

An Introduction to FT8 & WSJT-X

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KJ5XX



ARRL *The national association for
AMATEUR RADIO*

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“Stop, Hey, What’s that Sound...”

- Buffalo Springfield



What is FT8?

- Is a Digital Mode used on both HF & VHF
- Was a joint development by Steve Franke, K9AN, Nobel Prize Laureate & Princeton Physics Professor Dr. Joe Taylor, K1JT, and Bill Somerville, G4WJS, in June 2017 for weak signal communications
- Uses 15-second TX intervals, (13 seconds transmit, 2 seconds decode) and structured messages
- Exchanges the minimum information needed for a QSO (Call signs, Grid Squares, Signal Reports)
- Multi-decoder finds and decodes all FT8 signals in the passband - not just where you have the receive marker set

FT8 Characteristics

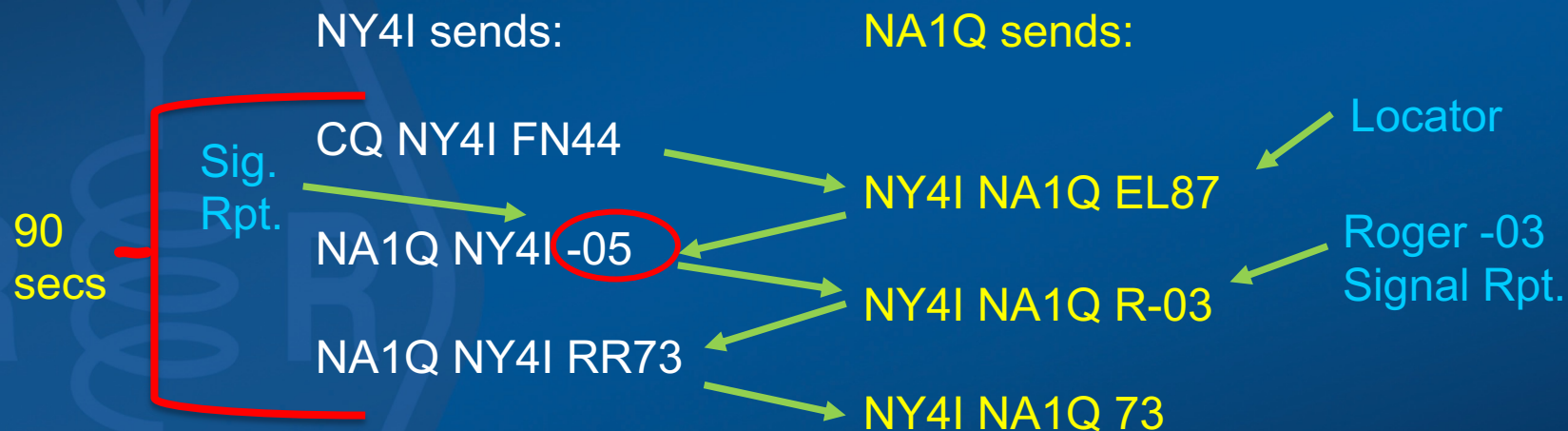
- Modulation is 8-FSK, tone spacing 5.86 Hz. With a total bandwidth of 47 Hz.
- Waveform is continuous phase with a constant envelope
- Decoding threshold is -24 dB, sometimes lower. This means decoding sometimes takes place when you hear nothing and see nothing on the waterfall!
- Accurate computer time, within two seconds, is REQUIRED (more on this later)

Mode Comparisons

Mode	Bandwidth (Hz)	Sensitivity (dB)	Sensitivity Range (dB)	TX Cycle (Sec)
FT-8	47.0	-20	-50 to +49	15
JT-9	15.6	-27	-50 to +49	60
JT-65 HF	177.6	-25	-30 to 1	60
JT-65 2M	355.3	-24	-30 to 1	60
JT65 70cm	710.6	-23	-30 to 1	60

Typical FT8 QSO

- Transmissions occur in alternating 15 second intervals
- Typical QSO Example:



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 MacOS
- Soundcard interface between the computer and the transceiver. (e.g. Xcvr Built-in, Signalink USB, Rigblaster or Homebrew)
- HF antenna
- Optional: CAT Control Software - (Ham Radio Deluxe, DXLab et. al)

Minimum Computer Requirements

- For Windows and Linux, a minimum 1.5 GHz dual core processor with 3 GB memory is recommended.
- A rig with internal sound card, second computer sound card, or external USB sound card
- 16 bit (or higher) sampling rate recommended for sound card.

Software

- WSJT-X supports FT4, FT8, JT65, JT9 (and several other modes) for Windows, Linux, and MacOS.

<http://physics.Princeton.edu/pulsar/K1JT/wsjsx.html>

- JT-Alert - <https://hamapps.com/> (more in a moment)
- Time Synchronization Software

