

# INTRODUCTION TO FT8

## THE BASICS

# WHAT IS FT8?

- FT8 is the most popular of the digital modes.
- It was developed and released in 2017 by Steven Franke (K9AN) and Joe Taylor (K1JT).
- Named after the developers, FT, with the 8 coming from its 8-frequency shift keying format (more on this later).
- It handles weak signals, noise and fading very well.
- It is much faster than the similar JT65.
- It is semi-automated with a predictable sequence of messages to constitute a QSO.
- Messages are limited to 13 characters.
- FT8 has a perpetual series of 15-second periods during which messages are sent and/or received.

# WHAT IS FT8?

- FT8 is sometimes called a sound-card mode.
- It uses a sound card to carry audio from your receiver into a computer for processing by software.
  - The software decodes the information embedded in the received signal.
- Then the process is reversed for transmitting.
  - The software encodes your message into audio tones that are sent to the transmitter via the sound card.
- Here is what an FT8 signal sounds like:



# ADVANTAGES OF FT8

- Can copy very weak signals.
  - Good for low power stations.
  - Good for stations with compromise antennas.
- Has short, canned messages for redundancy. e.g., CQ K2PS EL98
- Messages transition automatically from one to the next.
- An entire contact can take place in one minute.
- Specific frequencies on each band are used by agreement for FT8.
  - You don't have to tune up and down the band to find stations to work.

1.840	24.915
3.573	28.074
7.074	50.313
10.136	50.323
14.074	70.154
18.100	144.174
21.074	

## EXAMPLE OF A CONTACT WITH FT8

- CQ K2DM EL88
  - K2DM N0SMX EL98
  - N0SMX K2DM -03
  - K2DM N0SMX R+02
  - N0SMX K2DM RR73
  - K2DM N0SMX 73
- K2DM sends CQ during the first 15-sec period
  - N0SMX answers during the next period
  - K2DM sends a signal report to N0SMX
  - N0SMX rogers and sends a report back
  - K2DM rogers and says 73
  - N0SMX sends 73
- The entire sequence took 90 seconds!

# WHAT DO YOU NEED FOR FT8?

- A transceiver with data or SSB capability.
- A computer capable of running FT8 software.
  - Most common software is WSJT-X developed by Franke and Taylor.
- Time synchronization for the computer.
  - Very important for the 15-sec transmit/receive periods to be synchronized between stations.
- An audio interface.
  - Typically a sound card interface providing:
    - A way to get receive audio from the radio into the computer and
    - A way to get audio output of the computer into the radio.
  - Many modern radios have a sound card interface built in.
  - Older, or more basic, radios require an external sound card interface.

# EXTERNAL SOUND CARD INTERFACES FOR OLDER, MORE BASIC RADIOS

- Tigertronics SignalLink USB Interface Unit
  - Order with pre-built cable for your radio.
  - Connect the pre-built cable to your radio.
  - Connect a USB cable to your computer.
- MFJ 1204 Series USB Digital Mode Interface
  - Choose the model and cable combination that fits your radio.



# RADIOS AND FT8

- Best to have one capable of computer control.
- Nice to have one with a built-in sound card:
  - Icom IC-7300
  - Yaesu FT-991A
  - Kenwood TS-590S or SG
  - Icom IC-7100
  - Elecraft K3S
  - Flex
- Radios requiring an external sound card interface:
  - Icom IC-7000, IC-718
  - Elecraft K3
  - Kenwood TS-450, TS-850, TS-440
  - Yaesu FT-450

VIDEO OF COMPUTER SCREEN  
RUNNING FT8

WSJT-X - Wide Graph

Controls 500 1000 1500 2000 2500 3000 3500

185000 20m  
185000 20m  
185000 20m  
185000 20m  
185400 20m

Bins/Pixel 4 Start 200 Hz Palette Adjust... Flatten Ref Spec Spec 30 %  
Split 2500 Hz N Avg 3 Default Current Smooth 1

WSJT-X v2.6.1 by KI1T et al.

File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	DT	Freq	Message
185630	-12	0.2	1251	~ KN6KI KC9RF RR73
185630	1	0.7	1493	~ ON3RF KB8VGD EN91
185630	-12	0.1	998	~ OM4APF GOKPH IO92
185630	-6	0.5	772	~ CQ W5RAW DM95
185630	-16	0.1	1095	~ NY1V N1TRX 73
185630	-3	0.3	1457	~ KOVFO W5WNR +06
185630	-1	0.0	910	~ LY2J KB4RG EM02
185630	-2	0.1	682	~ DN1MGK YL3KW -24
185630	-15	0.1	1211	~ CQ G4YLJ IO83
185630	-13	0.2	654	~ R1994YU <HB9CRN> RR73
185630	-12	0.3	703	~ W9RL SP9UPH 73
185630	-16	0.4	1366	~ CQ EW1ZL KO43

Rx Frequency

UTC	dB	DT	Freq	Message
185545	Tx	2000	-	CQ K2DM EL88
185615	Tx	2000	-	CQ K2DM EL88
185645	Tx	2000	-	CQ K2DM EL88

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

20m **14.074 500**  Tx even/ist  Hold Tx Freq  
 Tx 2000 Hz  
 DX Call: KD1UA DX Grid: FN42  
 Az: 32 1176 mi  
 Report 7  
 Auto Seq CQ: First

Generate Std Msgs Next Now Pwr  
 KD1UA K2DM EL88  Tx 1  
 KD1UA K2DM +07  Tx 2  
 KD1UA K2DM R+07  Tx 3  
 KD1UA K2DM RR73  Tx 4  
 KD1UA K2DM 73  Tx 5  
 CQ K2DM EL88  Tx 6

Tx: CQ K2DM EL88 George FT8 Last Tx: CQ K2DM EL88 24 4/15 WD:5m

- Let's spend some time breaking down what FT8 looks like on your computer screen.
- This example is of the WSJT-X FT8 software.
- There is a TON of information on this screen, and we will examine each major area.

The screenshot displays the WSJT-X software interface, divided into two main sections: a wide graph at the top and a control panel below.

**Wide Graph (Top):** Shows a frequency spectrum from 500 to 3000 Hz. The graph displays several vertical bands of activity, with the most prominent ones around 1000 Hz and 2000 Hz. The signal strength is indicated by color, ranging from blue (low) to red (high).

**Control Panel (Bottom):** Contains various settings and data tables.

**Band Activity Table:**

UTC	dB	DT	Freq	Message
215930	-17	0.2	1003	~ HB9SAT IU5LRH JN53
215930	-18	-0.2	1026	~ CQ EB1FE IN63
215930	-18	-0.0	1064	~ IQ0PG IKOMIB R-15
220000	7	0.0	1391	~ IU8PYF HI8GSP -13
220000	12	0.0	1435	~ HA1BF WB2RUU EL96
220000	2	-0.1	444	~ K4JBL KR3T EM84
220000	15	0.2	936	~ 7X3WPL WA4DYD EM83
220000	-12	0.3	2014	~ ZS1WC HB9TUD JN36
220000	-13	0.0	2193	~ PZ5RA OK1DWQ JN69
220000	-17	0.7	2145	~ F1PBZ <CT9/DD8ZX> +10
220000	-13	1.1	308	~ CQ IZ1GEA JN35
220000	-9	-0.0	1387	~ K2DM N8ZPJ 73

**Rx Frequency Table:**

UTC	dB	DT	Freq	Message
215645	Tx		2000	~ N8LSU K2DM RR73
215700	-11	0.1	1597	~ K2DM N8LSU 73
215815	Tx		2000	~ CQ K2DM EL88
215845	Tx		2000	~ CQ K2DM EL88
215900	-7	-0.1	1388	~ K2DM N8ZPJ EN82
215900	-18	0.0	1393	~ ZS1WC ON2BCB JO21
215915	Tx		2000	~ N8ZPJ K2DM -07
215930	2	-0.0	1392	~ IU8PYF HI8GSP -13
215930	-8	-0.1	1387	~ K2DM N8ZPJ R-03
215945	Tx		2000	~ N8ZPJ K2DM RR73
220000	7	0.0	1391	~ IU8PYF HI8GSP -13
220000	-9	-0.0	1387	~ K2DM N8ZPJ 73

**Control Panel Details:**

- Frequency:** 7.074 000 MHz
- Mode:** FT8
- Call Sign:** N8ZPJ
- Grid:** EN82
- Distance:** Az: 360, 965 mi
- Time:** 2023 Mar 25 22:00:23
- Power:** 40m
- Buttons:** Monitor, Log QSO, Stop, Erase, Decode, Enable Tx, Halt Tx, Tune, Menus
- Message Queue:**
  - N8ZPJ K2DM EL88
  - N8ZPJ K2DM -07
  - N8ZPJ K2DM R-07
  - N8ZPJ K2DM RR73
  - N8ZPJ K2DM 73
  - CQ K2DM EL88
- Status:** Receiving, George, FT8, Last Tx: N8ZPJ K2DM RR73, 9

- Let's start with this green bar at the bottom right of the screen.
- The bar shows the progression of the 15 seconds that make up an FT8 transmit/receive cycle.
- The first 13 seconds of each cycle are the transmit portion of the cycle, and the last 2 seconds are the signal processing portion of the cycle.
- These 15-second cycles keep rolling along whether you are transmitting or not.

