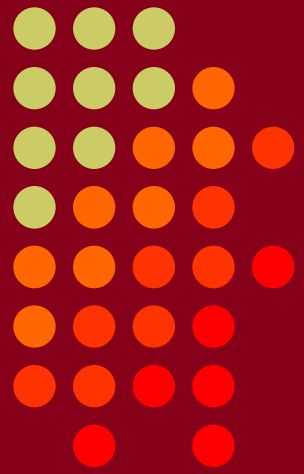
# CTU Presents

## FT8 and the WSJT-X 2.0 Software Suite for 6 Meter Contesting

Joel Harrison, W5ZN



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# Session Objective

- We’re not going to discuss or debate contest rules. They are what they are….follow them or change them
- We’re not going to debate FT8 as a mode compared to CW, SSB, AM or Spark
  - We will discuss how to implement it into your station
- FT8 is simply a “Disruptive Technology”!

# Disruptive Technology

- Technology that is new and constantly innovating
- Initially only appeals to a small group
- They disrupt by creating new users and challenging existing technology
- Examples
  - Email & social media transformed the way we communicate
  - Cell phones disrupted the telecom industry
  - Notebook computers & tablets created a mobile workforce
  - FT8 has transformed amateur digital communications


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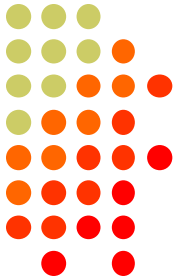
# FT4

More on this later

# First – A Bit of History

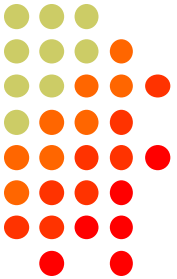
- Created by Dr. Joe Taylor, K1JT
  - Astrophysicist & Nobel Laureate
    - Nobel Prize in Physics - 1993
    - Discovered new type of pulsar that has opened up new possibilities for the study of gravitation.
- WSJT Originally Released in 2001
  - Has undergone major revisions since then
  - Became “Open Source” in 2005
  - Original version up through “WSJT7” contained 16 different modes

# WSJT-X 2.0 Modes



- 9 Different Protocols or Modes
- FT8, JT4, JT9, JT65, QRA64, ISCAT, MSK144, WSPR and Echo
- First 5 are for making reliable QSOs under extreme weak signal conditions
  - All use nearly identical message structure and source encoding.

# WSJT-X 2.0 Modes

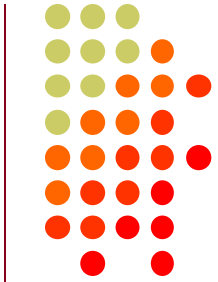


- JT65 and QRA64 were designed for EME (moonbounce) on the VHF/UHF bands
  - Also proven very effective for worldwide QRP communications on HF
- MSK144 and ISCAT are “fast” protocols designed forionized meteor trails, aircraft scatter and other types of scatter propagation

# WSJT-X 2.0 Modes

- WSPR (pronounced Whisper) stands for “Weak Signal Propagation Reporter”
  - Designed for probing potential propagation paths using low-power transmissions.
- Echo mode allows you to detect and measure your own station’s echoes from the moon, even if they are below the audible threshold

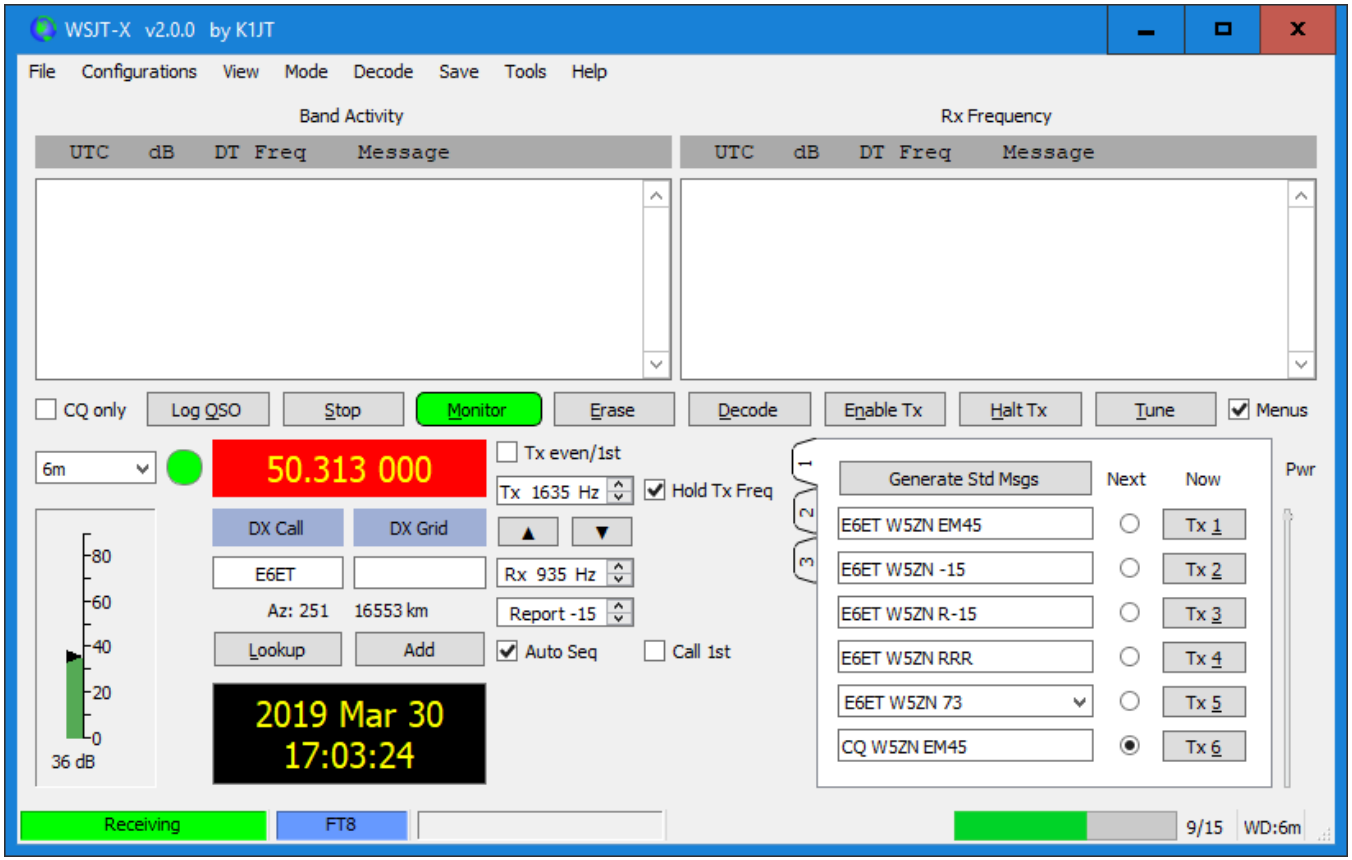
# WSJT-X 2.0 Modes



- Free software & documentation
- Download from WSJT “Home” is at:

https://www.physics.princeton.edu/pulsar/K1JT/

# WSJT-X 2.0 Modes

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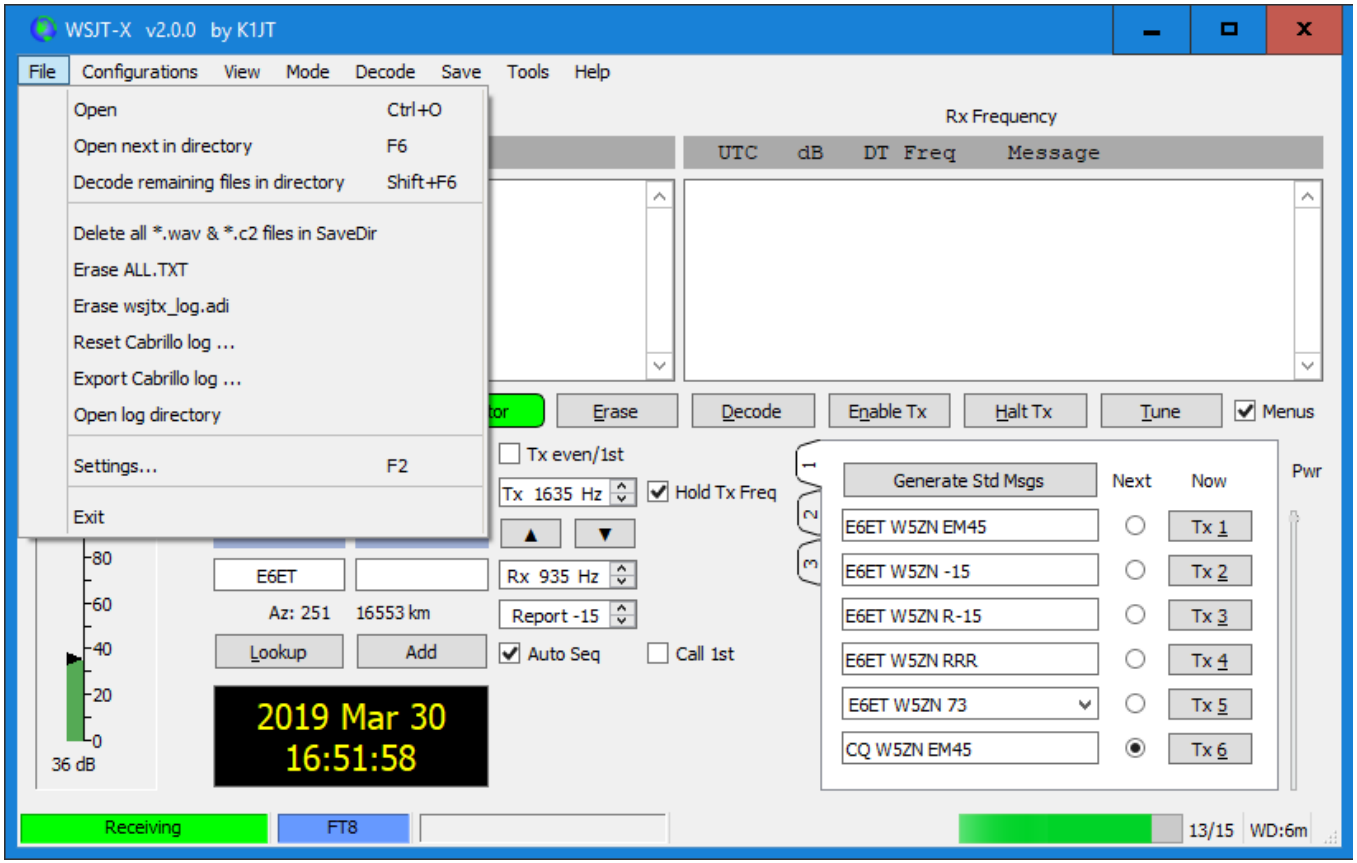


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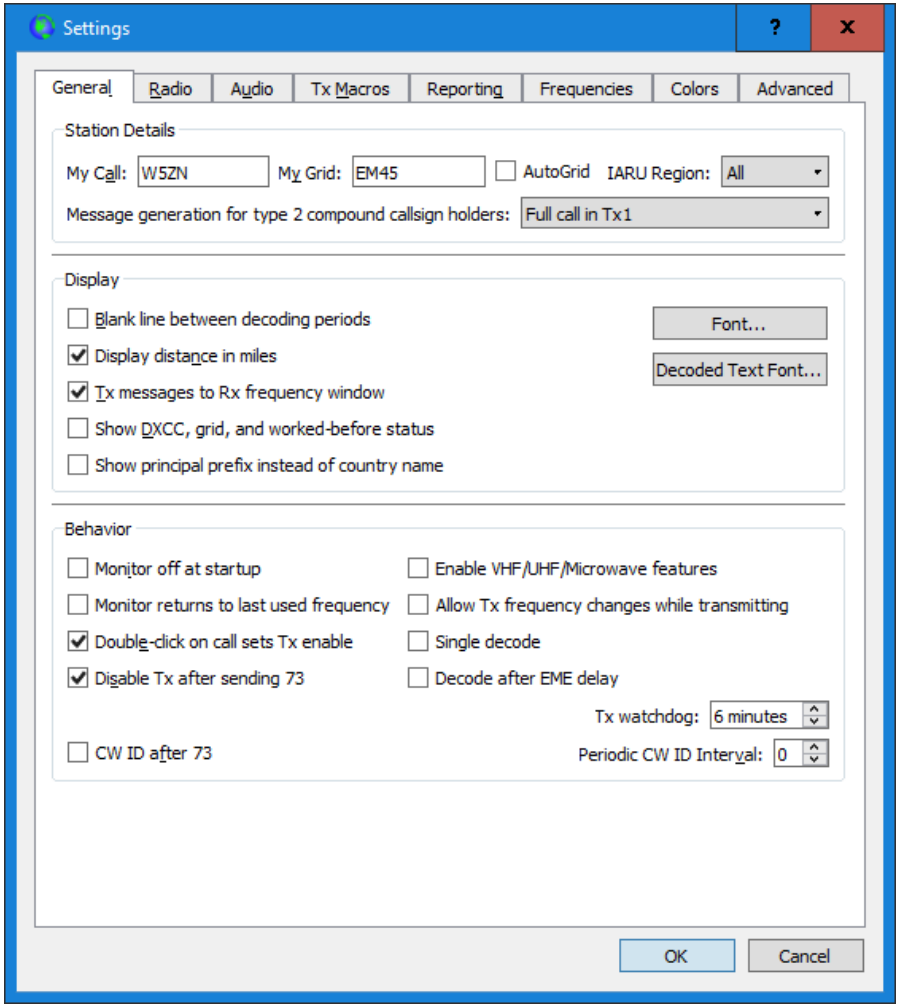