- Dimension 4 -

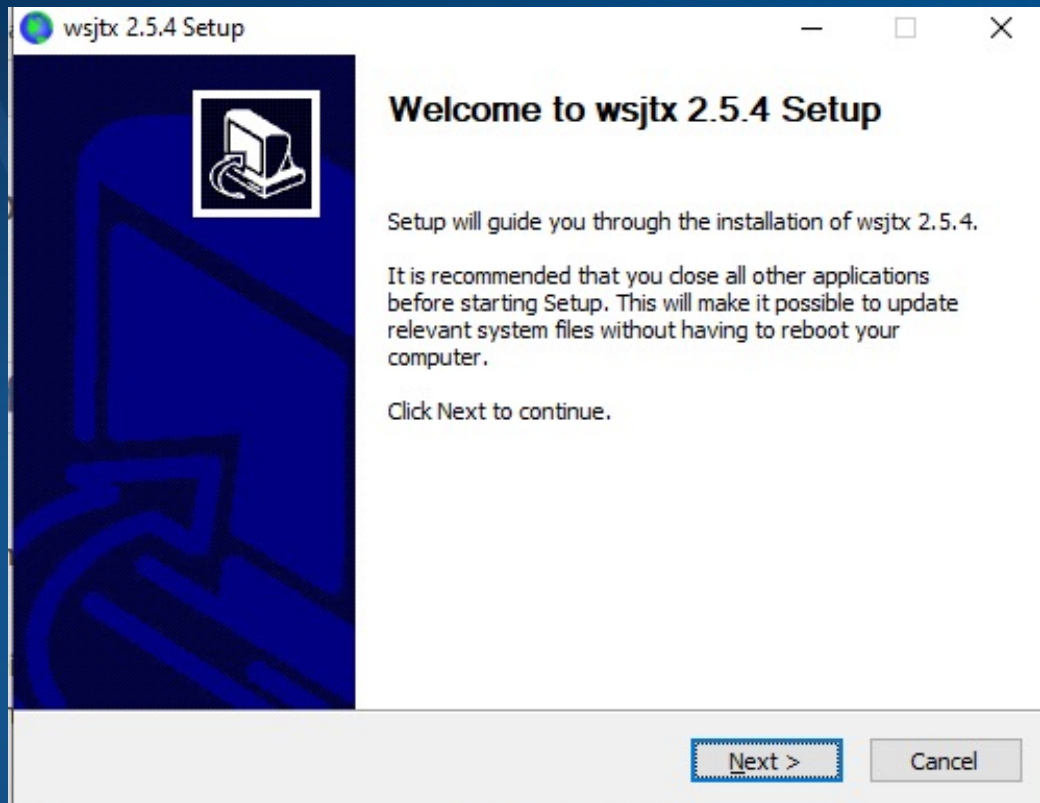
<http://www.thinkman.com/dimension4/download.htm>

- Meinberg -

<https://www.meinbergglobal.com/english/sw/ntp.htm>

- NetTime - <https://www.timesynctool.com/>

WSJT-X Installation & Config.



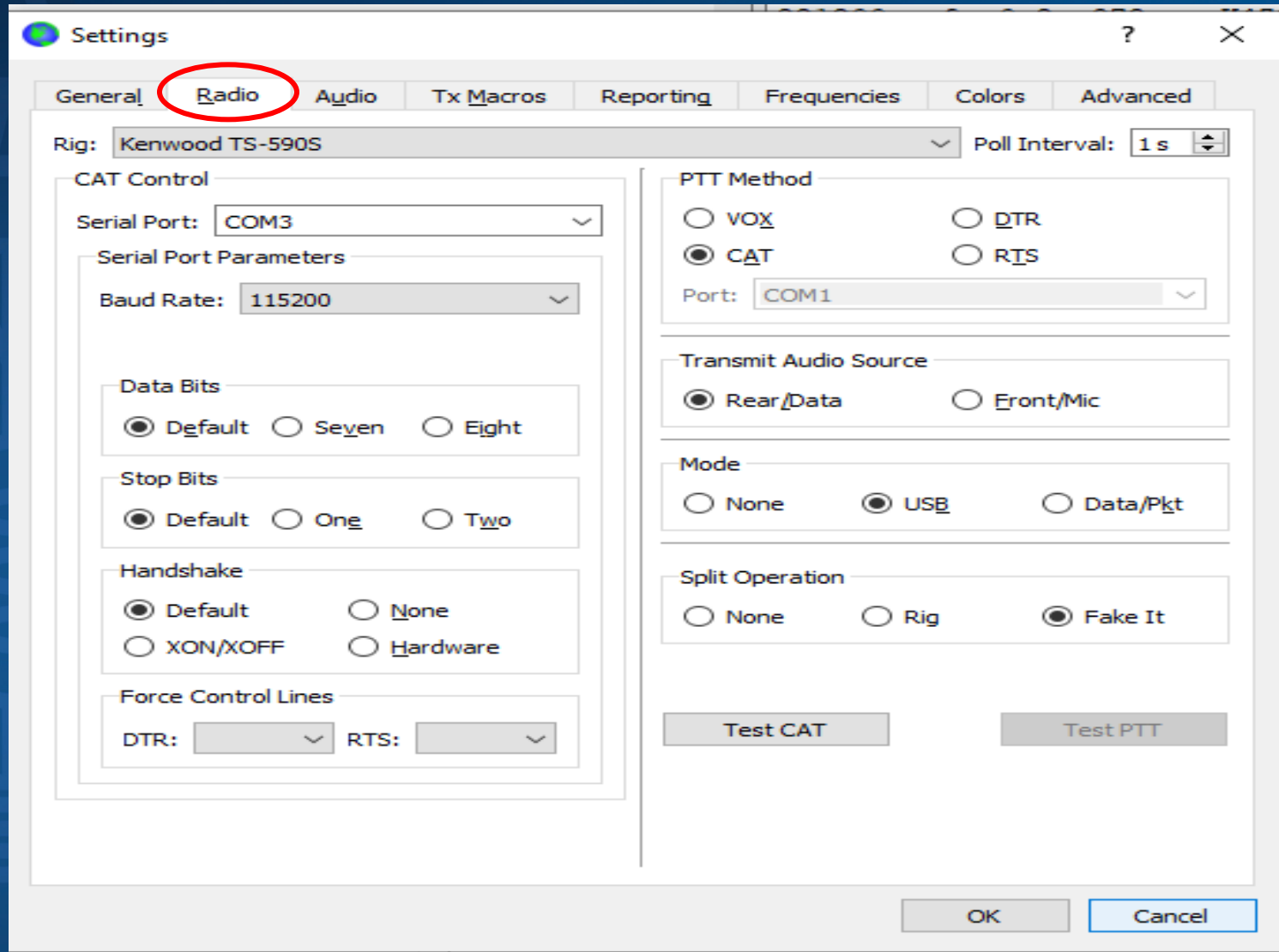
WSJT-X Installation & Config.