WSJT-X - Wide Graph

WSJT-X v2.6.1 by K1JT et al.

Band Activity				Rx Frequency					
UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message
215930	-17	0.2	1003	~ HB9SAT IU5LRH JN53	215645	Tx	2000	~	N8LSU K2DM RR73
215930	-18	-0.2	1026	~ CQ EB1FE IN63	215700	-11	0.1	1597	~ K2DM N8LSU 73
215930	-18	-0.0	1064	~ IQOPG IKOMIB R-15	215815	Tx	2000	~	CQ K2DM EL88
220000	7	0.0	1391	~ IU8PYF HI8GSP -13	215845	Tx	2000	~	CQ K2DM EL88
220000	12	0.0	1435	~ HALBF WB2RUU EL96	215900	-7	-0.1	1388	~ K2DM N8ZPJ EN82
220000	2	-0.1	444	~ K4JBL KR3T EM84	215900	-18	0.0	1393	~ ZS1WC ON2BCB JO21
220000	15	0.2	936	~ 7X3WPL WA4DYD EM83	215915	Tx	2000	~	N8ZPJ K2DM -07
220000	-12	0.3	2014	~ ZS1WC HB9TUD JN36	215930	2	-0.0	1392	~ IU8PYF HI8GSP -13
220000	-13	0.0	2193	~ PZ5RA OK1DWQ JN69	215930	-8	-0.1	1387	~ K2DM N8ZPJ R-03
220000	-17	0.7	2145	~ F1PBZ <CT9/DD8ZX> +10	215945	Tx	2000	~	N8ZPJ K2DM RR73
220000	-13	1.1	308	~ CQ IZ1GEA JN35	220000	7	0.0	1391	~ IU8PYF HI8GSP -13
220000	-9	-0.0	1387	~ K2DM N8ZPJ 73	220000	-9	-0.0	1387	~ K2DM N8ZPJ 73

40m 7.074 000

FT8 N8ZPJ EN82 Az: 360 965 mi

2023 Mar 25 22:00:23

Receiving George FT8 Last Tx: N8ZPJ K2DM RR73 9

8/15

- This section lists the standard messages that you might transmit during a contact or to initiate a contact.
- Once a contact has been initiated, the messages will be sent in the proper order to complete the contact.
- You can force a particular message to be sent by selecting it in the column labeled “Next” and clicking the “Enable Tx” button.
- I just completed a QSO with N8ZPJ.

The screenshot shows the WSJT-X v2.6.1 interface. The top window is a 'Wide Graph' showing signal activity. The bottom window is the main control panel, which includes a menu bar (File, Configurations, View, Mode, Decode, Save, Tools, Help) and several data tables.

Band Activity				Rx Frequency					
UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message
215930	-17	0.2	1003	~ HB9SAT IU5LRH JN53	215645	Tx		2000	~ N8LSU K2DM RR73
215930	-18	-0.2	1026	~ CQ EB1FE IN63	215700	-11	0.1	1597	~ K2DM N8LSU 73
215930	-18	-0.0	1064	~ IQOPG IKOMIB R-15	215815	Tx		2000	~ CQ K2DM EL88
220000	7	0.0	1391	~ IU8PYF HI8GSP -13	215845	Tx		2000	~ CQ K2DM EL88
220000	12	0.0	1435	~ HALBF WB2RUU EL96	215900	-7	-0.1	1388	~ K2DM N8ZPJ EN82
220000	2	-0.1	444	~ K4JBL KR3T EM84	215900	-18	0.0	1393	~ ZS1WC ON2BCB JO21
220000	15	0.2	936	~ 7X3WPL WA4DYD EM83	215915	Tx		2000	~ N8ZPJ K2DM -07
220000	-12	0.3	2014	~ ZS1WC HB9TUD JN36	215930	2	-0.0	1392	~ IU8PYF HI8GSP -13
220000	-13	0.0	2193	~ PZ5RA OK1DWQ JN69	215930	-8	-0.1	1387	~ K2DM N8ZPJ R-03
220000	-17	0.7	2145	~ F1PBZ <CT9/DD8ZX> +10	215945	Tx		2000	~ N8ZPJ K2DM RR73
220000	-13	1.1	308	~ CQ IZ1GEA JN35	220000	7	0.0	1391	~ IU8PYF HI8GSP -13
220000	-9	-0.0	1387	~ K2DM N8ZPJ 73	220000	-9	-0.0	1387	~ K2DM N8ZPJ 73

The 'Generate Std Msgs' section is highlighted with a red box and contains the following messages:

Message	Next	Now
N8ZPJ K2DM EL88	<input type="radio"/>	<input type="radio"/>
N8ZPJ K2DM -07	<input type="radio"/>	<input type="radio"/>
N8ZPJ K2DM R-07	<input type="radio"/>	<input type="radio"/>
N8ZPJ K2DM RR73	<input type="radio"/>	<input type="radio"/>
N8ZPJ K2DM 73	<input type="radio"/>	<input type="radio"/>
CQ K2DM EL88	<input type="radio"/>	<input checked="" type="radio"/>

- The “Rx Frequency” portion of the WSJT-X screen lists:
  - Activity that occurs on, or very near, your receive frequency.
  - Your transmissions.
  - Transmissions of other stations that are calling you.
- These entries are color coded so you can tell what is happening at a glance.
- These entries are populated from the bottom and scroll up past the top.
- You can see how my QSO with N8ZPJ played out.

The screenshot displays the WSJT-X software interface. At the top, a 'Wide Graph' shows a frequency spectrum from 500 to 3000 Hz. Below the graph are control panels for 'Bins/Pixel', 'Start', 'Split', 'N Avg', 'Palette', 'Flatten', 'Ref Spec', 'Cumulative', and 'Smooth'. The main window title is 'WSJT-X v2.6.1 by K1JT et al.' and it includes a menu bar (File, Configurations, View, Mode, Decode, Save, Tools, Help) and a toolbar with buttons like 'Monitor', 'Erase', 'Decode', 'Enable Tx', 'Halt Tx', and 'Tune'.

The 'Band Activity' table shows a list of received transmissions with columns for UTC, dB, DT, Freq, and Message. A red box highlights the 'Rx Frequency' table, which contains the following data:

UTC	dB	DT	Freq	Message
215645	Tx		2000	N8LSU K2DM RR73
215700	-11	0.1	1597	K2DM N8LSU 73
215815	Tx		2000	CQ K2DM EL88
215845	Tx		2000	CQ K2DM EL88
215900	-7	-0.1	1388	K2DM N8ZPJ EN82
215900	-18	0.0	1393	ZS1WC ON2BCB JO21
215915	Tx		2000	N8ZPJ K2DM -07
215930	2	-0.0	1392	IU8PYF HI8GSP -13
215930	-8	-0.1	1387	K2DM N8ZPJ R-03
215945	Tx		2000	N8ZPJ K2DM RR73
220000	7	0.0	1391	IU8PYF HI8GSP -13
220000	-9	-0.0	1387	K2DM N8ZPJ 73

Below the tables, there are controls for 'CQ only', 'Log QSO', 'Stop', 'Monitor', 'Erase', 'Decode', 'Enable Tx', 'Halt Tx', and 'Tune'. A central display shows the current frequency '7.074 000' and a 'Tx 2000 Hz' control. A 'Generate Std Msgs' section lists various messages like 'N8ZPJ K2DM EL88', 'N8ZPJ K2DM -07', 'N8ZPJ K2DM R-07', 'N8ZPJ K2DM RR73', 'N8ZPJ K2DM 73', and 'CQ K2DM EL88'. At the bottom, a status bar shows 'Receiving', 'George', 'FT8', 'Last Tx: N8ZPJ K2DM RR73', and '8/15 WD:6m'.

