FT8 - DXing in the Real World

Practical Operating Techniques for DX Success

Presentation to Rowan ARS – Apr. 2026

AI2F, Christopher Krstanovic, PhD – Member ARRL, RARS, CARS

Presentation for all License Classes

Agenda

FT8/4 is NOT Killing Amateur Radio

- ✓ Mimic DX or Contest Exchanges
- ✓ RF propagation, technical knowledge, experimentation, and communication
- ✓ Core elements of amateur radio

Presentation Content:

1. FT8 Background and how to use it - AI2F
2. FT8 Setup, Equipment and details - KR4DRH
3. Live Demonstration – 40m

- What is FT8? Description and Properties
- How FT8 Works and Implementation
- How to use FT8 for DXing
- POWER, AGC, Audio etc.
- Antenna Choices
- Reading the Bands
- Software, Software, Software…
- Situational Awareness in DX Environment
- Bands, Propagation and GrayLine Matters
- Great Expectations
- Questions and Discussion

AI2F

INTRODUCTION

- Digital communication mode.
- FT8 was designed *specifically* for weak-signal, long-distance communication
- Only the most basic info is exchanged – call, report & grid square
- FT8 is a pure DX animal!
- Most basic setup: Sound card to Rig Mic and Phones

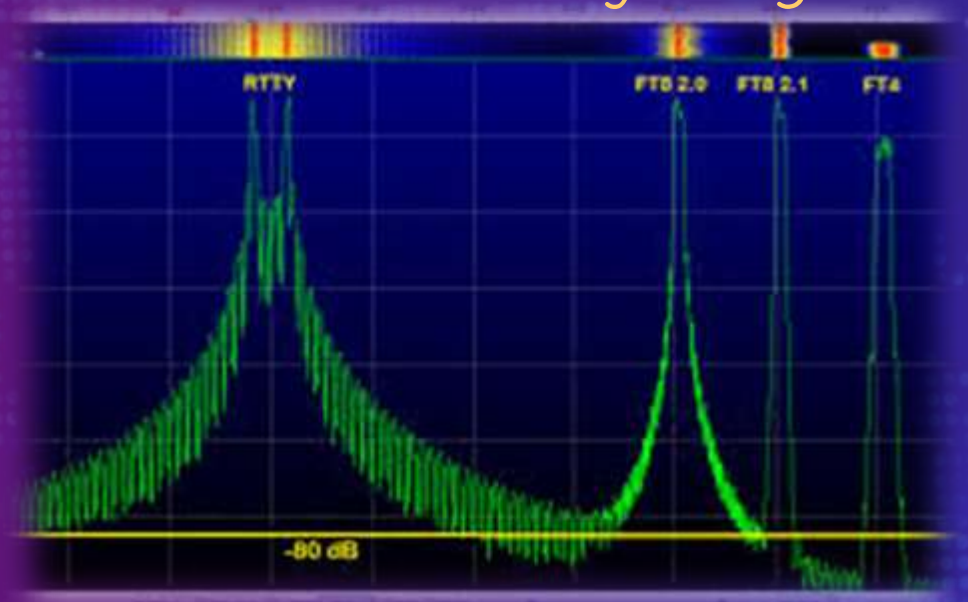
Optimized for:

Very low signal-to-noise ratios
Long-haul ionospheric paths
Marginal and closing band conditions

FT8 is not a general-purpose digital mode

1. Think of FT8 as a *DX instrument*, not a rag-chew mode
2. FT8 enables DX when SSB and often even CW fail
3. It shifts emphasis from voice or fist to precision and discipline

