FT8 DXpedition Mode
User Guide

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WSJT-X Version 1.9 includes special operating features that enable DXpeditions to make FT8 QSOs at very high rates. The following instructions explain how to use these new features. The instructions are intended for users already familiar with program *WSJT-X* and the FT8 protocol.

Basic Operation and Frequency Conventions

In FT8 DXpedition mode, QSOs between the DXpedition ("Fox") and calling stations ("Hounds") can be completed with as little as one Fox transmission per QSO. Moreover, Fox can transmit up to five signals simultaneously, thereby increasing the maximum possible QSO rate to 600/hour. With expected signal levels and likely levels of QRM, sustained rates of several hundred QSOs/hour are expected to be possible.

Please note:

- FT8 DXpedition mode is suitable for use *only* by legitimate DXpedition stations and those attempting to work them. Do not try to use it for normal FT8 operation.
- Everyone, including Fox and all Hounds trying to work Fox, must use WSJT-X v1.9.0 or later.
- Everyone must set their USB dial frequency to a publicly announced number for each band — for example, 14.080 MHz. DXpedition mode must not be used on the conventional FT8 working frequencies.
- Everyone must use CAT control with **Split Operation** — either **Rig** or **Fake It** on the *WSJT-X* **Settings | Radio** tab:

Fox transmits at audio frequencies between 300 and 900 Hz. When transmitting multiple simultaneous signals, the signals are spaced at 60 Hz intervals.

Hounds make initial calls anywhere in the range 1000 – 4000 Hz. Fox will not respond to Hounds initially calling below 1000 Hz. Hounds acknowledge having been called and send their "R+rpt" message at a randomly selected frequency between 300 and 900 Hz. These frequency conventions are enforced and orchestrated automatically by *WSJT-X.*

When Fox is running a pileup the standard messages look something like the following, in which Fox is signing KH1/KH7Z (a "Type 1" compound callsign):

```
     Fox                               Hounds_____
1.   CQ KH1/KH7Z
2.                                     KH1/KH7Z K1ABC, KH1/KH7Z W9XYZ, ...
3.   K1ABC KH7Z -13
4.                                     KH7Z K1ABC R-11
5.   K1ABC RR73; W9XYZ <KH1/KH7Z> -17
6.                                     KH7Z W9XYZ R-16
7.   W9XYZ RR73; G4AAA <KH1/KH7Z> -09
8.   ...
```

If Fox has a standard callsign (e.g., something like KH1DX), the example messages in lines 1 and 2 would include four-character grid locators after the transmitting station's callsign. If Fox has a "Type 2" compound callsign, say `VE2/KH7Z`, messages in line 2 would omit the add-on prefix and thus take the form `KH7Z K1ABC FN42`, etc.