- The “Band Activity” portion of the WSJT-X screen lists stations that have been received during recent 15-second receive intervals.
- It is populated from the bottom.
- As it fills up (over one or more receive intervals) entries slide off the top of the area. Those entries can be recovered for a while using the slider to the right of the area.
- The area only populates after a receive interval.
- See that the last entry in the window is the ‘73’ message I received from N8ZPJ.

The screenshot shows the WSJT-X software interface. The top part is a wide graph showing signal activity across a frequency range from 500 to 3000 Hz. Below the graph is a control panel with various settings like Bins/Pixel, Start Freq, Split, N Avg, Palette, Adjust, Flatten, Ref Spec, Spec, Cumulative, and Smooth.

The main window displays the Band Activity table, which is highlighted with a red box. The table has columns for UTC, dB, DT, Freq, and Message. The last entry in the table is 'K2DM N8ZPJ 73'.

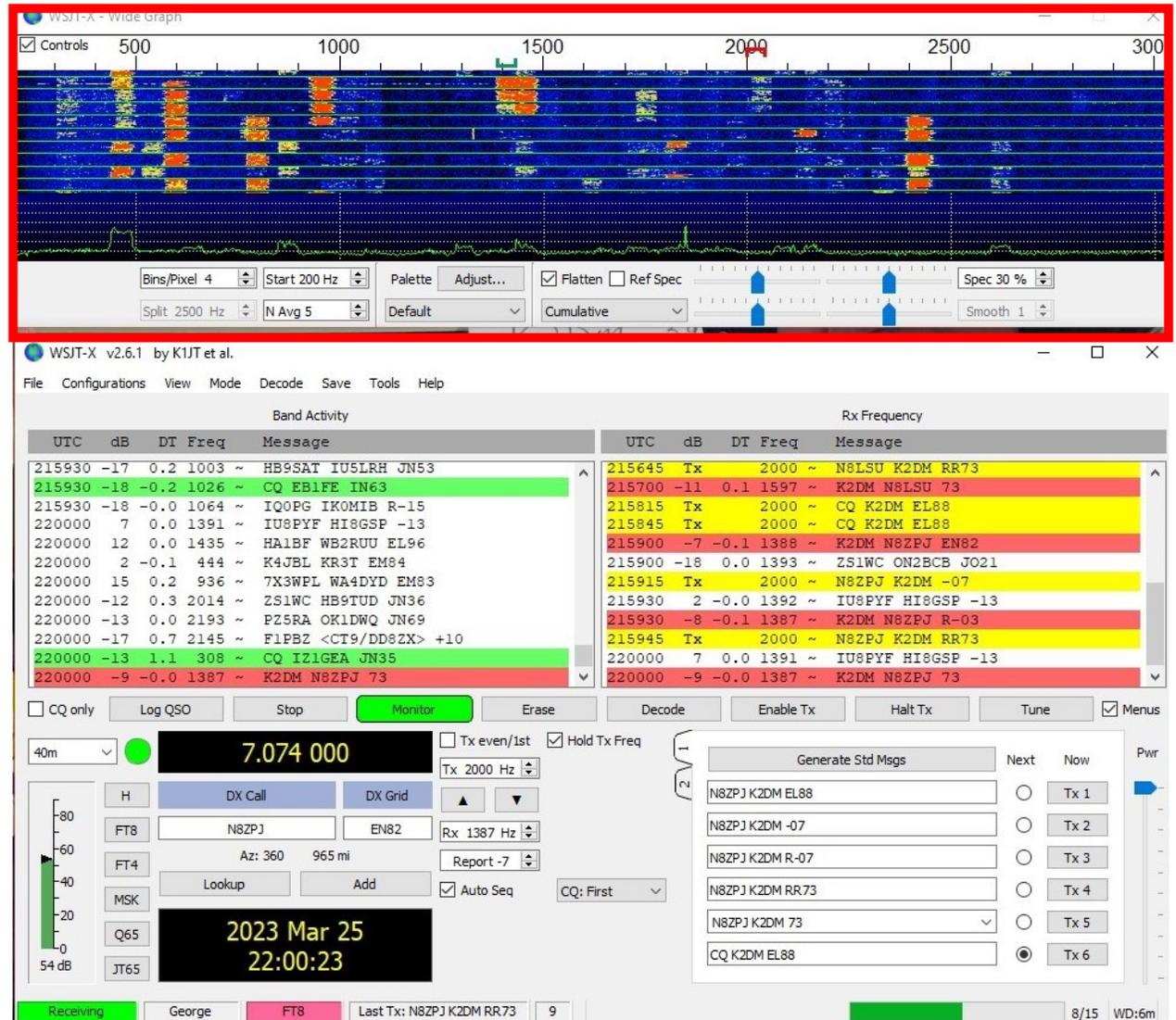
UTC	dB	DT	Freq	Message
215930	-17	0.2	1003	~ HB9SAT IU5LRH JN53
215930	-18	-0.2	1026	~ CQ EB1FE IN63
215930	-18	-0.0	1064	~ IQ0PG IKOMIB R-15
220000	7	0.0	1391	~ IU8PYF HI8GSP -13
220000	12	0.0	1435	~ HA1BF WB2RUU EL96
220000	2	-0.1	444	~ K4JBL KR3T EM84
220000	15	0.2	936	~ 7X3WPL WA4DYD EM83
220000	-12	0.3	2014	~ ZS1WC HB9TUD JN36
220000	-13	0.0	2193	~ PZ5RA OK1DWQ JN69
220000	-17	0.7	2145	~ F1PBZ <CT9/DD8ZX> +10
220000	-13	1.1	308	~ CQ IZ1GEA JN35
220000	-9	-0.0	1387	~ K2DM N8ZPJ 73

Below the Band Activity table is the Rx Frequency table, which shows the current receive frequency and message. The last entry is 'K2DM N8ZPJ 73'.

