

FT8
(Franke-Taylor design, 8-FSK
Modulation)

A new, robust and highly versatile
digital mode for HF

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What you will need to get on the air with FT8

- You should use a modern HF radio which likely has a built-in sound card. Examples of some common HF rigs (IC-7300, IC-7610, TS-590, FTDX-1200 and many more). If your rig has no sound card, the program (*WSJT-X*) will use your computer's sound card OR you may use an interface between the radio and computer such as the USB Signalink (~ \$100 + Tax at GigaParts in Las Vegas).
- You need a computer (desktop or laptop) with a 1.5 GHz or higher Pentium processor and at least 2GB of RAM installed and 200 MB of available memory.
- A monitor with at least 1024 X 780 resolution.
- It is **strongly advised** that you read, **in its entirety**, the new *WSJT-X* v.2.0.0 user guide available at: <http://physics.princeton.edu/pulsar/k1jt/wsjt-x-doc/wsjt-x-main-2.0.0.html>
- You will need to download and install the latest version of *WSJT-X* (v.2.0.0) at the link provided within the user guide documentation above or you can download it at SourceForge.net.
- **Important Note**: Earlier versions of *WSJT-X* will **NOT** decode currently generated 77-bit FT-8 messages. The latest version of *WSJT-X* was released on Dec. 10, 2018. Earlier versions would be sufficient for some of the other digital modes contained within the *WSJT-X* program but not FT8.

FT8 Basics

- FT8 is a **synchronous** digital mode for HF similar in character to its cousins JT65 and JT9 and its successful operation depends on accurate timing.
- FT8 requires a computer with a program designed to provide **accurate timing** through the internet.
- FT8 requires a program called WSJT-X or JTDX for the encoding and decoding of FT8 signals.
- FT8 uses 15 second TX/RX intervals.
- FT8 requires a connection between the radio and the computer (usually a USB connection) in order for the program to control the radio.
- **Always use low power** (20-40W) to avoid unnecessary interference to other hams.
- FT8 is a weak signal mode and **NOT** a high power mode.
- When setting up your transceiver for FT8 (or other similar digital modes), ensure that there is zero or very little ALC activity on transmit. This ensures a cleaner, less over driven signal in most all cases.

FT8 Basics Cont'd.

- You must read the WSJT-X user guide in its entirety!
- <http://physics.princeton.edu/pulsar/K1JT/wsjt-x-doc/wsjt-x-main-1.9.1.html#INTRO>
- Timing programs: Meinberg NTP, Dimension4, NetTime (easy, highly reliable, accurate, trouble free, etc.)
- NetTime is what I've been using for all digital modes for years and is infallible. Other programs are complicated, problematic and require much more computer memory and expertise.
- FT8 was designed for multi-hop E-skip where signals will be weak and fading, openings may be short, and for fast completion of reliable and confirmable QSO's.
- Using low power cannot be emphasized enough. Examples of the deleterious effects of using high power and/or improper ALC settings will be shown later in this presentation.

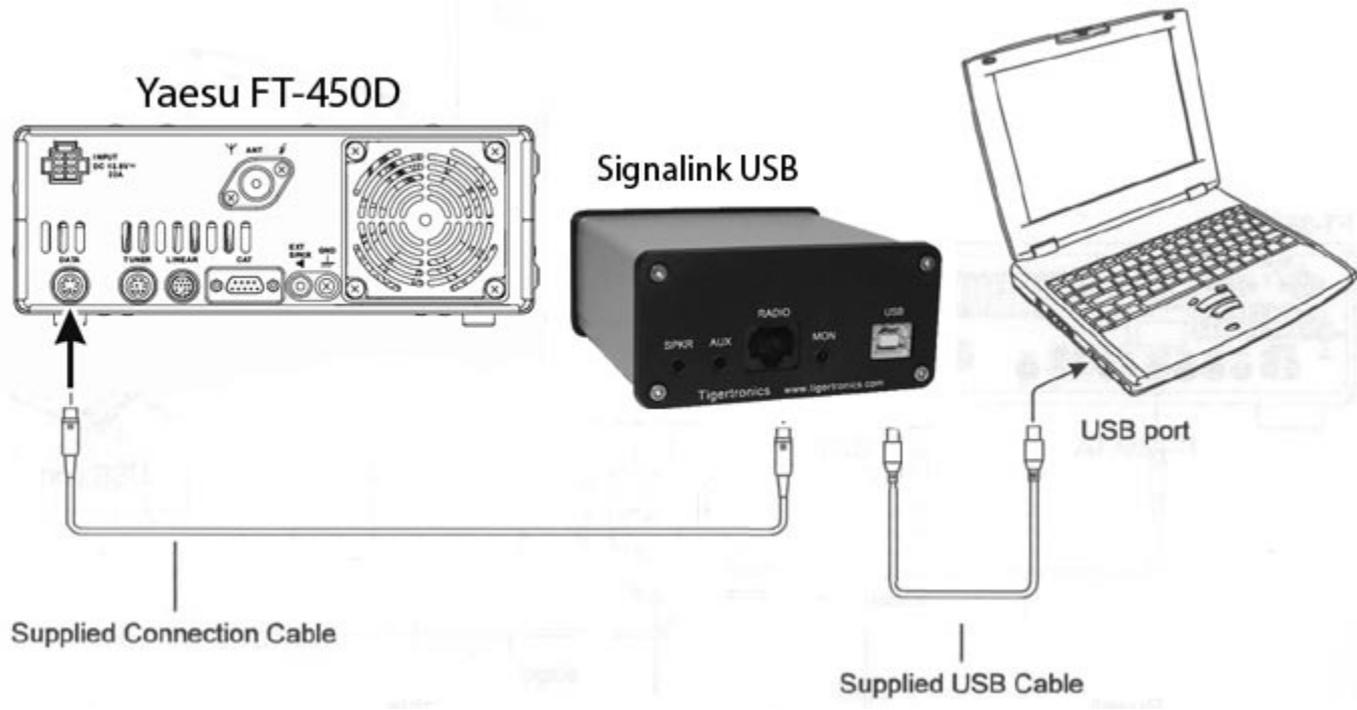
Software and Hardware Requirements

- Download the latest version of *WSJT-X* (v 2.0.0)
- Starting Jan 1, 2019 version 2.0 will not be backwards compatible with earlier versions and will not decode FT8 sigs generated by the older versions.
- JTDX is another program you can use. It's very similar to *WSJT-X* but has more functionalities and a different user interface.
- Minimum Pentium based PC (or equiv.) at 1.5 GHz or higher with at least 2 GB of RAM.
- You will also need an accurate clock timing program such as Meinberg NTP, Dimension 4 or NetTime.
- Your clock needs to be accurate to within ± 0.5 sec or so.
- The sound system in your computer needs to be set to sample at 48,000 Hz and 16-bits.

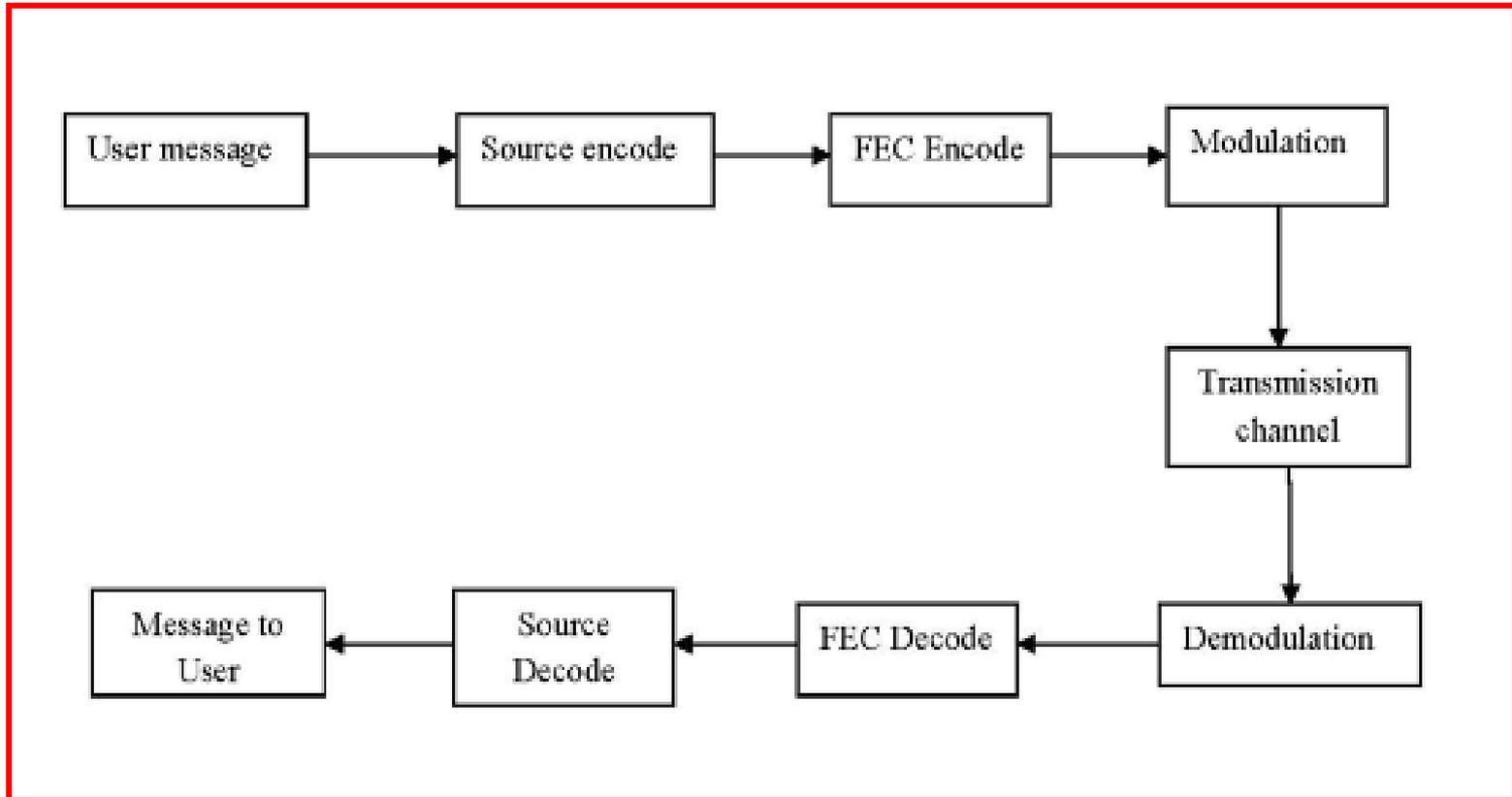
WSJT-X

- Open source software developed by the K1JT team
- Can operate the following digital modes: FT8, JT65, JT9, JT4, QRA64, MSK144, ISCAT, WSPR and Echo.
- The most common software used by amateurs for these modes
- Simple to use and highly versatile
- Newest version has the so-called “DXpedition mode”
- In DXpedition mode, you are the “Hound” and the DX station is the “Fox”
- You will likely never use the Fox functionality, only the hound
- The Fox can use up to five streams on a single transmission
- *WSJT-X* v.2.0.0 now supports various contest modes including ARRL Field Day, ARRL RTTY Roundup, NA and EU VHF contests.

Typical Station Setup for Digital HF using a Signalink USB



Block diagram showing steps in a typical digital communication System⁵



How do FT8 and Similar Synchronous Digital Modes Work?

- Digital information is modulated onto a carrier and transferred over a radio channel.
- The basic unit of transmitted data is a “*channel symbol*”.
- These *channel symbols* are each represented by numbers comprised of bits.
- The modulator will transmit m information bits in each symbol using 2^m different waveforms representing symbol values from 0 to $2^m - 1$
- The different waveforms may have distinct amplitudes, phases, frequencies or shapes. The *WSJT-X* waveforms are made of sinusoids with constant amplitude.
- Modes employing *frequency shift keying (FSK)* use a different tone frequency representing each allowed symbol value.
- Binary modulation ($m = 1$) implies transmitting only one bit at a time.
- Modulation schemes with larger m are used to an advantage in all but one of the *WSJT-X* modes.
- Controlled redundancy to a digital message to correct for errors can be obtained trivially via simple repetition of each symbol. However, much more powerful redundancy is achieved by mapping each sequence of k message symbols, in a controlled way, into a unique and longer sequence of n symbols called a *codeword*.
- This technique is known as *Forward Error Correction (FEC)*.¹

How do FT8 and similar synchronous digital modes work?