The screenshot shows the 'Settings' dialog box for WSJT-X, with the 'General' tab selected and highlighted by a red circle. The dialog is organized into several sections:

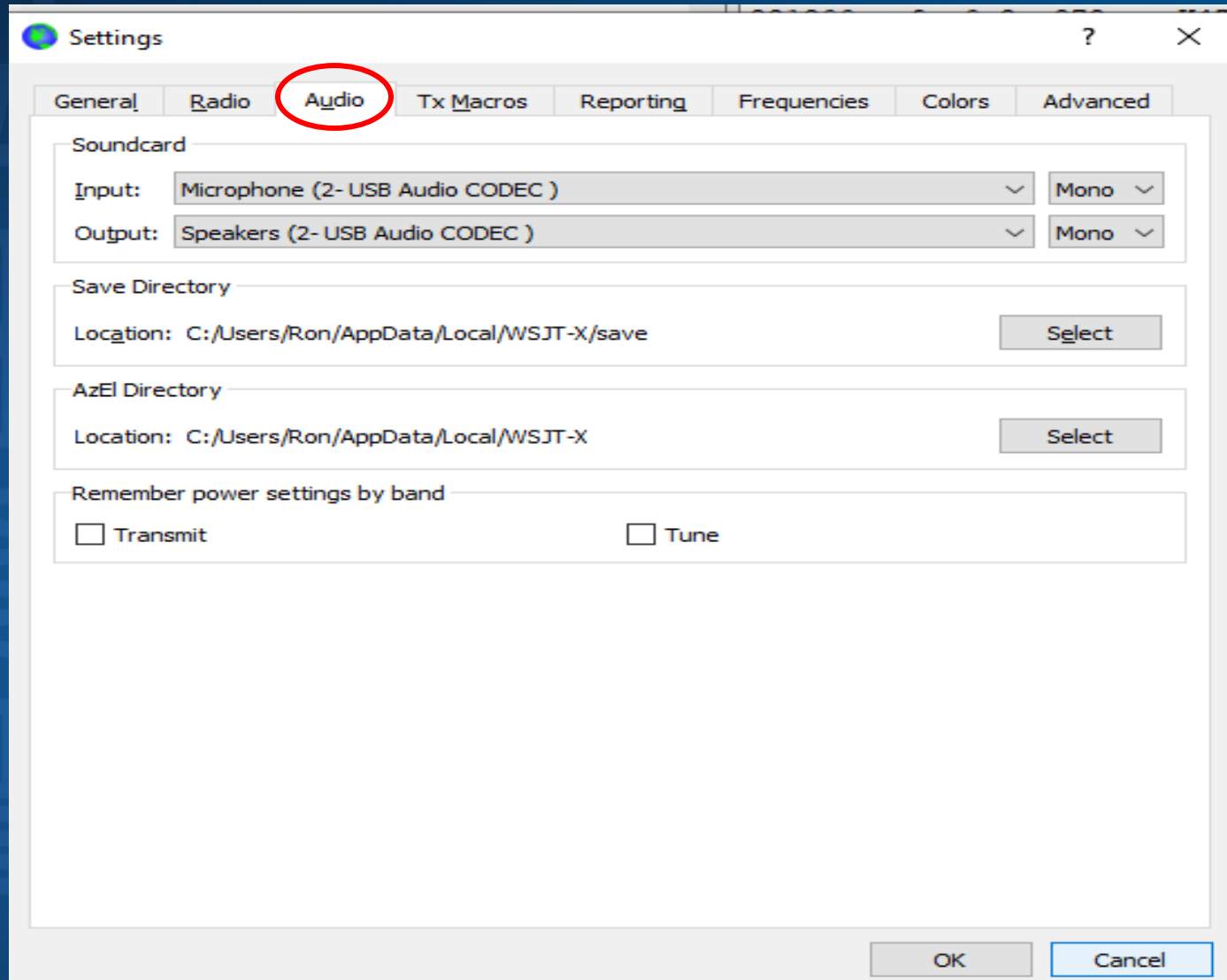
- Station Details:** Includes fields for 'My Call' (KJ5XX), 'My Grid' (EM22DC), an 'AutoGrid' checkbox, 'IARU Region' (All), and 'Message generation for type 2 compound callsign holders' (Full call in Tx3).
- Display:** Contains checkboxes for 'Start new period decodes at top', 'Blank line between decoding periods', 'Display distance in miles', 'Tx messages to Rx frequency window', and 'Show DXCC, grid, and worked-before status'. It also has a 'Font...' button and a 'Decoded Text Font...' button.
- Behavior:** Contains checkboxes for 'Monitor off at startup', 'Monitor returns to last used frequency', 'Double-click on call sets Tx enable', 'Disable Tx after sending 73', 'Calling CQ forces Call 1st', 'Alternate F1-F6 bindings', 'CW ID after 73', 'Enable VHF and submode features', 'Allow Tx frequency changes while transmitting', 'Single decode', and 'Decode after EME delay'. It also features a 'Tx watchdog' dropdown set to '6 minutes' and a 'Periodic CW ID Interval' dropdown set to '0'.

At the bottom of the dialog are 'OK' and 'Cancel' buttons.