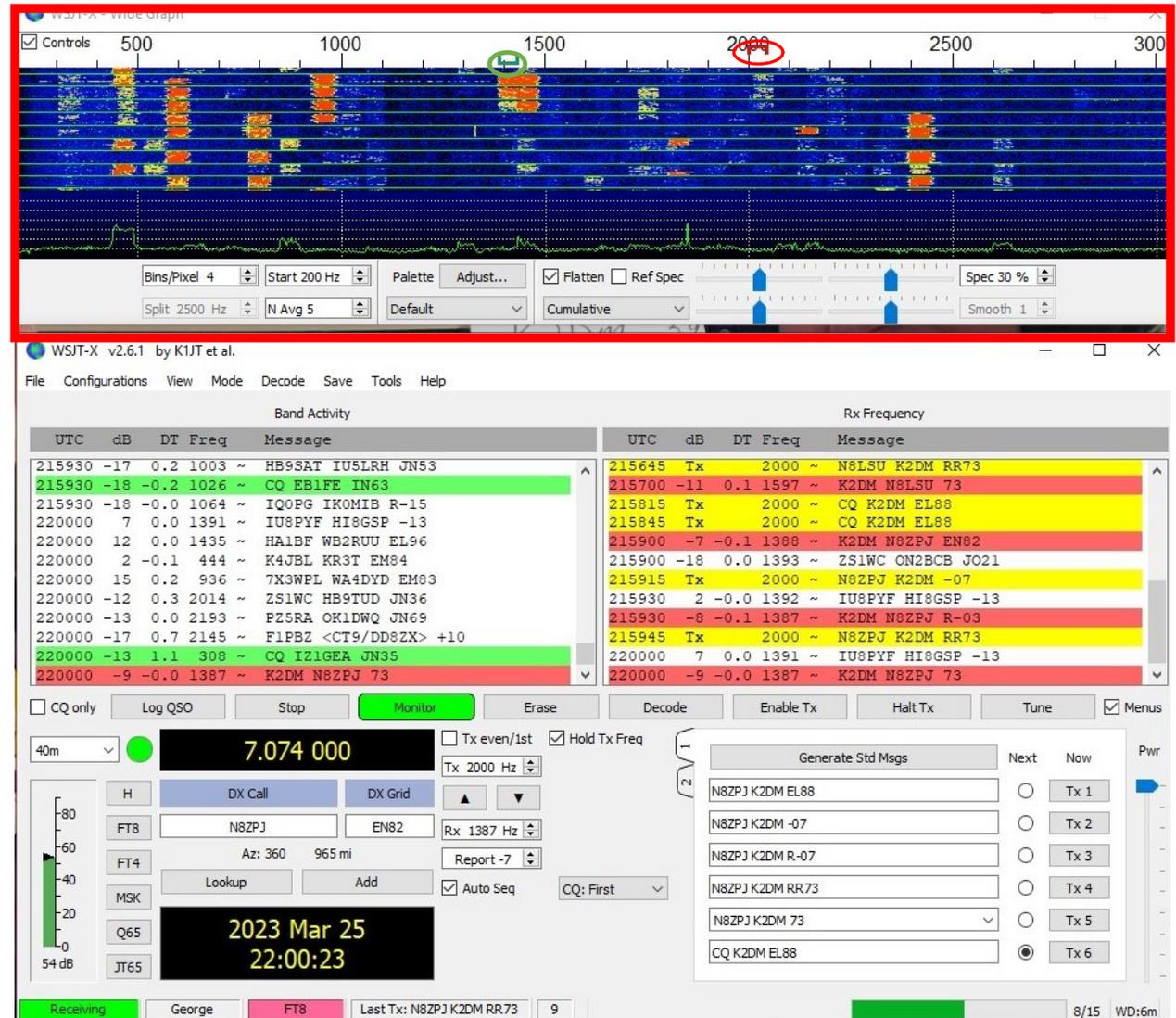
UTC	dB	DT	Freq	Message
215645	Tx		2000	~ N8LSU K2DM RR73
215700	-11	0.1	1597	~ K2DM N8LSU 73
215815	Tx		2000	~ CQ K2DM EL88
215845	Tx		2000	~ CQ K2DM EL88
215900	-7	-0.1	1388	~ K2DM N8ZPJ EN82
215900	-18	0.0	1393	~ ZS1WC ON2BCB JO21
215915	Tx		2000	~ N8ZPJ K2DM -07
215930	2	-0.0	1392	~ IU8PYF HI8GSP -13
215930	-8	-0.1	1387	~ K2DM N8ZPJ R-03
215945	Tx		2000	~ N8ZPJ K2DM RR73
220000	7	0.0	1391	~ IU8PYF HI8GSP -13
220000	-9	-0.0	1387	~ K2DM N8ZPJ 73

The bottom part of the screenshot shows the control panel with various settings like CQ only, Log QSO, Stop, Monitor, Erase, Decode, Enable Tx, Halt Tx, Tune, and Menus. The current frequency is 7.074 000 MHz. The current message is '2023 Mar 25 22:00:23'. The current station is 'N8ZPJ' and the current message is '73'.

- This waterfall window comes on every time you start WSJT-X.
- It shows a graphic representation of ALL stations copied by WSJT-X during each 15-second receive window.
- Beneath the waterfall is a spectrum analyzer display of all activity within the defined frequency range and the current 15-second receive interval.
- Waterfall images remain on the display until they reach the bottom of the waterfall.



- The scale above the display is in Hz.
- The display can be extended down to 0Hz and up to more than 4000Hz, but the practical upper limit for FT8 is around 3000Hz.
- All of the signals shown here are packed into the width of a single USB signal.
- Notice that each signal on the waterfall is 50Hz wide.
- The green “goalpost” above 1387Hz indicates the current receive frequency, and the red “goalpost” above 2000Hz indicates the current transmit frequency.
- Mouse click on the waterfall to change the receive frequency.
- Shift+click to change the transmit frequency.



- Here the highlighted area shows what your transmit and receive frequencies are.
- Observe that the Tx frequency of 2000 Hz is reflected by the red upside down U above the waterfall, with the Rx frequency being reflected by the green U.
- You can change these frequencies by typing over the existing frequency in the respective window.
- You can use the larger arrows (triangles) to copy the Tx frequency to the Rx frequency or vice versa.
- Also shown is the signal “Report” of the station you are working.

The screenshot displays the WSJT-X software interface. The top window, titled 'WSJT-X - Wide Graph', shows a waterfall plot with a frequency range from 500 to 3000 Hz. A red 'U' is visible at 2000 Hz, and a green 'U' is visible at 1387 Hz. Below the plot are control options for Bins/Pixel, Start, Palette, Split, N Avg, and Smooth.

The bottom window, titled 'WSJT-X v2.6.1 by K1JT et al.', shows a control panel with a 'Band Activity' table and an 'Rx Frequency' table. The 'Band Activity' table lists various stations and their frequencies. The 'Rx Frequency' table lists the current receive frequency and message. The control panel includes buttons for 'Log QSO', 'Stop', 'Monitor', 'Erase', 'Decode', 'Enable Tx', 'Halt Tx', and 'Tune'. A 'Report' button is highlighted in red, and the 'Tx 2000 Hz' and 'Rx 1387 Hz' fields are also highlighted in red.

Band Activity				Rx Frequency					
UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message
215930	-17	0.2	1003	~ HB9SAT IU5LRH JN53	215645	Tx		2000	~ N8LSU K2DM RR73
215930	-18	-0.2	1026	~ CQ EB1FE IN63	215700	-11	0.1	1597	~ K2DM N8LSU 73
215930	-18	-0.0	1064	~ IQ0PG IKOMIB R-15	215815	Tx		2000	~ CQ K2DM EL88
220000	7	0.0	1391	~ IU8PYF HI8GSP -13	215845	Tx		2000	~ CQ K2DM EL88
220000	12	0.0	1435	~ HA1BF WB2RUU EL96	215900	-7	-0.1	1388	~ K2DM N8ZPJ EN82
220000	2	-0.1	444	~ K4JBL KR3T EM84	215900	-18	0.0	1393	~ ZS1WC ON2BCB JO21
220000	15	0.2	936	~ 7X3WPL WA4DYD EM83	215915	Tx		2000	~ N8ZPJ K2DM -07
220000	-12	0.3	2014	~ ZS1WC HB9TUD JN36	215930	2	-0.0	1392	~ IU8PYF HI8GSP -13
220000	-13	0.0	2193	~ PZ5RA OK1DWQ JN69	215930	-8	-0.1	1387	~ K2DM N8ZPJ R-03
220000	-17	0.7	2145	~ F1PBZ <CT9/DD8ZX> +10	215945	Tx		2000	~ N8ZPJ K2DM RR73
220000	-13	1.1	308	~ CQ IZ1GEA JN35	220000	7	0.0	1391	~ IU8PYF HI8GSP -13
220000	-9	-0.0	1387	~ K2DM N8ZPJ 73	220000	-9	-0.0	1387	~ K2DM N8ZPJ 73

- The highlighted area shows what band you are operating on and the frequency to which your radio is tuned on that band.
- By convention there is one agreed-upon frequency that is used for FT8 on each band. As mentioned earlier, on 40M it is 7.074 MHz.
- With WSJT-X controlling your radio, you can change bands by clicking the down arrow and selecting from the bands in the drop-down list.

The screenshot displays the WSJT-X software interface. At the top, a 'Wide Graph' shows signal activity across a frequency range from 500 to 3000 kHz. Below the graph, control settings include 'Bins/Pixel 4', 'Start 200 Hz', 'Split 2500 Hz', 'N Avg 5', and 'Spec 30 %'. The main control panel shows the current band set to '40m' and the frequency tuned to '7.074 000' MHz. A table of band activity and a list of messages are also visible.