Cont'd

- *WSJT-X* protocols use **block codes** where the values of n and k are fixed and labeled as (n,k) codes. An integer parameter q is used to define a range of available symbol values for a code (similar to the m values used in the modulation scheme).
- Parameter $Q = 2^q$ is then created and defined as the **alphabet size** of the code.
- The code symbol values range from 0 to $Q - 1$ and each codeword conveys kq message bits.
- The amount of redundancy is characterized as by the ratio n/k , and its reciprocal k/n is known as the *code rate*. The mathematics underlying the design of such k -to- n mapping schemes and their corresponding n -to- k reverse transformations, forms a major branch of modern communication theory.
- Reception of transmitted symbols requires accurate synchronization of time and frequency between transmitting and receiving stations. To make this possible with typical amateur radio equipment, each *WSJT-X* protocol includes a unique synchronizing pattern: a sequence of known symbols interspersed with those carrying message information.²

Table obtained from November, 2017 QST article by Joe Taylor, K1JT, Steve Franke, K9AN and Bill Somerville, G4WJS

Parameters of the slow WSJT-X Protocols

Bandwidths (BW) are for the narrowest submodes. S/N threshold is referenced to a 2.5kHz bandwidth at a 50% probability for decoding of an unfading signal

Mode	FEC type (n,k)	q m	Modulation	Keying rate, baud	BW, Hz	Sync energy	TX duration, s	S/N threshold, dB
FT8	LDPC(174,87)	1 3	8-FSK	6.250	50.0	0.27	12.6	-20
JT4	C(206,72)	1 2	4-FSK	4.375	17.5	0.50	47.1	-23
JT9	C(206,72)	1 3#	9-FSK	1.736	15.6	0.19	49.0	-27
JT65	RS(63,12)	6 6#	65-FSK	2.692	177.6	0.50	46.8	-25
QRA64	QRA(63,12)	6 6	64-FSK	1.736	111.1	0.25	48.4	-26

#Modulation includes one additional tone used for synchronization³

Conventional Dial Frequencies for FT8, JT65, JT9 and WSPR

Band (m)

Frequencies (MHz)

	FT8	JT65	JT9	WSPR
160	1.840	1.838	1.839	1.8366
80	3.573	3.570	3.572	3.5686*
40	7.074	7.076	7.078	7.0386
30	10.136	10.138	10.140	10.1387
20	14.074	14.076	14.078	14.0956
17	18.100	18.102	18.104	18.1046
15	21.074	21.076	21.078	21.0946
12	24.915	24.917	24.919	24.9246
10	28.074	28.076	28.078	28.1246
6	50.313	50.310†	50.312	50.293

How does FT8 compare to its cousins JT65 & JT9?

- FT8 is narrower (50 Hz) than JT65 (178 Hz) but wider than JT9 (15.6 Hz).
- FT8 is not as sensitive as JT65 & JT9 (-24 dB vs. -29 dB).
- FT8 uses shorter XMIT and Receive intervals (15s vs. 60s).
- FT8 QSO's are completed in 1.5 min vs. 6.0 min for JT65/JT9.
- FT8 uses FEC just like JT65 & JT9.
- FT8 uses 8-FSK modulation with a keying rate/tone spacing of 6.25 Hz (there is no synch tone, unlike JT65).
- FT8 uses Low-Density-Parity-Check Code LDPC (174,87). It is a linear error correcting type code.
- Occupied bandwidth is 50 Hz.

Important characteristics of FT8:

- T/R sequence length: 15 s
- Message length: 77 bits + 14-bit CRC (Cyclic Redundancy Code)
- FEC code: LDPC(174,87)
- Modulation: 8-FSK, keying rate = tone spacing = 6.25 Hz
- Waveform: Continuous phase, constant envelope
- Occupied bandwidth: 50 Hz
- Synchronization: three 7x7 Costas arrays (start, middle, end of Tx)
- Transmission duration: $79 * 1920 / 12000 = 12.64$ s
- Decoding threshold: -20 dB (perhaps -24 dB with AP decoding)
- Operational behavior: similar to HF usage of JT9, JT65
- Multi-decoder: finds and decodes all FT8 signals in passband
- Auto-sequencing after manual start of QSO

Color coding in WSJT-X

- CQ's appear in band activity screen and are colored blue
- When you choose and double click a CQ, the CQ is copied onto the RX frequency section and is colored green.
- All text that you transmit appear in RX freq. section and are colored yellow.
- All text that contains your call sign is colored red
- Default colors may be changed in settings menu
- You may control everything on the radio through the software (i.e., band, mode, power, etc.)
- The date and time appear and the time is in UTC
- The exact dial frequency is also shown

Settings Menu Items in WSJT-X

The screenshot shows the 'Settings' dialog box for WSJT-X, with the 'Radio' tab selected. The dialog is titled 'Settings' and has a standard Windows window border with a question mark and close button in the title bar. The 'Radio' tab is active, and the 'General' tab is also visible. The 'Station Details' section contains fields for 'My Call' and 'My Grid', an 'AutoGrid' checkbox, and an 'IARU Region' dropdown menu set to 'All'. Below this is a 'Message generation for type 2 compound callsign holders' dropdown menu set to 'Full call in Tx3'. The 'Display' section has five checkboxes: 'Blank line between decoding periods', 'Display distance in miles', 'Tx messages to Rx frequency window', 'Show DXCC entity and worked before status', and 'Show principal prefix instead of country name'. There are two buttons, 'Font...' and 'Decoded Text Font...', to the right of the first two checkboxes. The 'Behavior' section has eight checkboxes: 'Monitor off at startup', 'Monitor returns to last used frequency', 'Double-click on call sets Tx enable', 'Disable Tx after sending 73', 'CW ID after 73', 'Enable VHF/UHF/Microwave features', 'Allow Tx frequency changes while transmitting', and 'Single decode'. There are also two spinners: 'Tx watchdog' set to '6 minutes' and 'Periodic CW ID Interval' set to '0'. At the bottom right, there are 'OK' and 'Cancel' buttons.

Settings

General Radio Audio Tx Macros Reporting Frequencies Colors Advanced

Station Details

My Call: My Grid: AutoGrid IARU Region: All

Message generation for type 2 compound callsign holders: Full call in Tx3

Display

Blank line between decoding periods

Display distance in miles

Tx messages to Rx frequency window

Show DXCC entity and worked before status

Show principal prefix instead of country name

Behavior

Monitor off at startup Enable VHF/UHF/Microwave features

Monitor returns to last used frequency Allow Tx frequency changes while transmitting

Double-click on call sets Tx enable Single decode

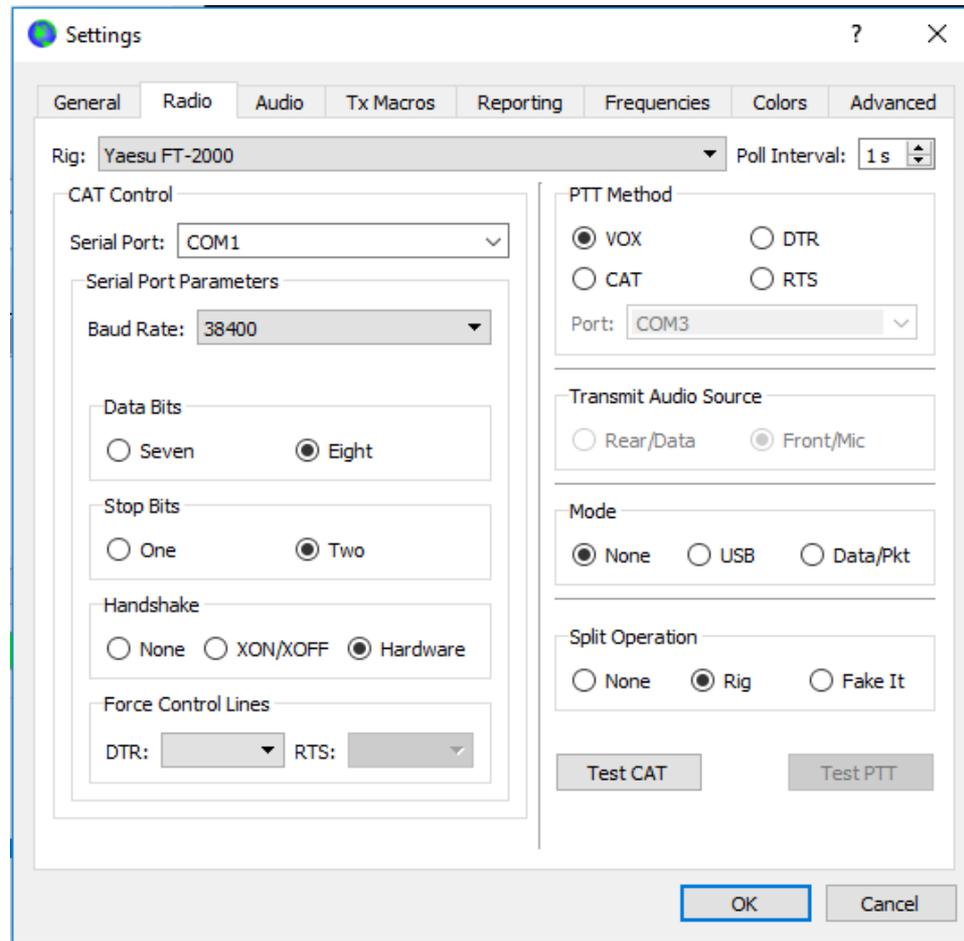
Disable Tx after sending 73 Decode after EME delay

CW ID after 73 Tx watchdog: 6 minutes

Periodic CW ID Interval: 0

OK Cancel

Radio settings in WSJT-X



General Settings tab in WSJT-X for IC-7300

The screenshot shows the 'Settings' dialog box for WSJT-X, with the 'General' tab selected. The window title is 'Settings' and it has standard Windows window controls (minimize, maximize, close). The 'General' tab is active, and other tabs include 'Radio', 'Audio', 'Tx Macros', 'Reporting', 'Frequencies', 'Colors', and 'Advanced'.

Station Details

My Call: My Grid: AutoGrid IARU Region:
Message generation for type 2 compound callsign holders:

Display

Blank line between decoding periods
 Display distance in miles
 Tx messages to Rx frequency window
 Show DXCC, grid, and worked-before status
 Show principal prefix instead of country name

Behavior

Monitor off at startup Enable VHF/UHF/Microwave features
 Monitor returns to last used frequency Allow Tx frequency changes while transmitting
 Double-click on call sets Tx enable Single decode
 Disable Tx after sending 73 Decode after EME delay
 CW ID after 73 Tx watchdog:
Periodic CW ID Interval:

Radio Settings tab in WSJT-X for IC-7300

The screenshot shows the 'Settings' dialog box in WSJT-X, with the 'Radio' tab selected. The 'Rig' is set to 'Icom IC-7300' and the 'Poll Interval' is '1 s'. The 'CAT Control' section includes 'Serial Port' (COM3) and 'Serial Port Parameters' (Baud Rate: 19200). The 'Data Bits' are set to 'Eight', 'Stop Bits' to 'One', and 'Handshake' to 'None'. The 'Force Control Lines' section has 'DTR' and 'RTS' dropdown menus. The 'PTT Method' section has 'CAT' selected, with 'Port' set to 'COM3'. The 'Transmit Audio Source' is 'Front/Mic', and the 'Mode' is 'Data/Pkt'. The 'Split Operation' is 'Fake It'. There are 'Test CAT' and 'Test PTT' buttons. The 'OK' button is highlighted in blue.

