



Tonight's Activity

January 2018 Topic	Tonight – a few words on the topic of WSJT Digital Modes.
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Digital Modes typically make use of PC Sound Card technology to send and receive information via Ham Radio. The PC generates the signals to be transmitted and controls the operation of the transmitter. The PC decodes and displays the signals and content that have been received.

To begin tonight's discussion I propose that Digital Modes can be categorized into Free-Style and Structured.

- Free-Style digital modes involve a real person at each end of the transmission. The person has some type of active role and free-will for creating the information that is travelling over the air waves. The parties to the QSO can send just about anything they find to be of interest. The exchanges can be long, short, or anything in between. Perhaps the term **Conversational** could take the place of Free-Style.
- Examples of Free-Style include RTTY, PSK-31, BPSK, Packet, Olivia, and more.
- Structured digital modes involve well-defined and quite predictable exchanges of information according to a standard protocol. Each person and the software they are using have an expectation of what is going to be sent (received) and in which sequence. The rules of protocol determine how to deal with exceptions.
- Examples of Structured include WSPR, JT65, JT9, FT8, and others less familiar to me such as MSK144 used for Meteor Scatter QSOs.

For tonight's discussion I plan to focus on the structured digital modes developed by Professor Joe Taylor, K1JT. If there is interest in other digital modes perhaps we can have a follow-up session as part of a future meeting.

Station Components

Basic Elements of a Digital Mode Station include:

- Personal Computer
- Digital Mode Software . no cost versions are widely available
The current version as of January 2018 is WSJT-X 1.8.0
<https://physics.princeton.edu/pulsar/k1jt/wsjtx.html>
- Time Synchronization Software . no cost versions are widely available
<http://www.thinkman.com/dimension4/>
- Sound Card Interface
- Transceiver
- Not to mention an Antenna and Feedline.

Inter-Connections

I have in mind three essential connections.

- a.) Received Audio sent to the PC from the Transceiver.
- b.) Audio to be transmitted sent to the Transceiver from the PC.
- c.) Push-To-Talk control sent to the Transceiver from the PC.

Tigertronics sells a Signal-Link USB Sound Card interface that provides those three connections.

If you are using a fairly modern Transceiver that offers a Data or Aux connection you probably can fulfill all three connections using one custom-made cable between the Signal-Link and your Transceiver. Also, one USB cable runs between the Signal-Link and your PC. The Signal-Link obtains power from the USB connection.

A Signal-Link USB Sound Card with Custom Cable costs about \$130.00

Older Transceivers might need to use two separate cables for the Receive and Transmit audio. Or, some radios might make both signals available in the MIC connector. You will need to know what audio I/O your Transceiver offers.

Radio Settings

The WSJT Digital Modes expect your Transceiver to be set for Upper Sideband USB on all bands.

You set your VFO to the standard frequency for the Band and Mode you are operating and leave it there. If it is adjustable, set your Receive Audio Bandwidth wide enough to allow 3 KHz without attenuation.

By *Gentleman's Agreement*, the 40 Meter Band standard frequency for FT8 is 7.074, JT65 is 7.076, and JT9 is 7.078. Other bands follow a similar pattern. The WSJT-X software shows you the expected VFO setting.

Note: FT8 has become so popular that interest and activity using JT65 and JT9 have largely disappeared.

If your Transceiver audio bandwidth (send or receive) cuts off the highs or lows there are workaround techniques to deal with that situation. Separate discussion. Or, limit your operation to %middle-of-the-road+audio frequencies that pass through your transceiver filters.

PC and Software Configurable Settings

Follow the installation instructions provided by your SoundCard Interface supplier.

The Signal-Link will install its own Audio CODEC drivers. You want to configure the WSJT software to use those drivers. For best results there are preferred sampling rates there you should configure.

I will post screen snapshots of my WSJT-X configuration settings at the end of this document.

Many of the configurable settings deal with User Convenience and personal preference.

I enjoy being able to double click on a call sign in the decode window and have that action ENABLE transmit.

I enjoy having the decode screen classify the signals with color codes. The colors are applied to decoded messages in which the other guy is sending his CQ. Light Purple is someone I have not previously worked. Dark Purple is a Country I have not previously worked. Green is someone I worked in the past who is calling CQ. Red is someone calling me. White represents people who are at other points in their QSO, but not calling CQ.

For FT8 protocol there are settings that enable the QSO to move along automatically based on what was decoded.

Sequence of QSO Events

In a conventional WSJT Digital Mode QSO there are two participants.

One Participant solicits a QSO by transmitting a CQ message.

The other Participant responds to the CQ message that he received and decoded.

In each cycle there is a SENDER and there is a RECEIVER.

The Sender and Receiver alternate their roles and take turns according to the protocol

The protocol defines a standard set of information to be exchanged in order to constitute a valid QSO.
Callsigns, Grid Squares, Signal Reports, Confirmations.

The goal of a WSJT Digital Mode QSO is to exchange that information. Due to the small amount of data that can be passed in any given message cycle, a QSO requires a minimum of six transmissions . three transmissions by the person who sent CQ and three transmissions by the person who responds to the CQ.

WSJT provides error checking as one of its many functions. It is almost certain that you will get a nice clean decode, or you will get nothing at the end of the cycle. I've never seen a garbled decode.

Timing Requirements

Each transmission begins and ends at a specific time according to the protocol for the mode in use. The WSJT software screen shows a clock and a cycle progress bar. I keep a pretty close eye on these portions of the screen so that I will know, and be prepared to take my next actions.

JT9 and JT65 work with 60 second cycles. The transmission uses 48 seconds allowing 12 seconds for decoding. The next transmission begins on the 1 second tick of your clock.

FT8 works with 15 second cycles. The transmission uses 13 seconds allowing 2 seconds for decoding. The next transmission begins on the 16, 31, 46, or 01 second tick of your clock.

Because the protocol has such a great dependency on timing it is vitally important that your PC clock be set to a reference standard. Likewise, it is vitally important that your PC clock keeps its time to within one second of the standard.

Many Digital Mode Operators download and install a program called DIMENSION 4 and configure it to handle the time synchronization. www.thinkman.com/dimension4 I believe you will find there is no charge for non-commercial use.

The flow of information in the QSO is as follows.

Gray shading indicates the person who is transmitting.

Unshaded cells indicate the person who is receiving and decoding.