Detailed Instructions for Hounds

1. Start *WSJT-X* in FT8 mode and select the desired band and pre-arranged dial frequency. If this frequency is not already present in the **Working Frequencies** table on the **Settings | Frequencies** tab, you should add it there. Right click on the **Working Frequencies** table, choose **Insert**, then select **Mode** = FT8 and enter the frequency in MHz. You can do this for any number of bands and frequencies.
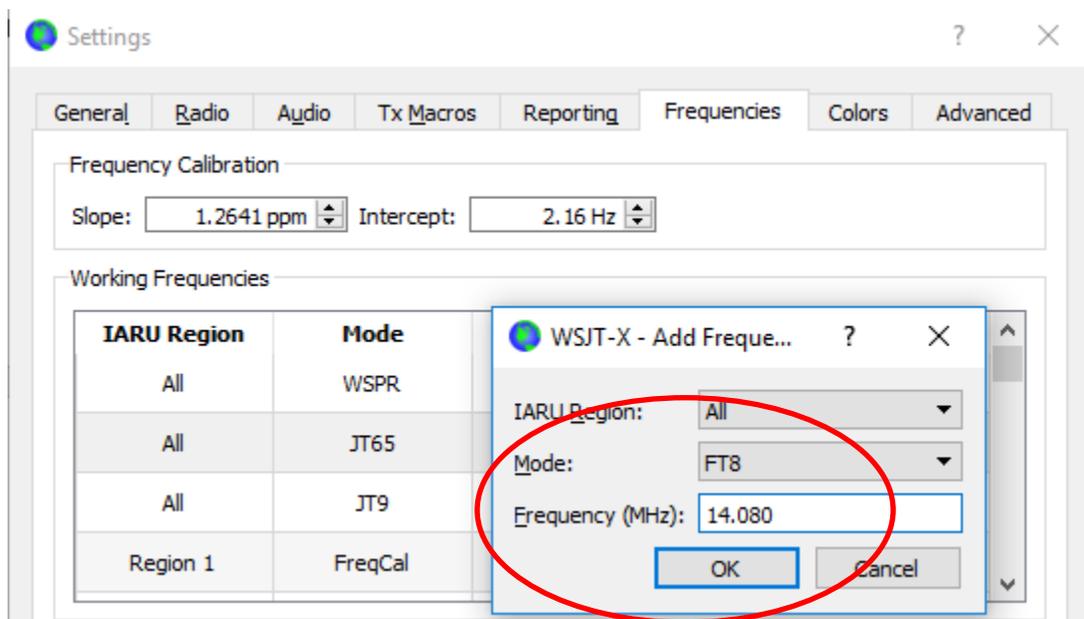
2. Select **Hound** under **FT8 DXpedition mode** on the **Settings | Advanced** tab.
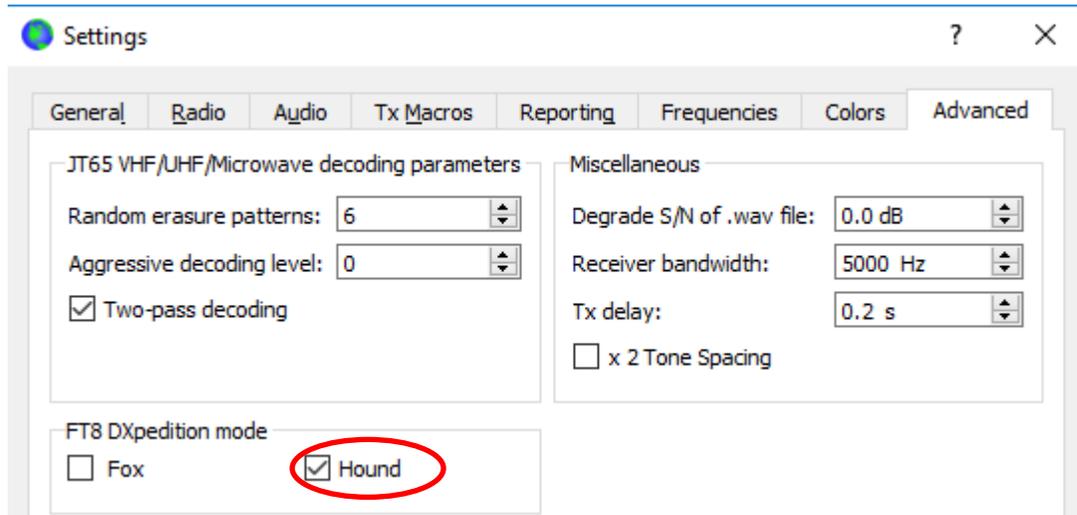
3. Select **Tab 1** on the main window for transmitted messages, and set **Tx nnnn Hz** to your chosen Tx frequency between 1000 and 4000 Hz. You can also select a Tx frequency by using **Shift+Click** on the waterfall display.
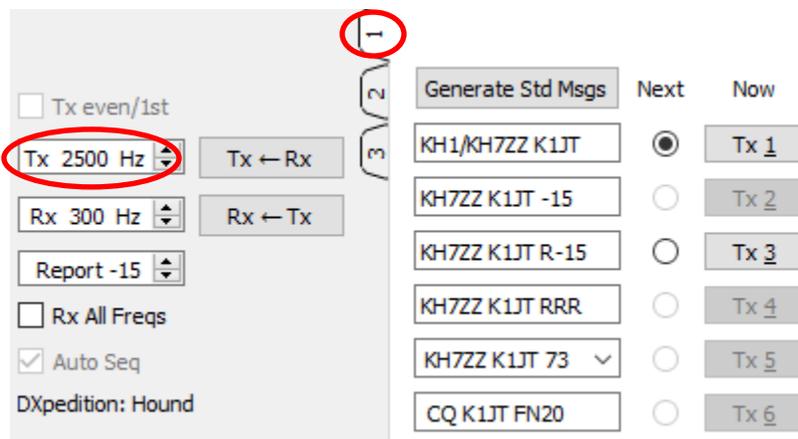
4. On the **Settings | General** tab, check **Double-click on call sets Tx enable**.
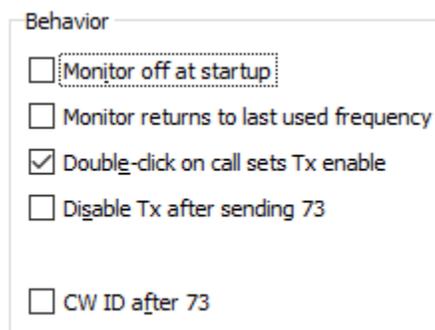
5. Enter Fox's callsign as **DX Call**. If Fox is using a compound callsign, be sure to enter all of it. The grid locator is optional but provides the advantage of displaying the short-path azimuth and distance from your location.