Settings

General Radio Audio Tx Macros Reporting Frequencies Colors Advanced

Rig: Icom IC-7300 Poll Interval: 1 s

CAT Control

Serial Port: COM3

Serial Port Parameters

Baud Rate: 19200

Data Bits

Default Seven Eight

Stop Bits

Default One Two

Handshake

Default None

XON/XOFF Hardware

Force Control Lines

DTR: RTS:

PTT Method

VOX DTR

CAT RTS

Port: COM3

Transmit Audio Source

Rear/Data Front/Mic

Mode

None USB Data/Pkt

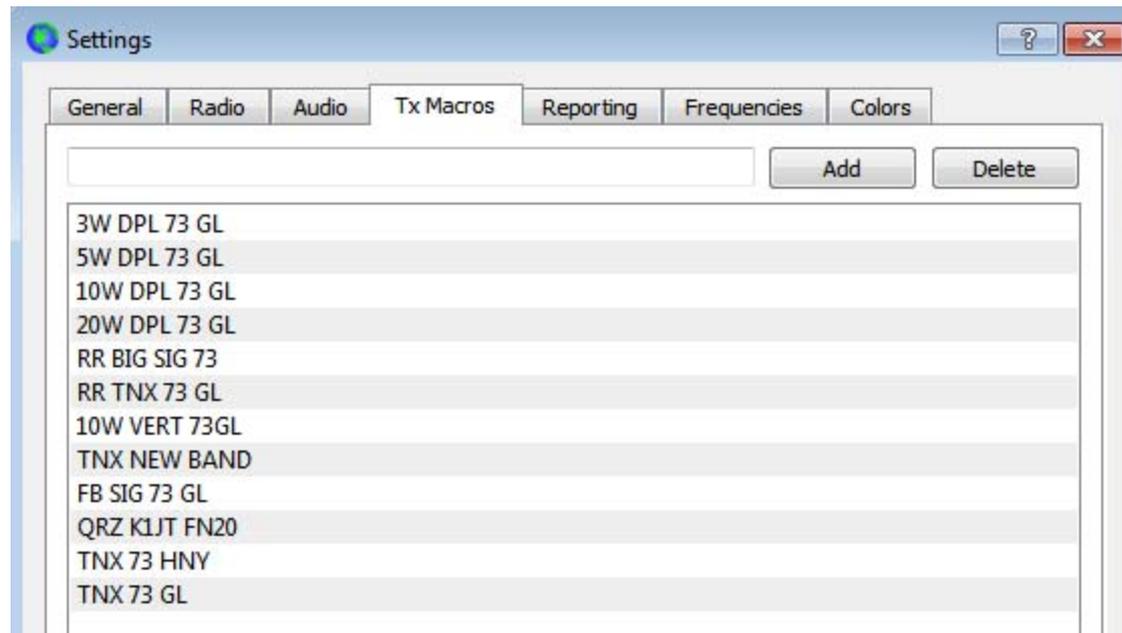
Split Operation

None Rig Fake It

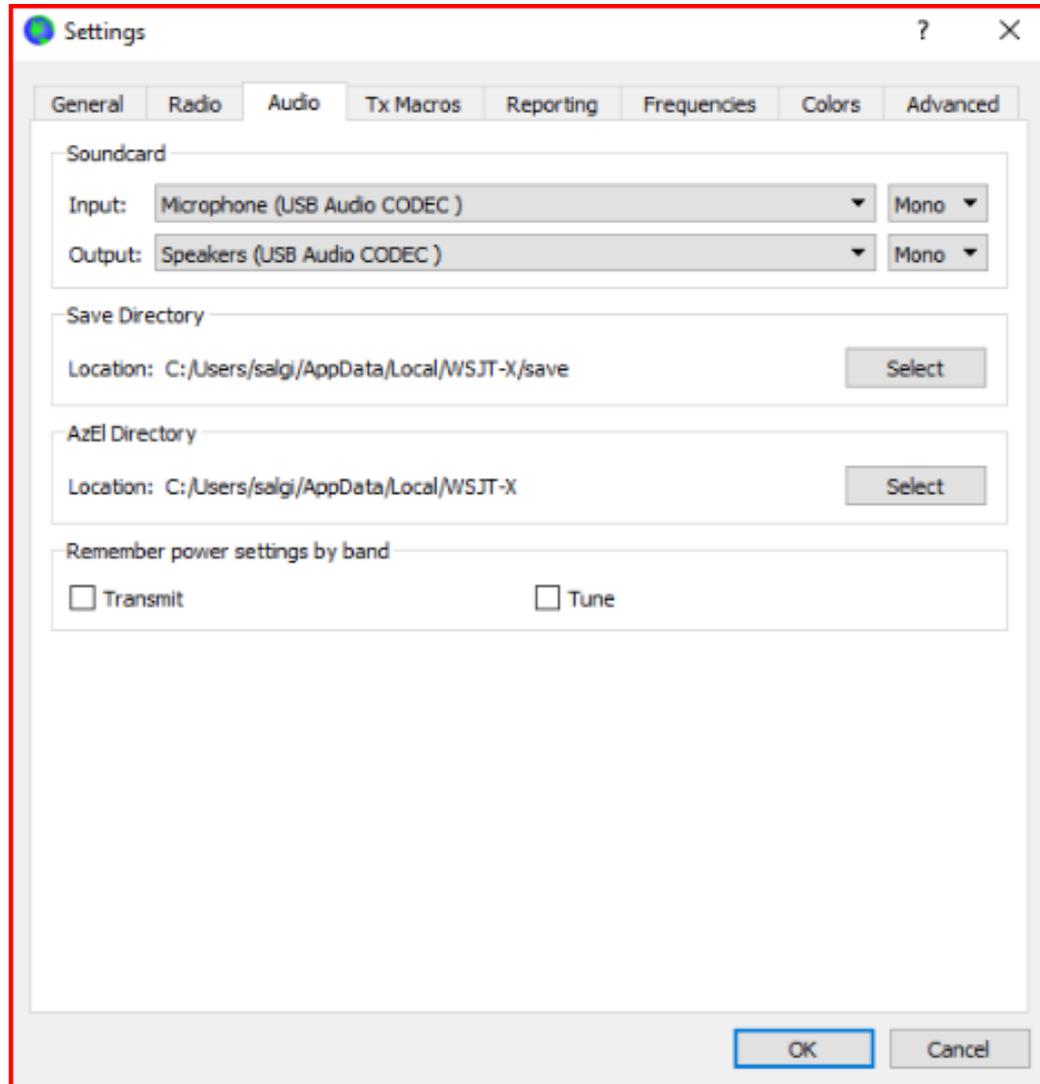
Test CAT Test PTT

OK Cancel

TX Macros (Optional messages): Limited to 13 characters (spaces count as one character)



Audio Settings tab in WSJT-X for the IC-7300



Reporting Settings in WSJT-X for the IC-7300

The image shows a screenshot of the 'Settings' dialog box in WSJT-X, specifically the 'Reporting' tab. The dialog box has a title bar with a question mark and a close button. The 'Reporting' tab is selected, and the 'Op Call' field is empty. The 'Logging' section contains five checkboxes: 'Prompt me to log QSO' (checked), 'Log automatically' (unchecked), 'Convert mode to RTTY' (unchecked), 'dB reports to comments' (checked), and 'Clear DX call and grid after logging' (unchecked). The 'Network Services' section has one checked checkbox: 'Enable PSK Reporter Spotting'. The 'UDP Server' section has three fields: 'UDP Server' (127.0.0.1), 'UDP Server port number' (2237), and three checkboxes: 'Accept UDP requests' (unchecked), 'Notify on accepted UDP request' (unchecked), and 'Accepted UDP request restores window' (unchecked). The 'N1MM Logger+ Broadcasts' section has one unchecked checkbox: 'Enable logged contact ADIF broadcast', and two fields: 'N1MM Server name or IP address' (127.0.0.1) and 'N1MM Server port number' (2333). The 'OK' and 'Cancel' buttons are at the bottom right.

Settings

General Radio Audio Tx Macros Reporting Frequencies Colors Advanced

Logging

Prompt me to log QSO Op Call:

Log automatically

Convert mode to RTTY

dB reports to comments

Clear DX call and grid after logging

Network Services

Enable PSK Reporter Spotting

UDP Server

UDP Server: Accept UDP requests

UDP Server port number: Notify on accepted UDP request

Accepted UDP request restores window

N1MM Logger+ Broadcasts

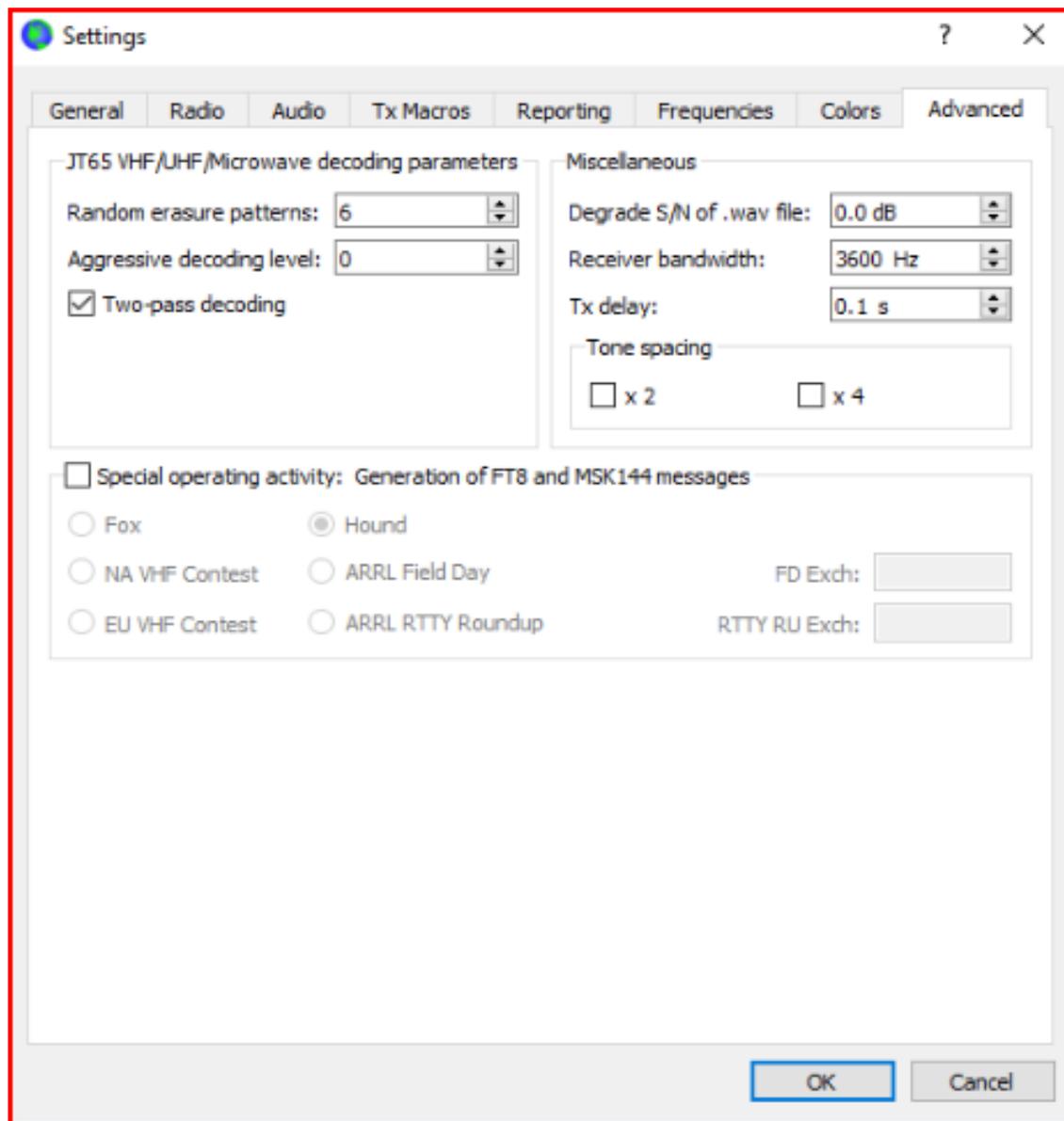
Enable logged contact ADIF broadcast

N1MM Server name or IP address:

N1MM Server port number:

OK Cancel

Advanced Settings in WSJT-X for the IC-7300



WSJT-X Log Dialog Box

Log QSO

Click OK to confirm the following QSO:

Call	Date	Time	Mode	Band
ON4QX	2013-07-02	2138	JT65	20m

Rpt Sent	Rpt Rcvd	Grid	Name
-13	-15	JO20	Herman

Tx power: 10 W Retain

Comments: JT65 Sent: -13 Rcvd: -15 Retain

OK Cancel

Methods for initiating contacts

- Calling CQ (Ex. CQ KM6JD DM26)
- Responding to other stations calling CQ
- All messages containing CQ's are highlighted in blue EXCEPT those who you have worked before on that band which are highlighted in green.
- Calling a DX station using the split frequency method
- If you are calling a rare DX station it is strongly recommend that your transmitting frequency not be on their receive freq.
- Try your best by transmitting on a clear frequency
- DXpedition mode (Fox and Hound)
- WSJT-X v.2.0.0 now supports various contest modes including ARRL Field Day, ARRL RTTY Roundup, NA and EU VHF contests.
- More supported contest modes are in the pipeline.