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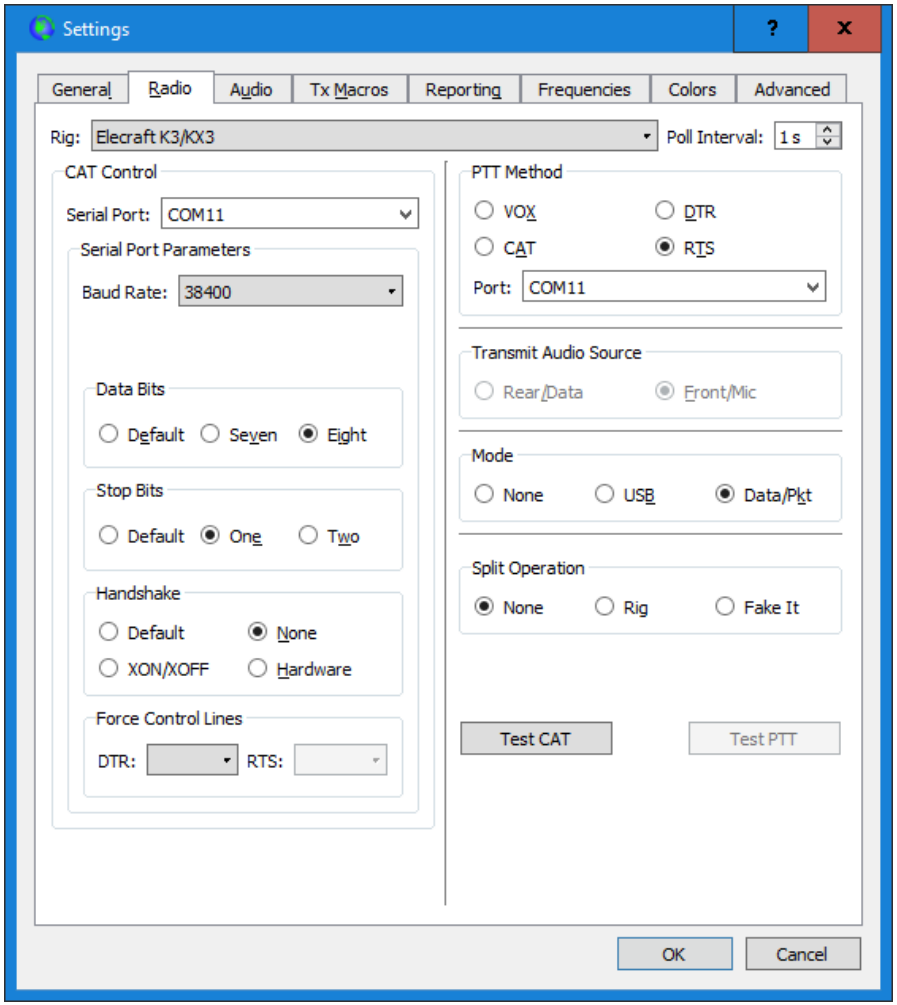


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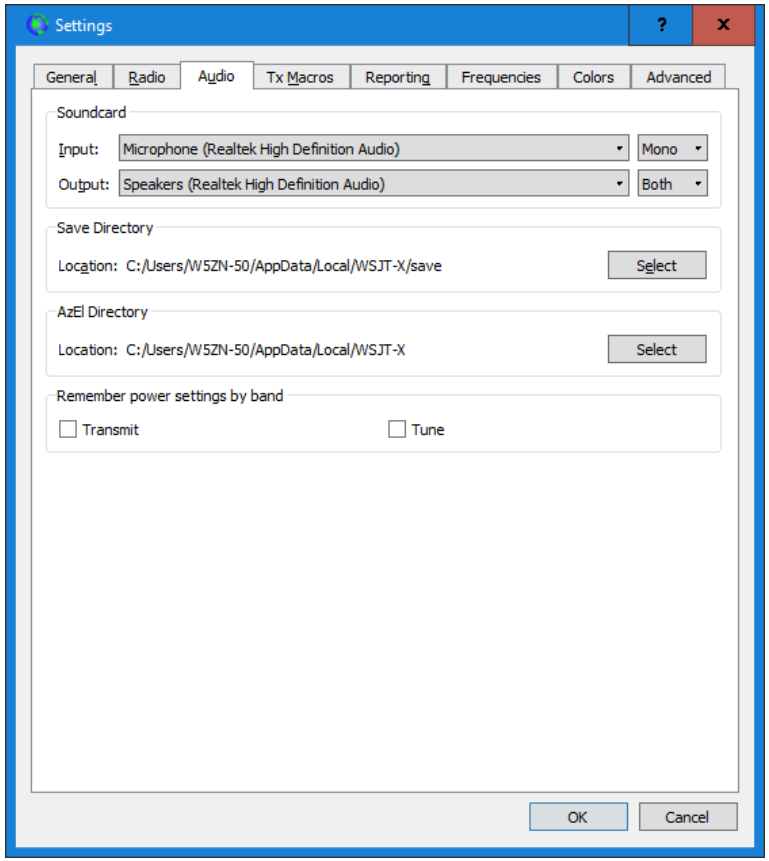


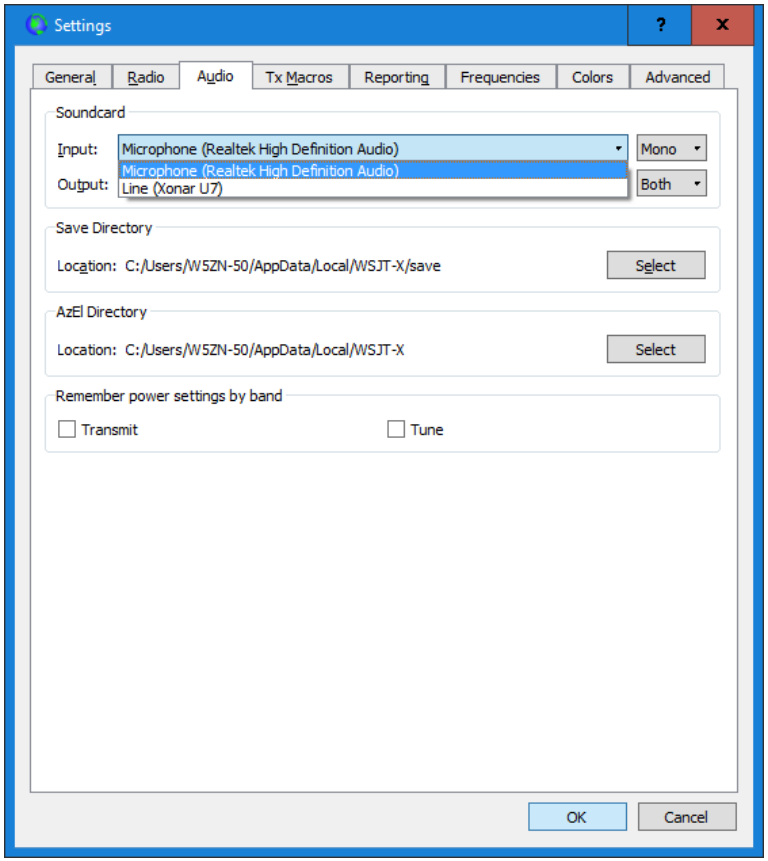


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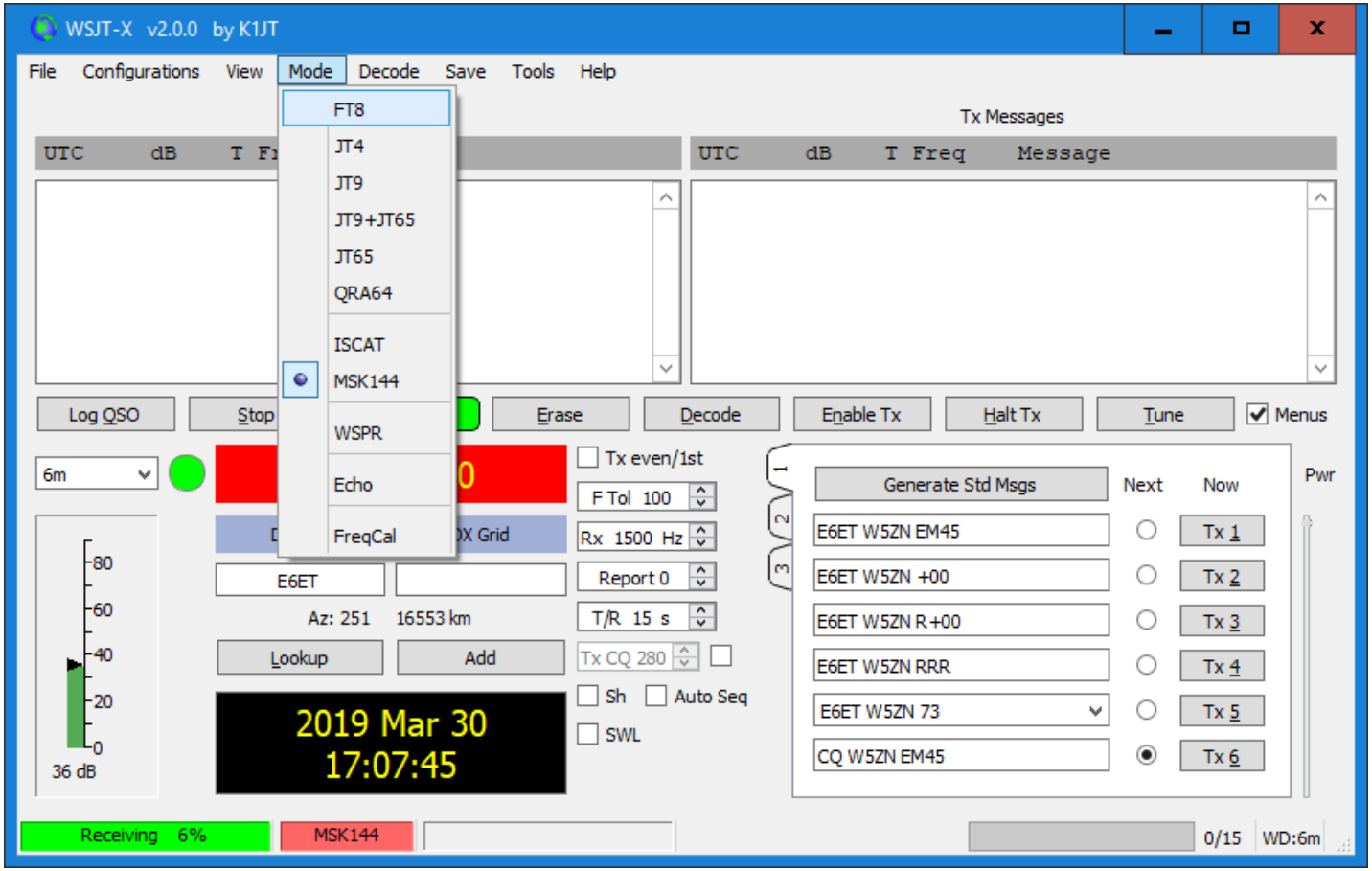
# WSJT-X 2.0 Modes

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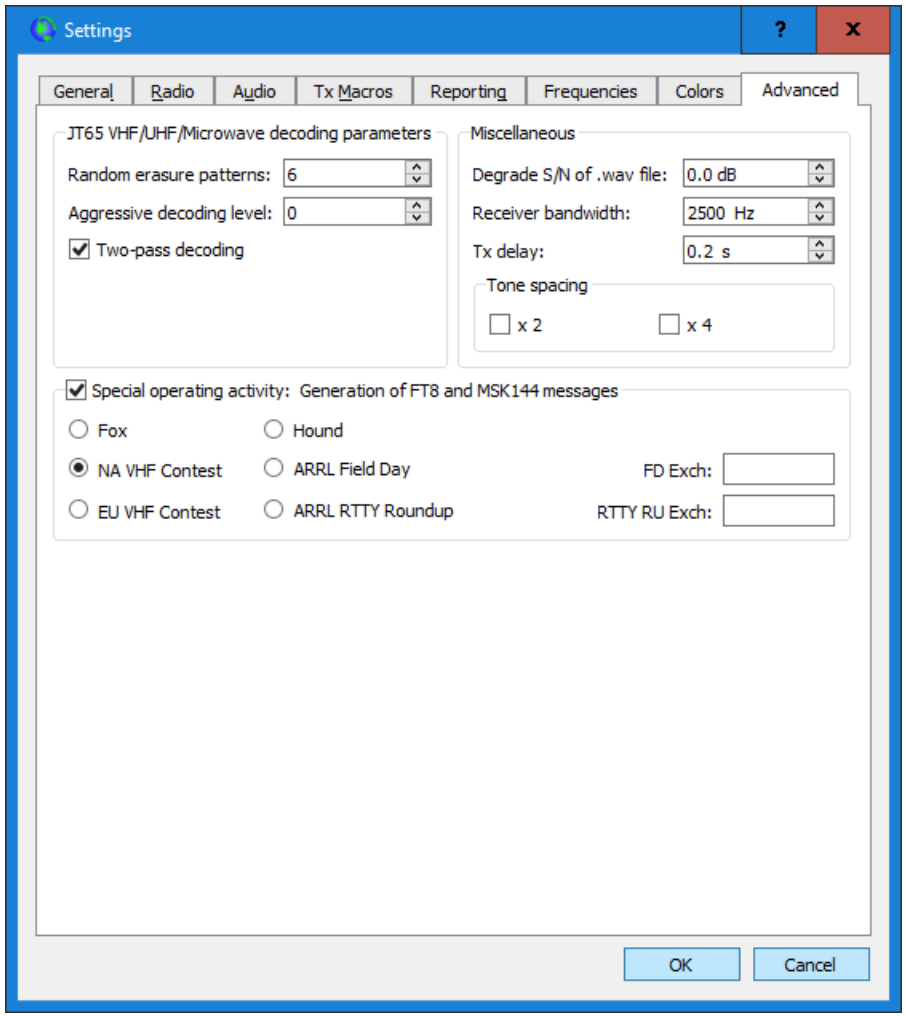
# WSJT-X 2.0 Special Operating