FT8 Is a DX Tool by Design

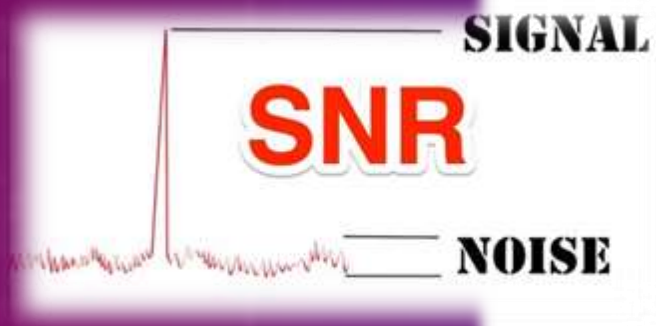


What FT8 Is (and What It Is Not)

Weak-signal digital mode designed for *reliable decoding*, not conversation

1. Mainstream digital modulation mode
2. Usually completes a QSO in 90 seconds
3. 4 times faster than JT65 or JT9
4. 8-FSK, Constant-envelope waveform

FT8 does *not* replace good operating skills



Weak-Signal Signal/Noise Ratio

SSB	+10 dB
CW	-15 dB *---CW Note**
FT8	-21 dB
JT65	-25 dB
JT9	-27 dB
WSPR	-31 dB

* 2500 Hz bandwidth

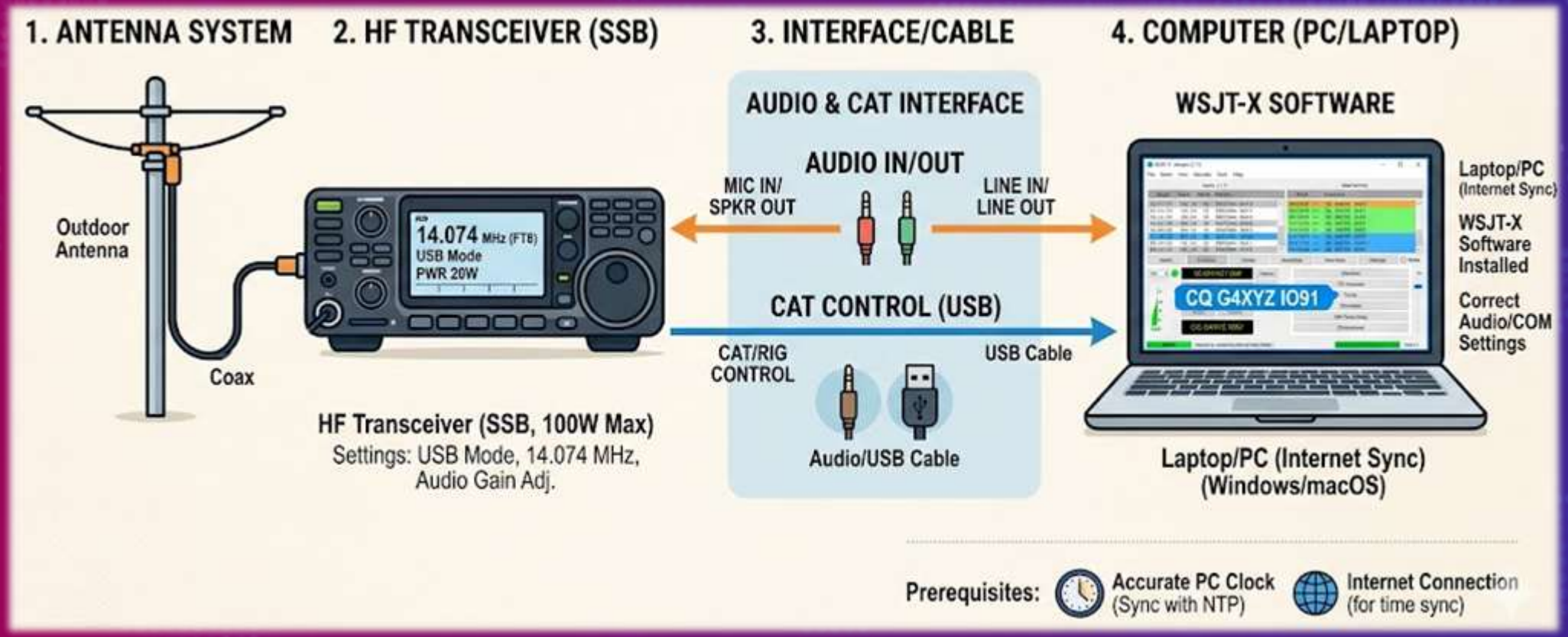
Doubling power results in a 3 dB increase in SNR
31dB difference is about 2^10 = 1,024
1W FT8 vs 1,024W SSB