The Person who sends the CQ – assume W3VRE		The Person who answers the CQ – assume AF3I
1	The CQ message includes the sender's grid square. CQ W3VRE FN10	I listen and decode. Double click on W3VRE to answer.
2	He listens and decodes.	The first response includes the receiver's grid square. W3VRE AF3I FN10
3	Assuming W3VRE decodes and responds to AF3I. His message includes my signal strength. AF3I W3VRE -04	I listen and decode.
4	He listens and decodes.	Assuming W3VRE responded to AF3I My second response includes confirmation of receiving my signal strength and sends his signal strength. W3VRE AF3I R-02
5	When he has my Callsign, Grid Square, and Signal Strength he sends RRR confirmation. AF3I W3VRE RRR . or-- AF3I W3VRE RR73	I listen and decode.
6	Listen, decode, and log the QSO	When I have his Callsign, Grid Square, Signal Strength, and Confirmation I send 73. W3VRE AF3I 73 and log the QSO
7	Some CQers send a final 73, others omit. AF3I W3VRE 73 omit if using the RR73 message	I listen and decode. No response to be sent.
8	Listen and decode. Expect nothing.	Move along looking for other CQs to answer or send my own CQ on a clear frequency.
	He starts sending a new CQ or goes looking for other CQs to answer.	

At any point in the message cycles, if you do not receive and decode the expected message for that cycle then you repeat your previous message. The WSJT FT8 software will automatically do this for you in most cases.

If the other station sends a message that differs what you were expecting it means he did not decode your last transmission. You should send the same answer to his message as you would have sent during the first attempt in that part of the cycle. The WSJT FT8 software will automatically do this for you in most cases.

Signal Strength

The WSJT software will calculate the other guy's signal strength and populate the message with the correct value.

WSJT Digital Modes should work fine with low power . start with 20 watts or less and see what signal reports you are given. Adjust up or down accordingly.

Any signal report having a +nn number or even -01, -02 is too strong. Reduce your power.

Good copy typically occurs between -05 and -15. WSJT will decode signals that your own ear cannot hear.

Watch your audio gain. You do not want the ALC to be clipping your peaks. Adjust the gain downward if ALC occurs. Also, know your rig. If the mic remains %open+or %live+when using the Data or Aux port you probably want to disconnect the mic. You do not want to pick up extraneous sounds from the shack.

You can learn a lot just by watching the other guy's signals on the waterfall display.

The more RED in the display the stronger the signal. When the RED widens out and covers adjacent stripes in the waterfall display, that guy is over powering.

Propagation Reporter

Many of the Joe Taylor Digital Modes provide a means for each listener to generate a summary of what has been decoded and automatically upload that information to a Propagation Reporter web site. You can visit the website and run queries to see how, what, when and where there is WSJT activity taking place. www.pskreporter.info Find and follow the link to Map Display. You can do this at any time for your own curiosity . you do not have to have the Digital Mode software working and you don't need to submit your own uploads before using this site.

Answer the six questions based on your own interests. e.g. Band, Mode, Timespan. Then click GO.

Drill down into the data by scrolling the screen magnification to suit your interests.

For each pin in the map there is someone who heard and reported the signal that fits your query selection criteria.

Hover over the pin and you will see the details of what he heard and reported.

WSJT-X with Waterfall Display and Decode Window

The upper portion of this screen snapshot (where the dark blue appears) is a WATERFALL display showing FT8 mode operations on 7.074 with six signals decoded in the most recent cycle.

Each horizontal stripe is one 15 second receive cycle. Transmit cycles are not shown in the Waterfall.

The RED horizontal bracket near 1200 is an indicator of Transmit frequency. GREEN bracket shows the RECEIVE frequency.

The lower portion of this screen snapshot is the WSJT-X software screen.

Much of your attention and focus will be drawn to the BAND ACTIVITY box where you see the decoded information from the entire audio passband.

When you zero-in on one particular station and attempt a QSO the two participant's information will be shown in the RX FREQUENCY box. What you send will be yellow. What the other guy sends will depend on what cycle the two of you have reached within the QSO.

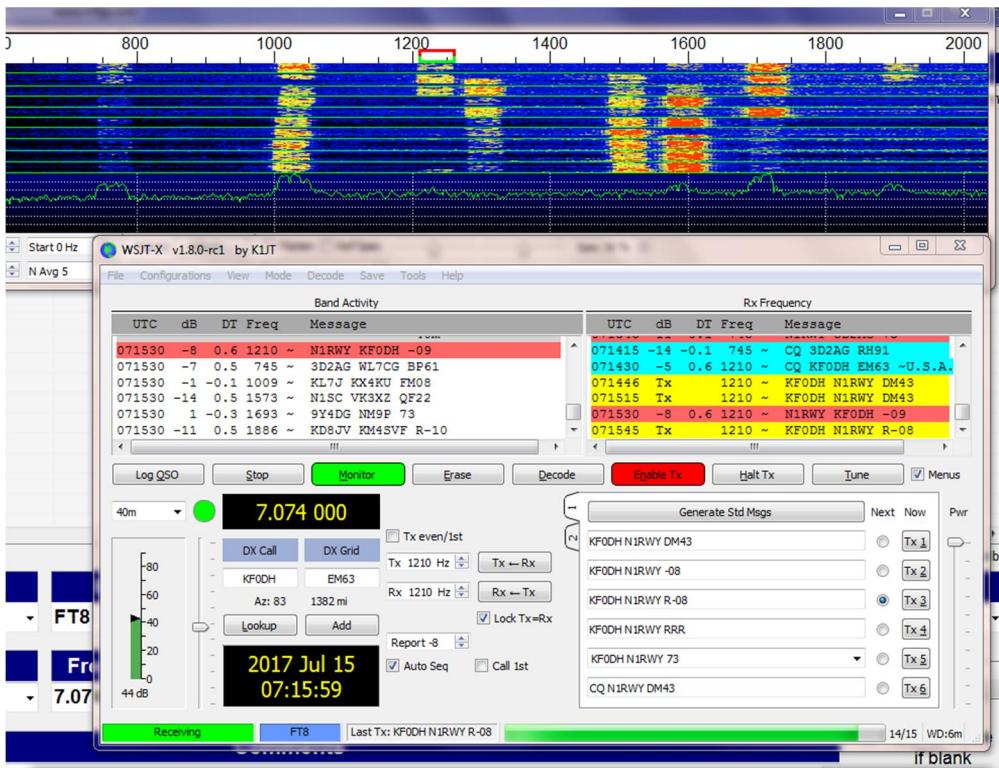
In the RX FREQUENCY box toward the right, I see:

KF0DH called CQ from Grid Square EM63 (blue- mine would have been purple) and N1RWY answered from DM43 (yellow). He did not get an immediate response and had to repeat that response. You see the same information on two lines.

KF0DH heard and decoded N1RWY on the second attempt and gave him a signal report -09 (red).

N1RWY confirmed receipt of that report and gave KF0DH a signal report R-08

The QSO on this screen has not yet been completed. There are additional steps RRR and 73 still to go.