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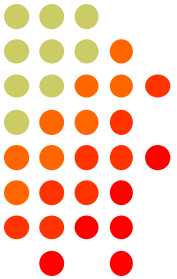
# WSJT-X 2.0 Modes

- WHAT TIME IS IT??????????????????
  - Your computer's time ***MUST*** be accurate
  - How you do dat?
    - Do NOT rely on the Windows time sync service
      - Time.is will identify your computers descrepancy
    - Dimension 4 is my recommendation

# FT-8

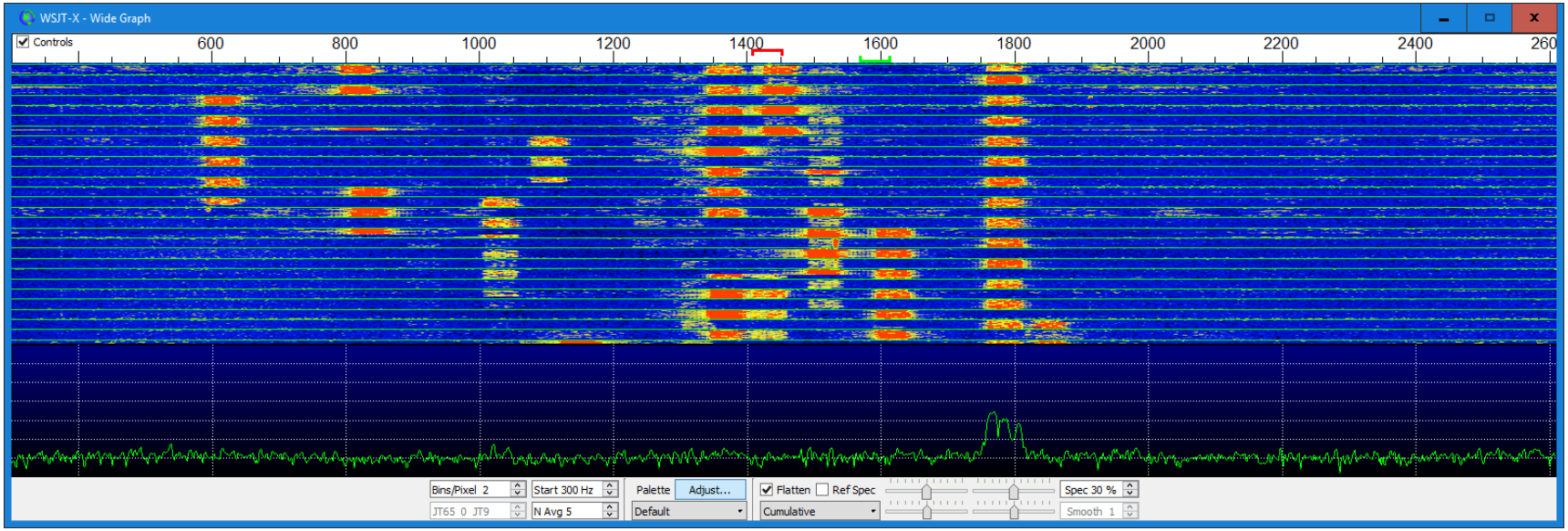
- Outgrowth of JT65
- Shorter transmit-receive cycle
  - Faster contacts – up to 4 times faster
  - Can complete within 1 minute
- Sensitivity down to -20 dB
- Uses 8-Frequency Shift Keying format

# FT-8 Six Meter Advantages



- Excellent for multi-hop sporadic E
  - Deep QSB often times impacts normal mode Q's
- Operation centered on 50.313

# FT-8 Wide Graph

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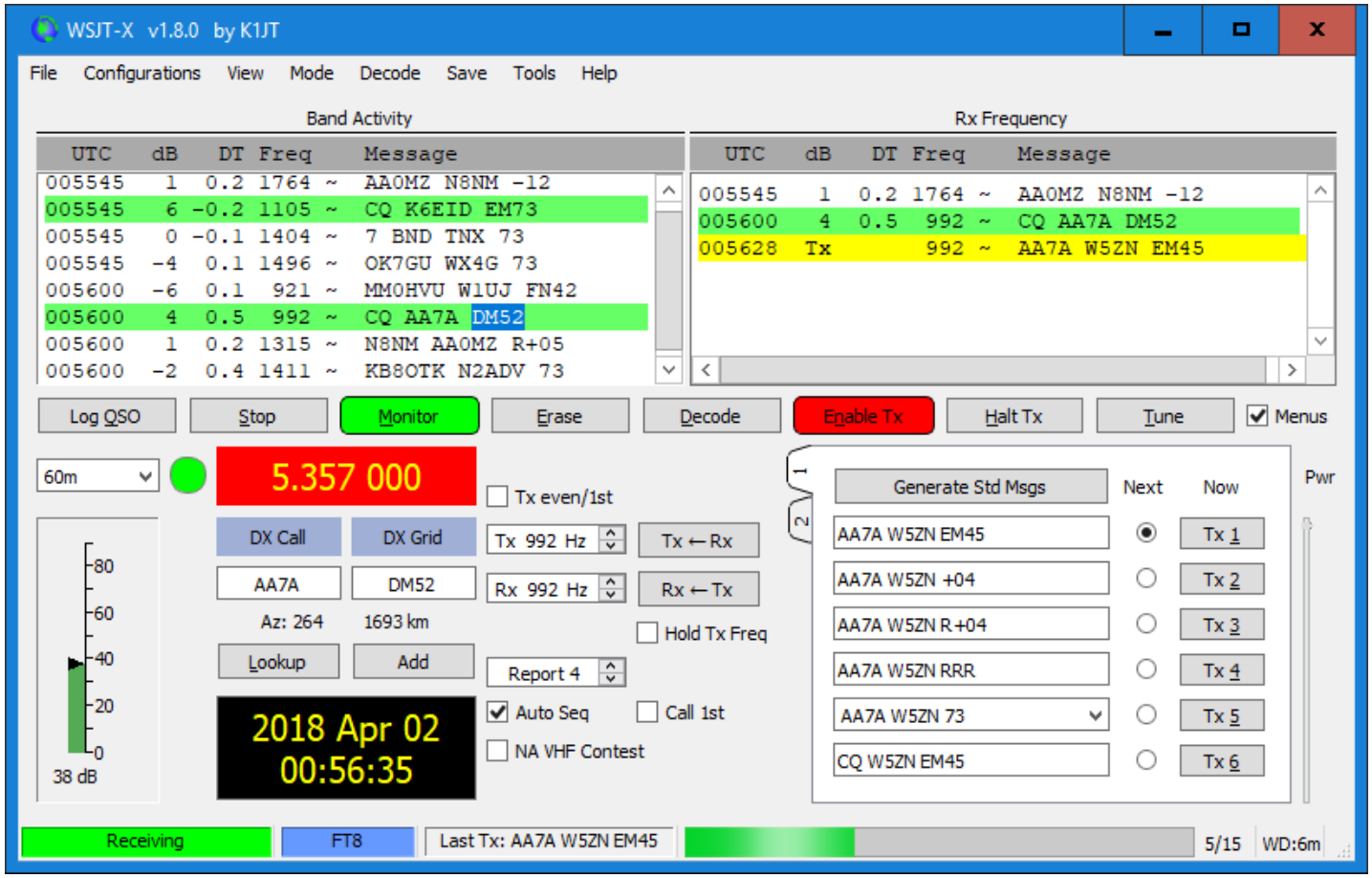
# FT-8 Main Screen

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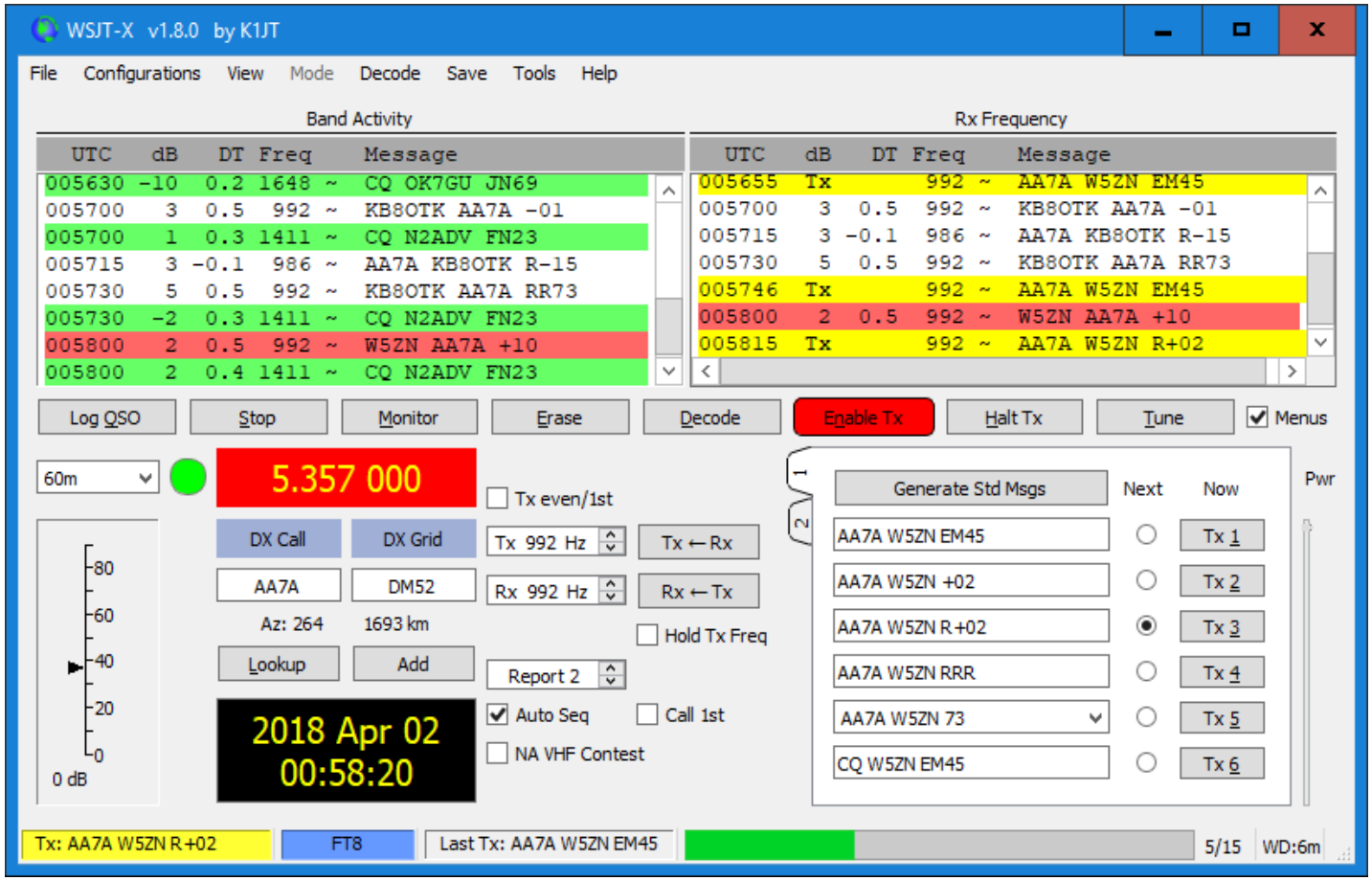