Optimized for:

- ✓ Low SNR paths
- ✓ Modest antennas
- ✓ Urban noise environments

MOST BASIC SETUP

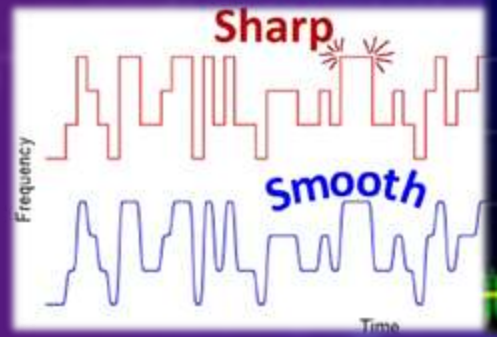
You probably already have everything you need:

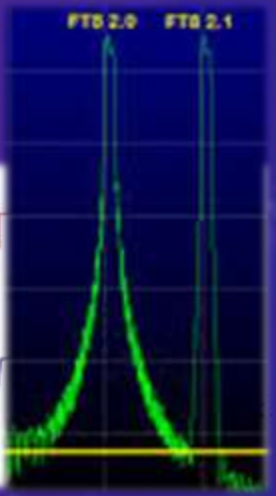


How and Why FT8 Works

Operating Principles

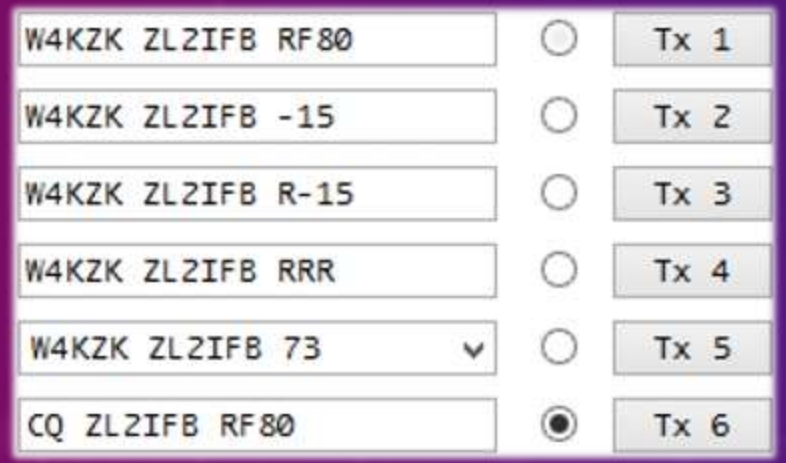
1. Transmission is only 50Hz wide, in a precisely crafted envelope.
2. FT8 does not simply encode and transmit messages character-by-character (like CW, RTTY…)
3. The entire message is encoded first, *as a block*, compressed to 77 bits and sent.
4. Each message is sent along with error correction and takes 12.6s.
5. 77 bits imposes a constraint how much can be sent in a message.
6. Messages are sent in 15s, precisely timed slots.
7. 4 slots per minute: Odd and Even slots.