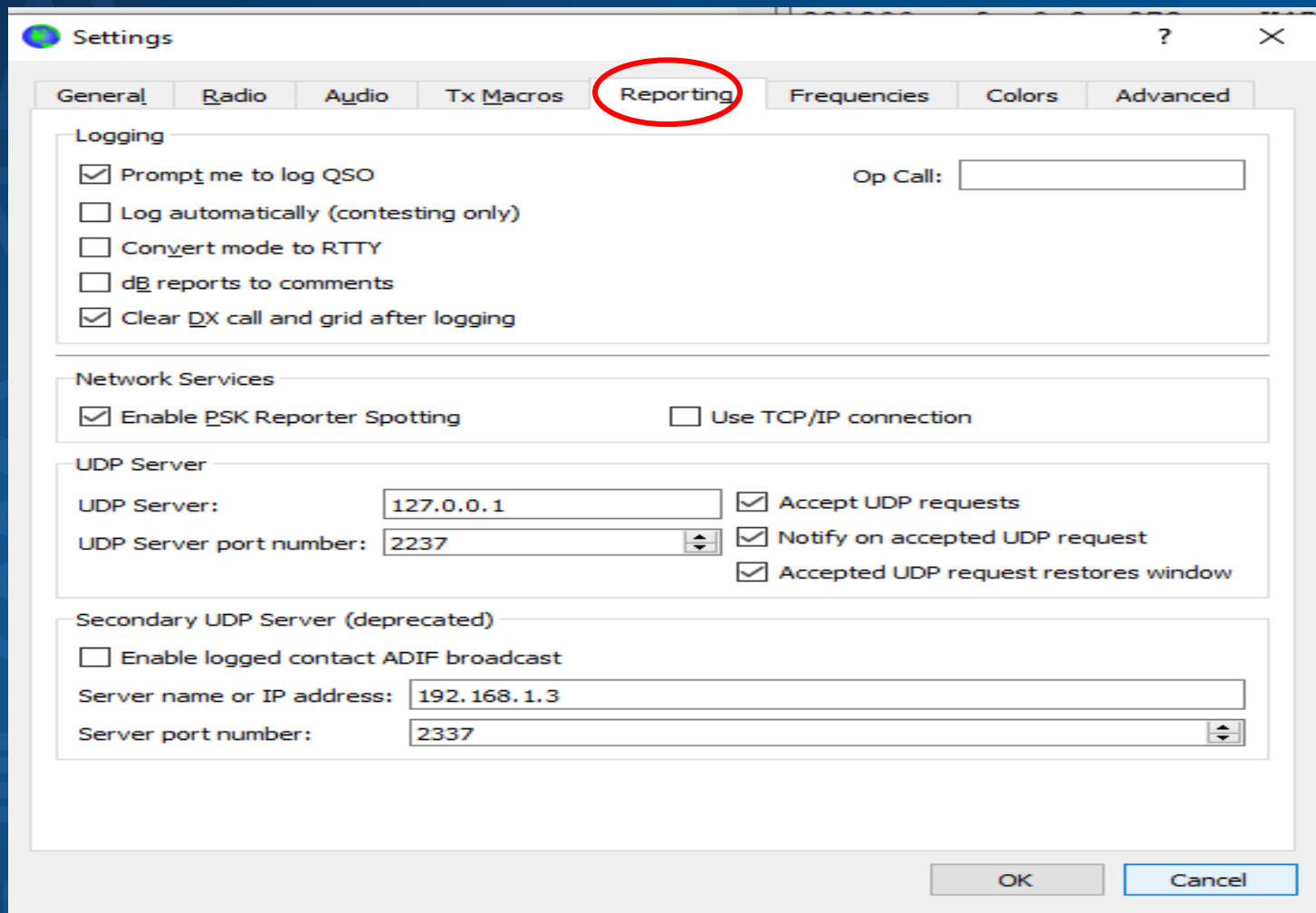
WSJT-X Installation & Config.



WSJT-X Installation & Config.



WSJT-X Installation & Config.