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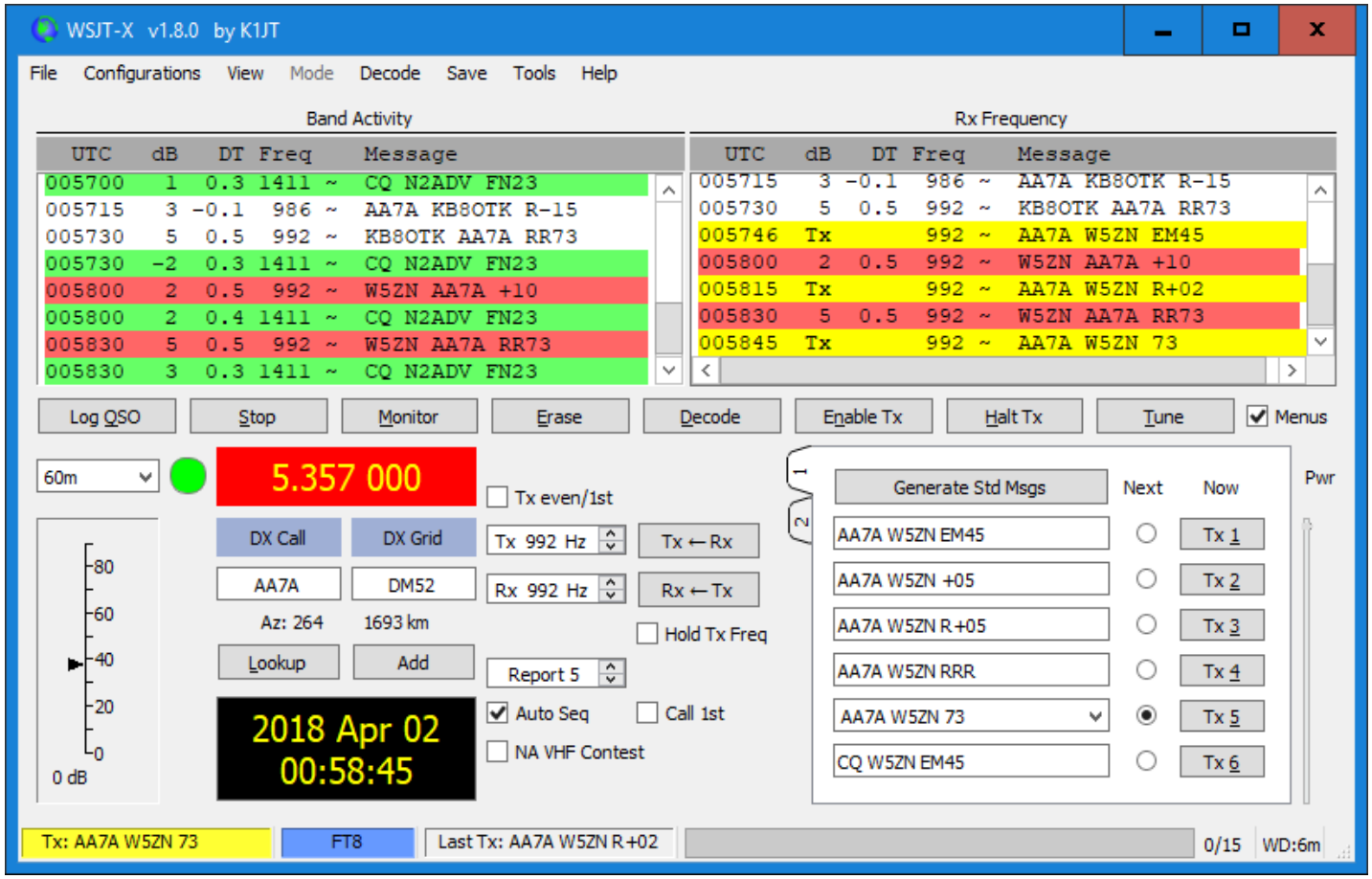


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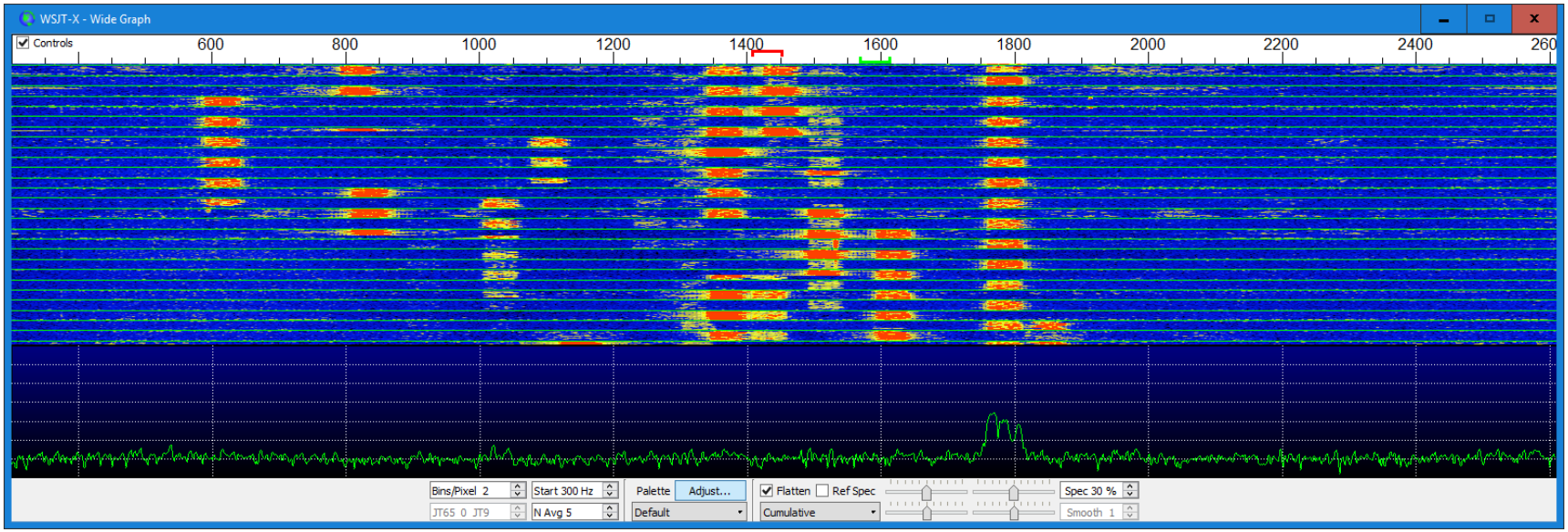
# FT-8 What Freq Am I On?

My dial says 14080.0 but the station was spotted on 14081.7

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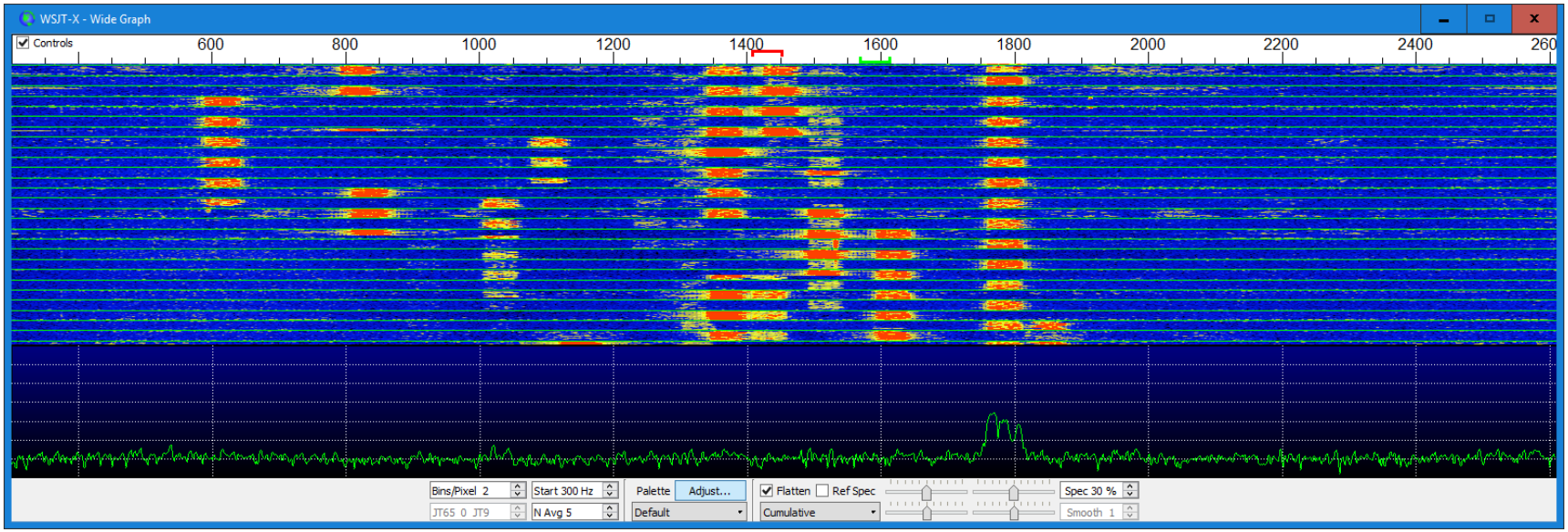
# FT-8 Bandwidth

An FT8 Signal has a 50 Hz bandwidth. Should I use my CW filter to narrow my receivers bandwidth?

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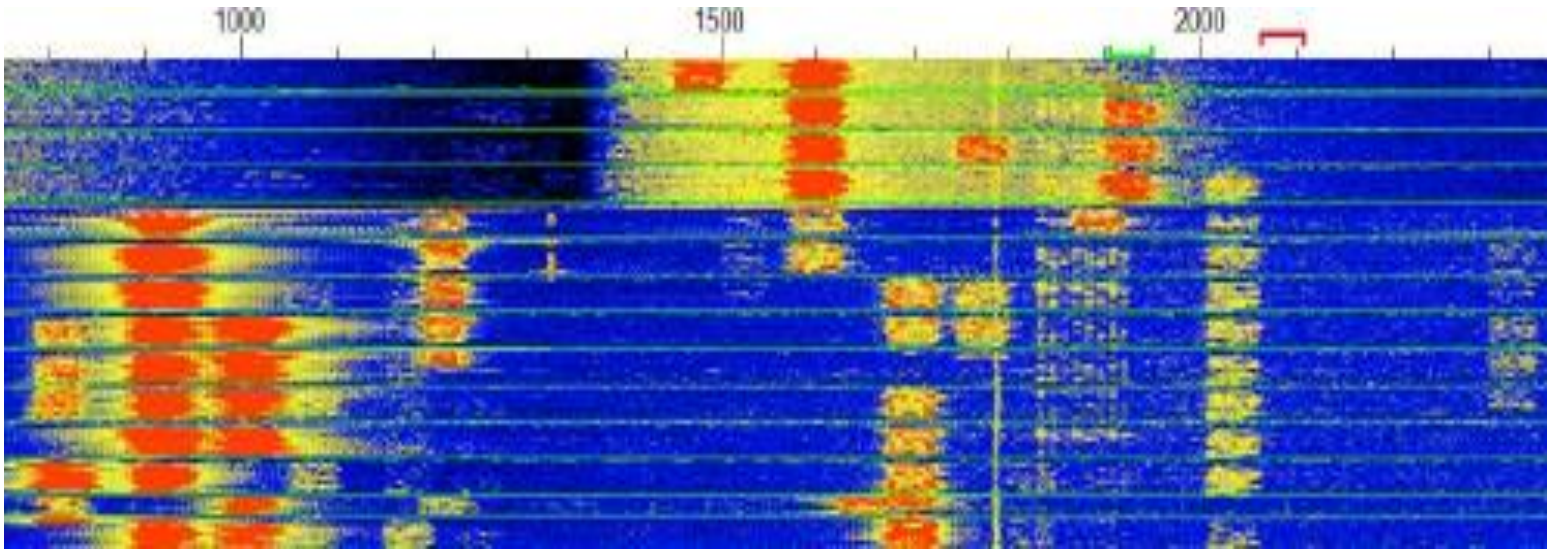
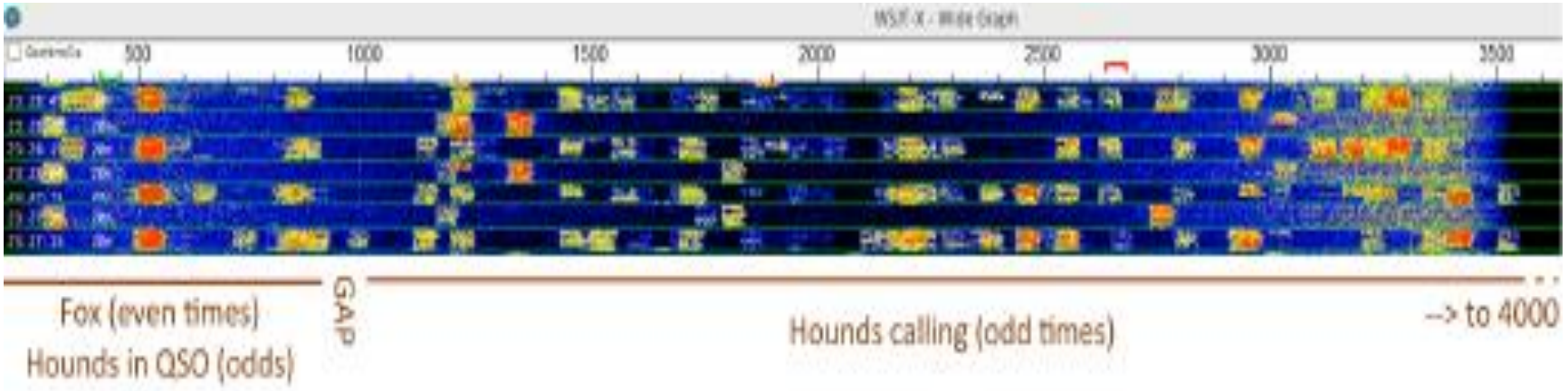
# FT-8 Narrow RX Filters

Narrowing your receivers bandwidth “may” improve the RX conditions.