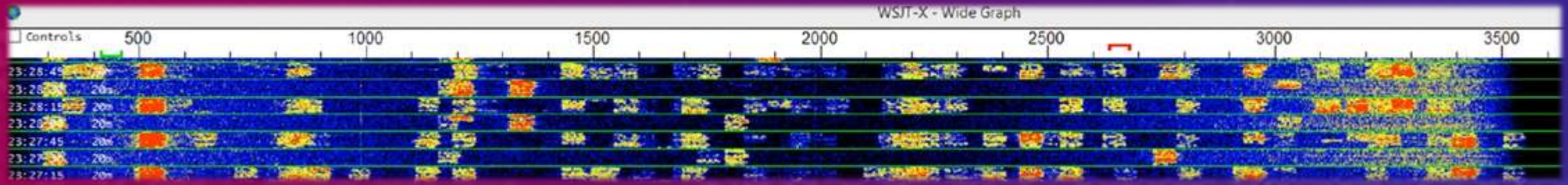
What is exchanged:

- ✓ Call Signs
- ✓ SNR Reports
- ✓ Grid Square (4 chr)
- ✓ 73s



FT8 Implementation

FT8 is transmitted in a single 50Hz slot in ~3500Hz wide designated blocks. Each block has ~2 x 64 slots



- FT8/4 blocks are located at pre-determined frequencies on each band.
- Special events may designate their own frequencies (DXpeditions etc.)
- Always transmitted USB, irrespective of the band!
- Split operation is preferred by most FT8 DXers.
- Even and odd periods are orthogonal and should be considered separately.

FT8	FT4
1.84	None
3.573	3.575
5.357	None
7.074	7.0475
10.136	10.14
14.074	14.08
18.1	18.104
21.074	21.14
24.915	24.919
Tech License ==> 28.074	28.18

SNR vs. Signal Strength Explained

We are used to thinking in terms of Signal Strength (S-Units)

- Why? Intuitive: strong signal will have a good SNR
- FT8/4 Reporting is SNR based, not S-units!
- Identical stations can report different SNRs due to differing noise floors.

Consider the following example:

- The signal strengths are equal at both ends
- The noise background is not!
- Thus the SNR will be different at two ends

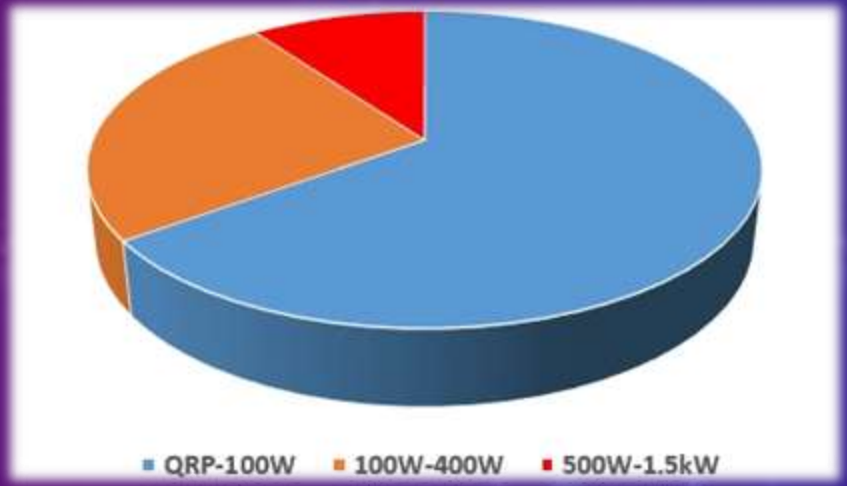
Easy Decode (SNR=-12db) No Decode (SNR<-24db)

SNR (db)	Type	QSO Probability	Comment
> -5db	Very Strong	100%	*Certain QSO*
-5db to -10db	Strong	100%	*Certain QSO*
-10db to -15db	Moderate	80%	*Good chance for QSO*
-15db to -18db	Weak	50%	*Decent chance of a QSO*
< -18db	Very Weak	25%	*Possible, but iffy - depends on his conditions*

Weak Signal Does *Not* Mean Low Power

"Weak signal" refers to received signal at the DX station, not transmitter output

FT8 does *not* mean QRP or Low Power!!!