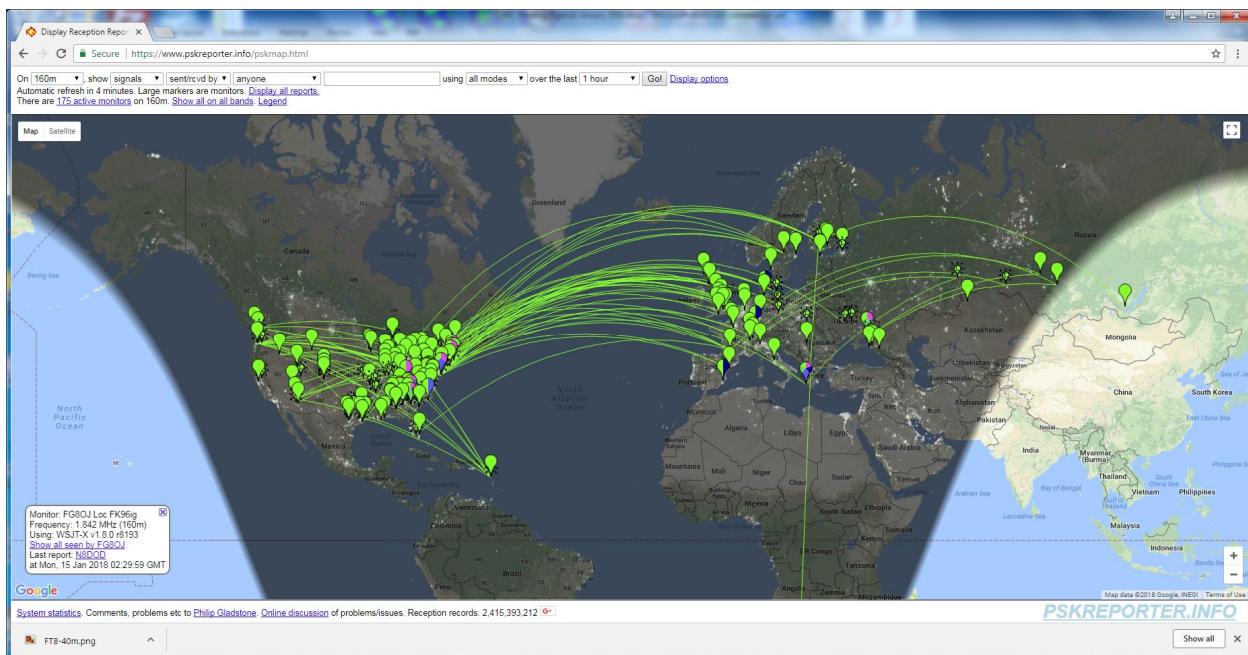


PSK Reporter Map Display

Query performed Sunday Night January 14, 2018 about 10 p.m. from the AF3I QTH in Dillsburg, PA.

Selection Criteria: 160 meters, signals sent or received by anyone, using any mode, in the past one hour. I hovered over the pin down in the Caribbean Sea. It shows FG8OJ is monitoring.

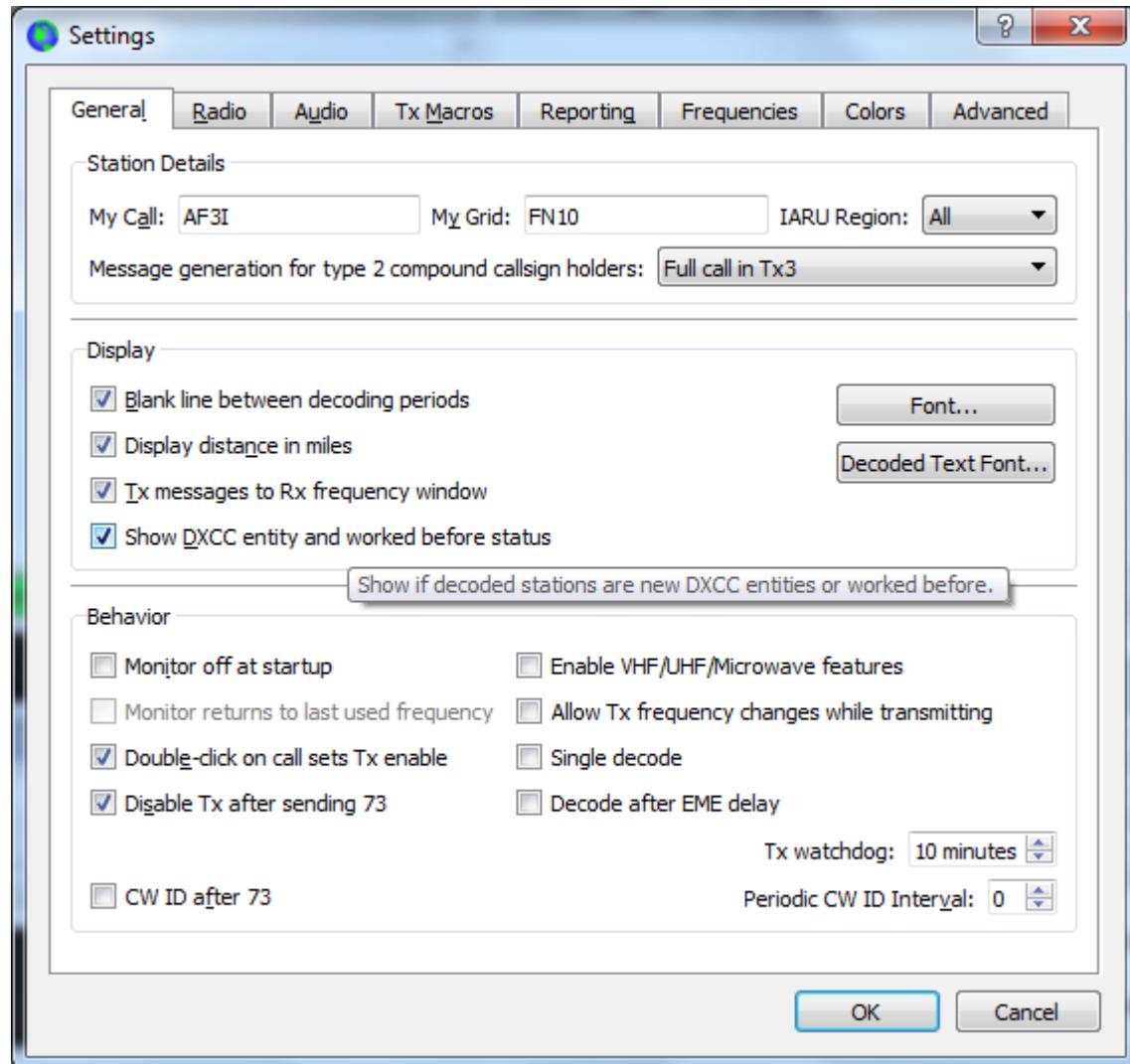
Notice that all but one of the 160 meter QSO activities takes place in darkness at both ends.