DX Call	DX Grid
KH1/KH7Z	AJ10
Az: 279	11018 km

6. Configure Wide Graph (the waterfall window) suitably for your system. It should look something like the screen shot below. Signals from Fox are expected at audio frequencies between 300 and 900 Hz, so be sure that the low-frequency end of your displayed spectrum goes down to 200 Hz or lower. You may want to set the high frequency end of the waterfall to 4000 Hz, to make it easy to set your Tx frequency with **Shift+Click** on the waterfall. Doing so can also make it easy to see the frequency distribution of other Hound signals while you monitor the band.
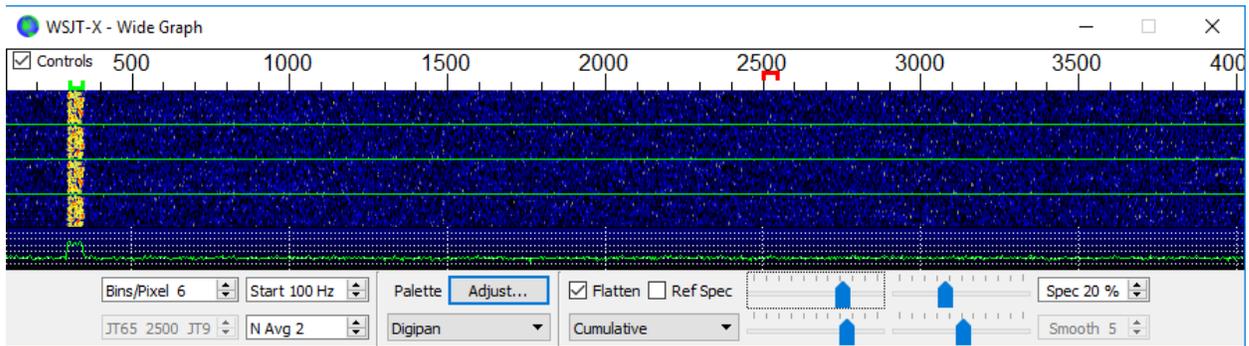
7. Toggle the **Monitor** button on the main window to green, to start receiving.