Many successful DX stations run:

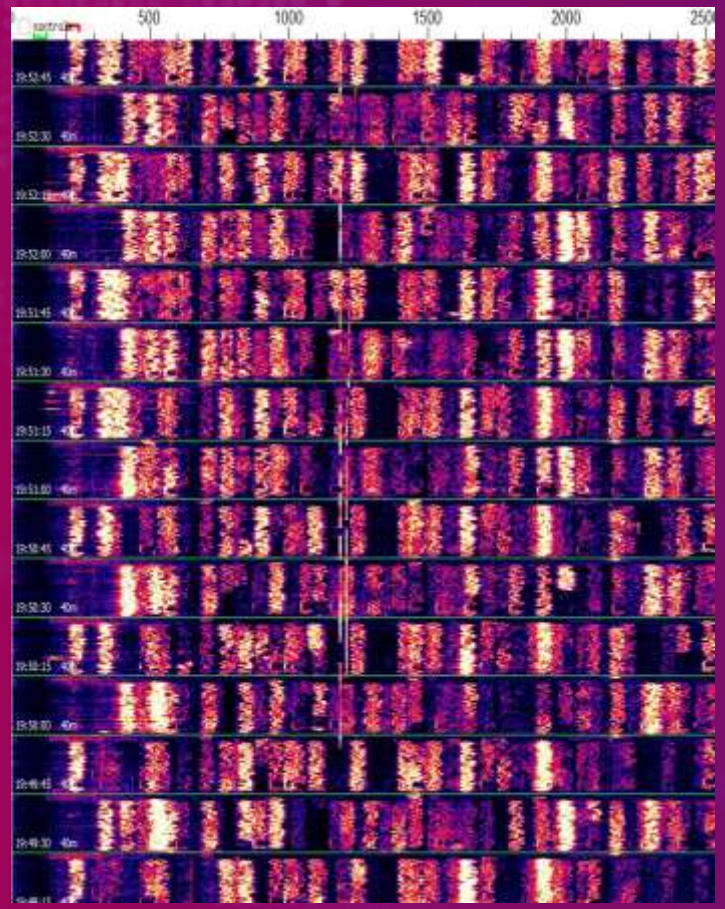
- High Power
- High-gain antennas

FT8 simply allows *decoding of signals that would otherwise be unusable*

Key point:

- Power (ERP) helps – *after* signal quality, timing, and frequency discipline

DX Reality Check



FT8 doesn't make DX "easy"

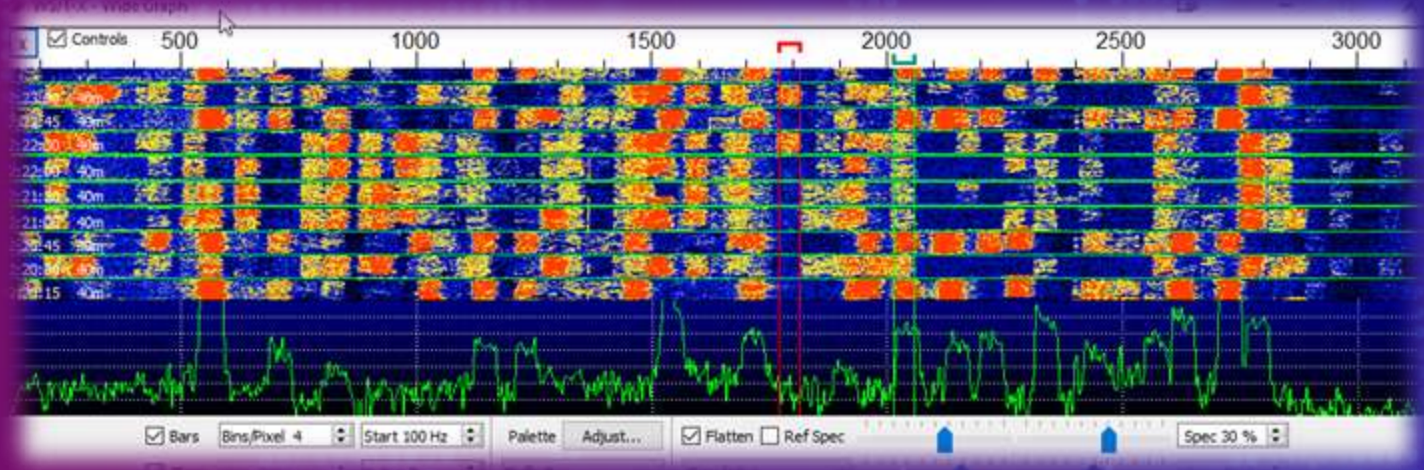
It makes it possible when otherwise impossible