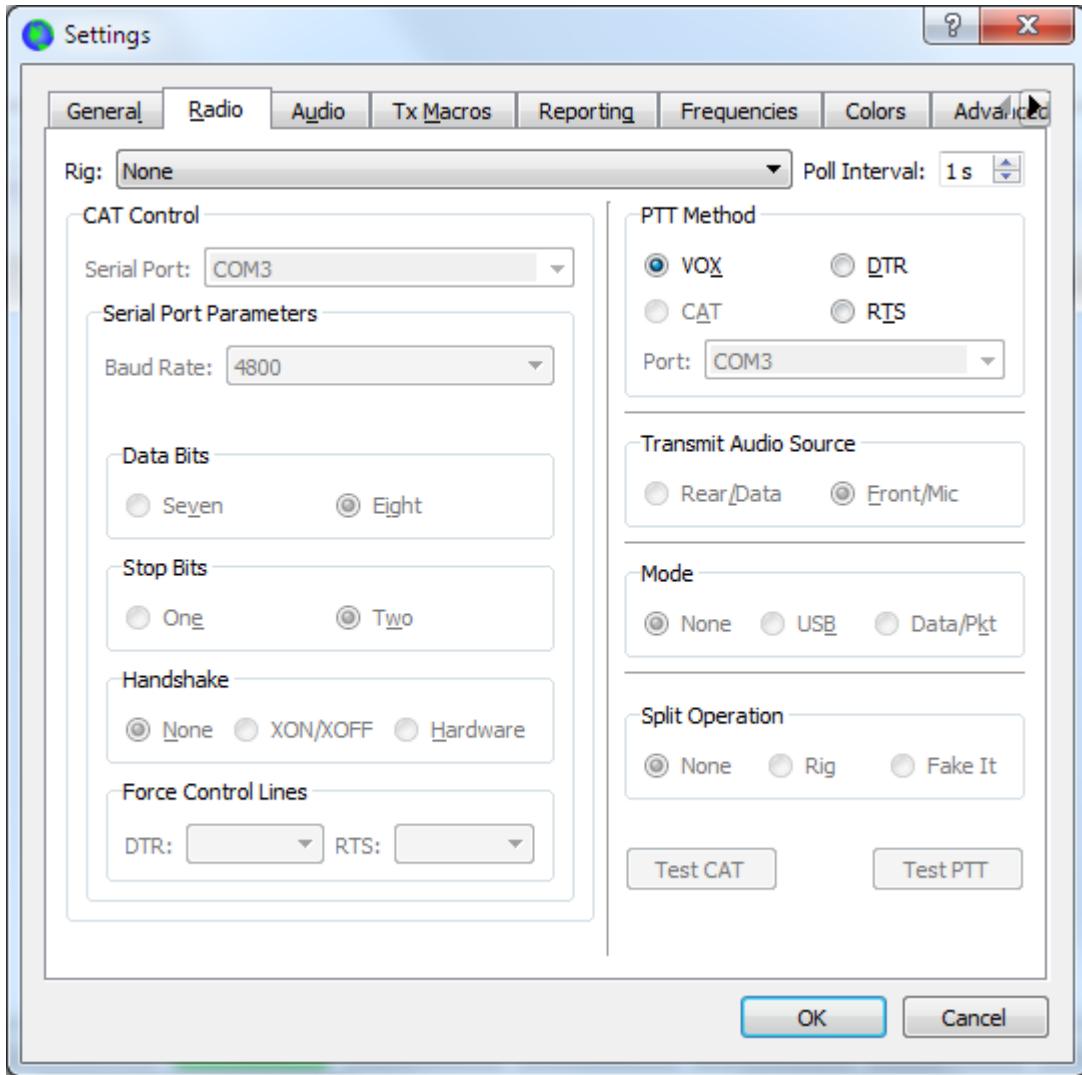
Screen snapshots of the WSJT-X Software Configurations used by AF3I.

From the WSJT-X screen, click in the Menu Bar -- first FILE, and then SETTINGS.