# FT-8 Special Applications

Fox/Hound Mode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# FT-8 Special Applications

## Fox/Hound Mode

- If you cannot copy the fox, ***DO NOT CALL HIM*** as you will simply create QRM and aggravation.
- Even if by some miracle he responds to you, you won't see his response and someone else may miss out on a QSO as he tries to contact you in vain.
- Simply be patient, watching the screen, poised to pounce like a hawk (hound) when you do see decodes from him.

# FT-8 Special Applications

Fox/Hound Mode

- In DXpedition mode, a special hard-coded timer automatically disables your transmissions after 2 minutes without a response

- During this time the fox may have put you in the queue.

# FT-8 Special Applications

Fox/Hound Mode

If the fox responds to you later, after your DXpedition mode timer has timed out and before you re-start transmissions, your Tx will automatically be re-enabled to send him his report, completing the QSO when he acknowledges it with his RR73 message back to you

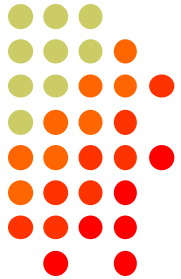
# FT-8 Special Applications

## Fox/Hound Mode

- If the fox responds to your call with his Tx 2 message (your callsign and report), your system will automatically QSY your Tx to a frequency below 1000 Hz to send him your Tx 3 message (both callsigns, R and his report).

- If you don’t have CAT control, you must QSY manually below 1,000 to make the QSO unless the DXpedition op is around and manually completes it.

# FT-8 Contest Disadvantage



- QSO rates can be larger on other modes during big Sporadic E Openings
  - While a quick FT-8 contact can be completed in 1 minute, SSB or CW rates can be 5 to 10 times that
- On 6 meters, too many stations sit on 50.313 when the band opens and closes quickly on CW & SSB Frequencies!

# FT-8 HF Operating Guide

Gary Hinson, ZL2IFB, has a detailed operating guide at:

https://www.g4ifb.com/FT8_Hinson_tips_for_HF_DXers.pdf

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# Meteor Scatter

- The earth is bombarded by a constant stream of small particles, remnants of comets that when entering the earth's atmosphere can ionize a column of atoms in the E region at approximately 100km (~60 miles) above the surface of the earth which can reflect radio waves in the VHF region of the spectrum

# Meteor Scatter

- There are seasonal variations in the number of sporadic meteors
  - Relative rate increases noticeably in May, peaking in July and August then tailing off into October and November.
- There is also an hourly variation in the relative rate of meteors peaking
  - around dawn local time with the minimum late afternoon before the ramp up begins again late evening.
  - The hourly relative rate is due to the fact that the earth's rotation is head on so to speak in the morning into the path of the particles and therefore there is an increase in the relative velocity of a particle entering the earth's atmosphere.

# Meteor Scatter

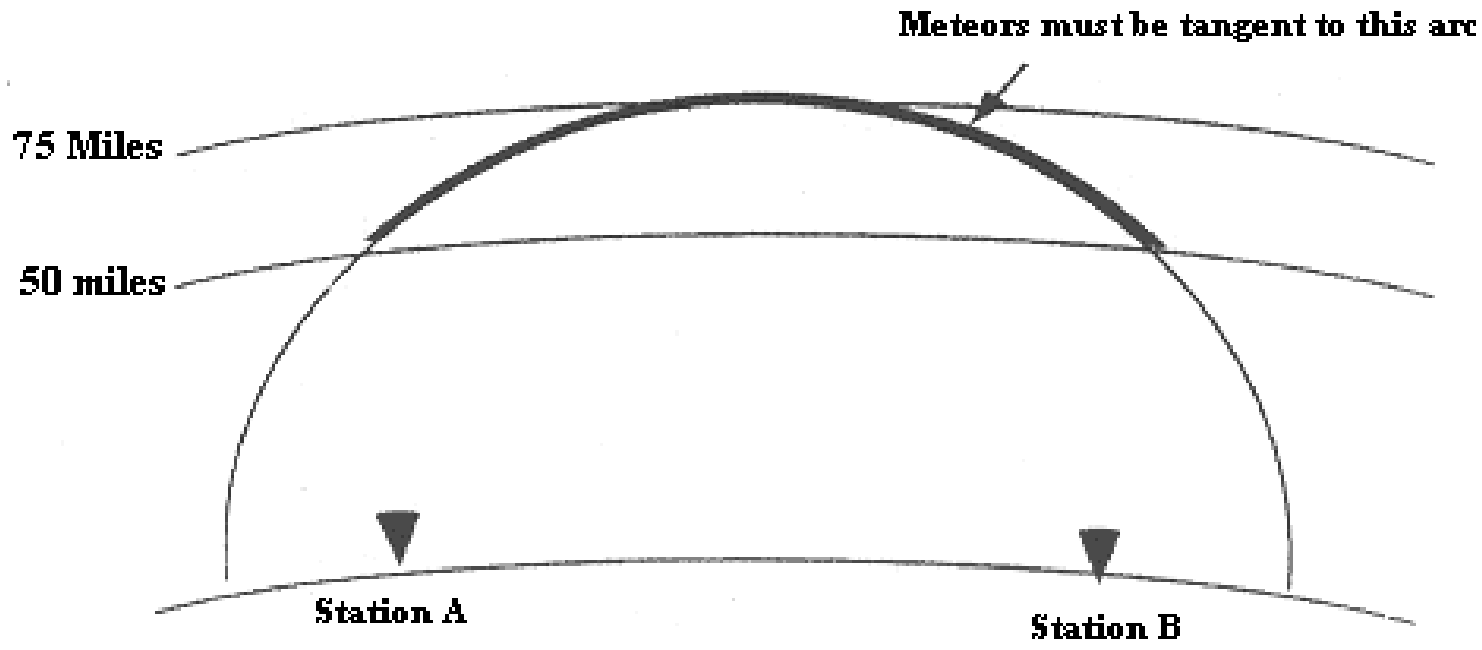
- The length of time of the ionization, or burst duration, is related to meteor velocity and increase in relative velocity results in longer ionization times.

# Meteor Scatter

- Most particles entering the earth's atmosphere are the size of a grain of sand resulting in ionization lasting only a fraction of a second
  - much too short to convey any meaningful information using SSB or even high speed CW.
- The digital modes of FSK441 and MSK144 were designed to compress a limited amount of information in a packet and transmit that packet in a very short period of time.
  - In the case of MSK144 the information packet, with a transmission length 0.072 seconds, is repeated over and over again during the duration of the selected transmit interval of 5, 10, 15 or 30 seconds.

# Meteor Scatter

Reflection will occur when the trail is oriented as shown



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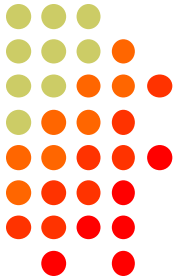
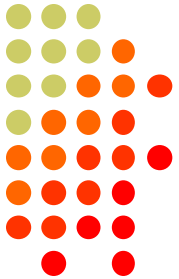


- Excellent for 50 MHz
- Very Predictable Paths
  - Best times between midnight & approx 9 AM
  - Peak during “showers” – Anytime with high speed procedures like ***WSJT***

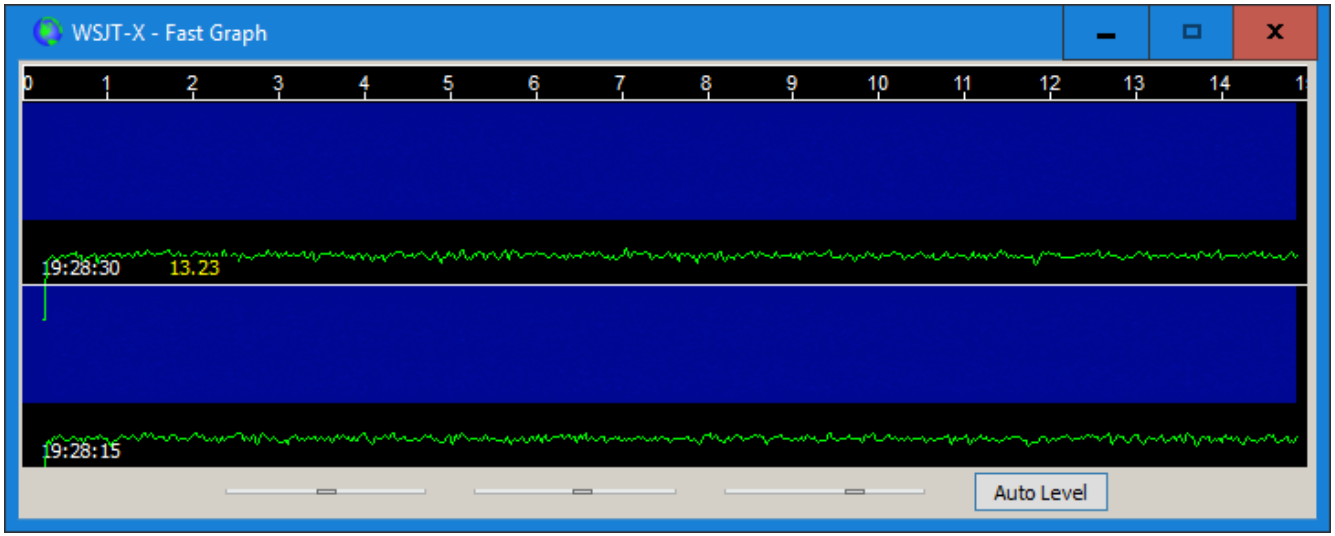
# Meteor Scatter



- Very Good for 144 MHz
- Very Predictable Paths
  - Best times between midnight & approx 9 AM
  - Peak during “showers” – Anytime with high speed procedures like ***WSJT***

# Meteor Scatter – MSK144

Signal display “Fast Graph”

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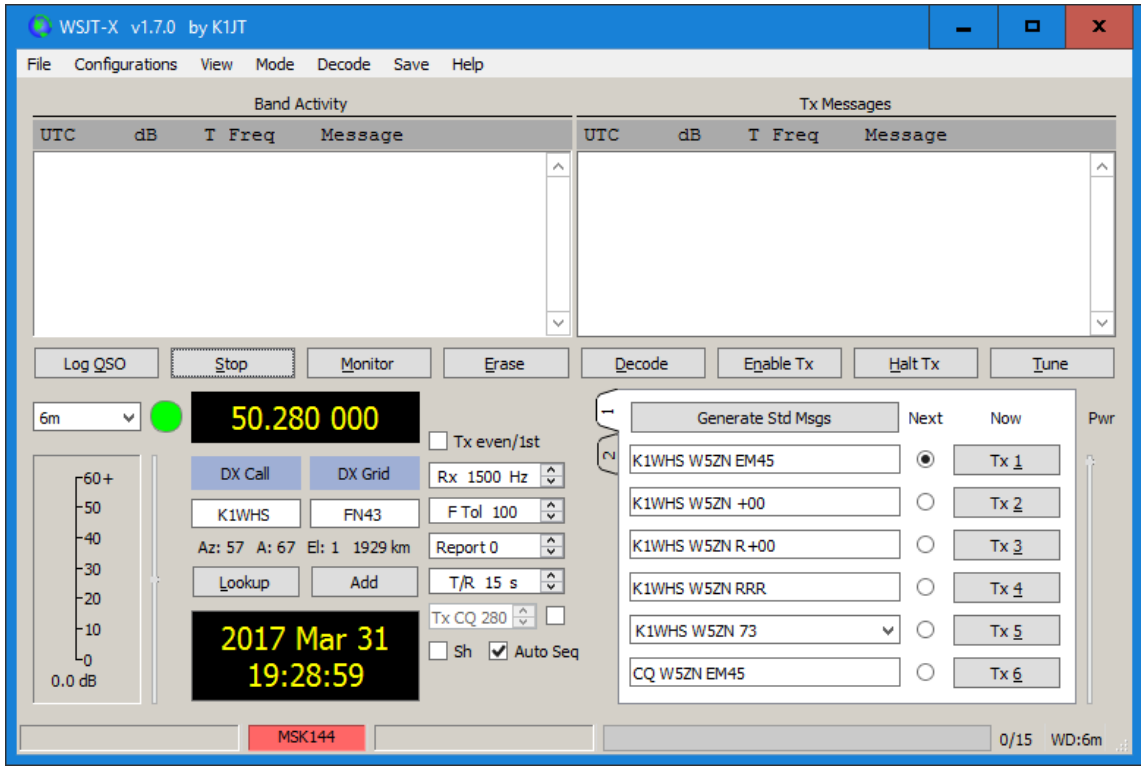
# Meteor Scatter – MSK144