- DX stations hear many callers!
- Decoding does *not* mean being heard
- Smart slot selection beats calling on the "loud pile"
- Watching the DX operator's pattern improves success (his noise situation)
- Skillful calling beats brute force… but force and antenna does help!

Listen First - Finding Your Transmit Slot

- Successful FT8 DX starts with *listening*, not transmitting
- Watch the waterfall to identify open transmit slots
- Make sure slot is open for your transmission!
- Last resort: squeeze between two adjacent slots – look for biggest gap
- In pileup, observe other station's TX frequencies
  - Those slots will likely be available when they are done
- Avoid calling on top of ongoing QSOs
- Free slots can:
  - Appear and disappear quickly
  - Change as pileups shift
  - If they don't respond - change the slot

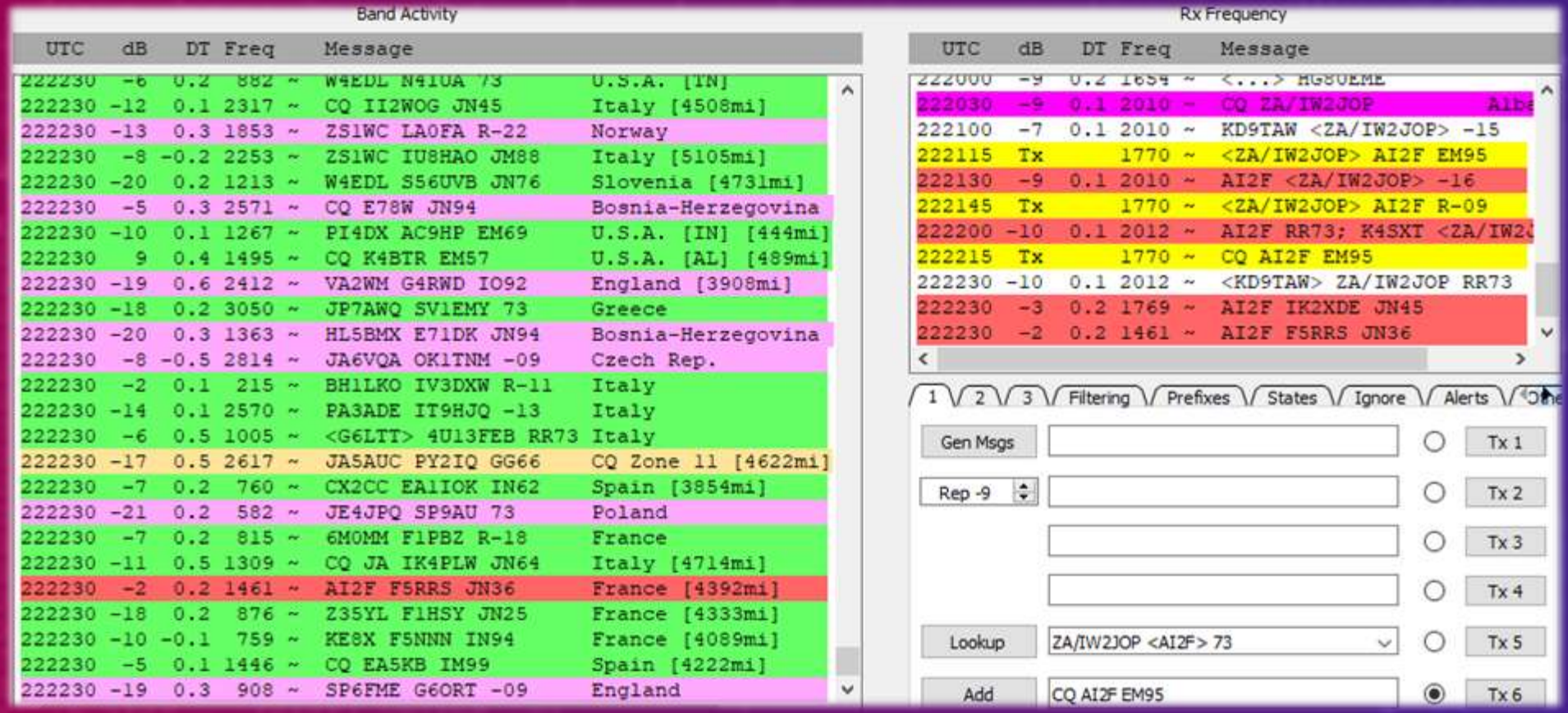
➢ Re-check slot availability often!