First tab GENERAL

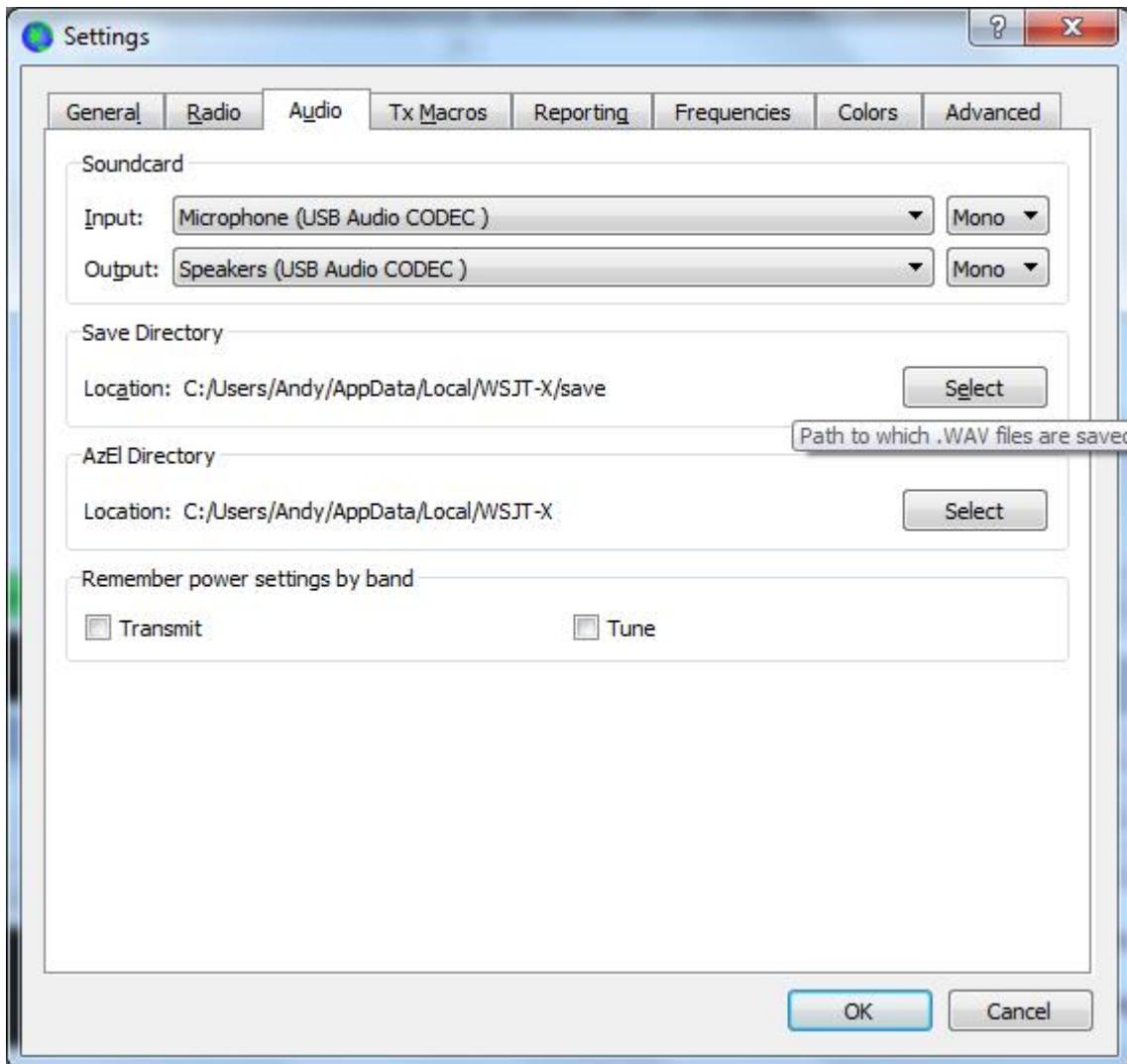


Second tab RADIO



If you are using CAT to control your Rig you would need to answer these questions.
My screen is based on using the Tigertronics Signal-Link USB to perform Rig Control.

Third tab AUDIO

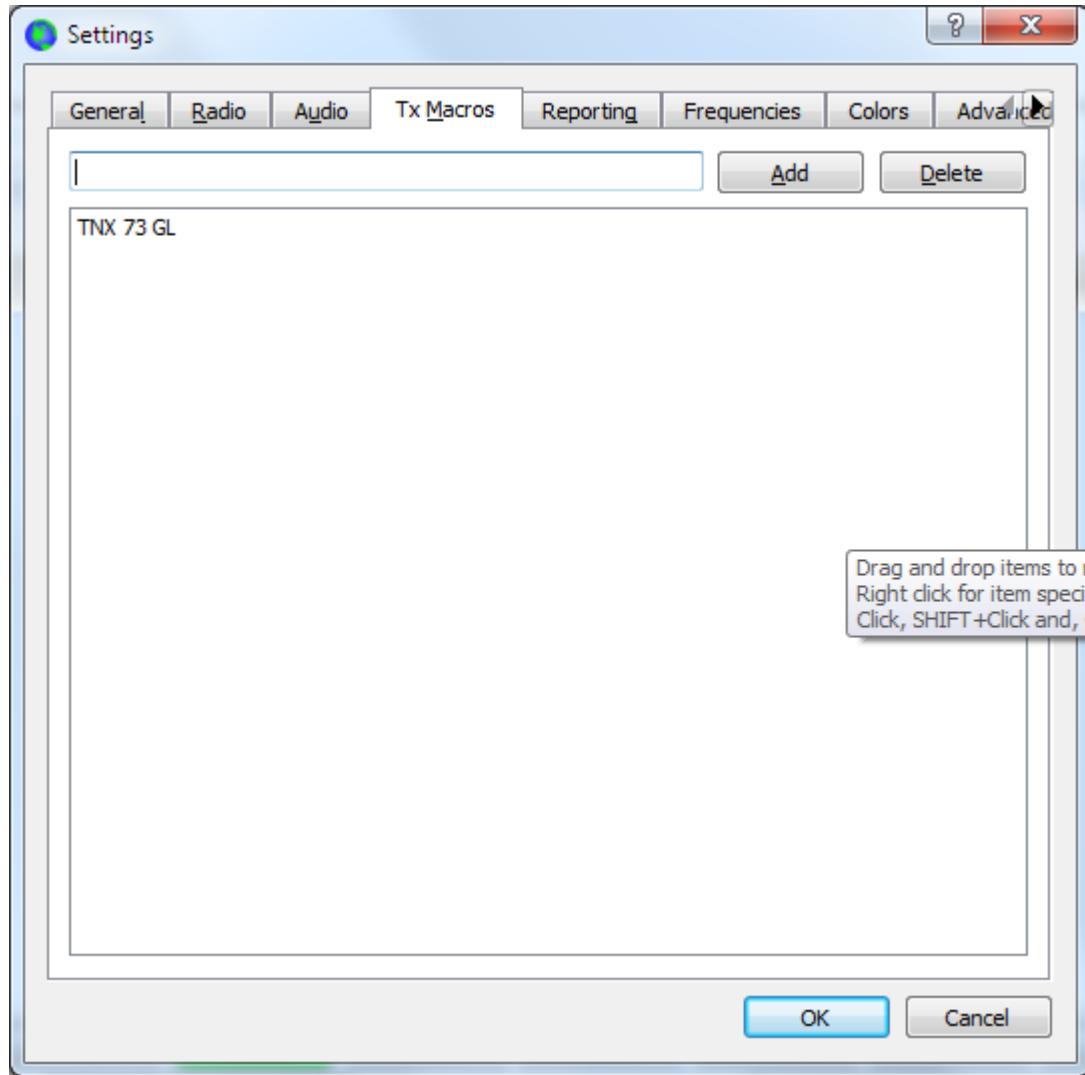


After you have successfully installed the Tigertronics Signal-Link USB you want to select the USB AUDIO CODEC options.

If you are running audio patch cables directly between your PC from your Transceiver (without a Signal-Link device) then you probably want to select your PC's own Speaker and Microphone as the audio devices.

The SAVE DIRECTORY and AzEl DIRECTORY will be specific to your own PC environment. Ignore my file locations.