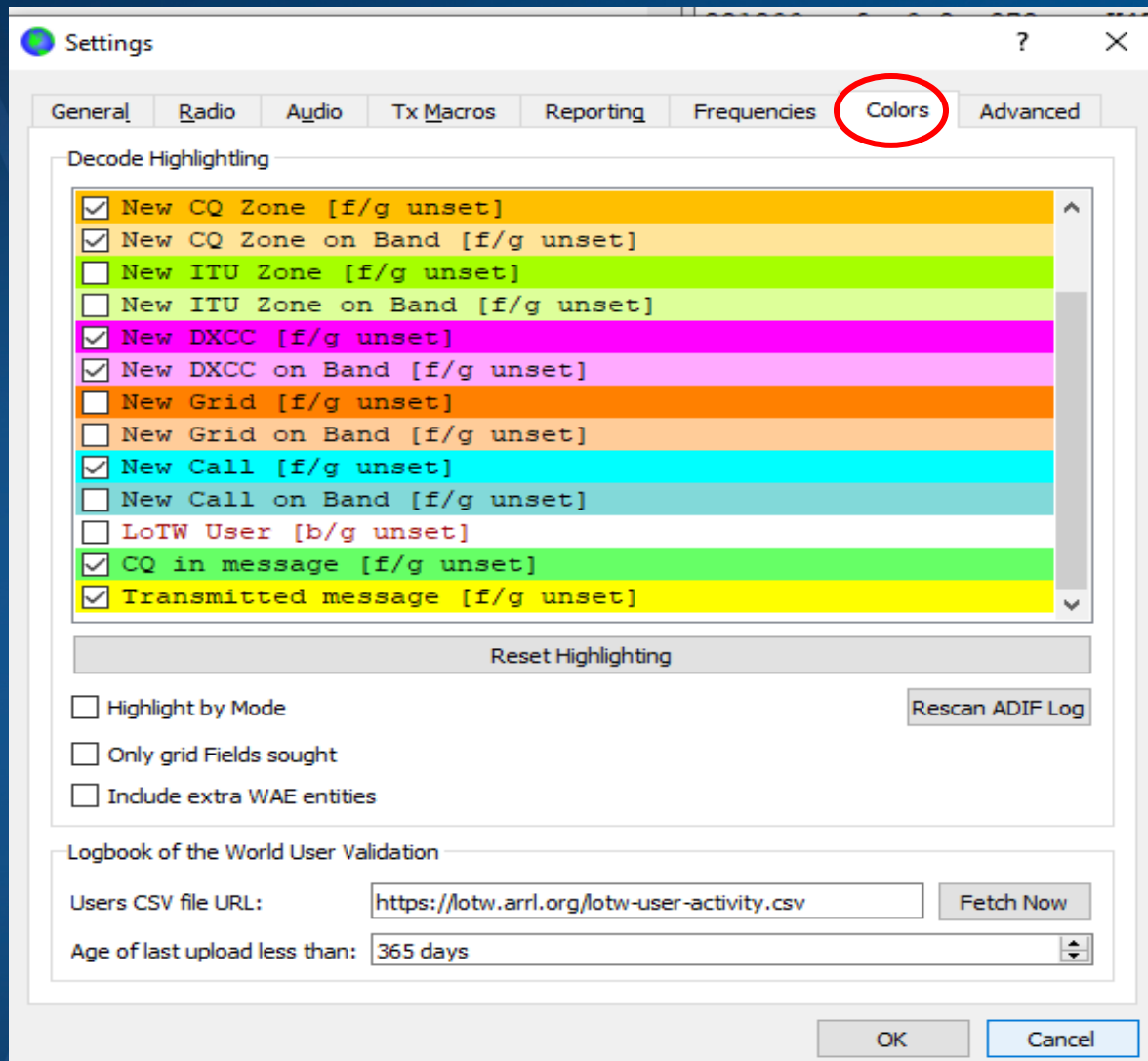


The screenshot shows the 'Settings' dialog box for WSJT-X, with the 'Reporting' tab selected and circled in red. The dialog has a title bar with a question mark and a close button. The tabs are: General, Radio, Audio, Tx Macros, Reporting, Frequencies, Colors, and Advanced. The 'Reporting' tab contains the following sections:

- Logging**
 - Prompt me to log QSO
 - Log automatically (contesting only)
 - Convert mode to RTTY
 - dB reports to comments
 - Clear DX call and grid after logging
- Op Call:**
- Network Services**
 - Enable PSK Reporter Spotting
 - Use TCP/IP connection
- UDP Server**
 - UDP Server:
 - UDP Server port number:
 - Accept UDP requests
 - Notify on accepted UDP request
 - Accepted UDP request restores window
- Secondary UDP Server (deprecated)**
 - Enable logged contact ADIF broadcast
 - Server name or IP address:
 - Server port number:

At the bottom of the dialog are 'OK' and 'Cancel' buttons.

WSJT-X Installation & Config.



IMPORTANT!! Configuring Audio

The screenshot displays the software interface for configuring audio. Two tables are visible at the top:

Band Activity					Rx Frequency				
UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message
195600	-4	0.3	413	~ IK1MIA N0ERV ZN03	195546	Tx		551	~ CQ KJ5XX EM22
195600	-6	1.0	1380	~ EA5BZ N3LH FM19	195615	Tx		551	~ CQ KJ5XX EM22
195600	1	1.2	936	~ S57AM KJ4MCT EM96					
195600	-9	0.1	1831	~ CQ NB7B DN31 U.S.A.					
195600	-16	0.1	310	~ CQ VE2LOA FN59 Canada					
195600	-18	0.1	869	~ W4LIX F5ADE -17					
195600	-24	0.1	1328	~ VE3IXA ON7HLU RR73					
195600	-11	-0.1	1829	~ CQ EA5J IM98 EU					

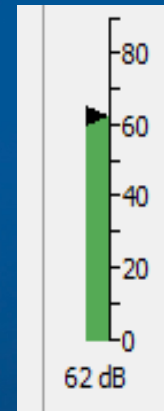
Below the tables, the interface includes a control panel with a volume meter on the left and a transmit level control on the right. Two callout boxes highlight these areas:

- Receive Audio:** A blue box with a red arrow pointing to the volume meter.
- Transmit Level/ALC Control:** A blue box with a red arrow pointing to the transmit level slider.

The status bar at the bottom shows "Receiving", "FT8", "Last Tx: CQ KJ5XX EM22", and "24".

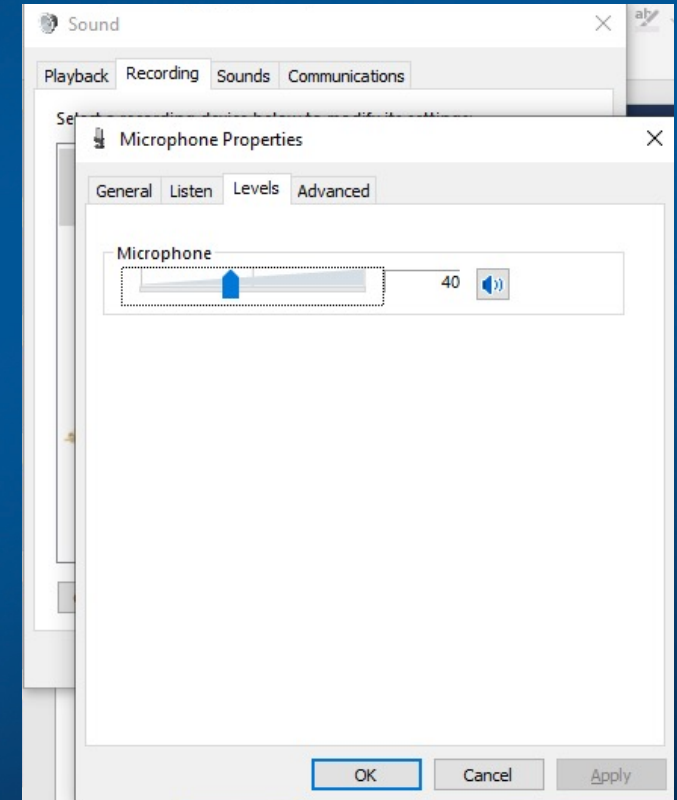
Recommended Receive Audio

- Receive Audio Recommended Level
 - 30dB when only noise present
 - Red – Level is too high & clipping may occur
 - Yellow – Receive audio is too low
 - Green = Good