## FSK441 Main Screen

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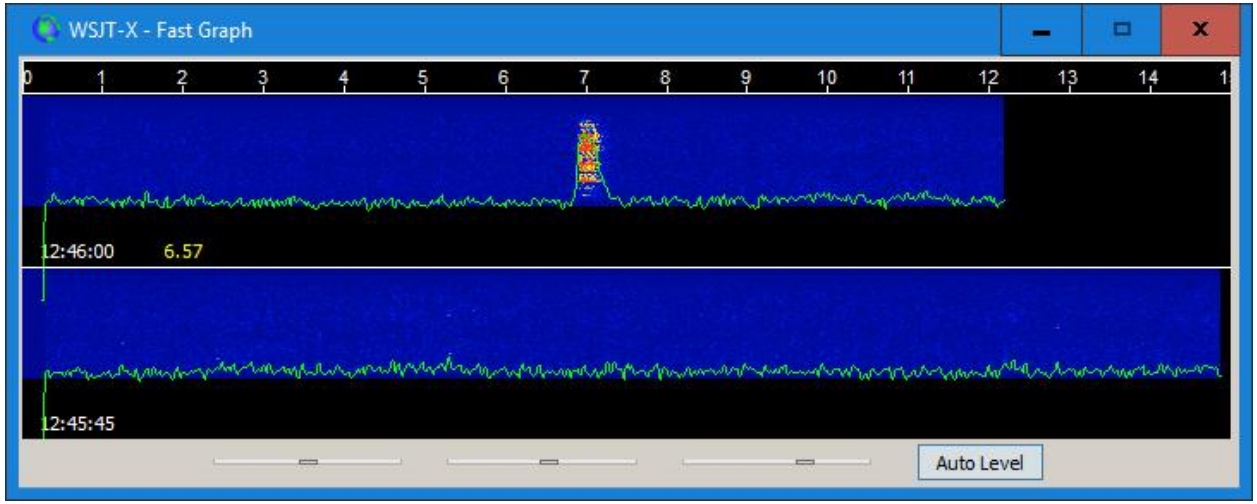
# Meteor Scatter – MSK144

Signal bursts appear in the “Fast Graph”



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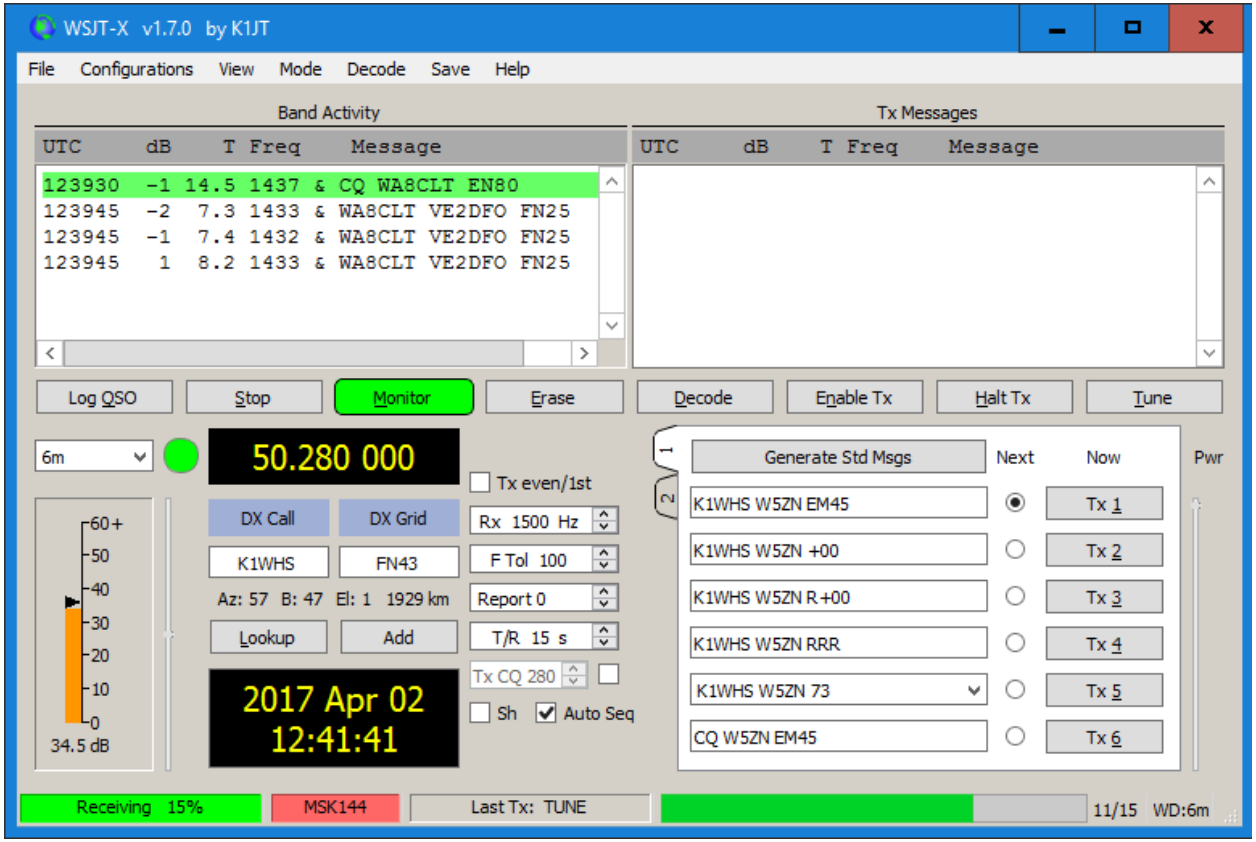


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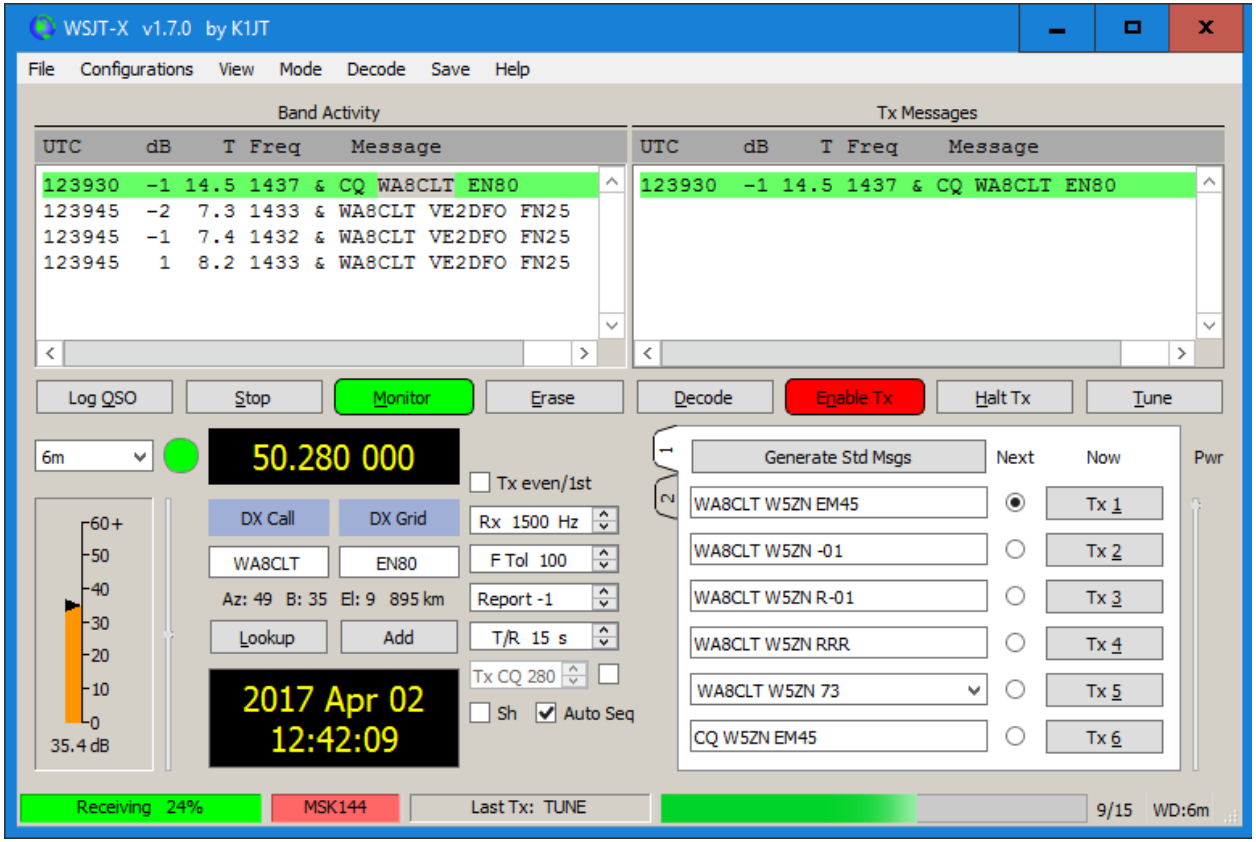


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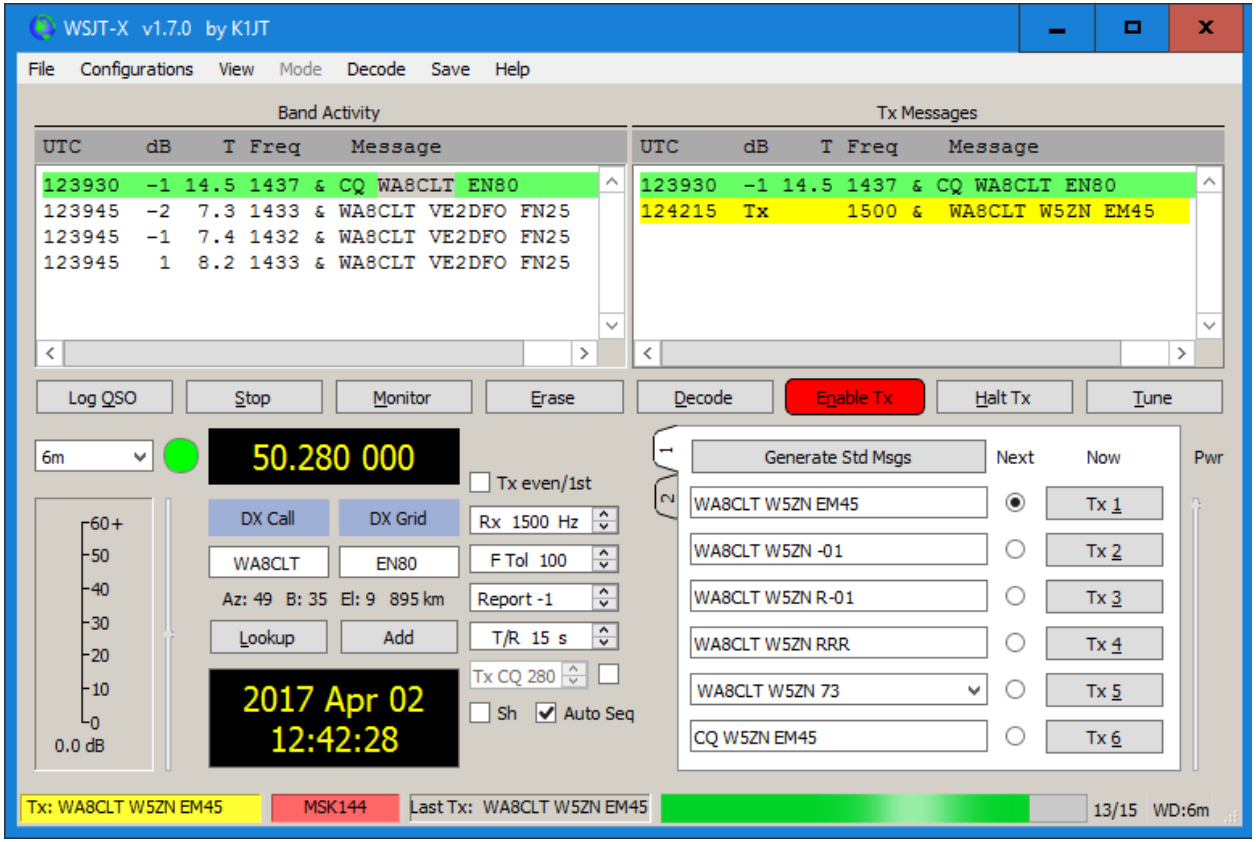


