmit Log About JT65-HF

Audio Input Levels
 L 4
 R 4
 Optimum input level is 0 with only background noise present.
 Digital Audio Gain
 L: -6
 R: -6

2013-Aug-04
 17:14:10
 Dial QRG KHz
 14076

Current Operation: Transmitting
 RX/TX Progress

Color-map Brightness Contrast Speed Gain
 Blue 5 0 Smooth

Transmitting: AF5LI AF5FH RRR
 TX Text (13 Characters) **TX IN PROGRESS**

TX Generated
 AF5LI AF5FH RRR TX Even TX Odd

Clear Decodes Decode Again 0 DT Offset Restore Defaults

Double click an entry in list to begin a QSO. Right click copies to clipboard.

UTC	Sync	dB	DT	DF	Exchange
17:13	9	-11	-0.0	-100	B AF5FH AF5LI R-19
17:11	7	-9	0.8	794	B CQ WA6OWM DM03
17:11	6	-16	-0.3	573	B KL2DV N8DZW R-21
17:11	7	-11	-0.2	347	B NV00 KF5KCE 73
17:11	5	-10	-0.3	92	B K4APJ NZ8V -15
17:11	5	-12	0.1	-100	B AF5FH AF5LI DM90
17:11	4	-12	-0.5	-310	B WA7AG KK8G R-10
17:09	5	-15	0.8	794	B CQ WA6OWM DM03
17:09	6	-16	-0.2	573	B KL2DV N8DZW R-21
17:09	7	-11	-0.2	350	B NV00 KF5KCE RRR
17:09	13	-12	-0.2	118	B CQ NZ8V EN73
17:09	6	-11	-0.4	-310	B WA7AG KK8G R-10
17:08	5	-12	-0.5	-423	K IS0GQX AE6XG DM12

Call CQ and answer callers

Answering CQ Send 73

TX DF RX DF TX DF = RX DF TX to Call Sign Rpt (#)
 -100 -100 AFC AF5LI -12
 Noise Blank

Single BW Multi BW Enable Multi
 100 100 Enable RB Enable PSKR

RB/PSKR Counts 31
 Sound In:
 03-Icom IC-7200 (3- USB Audio CODE)
 Sound Out:
 08-Icom IC-7200 (3- USB Audio CODE)

Find Your Grid Square

- Digital Mode software will ask you your grid square during installation. Find your grid square from your call sign or street address:

http://www.levinecentral.com/ham/grid_square.php

Amateur Radio Ham Radio Maidenhead Grid Square Locator Map

Enter any address, city & state or zip:

or Enter any call sign: Data provided by QRZ.com

or Enter any a 4 or 6 character grid square:

Call [AF5FH](#) found for [JAMES KAJDER](#)
Address found: 13205 Hugh Graham Road NE Albuquerque NM 87111 United States
Latitude: 35.1201 Longitude: -106.491
Accuracy: High - Address

Grid: [DM65sc](#)



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.
- 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.

Suggested Operating Frequencies

JT65 HF	PSK ₃₁	RTTY
3576 kHz	3580 kHz	3580 to 3600 kHz
7076 kHz	7035 kHz	7080 to 7100 kHz
10138 kHz	10140 kHz	
14076 kHz	14070 kHz	14080 to 14100 kHz
18102 kHz	18100 kHz	
21076 kHz	21070 kHz	21080 to 21100 kHz
24917 kHz	24920 kHz	
28076 kHz	28120 kHz	28080 to 28100 kHz



Closing Thoughts

- When using PSK₃₁, use lower case whenever possible. Different characters are represented by a variable-length combination of bits called Varicode. Lower case letters have the shortest patterns and are the fastest to transmit.
- Please upload your log to Logbook of the World (LoTW) and eQSL.cc (The Electronic QSL card center). The logging programs with DXLab and HRD make it “one button click” to upload.
- Hope to see you on the bands!