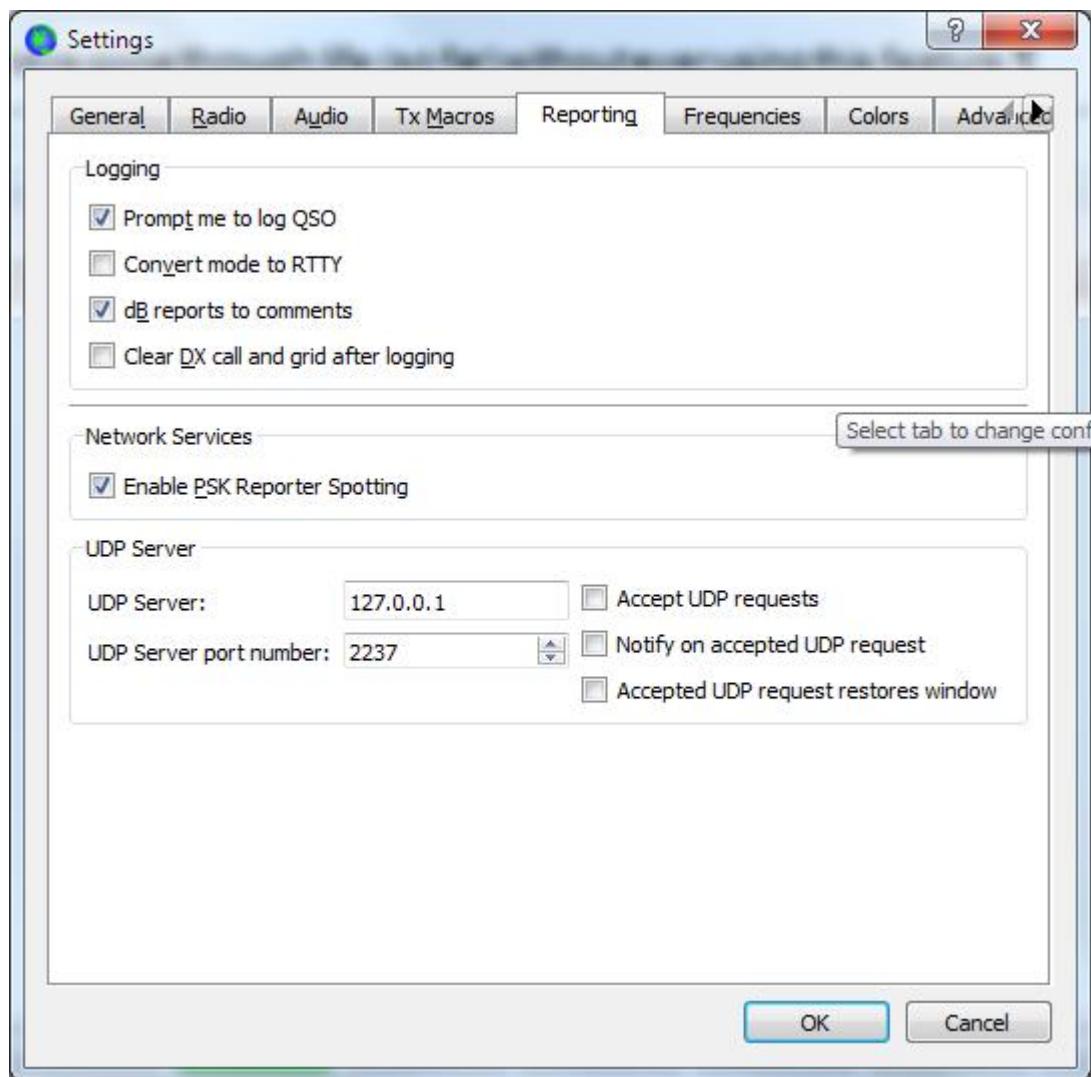
Fourth tab TX MACROS



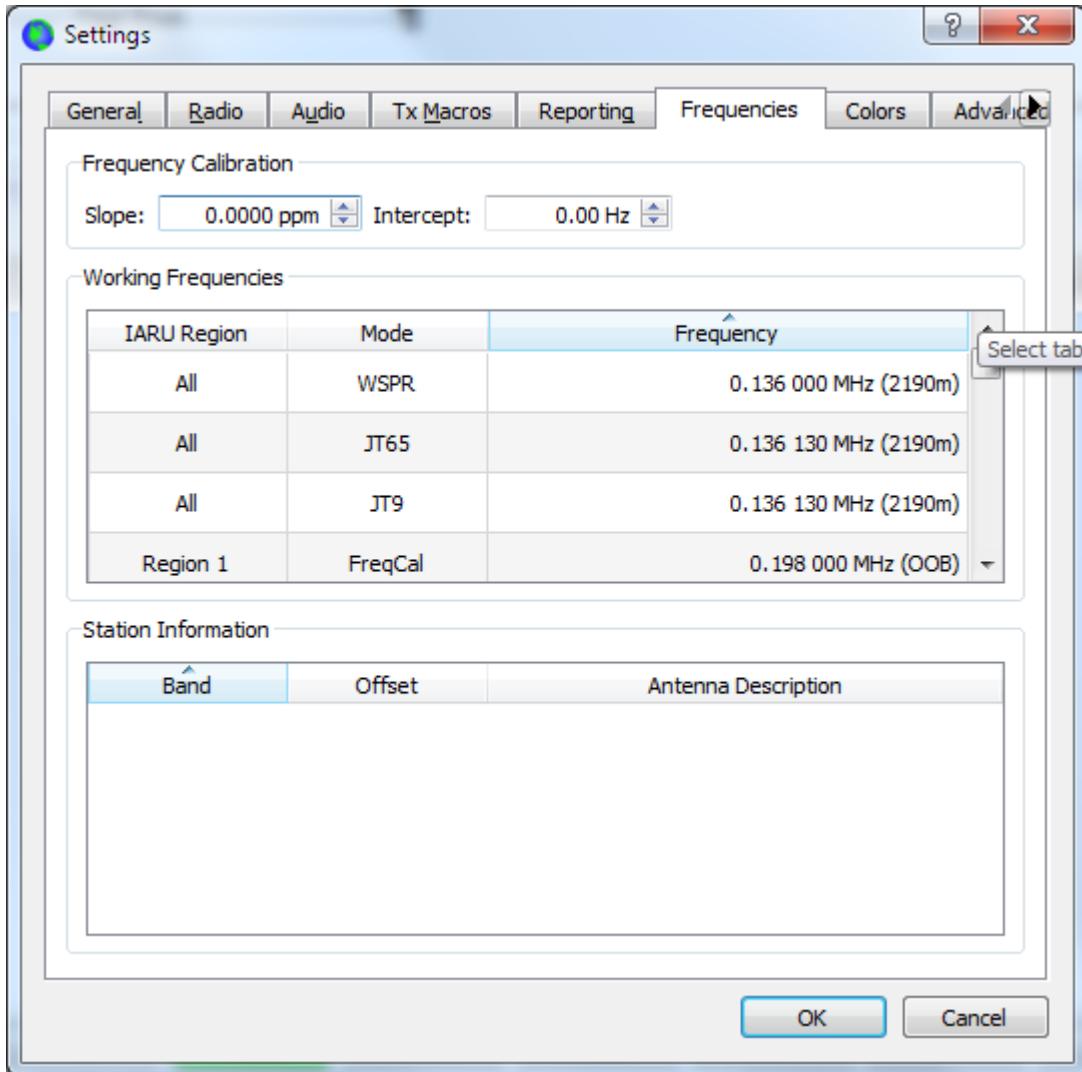
I think I have gone through life (so far) without ever using this feature.

Then I reminded myself that this is where I would configure the RR73 message I mentioned earlier.