Operating reality:

The best FT8 operators spend more time *observing* than transmitting

How to Answer DX Correctly



- Observe first – find TX slot!
- Call and listen
- Know when to stop calling

. . . . . CQ DX . . . . . CQ DX . . . . .

How ***Not*** to Answer DX

- Don’t reply immediately without checking for TX slot
  - Yeah, I know it is hard…
- On his TX frequency (same slot).
- Pileup: Failing to watch before transmitting
  - The best DXers will watch a pileup for a few minutes before clicking anything
- Ignoring DX instructions
  - If the DX calls "CQ AF“, “CQ NONA” or “CQ NOUS” DON'T answer it. It is considered rude!
- Calling when DX is answering someone else

How to Call CQ (DX)

. . . . . CQ DX . . . . . CQ DX . . . . .

- Observe first least a couple of cycles – find a clear TX slot!
- If you are having trouble from a station, it helps to synchronize to his TX
- Call and listen
- Know when to stop calling… and change your slot!
- Be specific:

  CQ AI2F EQ95

  CQ DX AI2F EQ95

  CQ ASIA AI2F EQ95 or CQ ASAF AI2F EQ95

  CQ IOTA/SOTA/POTA AI2F EQ95 – Indicating your condition

  CQ VKZL AI2F EQ95 – Specific Inclusions

  CQ NONA/NOUS/NOEU AI2F EQ95 – Specific Exclusion – Very Effective!

- Look at the answering stations and decide who to answer.
- Getting "73" at the end is a nice confirmation, but not strictly necessary.

POWER – is good, but…

FT8 favors linearity; overdrive reduces decode probability!