Band Activity				Rx Frequency					
UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message
215930	-17	0.2	1003	~ HB9SAT IU5LRH JN53	215645	Tx	2000	~	N8LSU K2DM RR73
215930	-18	-0.2	1026	~ CQ EB1FE IN63	215700	-11	0.1	1597	~ K2DM N8LSU 73
215930	-18	-0.0	1064	~ IQOPG IKOMIB R-15	215815	Tx	2000	~	CQ K2DM EL88
220000	7	0.0	1391	~ IU8PYF HI8GSP -13	215845	Tx	2000	~	CQ K2DM EL88
220000	12	0.0	1435	~ HALBF WB2RUU EL96	215900	-7	-0.1	1388	~ K2DM N8ZPJ EN82
220000	2	-0.1	444	~ K4JBL KR3T EM84	215900	-18	0.0	1393	~ ZS1WC ON2BCB JO21
220000	15	0.2	936	~ 7X3WPL WA4DYD EM83	215915	Tx	2000	~	N8ZPJ K2DM -07
220000	-12	0.3	2014	~ ZS1WC HB9TUD JN36	215930	2	-0.0	1392	~ IU8PYF HI8GSP -13
220000	-13	0.0	2193	~ PZ5RA OK1DWQ JN69	215930	-8	-0.1	1387	~ K2DM N8ZPJ R-03
220000	-17	0.7	2145	~ F1PBZ <CT9/DD8ZX> +10	215945	Tx	2000	~	N8ZPJ K2DM RR73
220000	-13	1.1	308	~ CQ IZ1GEA JN35	220000	7	0.0	1391	~ IU8PYF HI8GSP -13
220000	-9	-0.0	1387	~ K2DM N8ZPJ 73	220000	-9	-0.0	1387	~ K2DM N8ZPJ 73

## Control buttons.

- CQ only: check this if you only want to see stations calling CQ.
- Log QSO: brings up the logging window.
- Stop: terminates normal data acquisition, like maybe you want to freeze the waterfall.
- Monitor: toggles normal receive operation on or off. GREEN when on.
- Erase: click once to clear the Rx Frequency window. Double-click to also clear the Band Activity window.
- Decode: repeats the decoding procedure at the Rx frequency.
- Enable Tx: toggles automatic T/R sequencing on or off. RED when on.
- Halt Tx: terminates a transmission immediately and disables automatic T/R sequencing.
- Tune: Generates an unmodulated carrier at the specified Tx frequency. RED when on.
- Menu: toggles the top-of-window menus.

The image shows two windows from the WSJT-X software. The top window is a 'Wide Graph' showing a waterfall plot of frequency (500-3000 Hz) with signal activity. The bottom window is the main control interface, titled 'WSJT-X v2.6.1 by K1JT et al.', which includes a menu bar, a table of band activity and Rx frequency, and a control panel with various buttons and settings.

**Band Activity Table:**

UTC	dB	DT	Freq	Message
215930	-17	0.2	1003	~ HB9SAT IU5LRH JN53
215930	-18	-0.2	1026	~ CQ EB1FE IN63
215930	-18	-0.0	1064	~ IQOPG IKOMIB R-15
220000	7	0.0	1391	~ IU8PYF HI8GSP -13
220000	12	0.0	1435	~ HA1BF WB2RUU EL96
220000	2	-0.1	444	~ K4JBL KR3T EM84
220000	15	0.2	936	~ 7X3WPL WA4DYD EM83
220000	-12	0.3	2014	~ ZS1WC HB9TUD JN36
220000	-13	0.0	2193	~ PZ5RA OK1DWQ JN69
220000	-17	0.7	2145	~ F1PBZ <CT9/DD8ZX> +10
220000	-13	1.1	308	~ CQ IZ1GEA JN35
220000	-9	-0.0	1387	~ K2DM N8ZPJ 73

**Rx Frequency Table:**

UTC	dB	DT	Freq	Message
215645	Tx		2000	~ N8LSU K2DM RR73
215700	-11	0.1	1597	~ K2DM N8LSU 73
215815	Tx		2000	~ CQ K2DM EL88
215845	Tx		2000	~ CQ K2DM EL88
215900	-7	-0.1	1388	~ K2DM N8ZPJ EN82
215900	-18	0.0	1393	~ ZS1WC ON2BCB JO21
215915	Tx		2000	~ N8ZPJ K2DM -07
215930	2	-0.0	1392	~ IU8PYF HI8GSP -13
215930	-8	-0.1	1387	~ K2DM N8ZPJ R-03
215945	Tx		2000	~ N8ZPJ K2DM RR73
220000	7	0.0	1391	~ IU8PYF HI8GSP -13
220000	-9	-0.0	1387	~ K2DM N8ZPJ 73

**Control Panel:**

- Buttons: CQ only, Log QSO, Stop, Monitor (green), Erase, Decode, Enable Tx, Halt Tx, Tune, Menu (checked).
- Frequency: 7.074 000
- Mode: 40m
- TX Settings: Tx 2000 Hz, Rx 1387 Hz, Report -7, Auto Seq, CQ: First.
- Message List: N8ZPJ K2DM EL88, N8ZPJ K2DM -07, N8ZPJ K2DM R-07, N8ZPJ K2DM RR73, N8ZPJ K2DM 73, CQ K2DM EL88.
- Status: Receiving, George, FT8, Last Tx: N8ZPJ K2DM RR73, 9, 8/15, WD:6m.

- This control is a slider. It interacts with the power output setting on your transceiver.
- Let's say you have set your transceiver's output to 50W.
- When the slider is at the top, you are transmitting 50W.
- When the slider is halfway up, you are transmitting 25W.
- Because FT8 is a mode that transmits at a full duty cycle, you should never set your transceiver's output to full power. You can easily damage your finals.

The screenshot shows the WSJT-X software interface. The top window, titled 'WSJT-X - Wide Graph', displays a waterfall plot of signal activity. The bottom window, titled 'WSJT-X v2.6.1 by K1JT et al.', shows the main control panel. The 'Pwr' slider is highlighted in red, indicating its importance in controlling power output. The control panel also displays various settings and data, including a frequency display of 7.074 000 and a date/time display of 2023 Mar 25 22:00:23.

Band Activity					Rx Frequency				
UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message
215930	-17	0.2	1003	~ HB9SAT IU5LRH JN53	215645	Tx		2000	~ N8LSU K2DM RR73
215930	-18	-0.2	1026	~ CQ EB1FE IN63	215700	-11	0.1	1597	~ K2DM N8LSU 73
215930	-18	-0.0	1064	~ IQ0PG IKOMIB R-15	215815	Tx		2000	~ CQ K2DM EL88
220000	7	0.0	1391	~ IU8PYF HI8GSP -13	215845	Tx		2000	~ CQ K2DM EL88
220000	12	0.0	1435	~ HA1BF WB2RUU EL96	215900	-7	-0.1	1388	~ K2DM N8ZPJ EN82
220000	2	-0.1	444	~ K4JBL KR3T EM84	215900	-18	0.0	1393	~ ZS1WC ON2BCB JO21
220000	15	0.2	936	~ 7X3WPL WA4DYD EM83	215915	Tx		2000	~ N8ZPJ K2DM -07
220000	-12	0.3	2014	~ ZS1WC HB9TUD JN36	215930	2	-0.0	1392	~ IU8PYF HI8GSP -13
220000	-13	0.0	2193	~ PZ5RA OK1DWQ JN69	215930	-8	-0.1	1387	~ K2DM N8ZPJ R-03
220000	-17	0.7	2145	~ F1PBZ <CT9/DD8ZX> +10	215945	Tx		2000	~ N8ZPJ K2DM RR73
220000	-13	1.1	308	~ CQ IZ1GEA JN35	220000	7	0.0	1391	~ IU8PYF HI8GSP -13
220000	-9	-0.0	1387	~ K2DM N8ZPJ 73	220000	-9	-0.0	1387	~ K2DM N8ZPJ 73

- This highlighted area is an indicator, not a control.
- It indicates received audio level.
- It should normally read about 30dB on a band that has no signals.
- On an active band, with about 15 signals or so, it should read around 50dB.
- Notice that it reads 54dB at this time, with about 10 active signals.
- If the level gets too high, and turns red, you may be overdriving your sound card and causing sampling errors on receive.