Examples of contacts initiated by calling CQ or answering a CQ in WSJT-X

Calling CQ

CQ KM6JD DM26

KM6JD W1AW FN31

W1AW KM6JD -04

KM6JD W1AW R+02

W1AW KM6JD RR73

KM6JD W1AW 73

Answering a CQ

W1AW KM6JD DM26

KM6JD W1AW -07

W1AW KM6JD R-05

KM6JD W1AW RR73

W1AW KM6JD 73

- CQ's are colored blue by default (green if already worked) and can be answered simply by double clicking.
- Use of the Auto-Sequencer greatly improves reliability and accuracy.

Example of Calling CQ (WSJT-X)

The image displays the WSJT-X software interface. The top window, titled "WSJT-X - Wide Graph", shows a waterfall plot of the 20m band from 19:28:30 to 19:30:15. A green waveform is overlaid on the plot, indicating a signal at 14.074500 MHz. The bottom window, titled "WSJT-X v1.9.1 by K1JT", shows a log of received and transmitted messages. The log contains the following entries:

Time	Offset	Power	Frequency	Message
193015	-5	-0.8	2179	K5VJZ KD2ONF -13
193015	4	0.2	2295	SV5AZK KOPT R-17
193015	-14	-1.3	2554	JA9BFN NOPNQ 73
193015	-7	0.2	2612	VE2YNI WAOIYY R+06
193015	-13	0.2	211	N2IPH Z54AZ RRR
193015	-20	0.1	734	KC5E2C K7IN 73
193015	-18	0.1	1236	KZ4HX JF1LMB R-11
193015	-2	-0.1	1522	PY5AIE VE2ANW FN35
193015	-7	0.4	1994	NFSO WV2NY 73
193015	-22	0.1	752	CQ K7PRT DN20
192900			2379	Tx CQ KM6JD DM26
192915	-4	0.1	2380	KM6JD WSARE EN80
192930			2379	Tx WSARE KM6JD -04
192945	0	0.2	2379	KM6JD WSARE R-04
193000			2379	Tx WSARE KM6JD RRR
193015	-6	0.1	2379	KM6JD WSARE 73
193030			2379	Tx WSARE KM6JD 73

The interface also shows a control panel with the following settings:

- Frequency: 14.074 500
- Mode: S
- Band: 20m
- Power: 80
- TX/RX: Tx 2379 Hz, Rx 2379 Hz
- Buttons: Calling CQ, Answering CQ, CQ, Grid, dB, R+dB, RRR, 73
- Message: CQ KM6JD DM26
- Options: Tx even/1st, Hold Tx Freq, Report -6, Auto Seq, Call 1st

The status bar at the bottom indicates: Tx: WSARE KM6JD 73, FT8, Last Tx: WSARE KM6JD RRR, 10/15 WD:6m.

Example of answering a CQ (WSJT-X)

The image shows two windows from the WSJT-X software. The top window is a 'Wide Graph' showing a waterfall plot of radio frequency activity. The bottom window is the main control interface, displaying a 'Band Activity' table and various control buttons.

Band Activity Table:

Band Activity					Rx Frequency				
UTC	dB	DI	Freq	Message	UTC	dB	DI	Freq	Message
193300	-21	0.3	2553	- CQ DX JA9BPN FM86	193200	-8	0.3	2377	- CQ N3EMC FM19
193300	-23	0.2	2630	- CQ NW9F EM69	193216	Tx		2377	- N3EMC KM6JD DM26
193300	-15	0.1	298	- CQ AE1BB FM42	193230	-8	0.3	2377	- KM6JD N3EMC -14
193300	-10	0.2	752	- K7PRI KOPT EM94	193245	Tx		2377	- N3EMC KM6JD R-08
193300	-23	0.2	1433	- CQ K8KDS EL96	193300	-3	0.2	2377	- KM6JD N3EMC RRR
193300	-8	0.2	1799	- N7Y NSIII FM19	193315	Tx		2377	- N3EMC KM6JD 73

Control Panel Details:

- Frequency:** 14.074 500
- Mode:** 20m
- Buttons:** CQ only, Log QSO, Stop, Monitor, Erase, Decode, Enable Tx, Halt Tx, Tune, Menus
- Fields:** DX Call, DX Grid, Tx 2377 Hz, Rx 2377 Hz, Tx -- Rx, Rx -- Tx, Hold Tx Freq
- Reporting:** Report -3, Auto Seq, Call 1st
- Calling CQ / Answering CQ:** CQ, Grid, dB, R+dB, RRR, 73
- Message:** CQ KM6JD DM26, Gen msg, Free msg
- Status:** Tx: N3EMC KM6JD 73, P78, Last Tx: N3EMC KM6JD R-08, 9/15 WD:6m

Sample QSO Full view (WSJT-X)

WSJT-X v1.9.1 by K1JT

File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	DT	Freq	Message
215400	-3	0.1	1695	~ CQ W4BNT EM55 ~U.S.A.
215400	-4	-0.5	1854	~ JF1KMC KN4MKX EM97
215400	6	0.1	1933	~ K6YI AKOSK -15
215400	4	-0.5	2090	~ NOJHA YV5AAX RR73
215400	-22	0.1	2147	~ WOKIT VK7XX -07
215400	3	0.2	2421	~ JP1NWZ K9UO R-09
215400	-21	-0.5	662	~ JR2PAU KW4FF EM97
215400	-12	0.0	1029	~ JR1NHD KN4NBJ RRR
215400	-13	0.9	1374	~ KC3DGM PY7VI RR73
215400	2	0.1	2389	~ CQ AF9A EM69 ~U.S.A.
215400	-3	-0.1	2404	~ CQ DX AC4GW EM77 ~U.S.A.
----- 20m -----				
215430	0	0.9	1252	~ KM6JD K3ZK 73
215430	-3	0.1	430	~ CQ K9IJ EN52 ~U.S.A.
215430	-7	0.1	499	~ JA1JAN WA1ECA FN31
215430	4	0.1	561	~ JL1IEO KOHUU EM37
215430	-13	0.1	701	~ CQ KBOR EN34 ~U.S.A.
215430	-1	0.1	965	~ KAOKVW K9CS -17
215430	-3	0.8	1002	~ CQ W2MEB FN30 ~U.S.A.
215430	2	0.2	1212	~ KE0CAZ KOWJ EM29
215430	2	0.1	1439	~ CQ WC4H EL95 a1 ~U.S.A.
215430	-12	0.2	1542	~ N7F NS8T EN72
215430	-4	0.1	1611	~ N27M N9SW -10
215430	-3	0.1	1643	~ ND4Q VA7DHF R-07
215430	0	0.2	1695	~ K6HGF W4BNT -07
215430	-6	-0.5	1854	~ JP1NWZ KN4MKX R-17
215430	0	0.1	1933	~ K6YI AKOSK -09
215430	-12	0.1	2004	~ JF1KMC W1VET EL88
215430	-8	-0.6	2091	~ CQ YV5AAX FK60 !Venezuela
215430	-19	0.1	2146	~ WOKIT VK7XX RR73
215430	-20	0.1	2210	~ WA4AFJ KN4HJP FM16
215430	9	0.1	2339	~ WL7CG K24KX EM66
215430	4	-0.1	2404	~ CQ DX AC4GW EM77 ~U.S.A.
215430	-15	0.0	1029	~ JR1NHD KN4NBJ RRR
215430	-2	0.1	1454	~ S16QGF MV4VZN EL95
215430	-19	0.0	1803	~ KOSAZ JR8QVT -19
215430	2	0.1	2421	~ JP1NWZ K9UO 73
215430	-14	0.9	1375	~ CQ PY7VI HI21 !Brazil

Rx Frequency

UTC	dB	DT	Freq	Message
215300	2	0.9	1253	~ CQ K3ZK FN21
215316	Tx		1253	~ K3ZK KM6JD DM26
215330	3	0.9	1252	~ KM6JD K3ZK -03
215345	Tx		1253	~ K3ZK KM6JD R+03
215400	1	0.9	1252	~ KM6JD K3ZK RRR
215415	Tx		1253	~ K3ZK KM6JD 73
215430	0	0.9	1252	~ KM6JD K3ZK 73

CQ only

 Menus

20m S

65 dB

14.074 000

DX Call

DX Grid

2018 Nov 02
21:54:49

Tx even/1st

Tx 1253 Hz

Rx 1252 Hz

Hold Tx Freq

Report 1

Auto Seq Call 1st

Calling CQ	Answering CQ
<input type="button" value="CQ"/>	<input type="button" value="Grid"/>
<input type="button" value="dB"/>	<input type="button" value="R+dB"/>
<input type="button" value="RRR"/>	<input type="button" value="73"/>
CQ KM6JD DM26 <input checked="" type="radio"/> Gen msg	
SRY NO DECODE <input type="radio"/> Free msg	

Receiving FT8 Last Tx: K3ZK KM6JD 73

4/15 WD:6m

2:54 PM

Example of QSO between KE0EMJ and KS5H

WSJT-X v1.8.0-rc1 by K1JT

File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	DT	Freq	Message
024545	-17	-1.9	616	~ K9WZB WS4AM R-11
024545	-19	-2.0	901	~ WA2BLE AB0VD DM79
024615	-10	-2.2	608	~ F5PSI KA6U CM97
024615	-18	-1.7	1125	~ CQ TI2AIM EJ79
024615	-18	-2.0	1158	~ KT7AZ W0LV 73
024645	-13	-2.2	608	~ F5PSI KA6U CM97
024815	-13	-2.0	616	~ K9WZB WS4AM R-11
024815	-12	-1.8	834	~ K9WZB KS5H EM20
024845	-12	-1.9	834	~ K9WZB WS4AM R-11
024915	-5	-2.2	531	~ F5PSI KA6U -04
024915	-12	-2.0	665	~ XR1B AB4TC DN70
024915	-15	-1.8	834	~ K9WZB WS4AM EL89
024945	-11	-2.2	531	~ F5PSI KA6U -04
024945	-9	-1.8	834	~ K9WZB WS4AM R-10
025015	-16	-1.9	946	~ CQ AR KI7IMC CN84
025015	-17	-2.0	1158	~ KOERE NK7Z R-19
025045	-17	-2.0	851	~ W9BBF AB4TC DN70
025115	-16	-1.9	792	~ K9WZB WS4AM R-10
025115	-16	-1.8	847	~ W9BBF K9CJM R-06
025145	-18	-1.8	1104	~ KE0EMJ KS5H EM20
025145	-14	-1.8	847	~ W9BBF K9CJM 73
025145	-14	-1.9	899	~ K9WZB WS4AM R-10
025215	-12	-2.0	900	~ K9WZB WS4AM 73
025245	-14	-1.5	851	~ W9BBF AB4TC DN70
025315	-17	-1.8	1103	~ KE0EMJ KS5H R-19
025315	-20	-1.5	852	~ W9BBF AB4TC R-13
025345	-18	-1.9	1103	~ KE0EMJ KS5H 73
025345	-14	-2.0	900	~ K9WZB WS4AM 73
025415	-16	-2.0	900	~ K9WZB WS4AM 73
025415	-17	-2.0	1164	~ KOERE KM4WPR EL88
025430	-4	-1.9	920	~ KK4JFM WB5TOI R-03
025445	-18	-1.9	1164	~ KOERE KM4WPR R-11