8. Note that in Hound mode, *WSJT-X* is normally configured to ignore signals above 1000 Hz. If you wish to decode signals over the full range of the waterfall, perhaps in order to keep closer track of the pileup, check the box **Rx All Freqs**.

9. **Please do not call Fox if you are not receiving his transmissions!** Doing so only creates QRM for others; it will certainly not get you a QSO.

10. Remember that FT8 is a weak-signal mode! Contacts can be made reliably with signals well below the audible threshold. The Fox operator may explicitly decide to answer only calls with signal strength below some limit, for example S/N = −10 dB. Generally you will not need and should not use an amplifier. It's more important to find a calling frequency free of QRM.

11. After you have copied Fox calling CQ or working someone else, double-click on his decoded message to call him. You may keep calling until he answers, perhaps changing your Tx frequency in the hope of finding a frequency clear of

QRM. Use **Shift+Click** on the waterfall to change your Tx frequency, (the red "goal posts" marker on the waterfall scale).

12. After you receive a signal report from Fox, WSJT-X will automatically send your next transmission as message **Tx 3** ("R+rpt") at a randomly chosen frequency in the range 300 – 900 Hz.

13. When Fox receives your "R+rpt" message he responds with "RR73". At this point he considers your QSO as complete, and logs it. When you receive "RR73" you should log it, too !

14. If for some reason a Hound fails to copy an RR73 sent by Fox, that Hound will repeat his transmission of **Tx 3** ("R+rpt"). Fox will continue responding with "RR73" for up to several minutes of repeats, before the QSO attempt is abandoned.

Detailed Instructions for Fox

1. Start *WSJT-X* in FT8 mode and select the desired band and pre-arranged dial frequency. If this frequency is not already present in the **Working Frequencies** table on the **Settings | Frequencies** tab, you should add it. Right click on the **Working Frequencies** table, choose **Insert**, select **Mode** = FT8, and enter the frequency in MHz.

2. Select **Fox** on the **Settings | Advanced** tab. This choice will enforce that **Tx even/1st** and **Auto Seq** (on the main window, see next page) are checked.
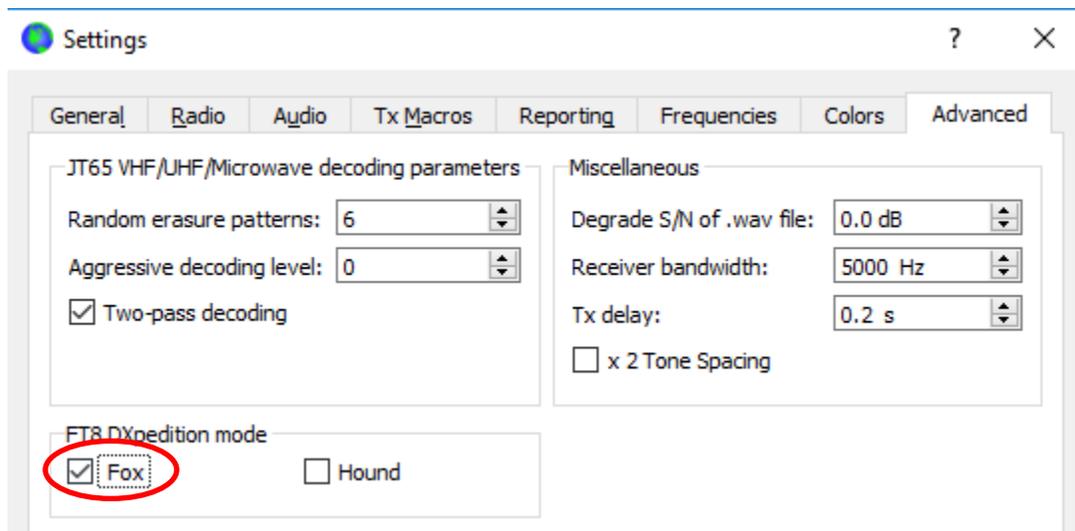
3. Configure the Wide Graph (waterfall window) as shown for Hounds earlier. Hounds make their initial calls at audio frequencies 1000 – 4000 Hz. After being

called they acknowledge and send their report at a frequency between 300 and 900 Hz. Be sure to configure the Wide Graph so that your waterfall extends at least from 200 to 4000 Hz !