The screenshot shows the WSJT-X software interface. The top window, titled "WSJT-X - Wide Graph", displays a frequency spectrum from 500 to 3000 Hz. A vertical red line is positioned at approximately 2000 Hz, and the area around it is highlighted in red, indicating a high audio level. Below the graph are various control options like "Bins/Pixel 4", "Start 200 Hz", "Palette", "Adjust...", "Flatten", "Ref Spec", "Split 2500 Hz", "N Avg 5", "Default", "Cumulative", and "Smooth 1".

The bottom window, titled "WSJT-X v2.6.1 by K1JT et al.", shows the main control panel. It features a "Band Activity" table and an "Rx Frequency" table. The "Band Activity" table lists various signals with their UTC, dB, DT, Freq, and Message. The "Rx Frequency" table shows the current receive frequency and message. The control panel includes buttons for "Log QSO", "Stop", "Monitor", "Erase", "Decode", "Enable Tx", "Halt Tx", and "Tune". A "40m" band is selected, and the frequency is set to 7.074 000. A "Tx 2000 Hz" setting is visible. A "Generate Std Msgs" section lists various messages like "N8ZPJ K2DM EL88", "N8ZPJ K2DM -07", "N8ZPJ K2DM R-07", "N8ZPJ K2DM RR73", "N8ZPJ K2DM 73", and "CQ K2DM EL88". A "Pwr" slider is also present. At the bottom, a status bar shows "Receiving", "George", "FT8", "Last Tx: N8ZPJ K2DM RR73", "9", "8/15", and "WD:6m".

Band Activity					Rx Frequency				
UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message
215930	-17	0.2	1003	~ HB9SAT IU5LRH JN53	215645	Tx		2000	~ N8LSU K2DM RR73
215930	-18	-0.2	1026	~ CQ EB1FE IN63	215700	-11	0.1	1597	~ K2DM N8LSU 73
215930	-18	-0.0	1064	~ IQ0PG IKOMIB R-15	215815	Tx		2000	~ CQ K2DM EL88
220000	7	0.0	1391	~ IU8PYF HI8GSP -13	215845	Tx		2000	~ CQ K2DM EL88
220000	12	0.0	1435	~ HA1BF WB2RUU EL96	215900	-7	-0.1	1388	~ K2DM N8ZPJ EN82
220000	2	-0.1	444	~ K4JBL KR3T EM84	215900	-18	0.0	1393	~ ZS1WC ON2BCB JO21
220000	15	0.2	936	~ 7X3WPL WA4DYD EM83	215915	Tx		2000	~ N8ZPJ K2DM -07
220000	-12	0.3	2014	~ ZS1WC HB9TUD JN36	215930	2	-0.0	1392	~ IU8PYF HI8GSP -13
220000	-13	0.0	2193	~ PZ5RA OK1DWQ JN69	215930	-8	-0.1	1387	~ K2DM N8ZPJ R-03
220000	-17	0.7	2145	~ F1PBZ <CT9/DD8ZX> +10	215945	Tx		2000	~ N8ZPJ K2DM RR73
220000	-13	1.1	308	~ CQ IZ1GEA JN35	220000	7	0.0	1391	~ IU8PYF HI8GSP -13
220000	-9	-0.0	1387	~ K2DM N8ZPJ 73	220000	-9	-0.0	1387	~ K2DM N8ZPJ 73

# FT8 SIGNAL REPORTS

- Are mostly negative, e.g., -8, -15.
- They are based on the noise floor at the receiving station, with -26dB representing that noise floor.
- This is the point at which FT8 can start decoding signals.
- Stronger signals receive higher reports, like -9, -3, etc.
- Really strong signals receive positive reports, like 3, 7, etc.
  - These are usually from the ham a block away, or someone running a kilowatt with a big yagi antenna.

# SETTING UP WSJT-X

# DOWNLOAD WSJT-X

- [WSJT Home Page \(sourceforge.io\)](http://sourceforge.io)
- Select WSJT-X (on the left side of the screen)
- Scroll down to Installation Packages and select the one that matches your system
  - **Installation packages for *WSJT-X 2.6.1***  
**Windows:**
    - Version 2.6.1, 32-bit: [wsjtx-2.6.1-win32.exe](#). (Windows 7 and later)
    - Version 2.6.1, 64-bit: [wsjtx-2.6.1-win64.exe](#). (Windows 7 and later)
- Select the installation package that matches your system to download it.
- Open the downloaded file, install it and run it.

ADMINISTER WSJT-X

- Open Ctrl+O
- Open next in directory
- Decode remaining files in directory Shift+F6
- Delete all \*.wav & \*.c2 files in SaveDir
- Erase ALL.TXT
- Erase wsjtx\_log.adi
- Erase WSPR hashtable
- Reset Cabrillo log ...
- Export Cabrillo log ...
- Open log directory
- Settings...**
- Exit

	Rx Frequency				
	UTC	dB	DT	Freq	Message
170215	-8	0.1	1695	~	CQ LY0UKR KO25
170230	-4	0.6	1688	~	WD4CVK K4VOR EM64
170230	-13	0.1	1696	~	LY0UKR KK4ZRP EL09
170245	-9	0.1	1696	~	CQ LY0UKR KO25
170300	-1	0.6	1688	~	NN8B K4VOR R-09
170300	-13	0.1	1697	~	LY0UKR KK4ZRP EL09

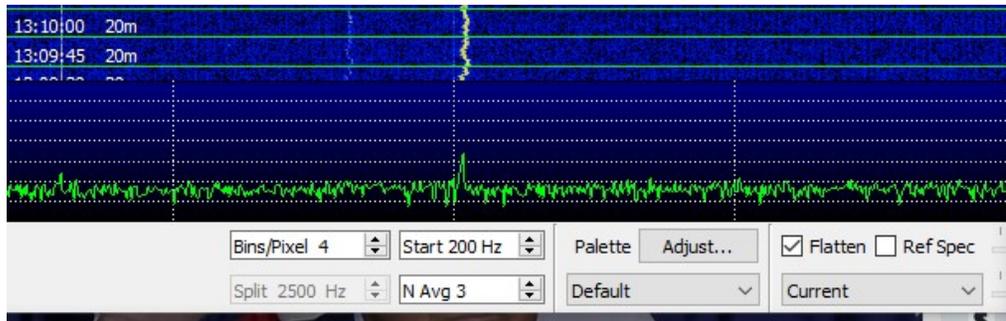
Menus

500  Tx even/1st  Hold Tx Freq  
 Tx 1246 Hz  
 DX Grid  
 Rx 1694 Hz  
 Report -15  
 Auto Seq

Generate Std Msgs

	Next	Now
VU7W K2DM EL88	<input type="radio"/>	<input type="radio"/> Tx 1
VU7W K2DM -15	<input type="radio"/>	<input type="radio"/> Tx 2
VU7W K2DM R-15	<input type="radio"/>	<input type="radio"/> Tx 3
VU7W K2DM RR73	<input type="radio"/>	<input type="radio"/> Tx 4
VU7W K2DM 73	<input type="radio"/>	<input type="radio"/> Tx 5
CQ K2DM EL88	<input checked="" type="radio"/>	<input type="radio"/> Tx 6

FT4  
 MSK  
 Q65  
 JT65  
 Lookup Add  
 2023 May 12  
 13:11:45



WSJT-X v2.6.1 by K1JT et al.

File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	DI	Freq	Message
170315	-8	0.2	2705	~ CQ KX8X EN82
170315	-17	0.1	2037	~ KB0TDW KQ4CEW EM96
170315	-16	0.1	2167	~ CQ KC3UEK FN00
170315	-14	0.2	1877	~ <8A100K> PF7DKW JO21
170315	-14	1.0	1209	~ CQ WB6OTG FM05
170315	-18	0.2	720	~ CQ N7RLK CN83

CQ only

20m  Tx even/1st  Hold Tx Freq

14.073 500

Tx 1246 Hz

Rx 1694 Hz

Report -15

Auto Seq

CQ: First

2023 May 12  
13:12:06

Receiving George FT8 0

### Settings

General Radio Audio Tx Macros Reporting Frequencies Colors Advanced

General station details and settings.