Rx Frequency

UTC	dB	DT	Freq	Message
024200	Tx		1124	~ TI2AIM KE0EMJ EN34
024215	-18	-1.6	1124	~ YV5OIE TI2AIM 73
024230	Tx		1124	~ TI2AIM KE0EMJ EN34
024300	Tx		1124	~ CQ KE0EMJ EN34
024330	Tx		1124	~ CQ KE0EMJ EN34
024400	Tx		1124	~ CQ KE0EMJ EN34
024430	Tx		1124	~ CQ KE0EMJ EN34
024500	Tx		1124	~ CQ KE0EMJ EN34
024530	Tx		1124	~ CQ KE0EMJ EN34
024515	-17	-2.0	1103	~ CQ KE0PMI DM79
024532	Tx		1103	~ KE0PMI KE0EMJ EN34
024600	Tx		1103	~ KE0PMI KE0EMJ EN34
024630	Tx		1103	~ KE0PMI KE0EMJ EN34
024700	Tx		1103	~ KE0PMI KE0EMJ EN34
024730	Tx		1103	~ KE0PMI KE0EMJ EN34
024800	Tx		1103	~ KE0PMI KE0EMJ EN34
024830	Tx		1103	~ KE0PMI KE0EMJ EN34
024900	Tx		1103	~ KE0PMI KE0EMJ EN34
024930	Tx		1103	~ KE0PMI KE0EMJ EN34
025000	Tx		1103	~ CQ KE0EMJ EN34
025030	Tx		1103	~ CQ KE0EMJ EN34
025100	Tx		1103	~ CQ KE0EMJ EN34
025130	Tx		1103	~ CQ KE0EMJ EN34
025145	-18	-1.8	1104	~ KE0EMJ KS5H EM20
025200	Tx		1103	~ CQ KE0EMJ EN34
025201	Tx		1103	~ KS5H KE0EMJ -18
025230	Tx		1103	~ KS5H KE0EMJ -18
025300	Tx		1103	~ KS5H KE0EMJ -18
025315	-17	-1.8	1103	~ KE0EMJ KS5H R-19
025330	Tx		1103	~ KS5H KE0EMJ RRR
025345	-18	-1.9	1103	~ KE0EMJ KS5H 73
025400	Tx		1103	~ KS5H KE0EMJ 73

Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune Menu

40m 7.074 000

Tx even/1st

DX Call: KSSH DX Grid: EM20 Tx 1103 Hz Rx 1103 Hz

Az: 189 1518 km Rx 1103 Hz

Lookup Add Report -18 Auto Seq Call 1st

2018 Feb 11
02:55:08

Generate Std Msgs

1 KSSH KE0EMJ EN34

2 KSSH KE0EMJ -18

3 KSSH KE0EMJ R-18

4 KSSH KE0EMJ RRR

5 KSSH KE0EMJ 73

6 CQ KE0EMJ EN34

Receiving FT8 Last Tx: KSSH KE0EMJ 73 8/15 WD:5m

Courtesy of Kelly Boles, KE0EMJ

Example of QSO between KE0EMJ and KB0RM

WSJT-X v1.8.0-rc1 by K1JT

File Configurations View Mode Decode Save Tools Help

Band Activity					Rx Frequency				
UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message
160200	-2	-3.2	1116	~ CQ DL8LAS JO54 !Germany	151200	-7	-1.9	666	~ KE0EMJ KC2BE RRR
160215	-2	-1.0	485	~ S55MZ WOPP EM37	151230	Tx		666	~ KC2BE KE0EMJ 73
160215	-7	-3.2	703	~ CQ KA9VDU EN53 ~U.S.A.	151400	0	-3.2	739	~ CQ KD7RF DM45 ~U.S.A.
160230	-6	-3.2	855	~ PD7RF AE4WG 73	151515	Tx		739	~ KD7RF KE0EMJ EN34
160300	-6	-3.2	1117	~ CQ DL8LAS JO54 !Germany	151530	-5	-3.2	739	~ DL2SWN KD7RF RRR
160330	-7	-3.2	855	~ PD7RF AE4WG 73	151545	Tx		739	~ KD7RF KE0EMJ EN34
160330	-5	-3.2	1117	~ CQ DL8LAS JO54 !Germany	151600	-5	-3.2	739	~ DL2SWN KD7RF RRR
160345	-20	-2.5	1012	~ NK4L AB3WF RRR	151615	Tx		739	~ KD7RF KE0EMJ EN34
160400	-6	-3.2	855	~ PD7RF AE4WG 73	151530	0	-3.2	929	~ CQ DX W0GJT DM59 ~U.S.A.
160430	-6	-3.2	1117	~ CQ DL8LAS JO54 !Germany	151618	Tx		929	~ W0GJT KE0EMJ EN34
160445	-19	-2.4	691	~ KC3IOQ NOVVFJ R-13	151630	4	-3.2	928	~ CQ DX W0GJT DM59
160445	-12	-2.7	1117	~ DL8LAS KC1ERO FN31	151645	Tx		929	~ W0GJT KE0EMJ EN34
160500	-7	-3.2	1116	~ CQ DL8LAS JO54 !Germany	151700	6	-3.2	928	~ CQ DX W0GJT DM59
160530	-12	-3.2	1012	~ AB3WF AE4WG R-03	151715	Tx		929	~ W0GJT KE0EMJ EN34
160600	0	-3.2	1013	~ AB3WF AE4WG 73	151745	Tx		929	~ W0GJT KE0EMJ EN34
160830	-7	-3.2	700	~ N0EPU AE4WG 73	152545	Tx		929	~ CQ KE0EMJ EN34
161130	-9	-2.2	759	~ KE5IRK WA6NFJ R-14	152615	Tx		929	~ CQ KE0EMJ EN34
161145	1	-3.0	1065	~ C31MF NE27M DN26	152630	2	-2.2	929	~ KE0EMJ KB0RM FN20
161230	-4	-2.1	1057	~ KA9VDU WA6NFJ CN85	152645	Tx		929	~ CQ KE0EMJ EN34
161330	-9	-2.6	1046	~ CQ ON8YB JO20 !Belgium	152652	Tx		929	~ KB0RM KE0EMJ +02
161400	-10	-2.7	741	~ OE9TZV KC1ERO FN31	152715	Tx		929	~ KB0RM KE0EMJ +02
161400	-15	-2.1	792	~ N3YFJ WA6NFJ R-10	152745	Tx		929	~ KB0RM KE0EMJ +02
161500	-12	-2.6	1036	~ KB9AVX ON8YB -09	152800	2	-2.2	929	~ KE0EMJ KB0RM R-08
161530	-6	-2.6	1036	~ KB9AVX ON8YB -09	152815	Tx		929	~ KB0RM KE0EMJ RRR
161600	-16	-2.6	1036	~ KB9AVX ON8YB RRR	152830	2	-2.2	929	~ KE0EMJ KB0RM 73
161630	-17	-2.6	1035	~ KB9AVX ON8YB 73	152845	Tx		929	~ KB0RM KE0EMJ 73
161730	-12	-1.8	1017	~ AB3WF KM4WPR EL88	160100	-16	-3.2	938	~ DL1SWB K1YQC -15
161800	-11	-2.1	760	~ KE5IRK WA6NFJ R-16	161715	Tx		929	~ CQ KE0EMJ EN34
161830	-6	-2.7	791	~ N3YFJ K5ENG EL29	161745	Tx		929	~ CQ KE0EMJ EN34
161900	-6	-2.5	759	~ KE5IRK WA6NFJ RRR	161815	Tx		929	~ CQ KE0EMJ EN34
161900	-14	-2.7	792	~ N3YFJ K5ENG EL29	161845	Tx		929	~ CQ KE0EMJ EN34
161900	-5	-3.2	1058	~ KA9VDU AE4WG EL99	161915	Tx		929	~ CQ KE0EMJ EN34

Log QSO Stop Monitor Erase Decode **Enable Tx** Halt Tx Tune Menu

20m **14.074 000**

Tx even/1st

Tx 929 Hz Tx ← Rx

Rx 929 Hz Rx ← Tx

Lock Tx=Rx

Report 2

Auto Seq Call 1st

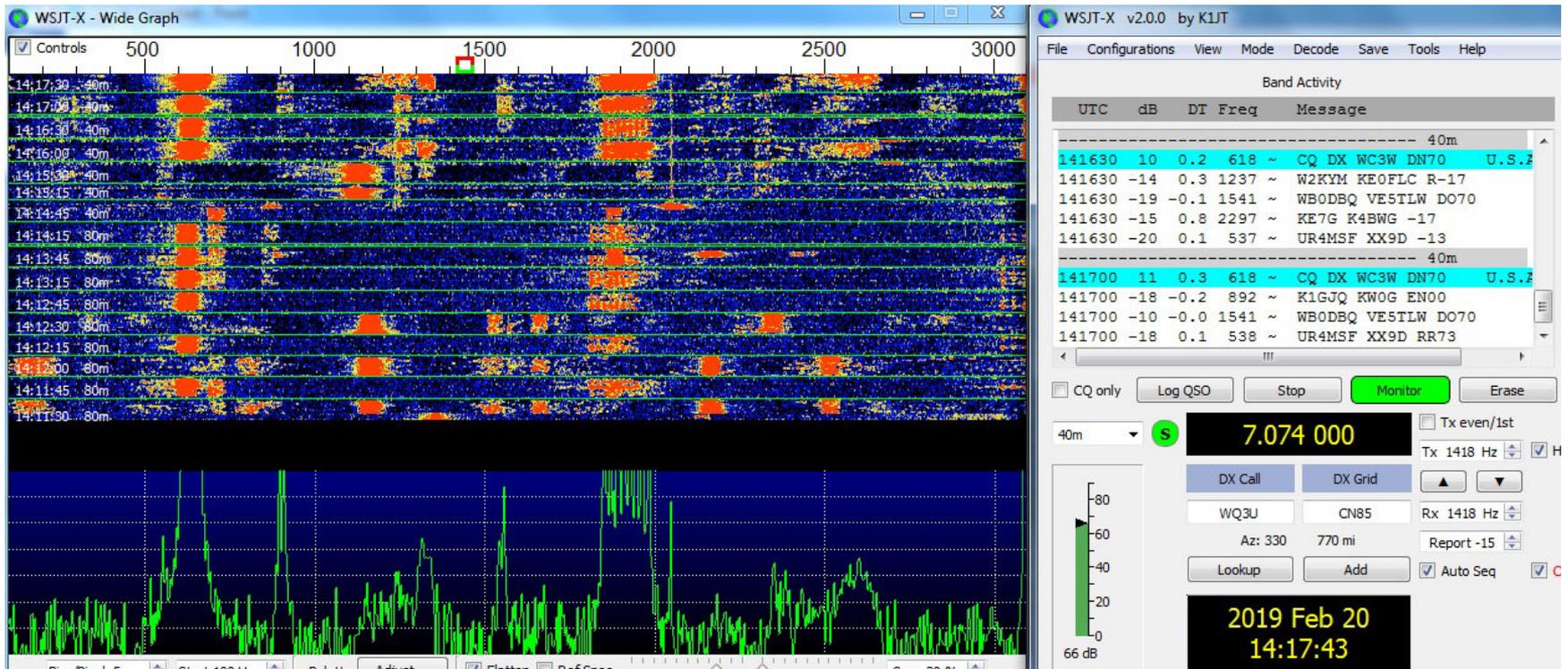
Generate Std Msgs Next Now Pwr

- KB0RM KE0EMJ EN34 Tx 1
- KB0RM KE0EMJ +02 Tx 2
- KB0RM KE0EMJ R+02 Tx 3
- KB0RM KE0EMJ RRR Tx 4
- KB0RM KE0EMJ 73 Tx 5
- CQ KE0EMJ EN34 Tx 6