Setting Receive Audio

1. Check Audio Level in Data Mode in your Rig Menu
2. Set Mic Audio Level in Windows for Appropriate Audio CODEC
 - Sound Control Panel>"Recording" Tab>"Levels" Tab
 - Configure so Receive Audio Level is about 30dB when no signal present



Setting Tx Audio

- Tx Audio
 - Listen via Rig's Monitor feature – Audio should be perfectly clean
 - Using a Dummy Load set Max Power
 - Execute WSJT-X
 - In Windows right-click on speaker icon, then go to Sounds>Playback>Properties>Levels
 - Adjust WSJT-X Pwr Slider & Windows Playback level until ALC on your radio just goes out
 - Adjust Pwr Output on your rig for desired operating level and keep an eye on your ALC
 - Excellent tutorial on this at:
<https://forums.qrz.com/index.php?threads/icom-7300-7610-digital-mode-alc-zone.608772/>

Putting it all Together

The screenshot displays the WSJT-X software interface, which is used for digital voice communication in amateur radio. The top portion of the window is a 'Wide Graph' showing a spectrogram of the radio spectrum from 200 to 2000 kHz. Below the graph is a control panel with various settings like 'Bins/Pixel 2', 'Start 0 Hz', 'Split 2500 Hz', and 'N Avg 5'. The bottom portion of the window is the main control panel, which includes a 'Band Activity' table, an 'Rx Frequency' table, and a 'Tx' control section.

Band Activity Table:

UTC	dB	DT	Freq	Message
195600	-4	0.3	413	IK1HIX NRERV EM53
195600	-6	1.0	1380	EA5BZ N3LH FM19
195600	1	1.2	936	S57AM KJ4MCT EM96
195600	-9	0.1	1831	CQ NB7B DN31 U.S.A.
195600	-16	0.1	310	CQ VE2LOA FN59 Canada
195600	-18	0.1	869	W4LIX F5ADE -17
195600	-24	0.1	1328	VE3IXA ON7HLU RR73
195600	-11	-0.1	1829	CQ EA5J IM98 EU

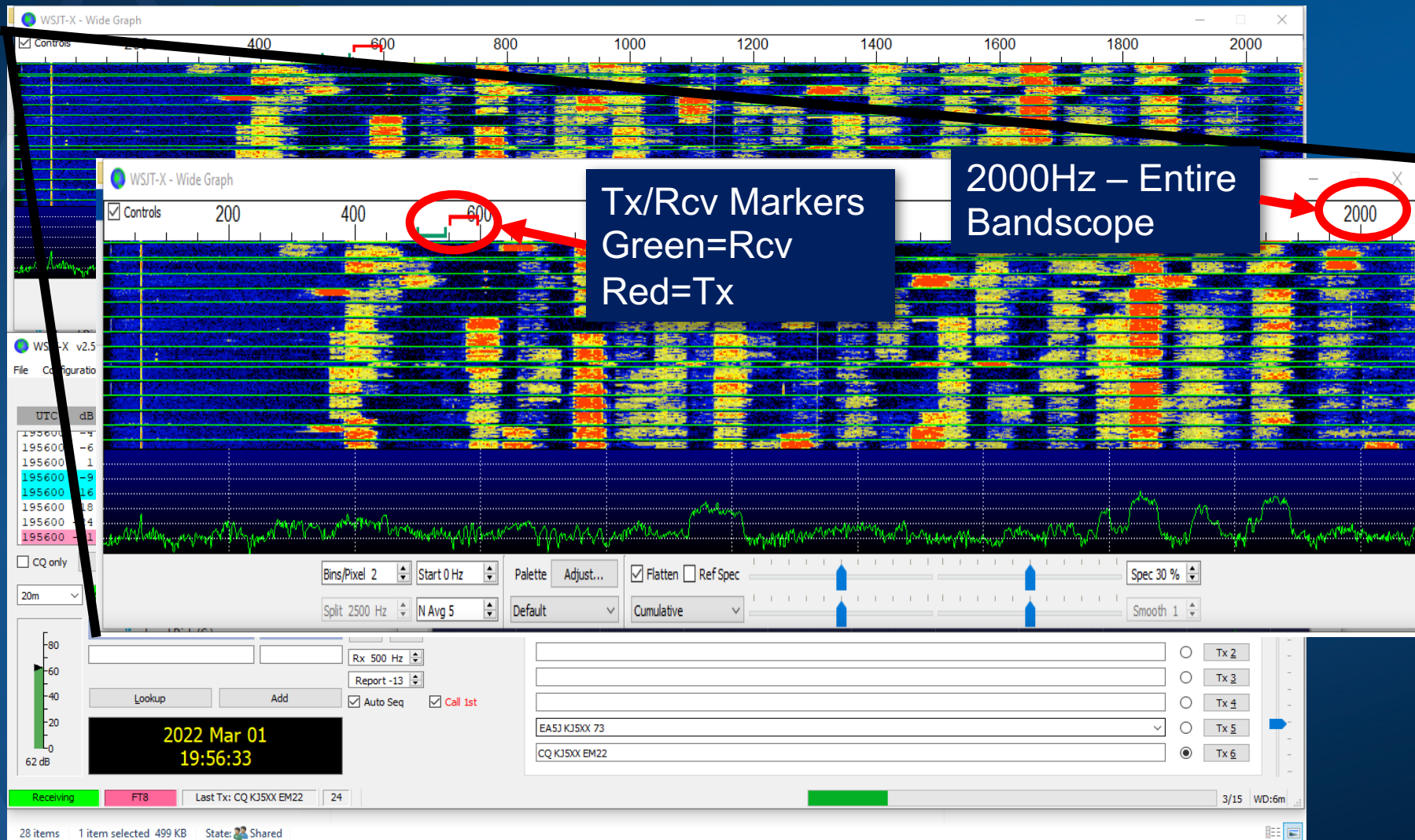
Rx Frequency Table:

UTC	dB	DT	Freq	Message
195546	Tx		551	CQ KJ5XX EM22
195615	Tx		551	CQ KJ5XX EM22

Control Panel:

- Frequency: 14.074 000
- Mode: FT8
- Power: 24
- Buttons: Monitor, Erase, Decode, Enable Tx, Halt Tx, Tune, Menus
- TX Settings: Tx 551 Hz, Rx 500 Hz, Report -13, Auto Seq, Call 1st
- TX Queue: EA5J KJ5XX 73, CQ KJ5XX EM22
- TX Buttons: Tx 1, Tx 2, Tx 3, Tx 4, Tx 5, Tx 6
- Status: Receiving, 3/15 WD:6m

Waterfall



Band Activity Window

WSJT-X - Wide Graph

File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	DT	Freq	Message
195600	-4	0.3	413 ~	IKIMIX N6ERV EM83
195600	-6	1.0	1380 ~	EA5BZ N3LH FM19
195600	1	1.2	936 ~	S57AM KJ4MCT EM96
195600	-9	0.1	1831 ~	CQ NB7B DN31 U.S.A.
195600	-16	0.1	310 ~	CQ VE2LOA FN59 Canada
195600	-18	0.1	869 ~	W4LIX F5ADE -17
195600	-24	0.1	1328 ~	VE3IXA ON7HLU RR73
195600	-11	-0.1	1829 ~	CQ EA5J IM98 EU

195615 Tx 551 ~ CQ KJ5XX EM22

20m 14.074 000

DX Call DX Grid

2022 Mar 01 19:56:33

Receiving FT8 Last Tx: CQ KJ5XX EM22 24

28 items 1 item selected 499 KB State: Shared

Rx Frequency Window

WSJT-X - Wide Graph

Controls 200 400 600 800 1000 1200 1400 1600 1800 2000

Rx Frequency

UTC	dB	DT	Freq	Message
202715	-6	0.4	1719	YU1EA K3CLS EL88
202715	-10	0.4	1730	K9SHY W7ESR CN94
202815	0	0.2	1719	YU1EA K3CLS EL88
202845	2	0.2	1719	YU1EA K3CLS EL88
202915	0	0.2	1719	YU1EA K3CLS EL88
202945	2	0.2	1719	YU1EA K3CLS EL88
202945	-12	0.1	1713	VA3VF EA5ASQ IM99
203015	4	0.2	1719	YU1EA K3CLS EL88

WSJT-X v2.5.4 by K1JT, G4WJS, K9AN, and IV3NWW

File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	DT	Freq	Message
203015	4	0.7	262	<SDRAVU> WFSK R-06
203015	11	0.3	1305	DC2AN N4NF EL96
203015	-13	-0.0	935	CQ S57AM JN66
203015	-8	0.2	396	OE3UKW HK3X R-16
203015	-8	0.2	809	CQ DF2WF JO30 EU
203015	-7	0.2	1382	VA3KIT EA5BZ -07
203015	-7	0.1	1516	ZS6DPS AB2RR FN02
203015	-10	0.2	1249	CQ HA1RB JN86 EU

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

20m 14.074 000

DX Call DX Grid

Lookup Add

2022 Mar 01 20:30:41

Receiving FT8 Last Tx: W8FDV KJ5XX RR73 15

33 items 1 item selected 542 KB State: Shared

Macros Window

The image displays two overlapping screenshots of a software interface, likely a radio communication program, showing a 'Macros Window'. The interface includes a list of call signs and frequencies, a control panel with buttons like 'Monitor', 'Erase', and 'Decode', and a 'Macros' list.

Top Screenshot:

- Callsign Field:** A blue box highlights the 'F6GGX' call sign in the 'DX Call' field.
- Auto-Generated Macros:** A blue box with a red arrow points to the 'F6GGX KJ5XX EM22' macro in the list.
- Frequency Data:** A table shows call signs and frequencies, with '204523 Tx 551 ~ F6GGX KJ5XX EM22' highlighted in yellow.

Bottom Screenshot:

- Frequency Data:** A table shows call signs and frequencies, with '204523 Tx 551 ~ F6GGX KJ5XX EM22' highlighted in yellow.
- Macros List:** A list of macros is shown, including 'F6GGX KJ5XX EM22', 'F6GGX KJ5XX -21', 'F6GGX KJ5XX R-21', 'F6GGX KJ5XX RR73', 'F6GGX KJ5XX 73', and 'CQ KJ5XX EM22'.

Annotations:

- A blue box labeled 'Callsign Field' points to the 'F6GGX' call sign in the 'DX Call' field.
- A blue box labeled 'Auto-Generated Macros' points to the 'F6GGX KJ5XX EM22' macro in the list.