Fifth tab REPORTING



Sixth tab FREQUENCIES



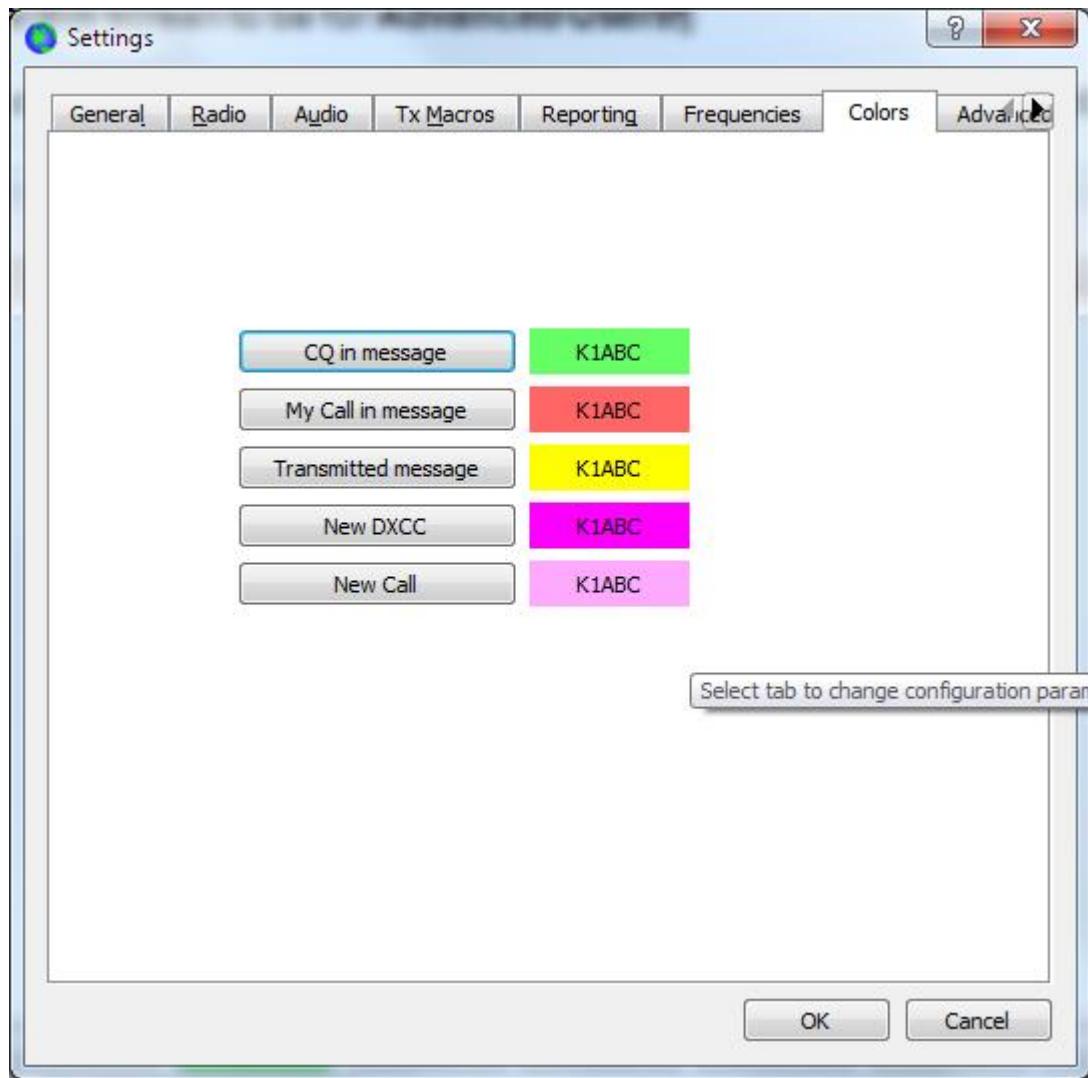
I consider this screen to be for **Advanced Users**

You can calibrate the software to the unique characteristics of your Sound Card.

You can modify the Working Frequencies to deal with special situations such as a really rare DX station working very low in your audio passband below your transceiver's audio cutoff frequencies.

I've never made use of the Station Information section.