Tx: CQ KE0EMJ EN34 FT8 Last Tx: CQ KE0EMJ EN34 0/15 WD:4m

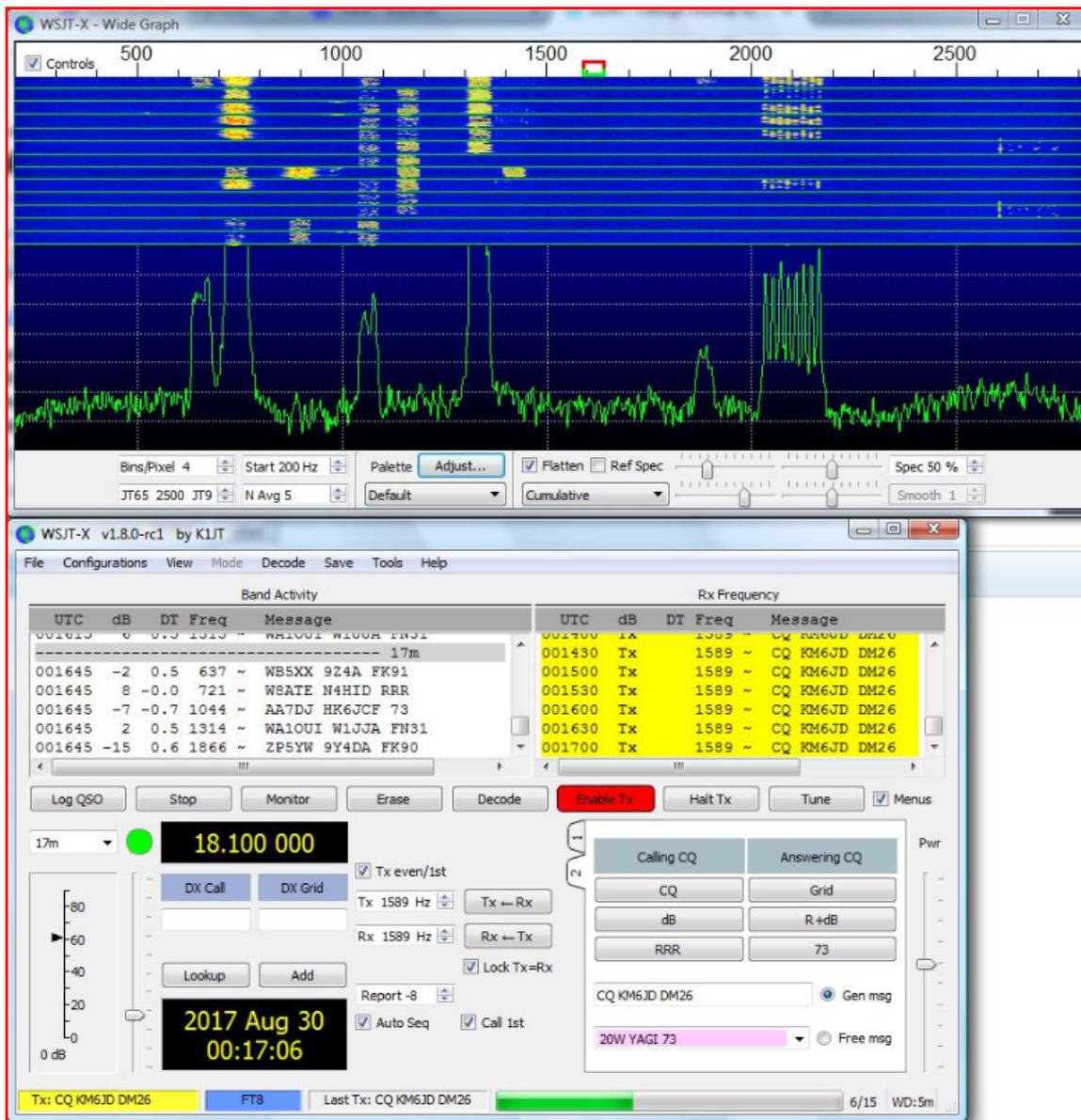
Courtesy of Kelly Boles, KE0EMJ

Examples of hams using too much power or ALC and their deleterious effects on the bands

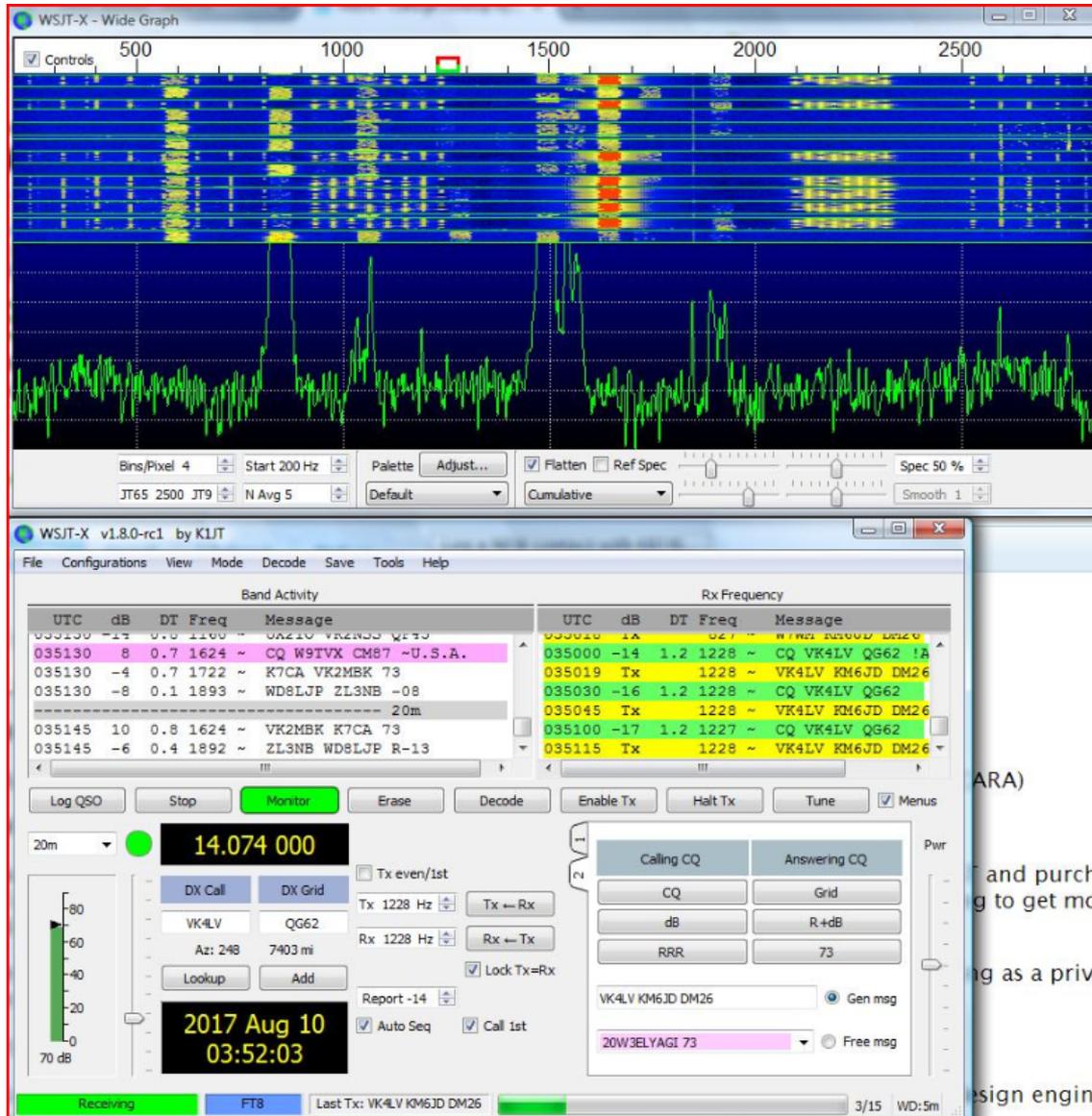


Courtesy of Joe Fitzpatrick, W1FIT

Examples of hams using too much power or ALC and their deleterious effects on the bands (cont'd)



Examples of hams using too much power or ALC and their deleterious effects on the bands (cont'd)



DXpedition mode in WSJT-X

- This mode is relatively new and somewhat experimental.
- It requires you to add additional frequencies and also to select “Hound” in the settings menu.
- The “Fox” is the rare DX station that all the Hounds wish to contact.
- The DX station (Fox) can run multiple streams (up to five).
- This means the Fox can initiate QSO’s with up to five hounds at a time. This therefore increases efficiency greatly.
- You must call the Fox above 1,000 Hz.
- Once the Fox calls you, your callsign will appear in red and the red transmit bracket will automatically track to his transmit frequency.

Examples of DXpedition mode

The image displays the WSJT-X software interface, which is used for digital voice communication in amateur radio. The top window, titled "WSJT-X - Wide Graph", shows a frequency spectrum from 500 to 2500 kHz. The bottom window, titled "WSJT-X v1.9.1 by K1JT", contains the control panel and a log of received messages.

Wide Graph Window:

- Frequency range: 500 to 2500 kHz.
- Time markers: 00:04:00, 00:03:45, 00:03:30, 00:03:15, 00:03:00.
- Controls: Bins/Pixel 4, Start 100 Hz, Palette Adjust..., Flatten, Ref Spec, Spec 50%, Smooth 1.

Control Panel Window:

- Buttons: Log QSO, Stop, Monitor, Erase, Decode, Enable Tx, Halt Tx, Tune, Menu.
- Frequency: 21.091 000 MHz.
- Mode: VP6D.
- Call: VP6D.
- Azimuth: Az: 251, Distance: 16553 km.
- Time: 2018 Oct 30 00:04:19.
- DXpedition: Hound.
- Status: Receiving, FT8, Last Tx: VP6D KM6JD R+03.

Log Window:

Time	Frequency	SNR	Mode	Call	Grid	Other
235400	-9	0.4	584	~	JG6CDH	VP6D -21
235426	Tx	1621	~	VP6D	KM6JD	DM26
235445	Tx	1621	~	VP6D	KM6JD	DM26
235515	Tx	1621	~	VP6D	KM6JD	DM26
235545	Tx	1621	~	VP6D	KM6JD	DM26
235615	Tx	1621	~	VP6D	KM6JD	DM26
235654	Tx	2031	~	VP6D	KM6JD	DM26
235700	3	0.4	404	~	KM6JD	VP6D +05
235715	Tx	404	~	VP6D	KM6JD	R+03
235730	-11	0.4	344	~	KM6JD	RR73; JA2JRG <
235730	-11	0.4	404	~	JE2EBT	RR73; JR1WCI <

Calling CQ / Answering CQ Panel:

- Calling CQ: CQ
- Answering CQ: Grid
- Power: dB, R+dB
- RRR: 73
- CQ: KM6JD DM26
- SRY: NO DECODE
- Options: Gen msg, Free msg

Examples of DXpedition mode (cont'd)

The image displays two windows from the WSJT-X software. The top window, titled "WSJT-X - Wide Graph", shows a frequency spectrum from 500 to 2500 kHz. The bottom window, titled "WSJT-X v1.9.1 by K1JT", shows the control interface for DXpedition mode.

Wide Graph Window:

- Frequency range: 500 to 2500 kHz.
- Controls: Bins/Pixel 4, Start 100 Hz, N Avg 5, Palette Default, Adjust..., Flatten checked, Ref Spec unchecked, Spec 50 %, Smooth 1.
- Buttons: J165 2500 J19, Cumulative.

Control Panel Window:

Log QSO Stop Monitor Erase Decode **Enable Tx** Halt Tx Tune Menu

20m **S** **14.090 000** Tx 2236 Hz Rx 2236 Hz Tx ← Rx Rx ← Tx

DX Call: KH1/KH7Z DX Grid: AJ10 Report -15 Az: 253 4651 mi Rx All Freqs Auto Seq

2018 Jul 02 04:34:42 DXpedition: Hound

Receiving FT8 Last Tx: KH7Z KM6JD DM26 12/15 WD:6m

Log Data:

Time	Offset	Power	Grid	Call	Mode	Time	Offset	Power	Grid	Call	Mode		
043330	-8	0.1	375	WW6G	KH7Z	-03	040915	-21	0.1	1207	KH7Z	WA8R	EM89
043330	-7	0.1	434	WX7HS	KH7Z	-04	041045	-18	0.1	1207	KH7Z	WA8R	EM89
043330	-7	0.1	495	KL1SF	KH7Z	-04	041815	-21	0.1	1207	KH7Z	NA3F	FN10
043330	-6	0.1	555	WG7H	KH7Z	-05	041915	-13	0.2	1213	KH7Z	K1NY	FN30
----- 20m -----													
043400	-8	0.1	314	KL1SF	RR73; WW6G	<KH1	042045	-20	0.3	1213	KH7Z	K1NY	FN30
043400	-7	0.1	374	WX7HS	KH7Z	-04	042115	-22	0.3	1214	KH7Z	K1NY	FN30
043400	-8	0.1	434	WG7H	KH7Z	-05	042145	-22	0.3	1214	KH7Z	K1NY	FN30
043400	-9	0.1	494	WD8KRV	KH7Z	-05	043315	Tx	1084	-	KH7Z	KM6JD	DM26
043400	-8	0.1	555	WBOEMJ	KH7Z	-05	043345	Tx	1084	-	KH7Z	KM6JD	DM26
							043415	Tx	1084	-	KH7Z	KM6JD	DM26

Message Queue:

Message	Next	Now	Pwr
KH7Z KM6JD DM26	<input checked="" type="radio"/>	<input type="radio"/>	Tx 1
KH7Z KM6JD -15	<input type="radio"/>	<input type="radio"/>	Tx 2
KH7Z KM6JD R-15	<input type="radio"/>	<input type="radio"/>	Tx 3
KH7Z KM6JD RRR	<input type="radio"/>	<input type="radio"/>	Tx 4
KH7Z KM6JD 73	<input type="radio"/>	<input type="radio"/>	Tx 5
CQ KM6JD DM26	<input type="radio"/>	<input type="radio"/>	Tx 6