Multi-function Window

The screenshot displays the WSJT-X v2.5.4 software interface, specifically the 'Wide Graph' window. The interface is divided into several functional areas:

- Top Panel:** Shows the frequency spectrum with a central display of **14.074 000** MHz. A green 'S' icon indicates signal strength. A vertical bar on the left shows a signal level of **64 dB**.
- Call and Grid Information:** Displays **F6GGX** as the DX Call and **JN03** as the DX Grid. It also shows **Az: 49** and **5049 mi**.
- Transmission Settings:** Includes fields for **Tx 551 Hz**, **Rx 1845 Hz**, and **Report -21**. Checkboxes for **Tx even/1st**, **Hold Tx Freq**, **Auto Seq**, and **Call 1st** are visible.
- Band Activity Table:** A table listing received signals with columns for UTC, dB, DT, Freq, and Message. The current signal is highlighted in blue: **204630 -1 0.2 790 ~ CQ W4ZPG EM**.
- Control Panel:** Features buttons for **Receiving** (green), **FT8** (pink), **Last Tx: F6GGX KJ5XX EM22**, and **20**. Other buttons include **Log QSO**, **Stop**, **Monitor**, **Erase**, **Decode**, **Enable Tx**, **Halt Tx**, and **Menu**.
- Message Queue:** A list of messages with columns for 'Next', 'Now', and 'Pwr'. The current message is **F6GGX KJ5XX EM22**.
- Status Bar:** Shows **13/15** and **WD:6m**.

Now How Much Would You Pay??

Don't Answer that Until
You've Seen This!

A faint, light blue watermark of an electrical circuit diagram is visible in the background. The diagram is enclosed in a diamond shape and includes a battery at the bottom, a resistor labeled 'R' on the left, a resistor labeled 'R' on the right, and an inductor labeled 'L' at the bottom. A letter 'A' is positioned at the top of the diamond.

JTAlert – Companion to WSJT-X

The image shows a screenshot of the WSJT-X software interface. A red circle highlights the JTAlert overlay window. The background shows a waterfall plot and a log of received messages. The JTAlert overlay displays a grid of call signs and their locations, along with a list of callers and alert DXCCs.

Call Signs #1

- K4IO AL U.S.A.
- K4IO GA U.S.A.
- K9ZW WI U.S.A.
- F5MYH France

1. Callers

- WP4KMB 73 Puerto Rico
- K4SHA AL U.S.A.
- K4IO GA U.S.A.
- KB1RZA VT 76
- N1EVK NH U.S.A.
- K9ARZ IL U.S.A.
- KE0WSW ND U.S.A.
- WA9GON WI U.S.A.
- KA2IRQ NJ U.S.A.
- AB2RR NY U.S.A.
- HK3PJ Colombia
- AA5VI NM U.S.A.
- YV5JAU Venezuela
- K9ZW WI U.S.A.
- KB4KBS GA U.S.A.
- KC3SBT MD U.S.A.
- KB7AK WA U.S.A.
- K3RAW PA U.S.A.
- PA7AVS Netherlands
- F5MYH France

2. Alert DXCC

Band Activity

UTC	dB	DT	Freq	Message
213200	4	0.2	972	CQ K9ZW EN64 U.S.A.
213200	21	0.2	342	7Q7CT KB4KBS -15
213200	0	0.1	1208	WB5BHS KC3SBT RR73
213200	-20	0.2	1794	OH6Z KB7AK CN85
213200	3	0.3	750	KG5KGU K3RAW RRR
213200	-11	-0.3	542	WA4VMF PA7AVS JO23
213200	-12	0.1	506	CQ DX F5MYH JN07 EU

Message Log

Time	DT	Freq	Message
21:32:25	4	0.2	F6GGX 20m FT8 [Filtered]
213015	-4	0.1	1847 ~ WP4KMB KC9VGQ EM69
213015	-11	2.2	1847 ~ WP4KMB NT1J FM06
213030	-3	0.1	1847 ~ WP4KMB KC9VGQ EM69 Puerto Rico
213045	-1	0.1	1847 ~ WP4KMB KC9VGQ EM69
213045	-2	2.2	1847 ~ WP4KMB NT1J FM06
213130	-7	0.1	1847 ~ EA5IBI WP4KMB -14
213200	-7	0.1	1847 ~ EA5IBI WP4KMB RR73

Control Panel

20m **S** 14.074 000 Tx 551 Hz Rx 1845 Hz Report -21

DX Call F6GGX **DX Grid** JN03 Az: 49 5049 mi

2022 Mar 01 21:32:25

Receiving FT8 Last Tx: F6GGX KJ5XX EM22 21

JTAlert Companion to WSJT-X

Callsigns #1

* CQ

- K4SHA AL U.S.A. (CQ)
- K4IO GA U.S.A. (CQ)
- K9ZW WI U.S.A. (CQ)
- F5MYH France (DX)

1. Callers

2. Alert DXCC

WP4KMB Puerto Rico (73)	K4SHA AL U.S.A. (CQ)	K4IO GA U.S.A. (CQ)	KB1RZA VT U.S.A. (73)	N1EVK NH U.S.A. (*)
K9ARZ IL U.S.A. (*)	KE0SW ND U.S.A. (*)	WA9GON WI U.S.A. (*)	KA2IRQ NJ U.S.A.	AB2RR NY U.S.A.
HK3PJ Colombia	AA5VI NM U.S.A.	YV5JAU Venezuela	K9ZW WI U.S.A. (CQ)	KB4KBS GA U.S.A. (*)
KC3SBT MD U.S.A. (73)	KB7AK WA U.S.A.	K3RAW PA U.S.A. (*)	PA7AVS Netherlands	F5MYH France (DX)

21:32:25 * 4 1. 0 2. 20 DT+0.1 F6GGX 20m FT8 [Filtered]

JTAlert Features

- Completely interoperable with WSJT-X, LotW, HRD and others
- Voice notification of New Countries, Continents, States, etc.
- Visually shows stations calling CQ, DX, Wanted States, Countries, etc.
- Completely configurarable based on what you are tracking and “needed” entities
- “Chat Mode” with other JTAlert Users



- Questions?
- Comments?
- Nasty Remarks?