My Call: K2DM My Grid: EL88  AutoGrid IARU Region: All

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

Display

Start new period decodes at top

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

Highlight DX Call in message  Highlight DX Grid in message

Behavior

Monitor off at startup  Enable VHF and submode 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

Calling CQ forces Call 1st

Alternate F1-F6 bindings Tx watchdog: 6 minutes

CW ID after 73 Periodic CW ID Interval: 0

WSJT-X v2.6.1 by K1JT et al.

File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	DT	Freq	Message
170315	-8	0.2	2705 ~	CQ KX8X EN82
170315	-17	0.1	2037 ~	KB0TDW KQ4CEW EM96
170315	-16	0.1	2167 ~	CQ KC3UEK FN00
170315	-14	0.2	1877 ~	<8A100K> PF7DKW JO21
170315	-14	1.0	1209 ~	CQ WB6OTG FM05
170315	-18	0.2	720 ~	CQ N7RLK CN83

CQ only

20m ● **14.073 500**  Tx even/1st  Hold Tx Freq

Tx 1246 Hz

Rx 1694 Hz

Report -15

Auto Seq

**2023 May 12**  
**13:12:58**

Receiving George FT8 0

Settings

General Radio Audio Tx Macros Reporting Frequencies Colors Advanced

Rig: Elecraft K3 Radio interface configuration settings. Poll Interval: 1 s

CAT Control

Serial Port: COM5

Serial Port Parameters

Baud Rate: 38400

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: COM5

Transmit Audio Source

Rear/Data  Front/Mic

Mode

None  USB  Data/Pkt

Split Operation

None  Rig  Fake It



WSJT-X v2.6.1 by K1JT et al.

File Configurations View Mode Decode Save Tools Help

### Band Activity

UTC	dB	DI	Freq	Message
131500	-15	0.7	1944	~ W5JDC KE8STO R-17
131500	-9	-0.1	2327	~ YB9RIE KD9WVB EN53
131500	-11	0.1	1723	~ CQ K4WPC EM97
131500	-11	0.1	372	~ CQ KE8ESJ EM79
131500	9	0.2	2169	~ CQ VOTA WD9HSY EN61
131500	5	0.1	2181	~ AB8MO WD5GRW RR73

CQ only     Log QSO           

20m    14.074 000     Tx even/1st     Hold Tx Freq

H    DX Call    DX Grid    Tx 1246 Hz  
 FT8    VU7W    Rx 1694 Hz  
 FT4    Report -15  
 MSK    Lookup    Add     Auto Seq    CQ: First

2023 May 12  
13:15:24

Receiving    George    FT8    31

### Settings

General    Radio    Audio    Tx Macros    Reporting    Frequencies    Colors    Advanced

Rig: Elecraft K3    Poll Interval: 1 s

#### CAT Control

Serial Port: COM5

#### Serial Port Parameters

Baud Rate: 38400

#### 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: COM5

#### Transmit Audio Source

Rear/Data     Front/Mic

#### Mode

None     USB     Data/Pkt

#### Split Operation

None     Rig     Fake It

Attempt to connect to the radio with these settings.

The button will turn green if the connection is successful or red if there is a problem.

13:13:45 20m  
13:13:30 20m

Bins/Pixel 4 Start 200 Hz Palette Adjust... Flatten Ref Spec  
Split 2500 Hz N Avg 3 Default Current

WSJT-X v2.6.1 by K1JT et al.  
File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	DT	Freq	Message
131530	-15	0.2	200	~ YB1LK KM7S -10
131530	-11	0.2	614	~ KD4YXM KCOBLK R-13
131530	-16	0.1	845	~ CQ K4WPC EM97
131530	-19	0.2	378	~ CQ NP3DM FK68
131530	-4	0.1	492	~ N4NR N7WFK EM15
131530	-9	-0.1	1450	~ YB9RIE KD9WVB EN53

CQ only

20m  **14.074 000**  Tx even/1st  Hold Tx Freq  
Tx 1246 Hz

H DX Call DX Grid  
FT8 VU7W Rx 1694 Hz  
FT4 Report -15  
MSK Lookup Add  Auto Seq CQ: First

80  
60  
40  
20  
0  
10 dB

2023 May 12  
13:15:52

Receiving George FT8 23

Settings

General Radio Audio Tx Macros Reporting Frequencies Colors Advanced

Rig: Elecraft K3 Poll Interval: 1 s

CAT Control  
Serial Port: COM5

Serial Port Parameters  
Baud Rate: 38400

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: COM5

Transmit Audio Source  
 Rear/Data  Front/Mic

Mode  
 None  USB  Data/Pkt

Split Operation  
 None  Rig  Fake It

Attempt to activate the transmitter. Click again to deactivate. Normally no power should be output since there is no audio being generated at this time. Check that any Tx indication on your radio and/or your radio interface behave as expected.



WSJT-X v2.6.1 by K1JT et al.

File Configurations View Mode Decode Save Tools Help

### Band Activity

UTC	dB	DT	Freq	Message
131600	-13	0.3	729	~ KW2E NG5P EM34
131600	-14	0.7	1067	~ W5JDC KE8STO 73
131600	-10	0.2	213	~ CQ KA0BOJ EN10
131600	3	0.2	542	~ VK5PO AG5MS R-11
131600	-20	0.1	378	~ CQ NP3DM FK68
131600	-13	0.3	201	~ YB1LK KM7S -10

CQ only               

20m    14.074 000     Tx even/1st     Hold Tx Freq  
 Tx 1246 Hz    Rx 1694 Hz    Report -15     Auto Seq    CQ: First

H    DX Call    DX Grid  
 FT8    VU7W  
 FT4  
 MSK    Lookup    Add  
 Q65  
 JT65

2023 May 12  
 13:16:13

Receiving    George    FT8    22

### Settings

General Radio Audio Tx Macros Reporting Frequencies Colors Advanced

Soundcard Audio interface settings

Input: Microphone (2- USB Audio CODEC )    Mono  
 Output: Speakers (2- USB Audio CODEC )    Both