Examples of JTDX software and QSO's

JTDX by HF community v1.8.10.90, derivative work based on WSJT-X by K1JT

File View Mode Decode Save AutoSeq Misc Help

UTC	dB	DT	Freq	Message	Band	Activity
013915	-3	-0.0	1285	~ CQ WODYD EN34	U.S.A.	
013915	-8	-0.0	1473	~ WOREW K4SHA 73	U.S.A.	
013915	-14	1.8	1505	~ CQ W9CAR EM76	U.S.A.	
013915	-8	0.1	638	~ CQ K9DXR EN60	U.S.A.	
013915	-7	0.1	864	~ AE0XI KI1TK FN42	U.S.A.	
013915	-9	-0.6	1069	~ K5IBK NY8T -19	U.S.A.	
013915	-11	0.1	1443	~ N9YLZ W2PCC R-13	U.S.A.	
013915	-11	0.6	1502	~ CQ VE3NOO FN14	Canada	
----- 26.07.18 01:39:44 UTC ----- 20m -----						
013930	-11	0.2	304	~ W9CAR NOORY EM57	U.S.A.	
013930	-2	0.2	367	~ OD5ZZ N8QNM EM79	U.S.A.	
013930	1	0.2	1831	~ NA4MM WA2HIP 73	U.S.A.	
013930	4	0.1	1910	~ WL7CG KD4LEM R-16	U.S.A.	
013930	3	0.3	428	~ CQ N2BJ EN61	U.S.A.	
013930	-5	0.2	2035	~ KE00IR W6SAI RRR	U.S.A.	
013930	-6	0.2	2208	~ CQ DX W0XG EN34	U.S.A.	
013930	0	0.2	502	~ V6J W9DC EM84	U.S.A.	
013930	-3	0.2	2327	~ CQ N2IEC FM29	U.S.A.	
013930	-8	0.1	730	~ WD8IJJ W2ZEN -12	U.S.A.	
013930	-10	1.5	770	~ PYSZD N8ZVT 73	U.S.A.	
013930	-5	1.4	2629	~ KF0UR N7AY RRR	U.S.A.	
013930	-14	0.6	1048	~ KW4CK N8URE FM09	U.S.A.	
013930	-14	0.2	1798	~ CQ KP5BA EM50	U.S.A.	
013930	1	0.2	1142	~ W4BNT WA1WCC +11	U.S.A.	
013930	-8	0.3	2181	~ CQ W1FIT DM26	U.S.A.	
013930	5	0.6	1229	~ N9OK K4YYL 73	U.S.A.	
013930	-3	0.2	1937	~ WP4CQ KE0CAZ -15	U.S.A.	
013930	-3	0.2	1473	~ K4SHA WOREW 73	U.S.A.	
013930	-5	-0.1	542	~ CQ K3STL FN00	U.S.A.	
013930	-7	0.2	700	~ CQ W2TT FM29	U.S.A.	
013930	-2	0.2	1505	~ W9CAR KB1EFS FN42	U.S.A.	
----- 26.07.18 01:39:59 UTC ----- 20m -----						
013945	-7	0.4	496	~ W5ETL OD5ZZ -14	Lebanon	
013945	6	0.1	1671	~ K6DMA N7BT CN88	U.S.A.	
013945	-4	0.0	554	~ CQ WJ6J EN82	U.S.A.	
013945	2	0.1	1781	~ W8WLK N8RY EN66	U.S.A.	
013945	-12	0.1	619	~ KM3U W0DIT -09	U.S.A.	
013945	-9	0.1	637	~ CQ K9DXR EN60	U.S.A.	
013945	-3	0.1	1920	~ WA1WCC KB2URI FN02	U.S.A.	
013945	2	0.1	685	~ WA1WCC W4BNT R+06	U.S.A.	
013945	2	0.2	1989	~ CQ KALAQP FN42	U.S.A.	
013945	-5	0.4	851	~ KC0LR K1DLM -24	U.S.A.	
013945	-3	0.1	2138	~ CQ NM WB4KTF EN74	U.S.A.	
013945	-4	0.6	2379	~ KB9GC VE3NOO -12	Canada	
013945	10	0.1	1230	~ K4YYL N9OK 73	U.S.A.	
013945	-2	0.1	2525	~ N7AY KA4RON EM96	U.S.A.	
013945	-6	0.0	1285	~ W9HT WODYD -09	U.S.A.	
013945	-10	0.9	1644	~ CQ WD4ELG FM06	U.S.A.	
013945	-12	-0.1	1910	~ KD4LEM WL7CG RR73	Alaska	
013945	0	1.9	1504	~ CQ W9CAR EM76	U.S.A.	
013945	-6	0.1	864	~ AE0XI KI1TK FN42	U.S.A.	
013945	-13	0.1	2385	~ CQ EA5UB JM08	Spain	
013945	-4	-0.0	1473	~ CQ K4SHA EM72	U.S.A.	
013945	-8	-1.8	731	~ W2ZEN WD8IJJ R-06	U.S.A.	
013945	-7	0.1	1443	~ N9YLZ W2PCC R-13	U.S.A.	

14.074 000

20m

DX Call DX Grid

01:40:05 TX 00/30

Tx FT8 ~ Report -13 S meter

Tx 2411 Hz Tx=Rx DistX73

Rx 2112 Hz Rx=Tx AutoTX

beep on Tx/Rx Split AutoSeq2

UTC	dB	DT	Freq	Message	Band	Activity
011945	4	0.2	2118	~ K3CNR K7SAB CN87	U.S.A.	
012000	Tx		2411	~ UN7JO KM6JD R-13		
012030	Tx		2411	~ UN7JO KM6JD R-13		
012015	-11	-0.1	2112	~ KM6JD UN7JO RR73	Kazakhstan	
012034	Tx		2411	~ UN7JO KM6JD 73		
012045	-10	-0.1	2111	~ CQ UN7JO NN19	Kazakhstan	
012100	-9	0.0	2112	~ AA7VA AE4DC 73	U.S.A.	
012115	-9	-0.1	2111	~ AE2A UN7JO -16	Kazakhstan	
012130	2	0.1	2115	~ UN7JO K9AZY EM58	U.S.A.	
012145	-12	-0.1	2111	~ AE2A UN7JO RR73	Kazakhstan	
012200	7	0.1	2115	~ UN7JO K9AZY EM58	U.S.A.	
012215	-11	-0.1	2111	~ CQ UN7JO NN19	Kazakhstan	
012230	0	0.1	2114	~ UN7JO K9AZY EM58	U.S.A.	
012245	-9	-1.1	2111	~ AE4DC AEOX R-20	U.S.A.	
012315	-14	-1.1	2112	~ AE4DC AEOX R-20	U.S.A.	
012330	-14	-0.0	2110	~ AEOX AE4DC RRR	U.S.A.	
012345	-6	-1.2	2111	~ AE4DC AEOX R-20	U.S.A.	
012400	-11	-0.0	2111	~ AEOX AE4DC RRR	U.S.A.	
012430	-15	0.0	2110	~ AEOX AE4DC RRR	U.S.A.	
012500	-14	-0.0	2110	~ AEOX AE4DC RRR	U.S.A.	
012530	-11	0.0	2112	~ AEOX AE4DC RRR	U.S.A.	
012600	-9	0.0	2112	~ AEOX AE4DC RRR	U.S.A.	

Rx Frequency

Tune Monitor Bypass 1 QSO AnsB4 Stop

Enable Tx Halt Tx Log QSO Erase Hint SWL mode AGCC Filter Decode Clear DX

AnsCQ SkpGrid

CQ Grid

dB R+dB

RR73 73

CQ KM6JD DM26 Gen msg Free msg

TXN 73

Receiving FT8 Last Tx: UN7JO KM6JD 73 WD 6m 5/15 Logd UN7JO 26 Jul 2018 FT8 8

6:40 PM

Examples of JTDX software and QSO's

JTDX by HF community v18.1.0.90, derivative work based on WSJT-X by K1JT

File View Mode Decode Save AutoSeq Misc Help

UTC	dB	DT	Freq	Message	Band Activity
014030	2	0.1	1910	~ N9OK K7WLM EN61	U.S.A.
014030	2	0.1	1910	~ W17CG KD4LEM 73	U.S.A.
014030	7	-0.0	637	~ K1HZ KN0W 73	U.S.A.
014030	1	0.2	2036	~ KE0OIR W6SAI 73	U.S.A.
014030	-7	0.1	730	~ WD8IIJ W2ZEN -12	U.S.A.
014030	-8	0.1	2177	~ OD5ZZ N8QNM EM79	U.S.A.
014030	-4	0.1	2208	~ CQ DX W0XG EN34	U.S.A.
014030	-8	1.5	769	~ CQ IA N8ZVT EN75	U.S.A.
014030	-2	1.9	2629	~ KA4RON N7AY -10	U.S.A.
014030	-6	0.1	851	~ WJ6J WA9WA R+02	U.S.A.
014030	-1	0.1	1141	~ W4BNT WA1WCC 73	U.S.A.
014030	-7	0.1	1192	~ CQ N9YLZ EN51	U.S.A.
014030	-13	0.1	1287	~ W0DYD W9HT 73	U.S.A.
014030	-5	0.1	1337	~ WP4CQ KE0CAZ -15	U.S.A.
014030	-10	0.2	542	~ CQ K3STL FN00	U.S.A.
014030	-7	-0.4	1235	~ N9OK KG7TFI CN88	U.S.A.
014030	-13	0.5	1498	~ KE0KZ K4YVL EM84	U.S.A.
014030	-13	0.1	496	~ OD5ZZ KA6SGT EN91	U.S.A.
014030	-10	0.1	699	~ CQ W2TT FM29	U.S.A.
26.07.18	01:40:59	UTC	20m		
014045	-6	0.1	1576	~ CQ DX W2PCC FN02	U.S.A.
014045	-9	0.4	496	~ CQ OD5ZZ RM74	U.S.A.
014045	4	0.4	1644	~ CQ WD4ELG FM06	U.S.A.
014045	-8	-0.0	555	~ WA9WA WJ6J RR73	U.S.A.
014045	-13	0.1	1781	~ W8WLK N8RY EN66	U.S.A.
014045	-9	0.8	1798	~ KF5BA KC7AF CN87	U.S.A.
014045	0	0.1	637	~ CQ K9DXR EN60	U.S.A.
014045	-8	-1.8	730	~ W2ZEN WD8IIJ R-04	U.S.A.
014045	5	0.2	1989	~ KZ5S KA1AQF RRR	U.S.A.
014045	-6	0.3	851	~ KC0LR K1DLM -24	U.S.A.
014045	0	-0.0	1048	~ WB4HXE KW4CK RRR	U.S.A.
014045	2	0.0	2137	~ CQ NM WB4RTF EN74	U.S.A.
014045	6	0.1	1230	~ KG7TFI N9OK -24	U.S.A.
014045	-3	0.0	1286	~ W9HT W0DYD 73	U.S.A.
014045	0	1.8	1504	~ CQ W9CAR EM76	U.S.A.
014045	-2	0.6	2379	~ KB9GC VE3NOO RRR	U.S.A.
014045	-6	0.1	864	~ AE0XI KT1TK FN42	U.S.A.
014045	-10	-0.5	1070	~ K5IBK NY8T -19	U.S.A.
014045	-2	0.1	2525	~ N7AY KA4RON R-07	U.S.A.
014045	-10	0.2	1747	~ VA3TPS KE8JNT 73	U.S.A.
014045	-12	0.2	1802	~ KF5BA NQ1D FN42	U.S.A.
014045	-11	-0.1	1910	~ CQ W17CG BP61	U.S.A.
014045	0	0.1	2300	~ N8ZVT N7BT CN88	U.S.A.
26.07.18	01:41:14	UTC	20m		
014100	-10	0.2	1798	~ CQ KF5BA EM50	U.S.A.
014100	-13	-2.0	637	~ K9DXR WA7CXG CN84	U.S.A.
014100	-4	0.2	2036	~ CQ W6SAI EM63	U.S.A.
014100	-6	0.1	730	~ WD8IIJ W2ZEN -12	U.S.A.
014100	-7	1.4	2629	~ KA4RON N7AY RRR	U.S.A.
014100	-3	0.2	850	~ WJ6J WA9WA 73	U.S.A.
014100	1	0.1	1141	~ CQ WA1WCC FN51	U.S.A.
014100	-9	0.1	1192	~ WB8FVB N9YLZ -03	U.S.A.
014100	-4	-0.4	1234	~ N9OK KG7TFI R-09	U.S.A.
014100	-7	0.2	699	~ CQ W2TT FM29	U.S.A.
014100	-11	1.5	770	~ CQ IA N8ZVT EN75	U.S.A.
014100	-9	0.1	865	~ KT1TK AE0XI -09	U.S.A.