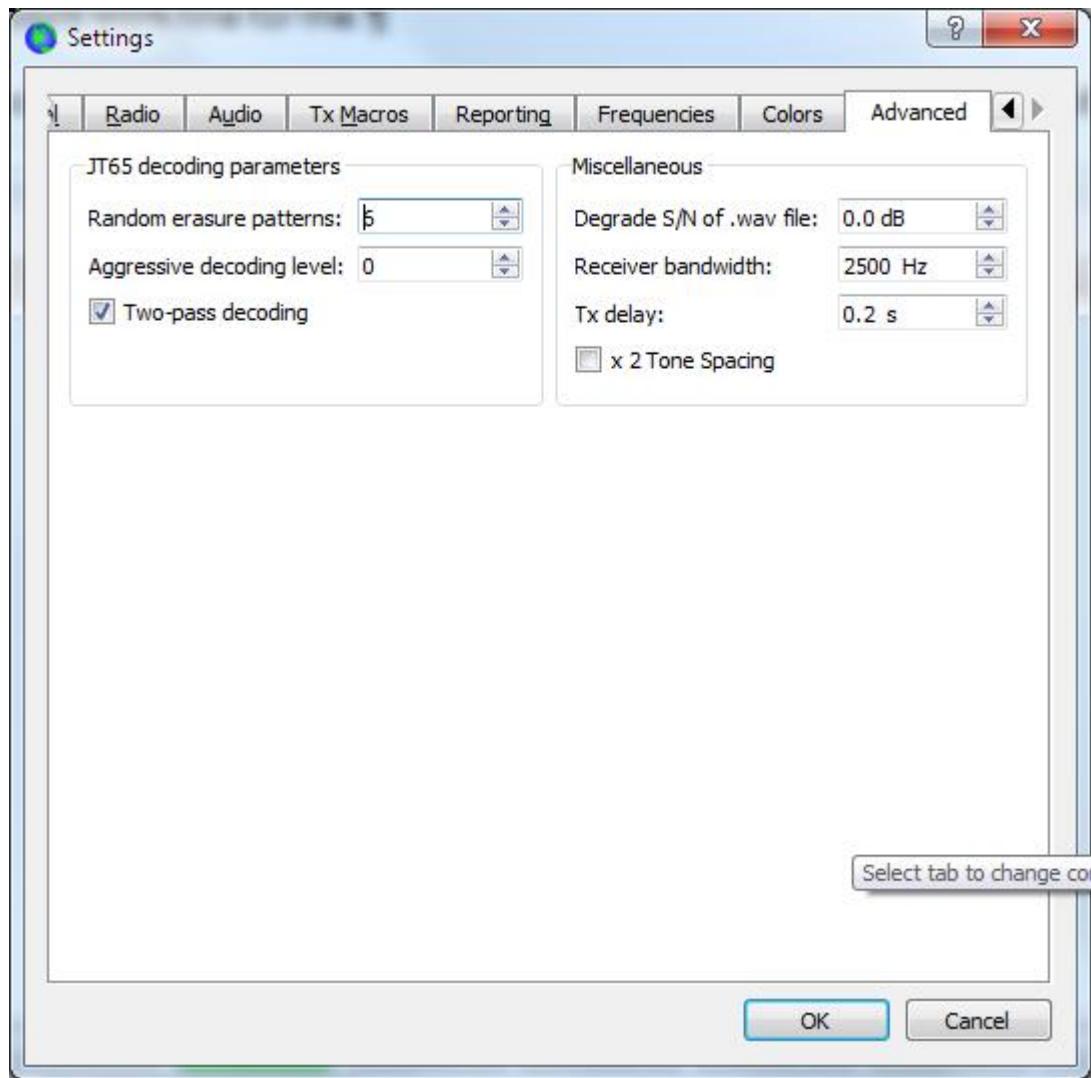
Seventh tab COLORS



These colors work fine for me.

If your monitor or video card has difficulty you might wish to experiment with other colors.

Eighth tab ADVANCED



Another screen for **Advanced Users**.

Other Settings: Behind MODE, select FT8, JT65, or JT9. Hardly anybody uses JT65 or JT9 these days.

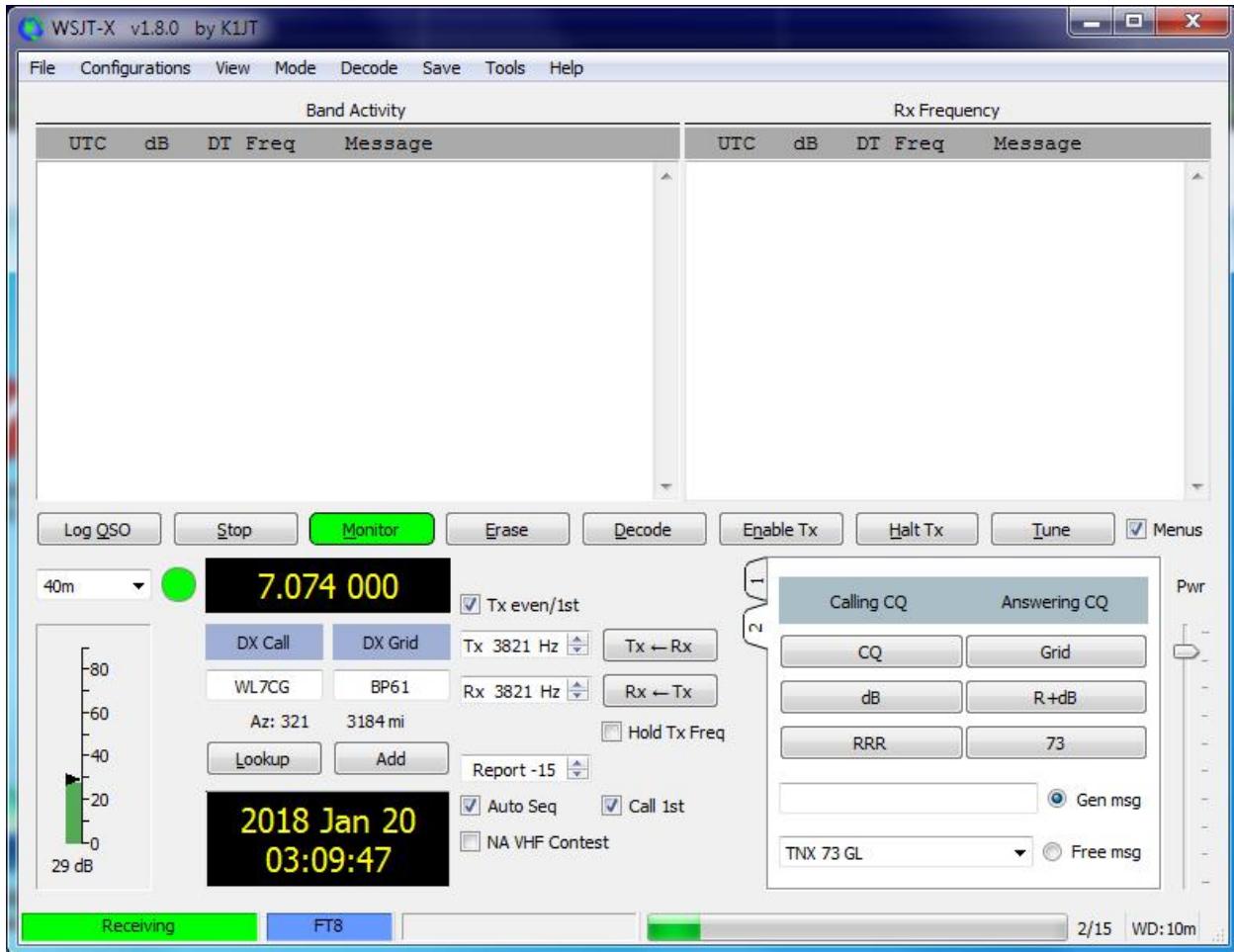
Behind DECODE, select FAST or NORMAL for most purposes. If there is a lot of activity on the band you might need to select FAST, otherwise the very short decode part of the cycle will pass before your PC finishes the job.

To get to your WSJT-X Log click FILE and then OPEN LOG DIRECTORY.

The Log File Name is: wsjtx_log.adi.

This file is in plain ASCII Text, and ADIF formatted for compatibility with ARRL LOTW, eQSL, and many popular logging software programs.

The WSJT-X software queries this log file to determine whether you have previously worked a Station or a Country and sets the screen color accordingly. If you have special operating objectives you might wish to have multiple log files. For example, separate logs by Band or Mode for award purposes.



MONITOR needs to be GREEN for Receiving Purposes.

ENABLE TX needs to be RED for Transmitting Purposes.

Double Click on anyone's callsign to set the Transmit and Receive frequencies and automatically ENABLE TX (based on one of the configuration settings.)

Hit HALT TX if your rig unexpectedly begins transmitting. If the rig doesn't stop right away try clicking TUNE twice.

Check the AUTO SEQ and CALL 1ST in order to semi-automate your FT8 QSOs. You will have to click the other guy's callsign to begin the QSO.

I do almost all my work with the #2 TAB where you see CALLING CQ in the bottom right.
For special DX or Contest situations I probably would use the #1 TAB and customize as needed.