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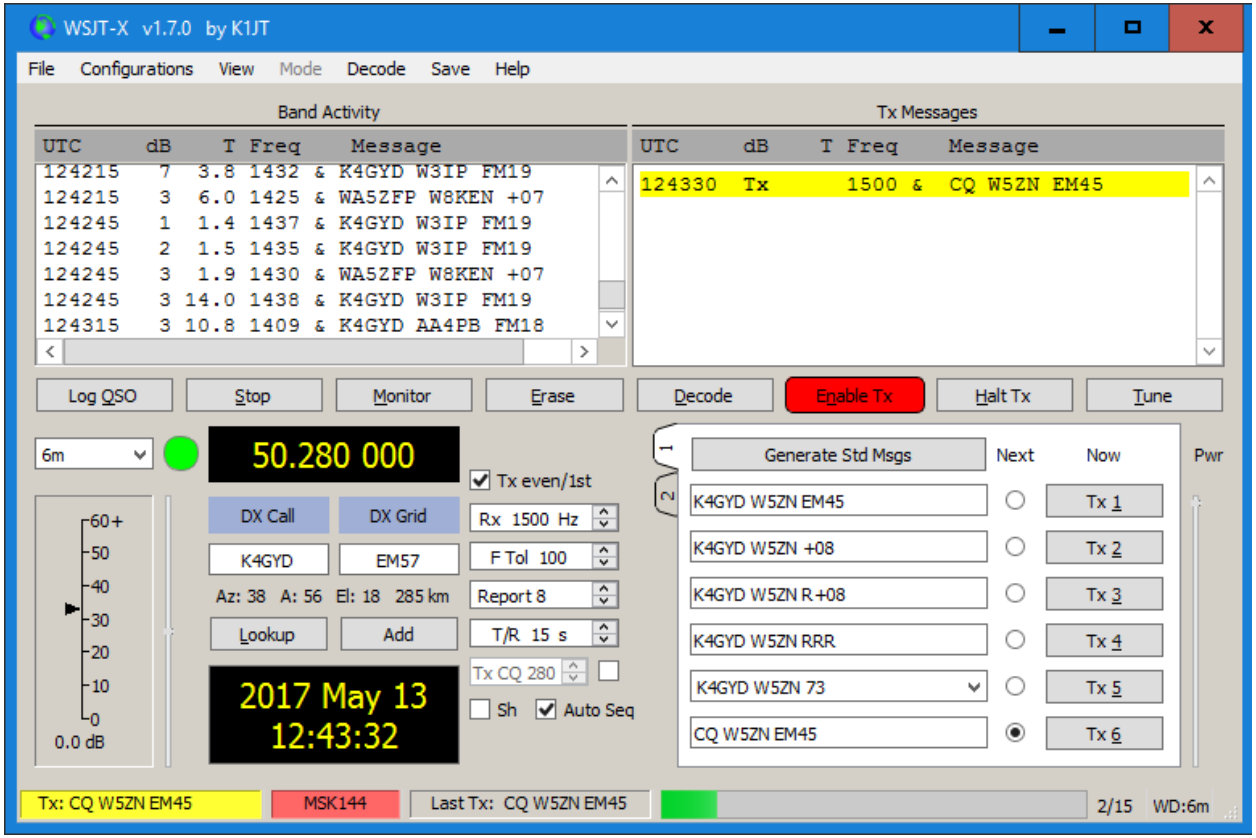


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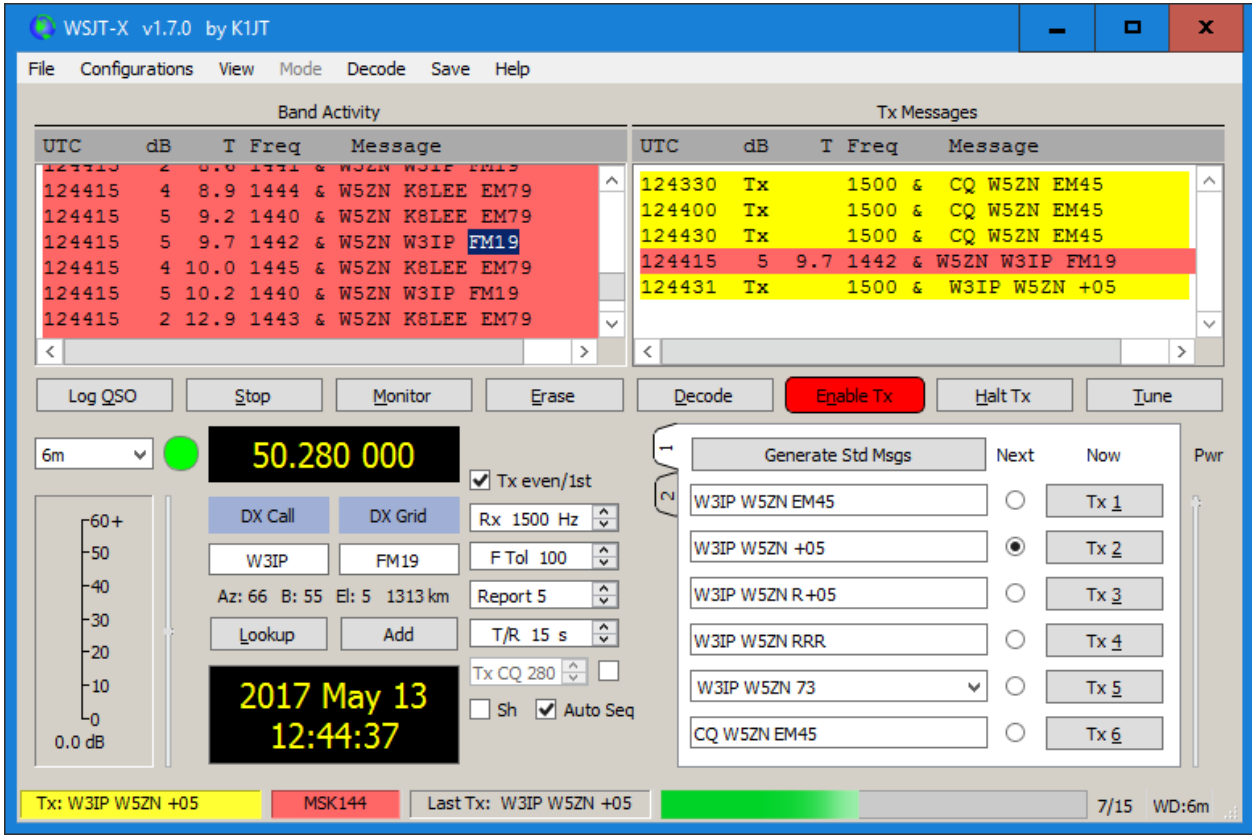


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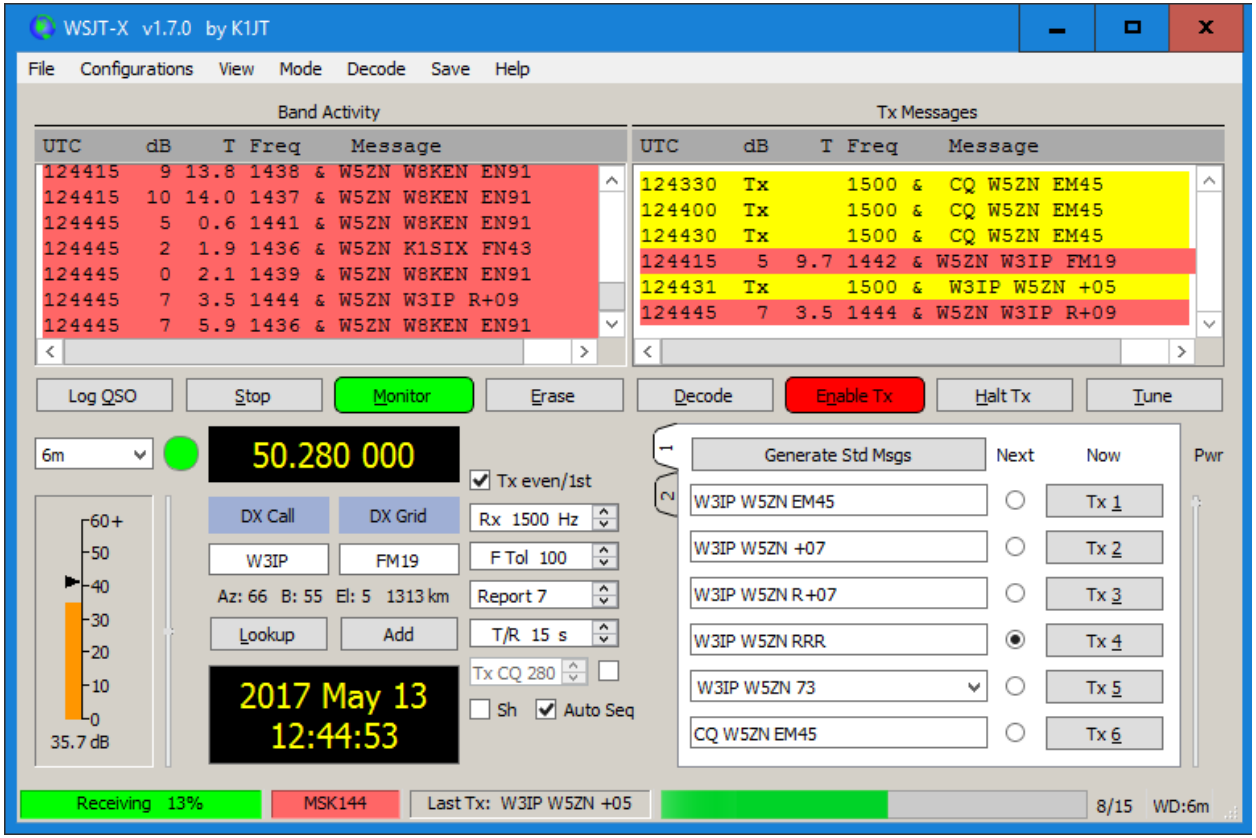


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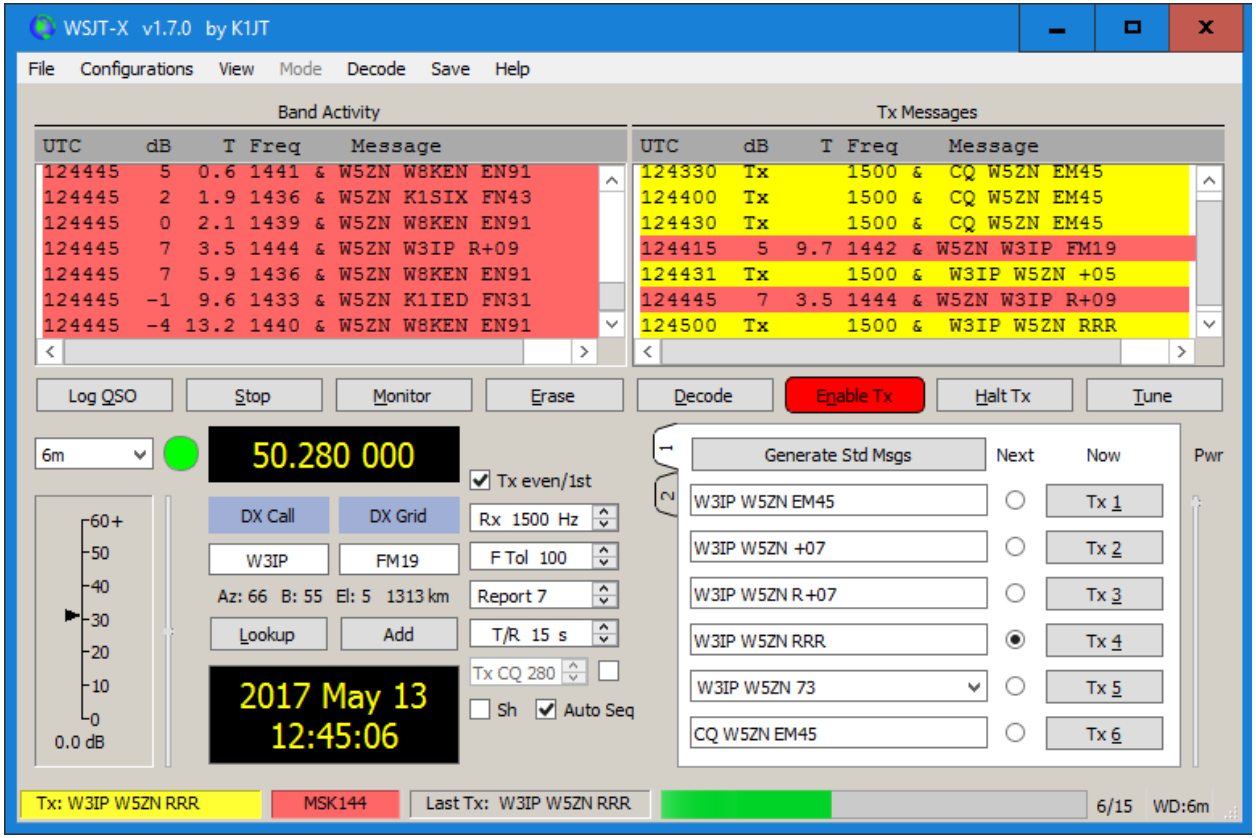