14.074 000
20m
DX Call
DX Grid
Lookup
Add

01:41:21
TX 00/30
Tx FT8 ~ Report -13 S meter
Tx 2411 Hz Tx=Rx DisTX73
Rx 2112 Hz Rx=Tx AutoTX
beep on Tx/Rx Split AutoSeq2

Rx Frequency
011945 U.2 2118 ~ K3CNR K7BAB CN87 U.S.A.
012000 Tx 2411 ~ UN7JO KM6JD R-13

Settings

Audio Sequencing Tx Macros Reporting Frequencies Notifications Filters Scheduler Advanced

'New one' and 'worked B4' status notifications

- Check and highlight new DXCC per band per mode Beep as well
- Check and highlight new grids per band per mode Beep as well
- Check and highlight new calls per band per mode Beep as well
- Highlight worked ones strike it underline it don't show it
- Inverse text/background color
- Check other standard messages

Markers red / my call in message blue / my call at QSO

Configuration tips

Transmitted message: K1ABC
CQ in message: K1ABC
My Call in message: K1ABC
Other standard message: K1ABC

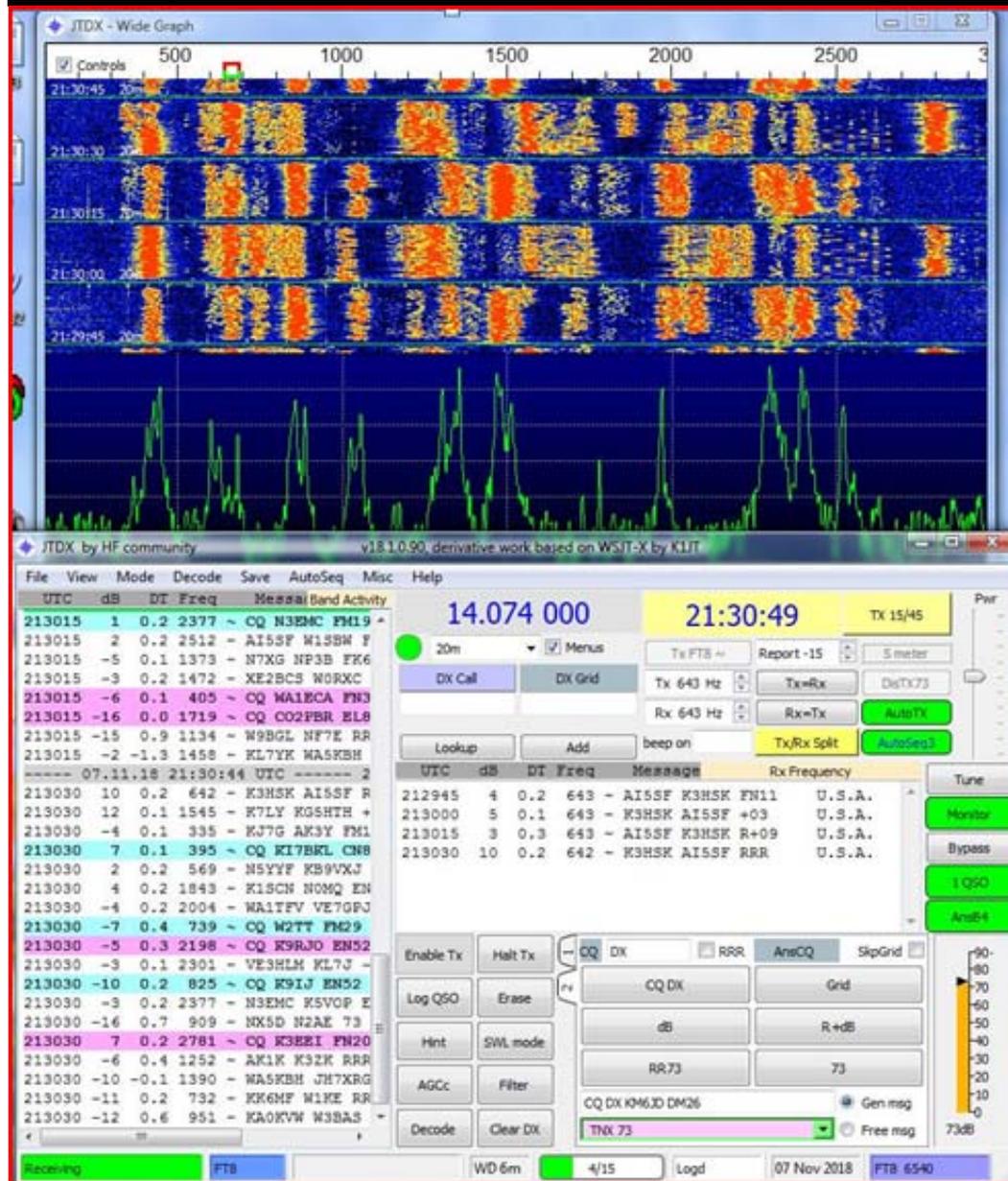
New DXCC: K1ABC
New DXCC on Band/Mode: K1ABC
New Grid: K1ABC
New Grid on Band/Mode: K1ABC
New Call: K1ABC
New Call on Band/Mode: K1ABC
Worked one: K1ABC

OK Cancel

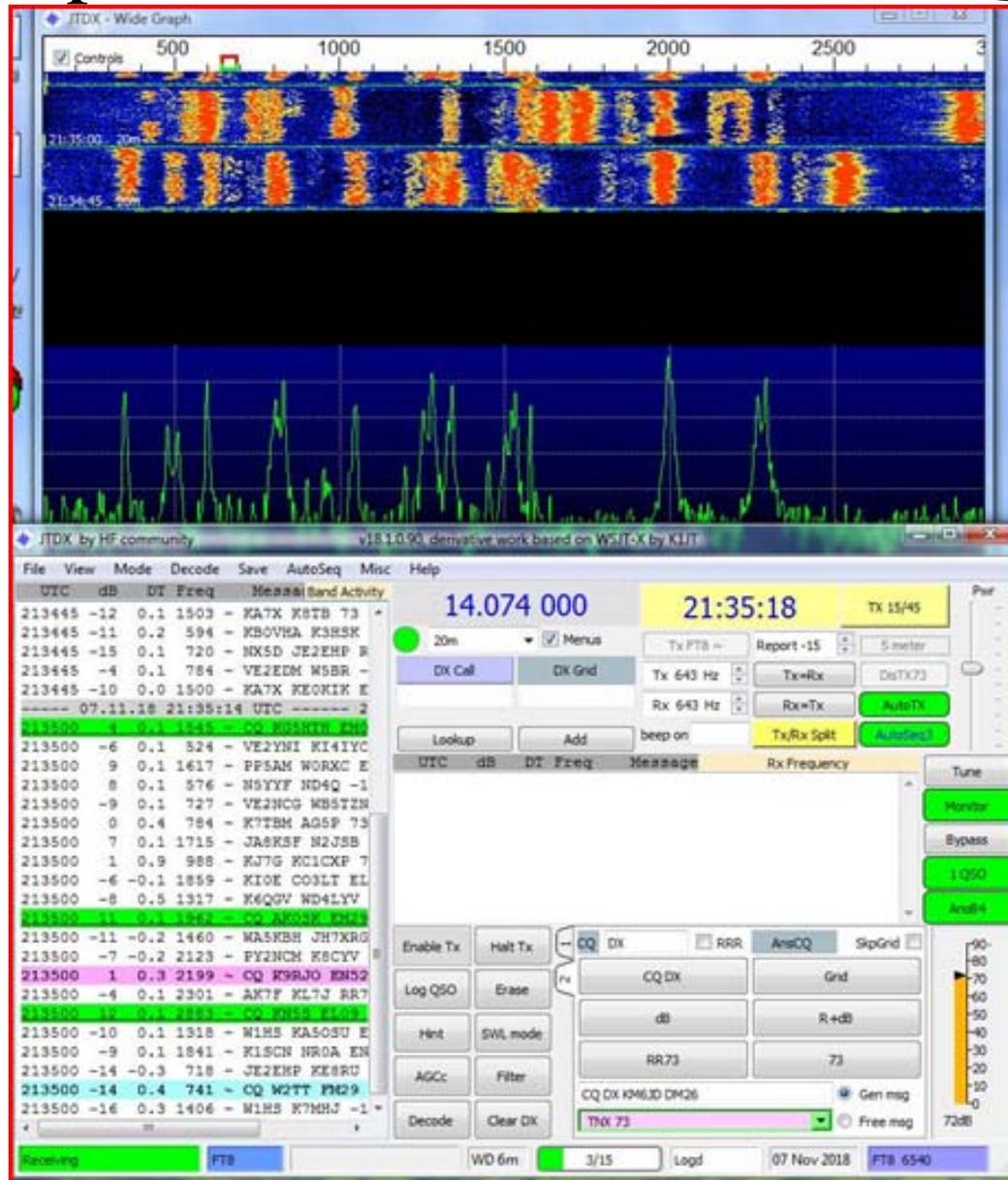
Receiving FT8 Last Tx: UN7JO KM6JD 73 WD 6m 6/15 Logd UN7JO 26 Jul 2018 FT8 8

(21,811 unread) - sal... JTDX - Wide Graph JTDX by HF comm... Untitled - Paint 6:41 PM

Example of JTDX software and QSO's



Example of JTDX software and QSO's



Useful Online Resources and Further Reading Material

- http://physics.princeton.edu/pulsar/k1jt/wsjpg-doc/wsjpg-main-2.0.0.html#_free_text_messages
- <https://www.wsjpg.net/home/ft8-mode.html>
- http://www.g4ifb.com/FT8_Hinson_tips_for_HF_DXers.pdf
- http://fbnews.jp/201712/technical_en/index.html
- <https://www.jimcarson.com/2017/setting-up-ft8/>
- <https://ft8dmc.eu/>
- [https://en.wikipedia.org/wiki/WSJT_\(amateur_radio_software\)](https://en.wikipedia.org/wiki/WSJT_(amateur_radio_software))
- <https://www.jtdx.tech/en/>
- <https://ft8dmc.eu/AWARDS>
- <http://www.w0wn.org/downloads/n0dl/Introduction%20to%20Ham%20Radio%20Digital%20Mode%20FT8.pdf>

How FT8 is encoded, transmitted and then decoded

- Each character in a 13-character free message is converted to a number .
- Then, those numbers are multiplied together forming a large integer of 71 binary bits.
- Standard messages consist of two 28-bit fields normally used for callsigns and a 15-bit field for a grid locator, report, acknowledgment, or “73” message, also totaling 71 bits.
- *Six message-type bits (flags) are appended, giving 77 bits.*
- These are the precious information payload. All the remaining bits in the FT8 messages are required for error-correction purposes, enabling the payload to be reliably communicated over a noisy radio channel.
- The LDPC is assembled as follows:
 - A 14-bit Cyclic Redundancy Check is calculated on the 77 bits and appended, giving 91 bits.
 - Next an 83-bit parity code is calculated and appended, giving 174 bits.
 - The 174 bits are grouped into 58 chunks of three bits each, which are then Gray coded.⁴

How FT8 is encoded, transmitted and then decoded (cont'd)

- Symbols are now assembled from a 7-chunk Costas array + the first 29 Gray-coded chunks + the 7 Costas + the remaining 29 Gray-coded chunks + the 7 Costas, resulting in 79 symbols for transmission.
- Those Costas arrays (“sync vectors”) sent at the start, middle and end of each FT8 message are used to synchronize the receiver to the sender such that bits can be reliably timed within the transmissions.

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Arthur Brigida, AB7FB
Joseph Fitzpatrick, W1FIT
Larry S. Hinsdale, WG7H

REFERENCES

- 1.) QST, November, 2017, pp 34-9.
- 2.) *Ibid.*
- 3.) *Ibid.*
- 4.) FT8 Operating guide, version 2.12, G. Hinson, 2019, pp 62.
- 5.) QST, November, 2017, p 35.