4. Select **Tab 3** for Tx messages. Set **Tx 300 Hz**, and check **Hold Tx Freq**.
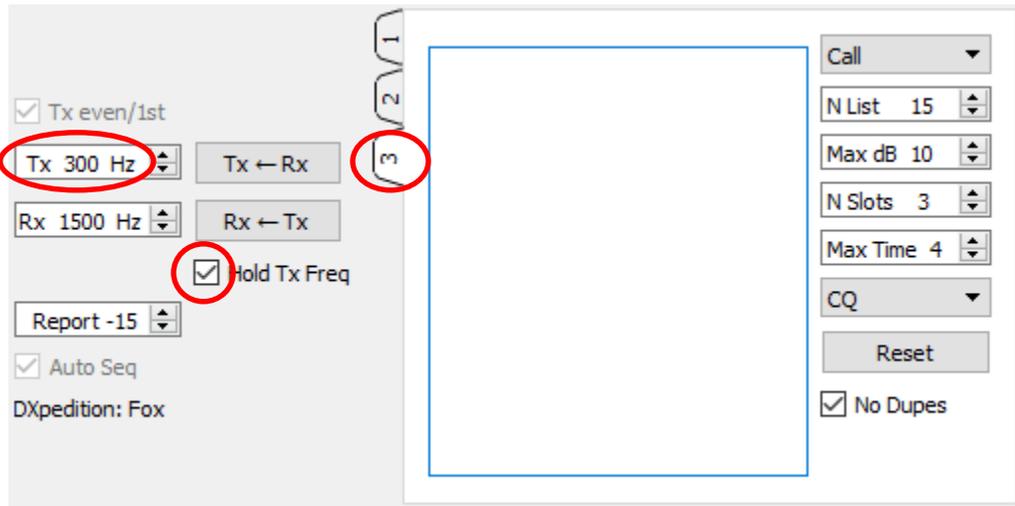
5. To evade QRM you can choose another Tx frequency in the range 300 – 600 Hz. Alternatively, you can uncheck **Hold Tx Freq** and *WSJT-X* will randomly choose a frequency in this range for each transmission.

6. In Fox mode the left text panel on the main window is labeled "Stations calling DXpedition <MyCall>". When Hounds are calling Fox, this window will be filled with a sorted list of callsigns and associated information, as shown below. By using the drop-down list at the top right of **Tab 3** you can choose to sort the list by **Call**, **Grid**, **S/N**, **Distance**, or **Random** order. The **Age** parameter tells how many Rx sequences ago each Hound was most recently decoded. Hound callsigns are dropped from the list if their **Age** exceeds 4 sequences.

7. **N List** on **Tab 3** sets the maximum number of sorted callsigns that will be displayed in the left text panel.

8. You can limit displayed callsigns to those no stronger than **Max dB**. As Fox you can use this feature to work weaker stations, thereby discouraging Hounds from engaging in a high-power "arms race". Remember that FT8 is designed as a weak-signal mode, and it provides reliable decoding at signal-to-noise ratios down to about –20 dB.

9. **N Slots** sets the maximum number of simultaneous Fox signals that can be transmitted. Fox can conduct as many as **N Slots** QSOs simultaneously.

10. **Max Time** sets the maximum time in minutes that Fox will devote to trying to work a particular Hound. A QSO attempt is aborted when this time limit is exceeded. Fox will then select a new Hound to call, or will call CQ if there are no Hounds in the queue.