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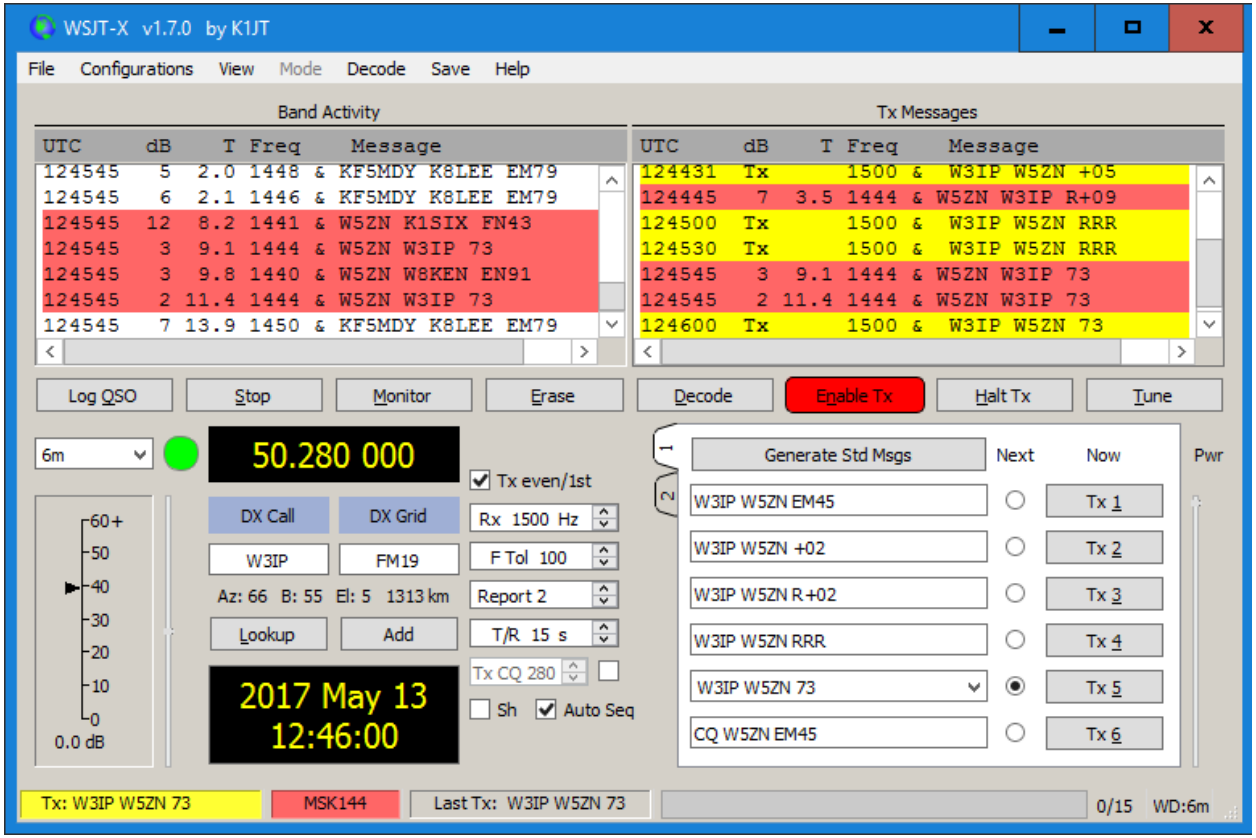


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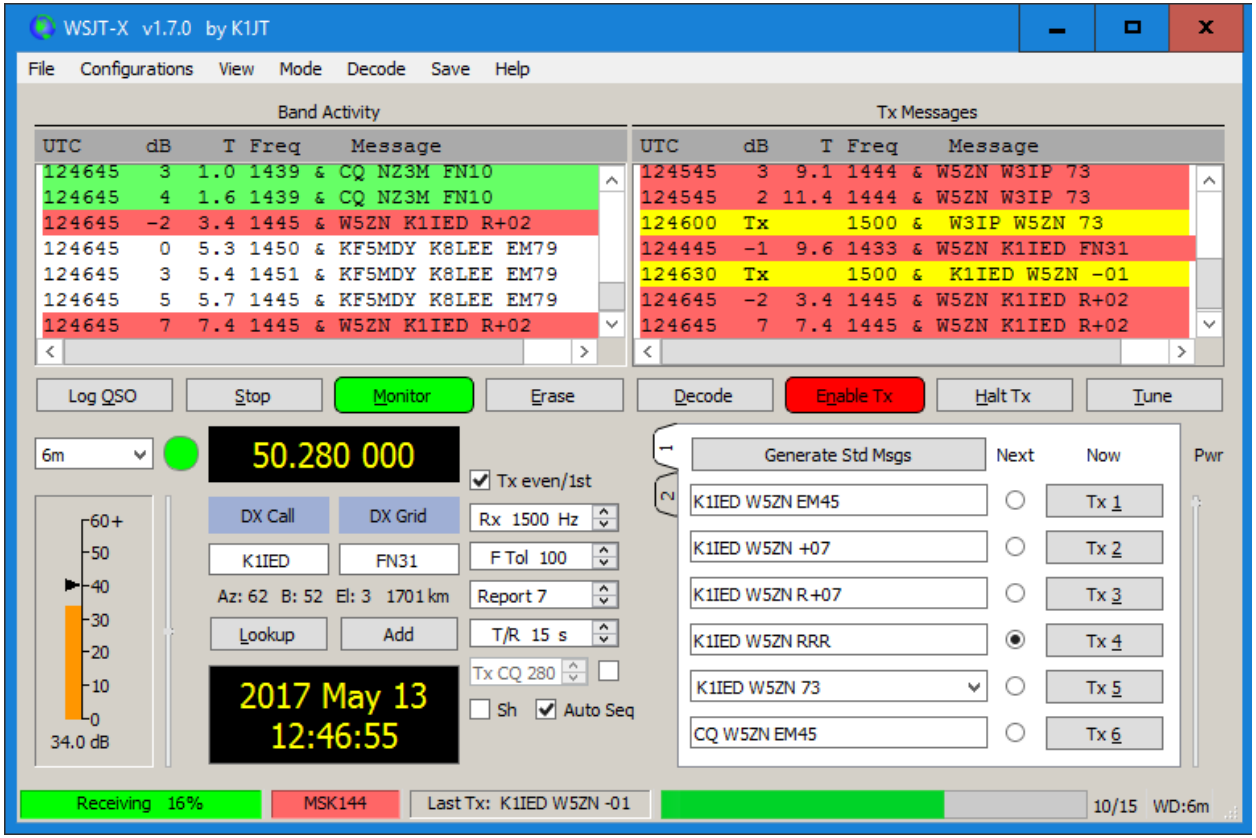


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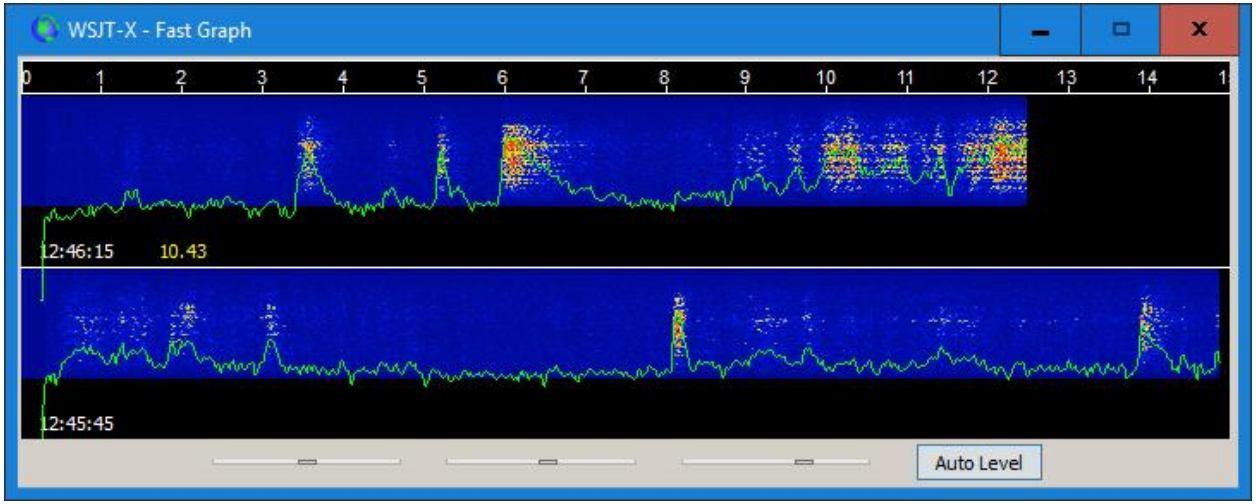


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# Meteor Scatter – MSK144

## K8ZR Test Results

- **Contest QSO Non-Contest QSO**
- **Tx Time:**
- 15 sec. CQ N8JX EN64
- 15 sec. N8JX K8ZR EN91
- 15 sec. K8ZR N8JX R EN64
- 15 sec. N8JX K8ZR RRR
- 15 sec. K8ZR N8JX 73
- Total time: 75 seconds

- **Non-Contest QSO**
- **Tx Time:**
- 15 sec. CQ WB4JWM EM83
- 15 sec. WB4JWM K8ZR EN91
- 15 sec. K8ZR WB4JWM +05
- 15 sec. WB4JWM K8ZR R+07
- 15 sec. K8ZR WB4JWM RRR
- 15 sec. WB4JWM K8ZR 73
- Total time: 90 seconds

# Meteor Scatter – MSK144

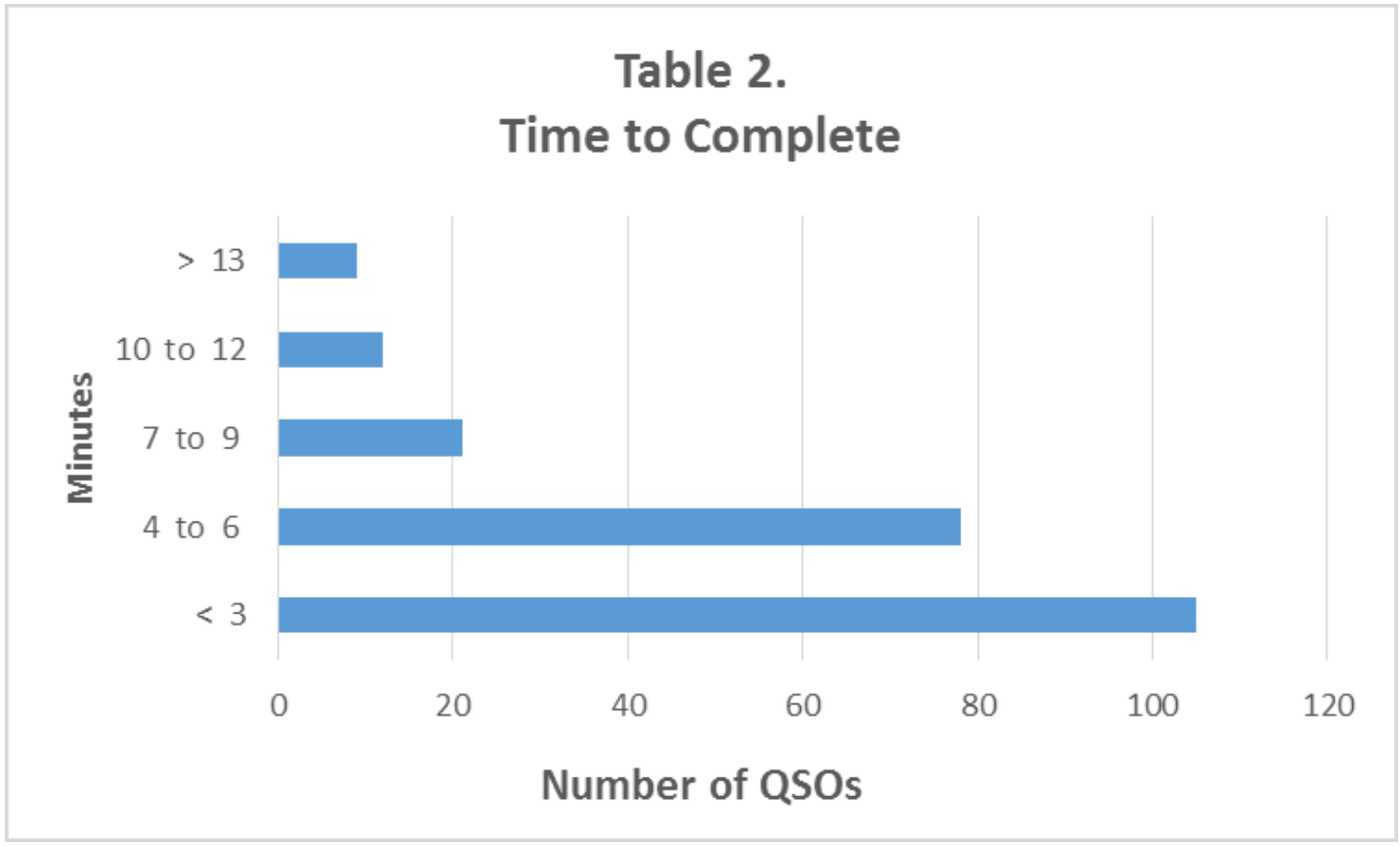
## K8ZR Test Results

50 MHz MSK144 QSO Summary

| | |
|---|---|
| Period January 23rd- March 13th: | 50 days |
| Number of 50 MHz MSK144 QSOs: | 225 |
| Average number of minutes to complete a QSO: | 4.6 |
| Number of unique callsigns worked: | 50 |
| Number of unique callsigns decoded: | 98 |
| Number of States worked: | 22 |
| Number of unique Grids worked: | 42 |
| Number of 90 second QSOs: | 10 |
| Best DX K5DOG EM00wh: | 1,223 miles |

# Meteor Scatter – MSK144

## K8ZR Test Results

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# FT4

- Designed for digital contesting
- Message formats same as FT8
  - Same low density parity check
- 2.5 times faster than FT8
  - TR sequences are 6 seconds –vs- 15 secs FT8
  - Message Length: FT4=4.48 secs  FT8=12.64 secs
- Occupies a 90 Hz bandwidth
- Slightly less sensitive than FT8
  - 10 dB better than RTTY and uses less bandwidth

# FT4

- **Does not require accurate time**
  - **Can occur during any time sequence**
- **Modulation uses 4-tone frequency-shift keying**
  - **Approx.  23.4 baud, with tones separated by the baud rate**
- ***STILL IN DEVELOPMENT!!!!!!***

# WSJT-X 2.0 Modes

Or During the 3:15 PM Digital Contesting Discussion in this room

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