Save Directory  
 Location: C:/Users/k2dm/AppData/Local/WSJT-X/save   

AzEl Directory  
 Location: C:/Users/k2dm/AppData/Local/WSJT-X   

Remember power settings by band  
 Transmit     Tune

# INTO THE BELLY OF THE BEAST

# HOW FT8 ENCODES MESSAGES

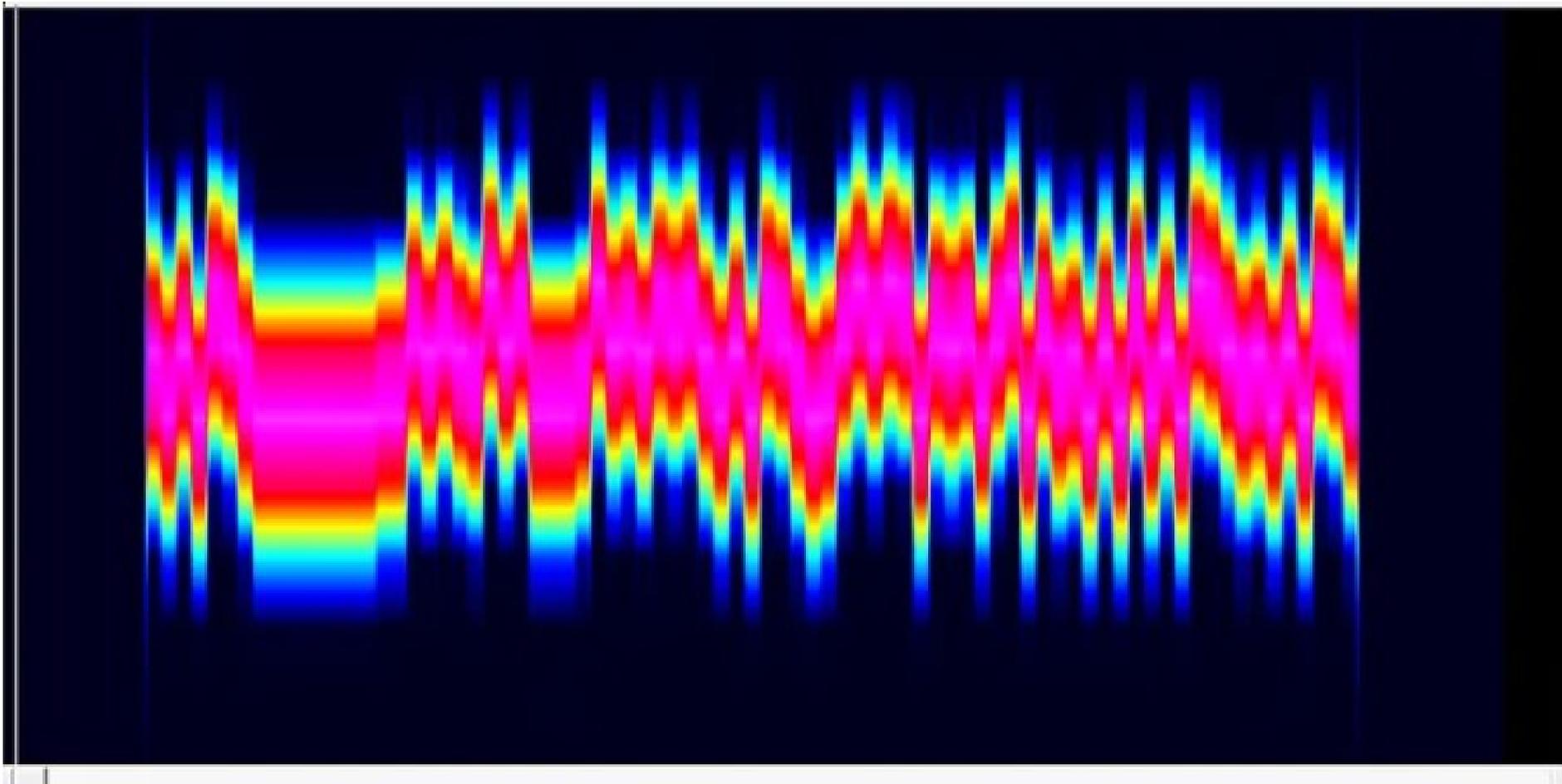
- Common abbreviations (like CQ, DX) are replaced by shorter codes.
- Because of their strictly defined nature, callsigns can be recorded in a more compact form, using indexes to replace characters.
- Similarly with grid locators.
- These steps are necessary because the maximum MESSAGE length is 77 bits.
- To this is added a 14-bit CRC, so the DATA STREAM is now 91 bits.
- The message is then converted to a Low-Density Parity-Check code 174 bits long.
  - This redundancy is used to correct errors during transmission.
- Example: CQ DL1ABC JO62 is converted to this data block:
  - 00 00 00 23 44 4A 11 91 3F 8B 57 7E CF 78 77 39 55 DE 36 EF 01 48

# TRANSFORMING AND SENDING THE MESSAGE

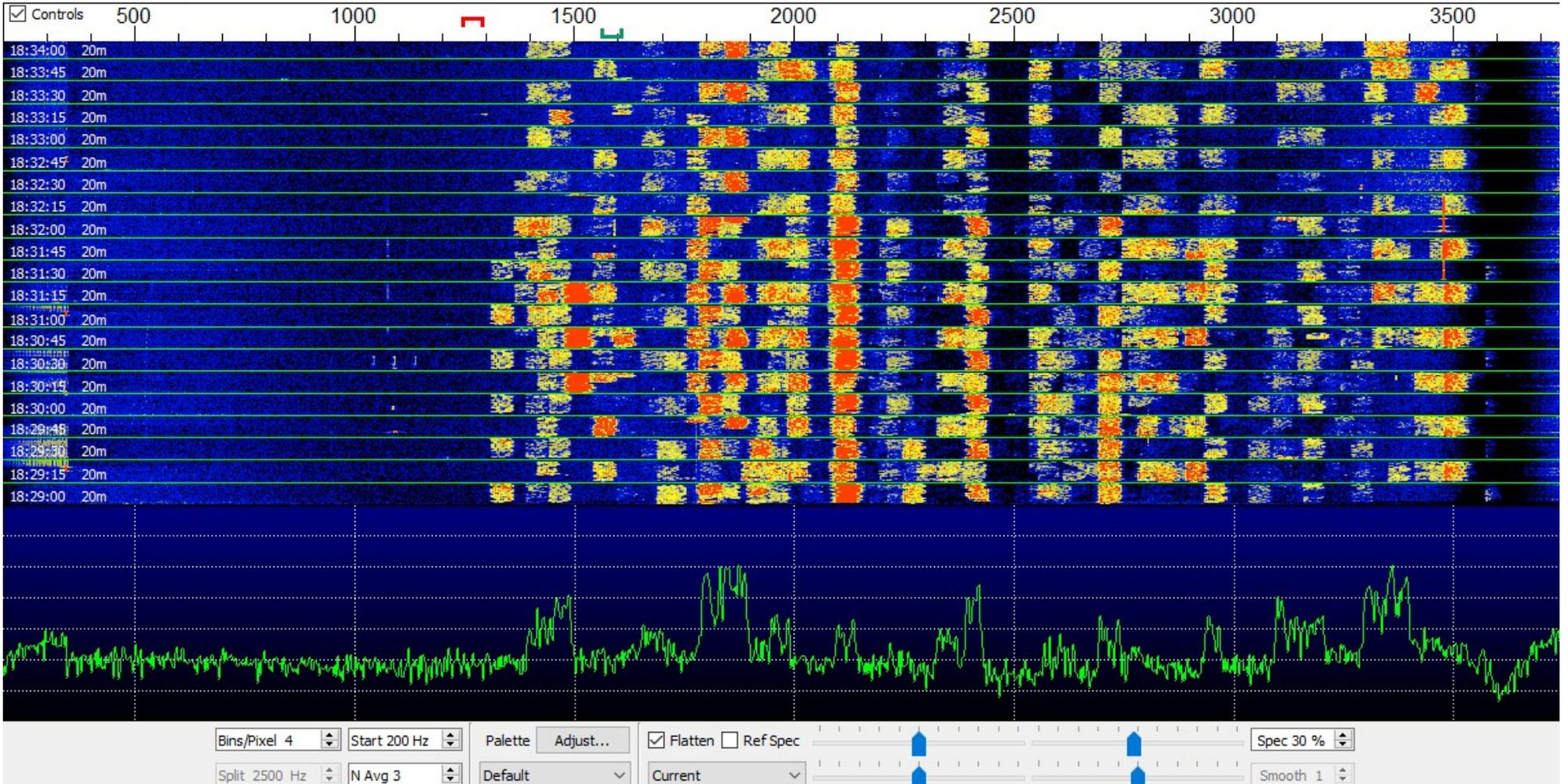
- After digitizing the text, FT8 uses an 8-frequency shift keying format to transmit the text.
  - So the data block has to be transformed into a tones sequence of 8 tones.
  - Special data for synchronization is added for proper signal decoding.
  - This yields a final sequence of:
    - 31406520 00000001 04531130 52105775 34623140 65267442 47514714 36372416  
64750133 3140652 where each digit represents a tone number from 0 to 7
- The 8 tones are spaced 6.25 Hz apart, so an FT8 signal occupies 50 Hz ( $8 \times 6.25 = 50$ ).
- Each tone is sent for 0.16 seconds, so the entire message takes 12.64 seconds to send.
- Compare this to a CW signal that occupies between 25 Hz and 50 Hz depending on keying speed, and an SSB signal that occupies 3 kHz.

# CQ DL1ABC JO62 – FT8 SPECTRUM DISPLAY

31406520 00000001 04531130 52105775 34623140 65267442 47514714 36372416 64750133 3140652



WSJT-X - Wide Graph



# ADMINISTERING THE RADIO FOR FT8