11. The **CQ** drop-down list offers a selection of CQ messages directed to a particular continent or numerical call area. (NB: if this feature is considered important, we may program things so that Hounds cannot transmit in response to a non-matching directed CQ, and non-matching calls will not be displayed to Fox.)
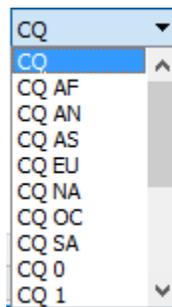
12. Click on **Fox Log** on the **View** menu to display an optional window showing the most recent logged QSOs. This window also displays the number of decodable Hounds found to be calling, the number presently queued to be called, the number logged in the current *WSJT-X* session, and the hourly QSO rate.
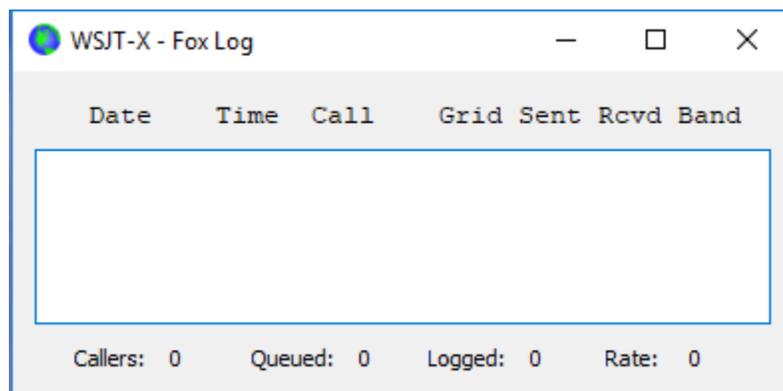
13. To send logged QSOs directly to *N1MM Logger+*, go to **Settings | Reporting**, check **Enable logged contact ADIF broadcast**, and enter the IP address and port number used by your N1MM server.

14. The Fox operator's main task is to select Hounds to be called and worked. The rectangular text box on **Tab 3** holds the **QSO queue**: a list of Hound calls to be worked and the signal reports they will be sent. Hit **Enter** to select the top callsign from the sorted list and enter it in the **QSO queue**. Alternatively, you may double-click on any call in the list to move that one to the **QSO queue**.

15. Double-click on a callsign in the **QSO queue** to delete it from the queue. The **Reset** button erases all Hound callsigns from the queue.

16. Check **No Dupes** to prevent accepting Hound callsigns already worked on the current band, in the current *WSJT-X* session.

17. The right text window (labeled "Rx Frequency") displays decodes of signals below 1000 Hz (by default these will be highlighted in red) and Fox's own transmissions (highlighted in yellow). The red messages should include only Hound messages containing "R+rpt", signifying that a QSO is awaiting the concluding "RR73" from Fox.

18. To start a run, toggle the **Enable Tx** button to red. If a Hound call is available in the **QSO queue**, that station will be called in Fox's next transmission. If the **QSO queue** is empty, Fox will call CQ. If **N Slots** is greater than 1 and Hounds are available in the queue, Fox will call more than one Hound.

19. After receiving "R+rpt" from a Hound that had previously been called, Fox will send "RR73" in the next transmission to that Hound, and will log the QSO.

Important Note for Fox Operators: When using **N slots** > 1, your transmitted signal will be different from standard transmissions in that it will not have a constant envelope. To avoid producing unwanted sidebands you must ensure good linearity throughout your Tx system. One way to get things about right is to use the *WSJT-X* **Tune** button to generate an unmodulated carrier. Configure your transmitter and PA as required for the desired peak output power, say P_0. Then pull the **Pwr** slider (bottom right of the *WSJT-X* main window) down until your output power decreases by about 10%. Use this audio level setting for all your Fox transmissions. If you are using **N slots** signals, your average transmitted power will be $P_0/($**N slots**$)$ and the power in each signal will be $P_0/($**N slots**$)^2$. Thus, for **N slots** = 1, 2, 3, 4, and 5 the average power *per signal* will be down from P_0 by about 0, 6, 9.5, 12, and 14 dB, respectively.