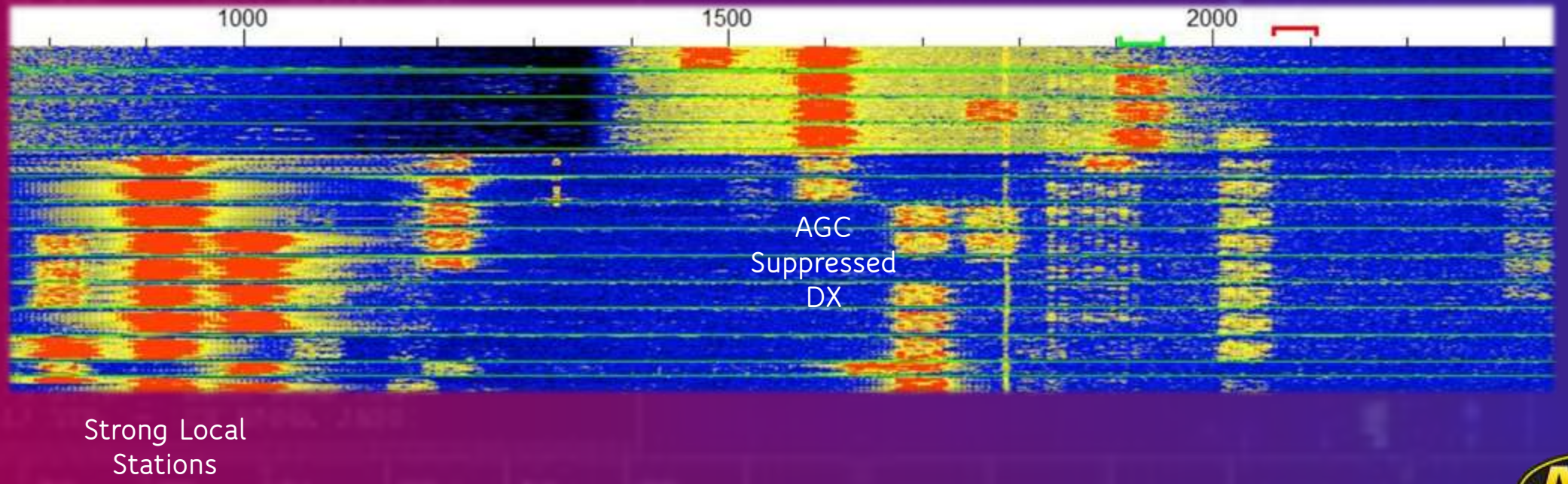
- Overdriven signals reduce decode probability!
- Power helps (a lot)–but only after:
  - ✓ Clean Audio
  - ✓ Proper ALC Behavior
- However, the fact is - ERP helps. Example:
  - 600W/Yagi vs. 30W/EFHW = ~18db delta!
  - SNR Difference: -8db vs. -25db

FT8's high duty cycle puts sustained stress on transmitter finals, so reduce power for long runs (1/3rd Rule):

- Limit a 100W Rig to about 30-40W on prolonged FT8 and monitor finals temperature.
- Limit a 1500W Amp to about 400-600W on prolonged FT8 and increase blower speed if possible.

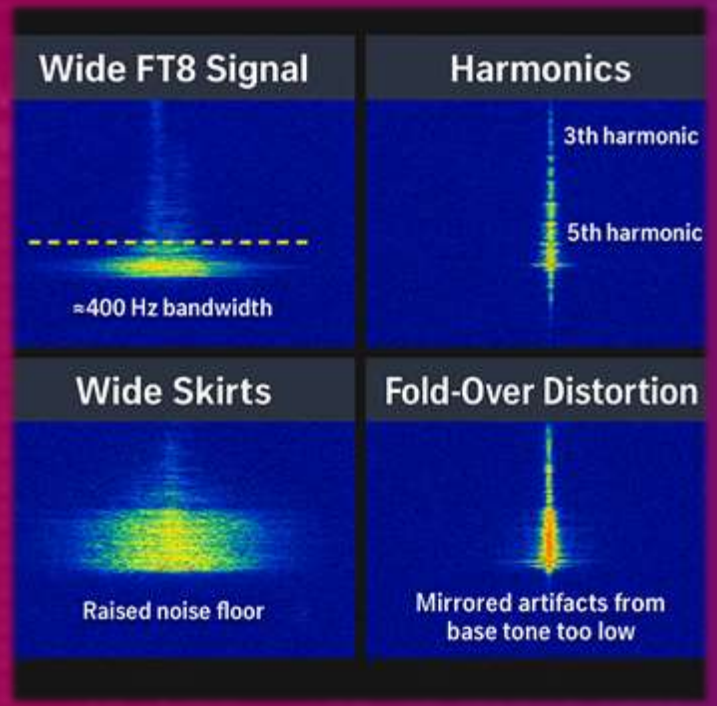
AGC and Filtering

- ✓AGC ideally OFF, but in reality best to use Fast or Medium unless your RX Dynamic range is really, really good. Why?
- ✓AGC Settings: Rig dependent, but for most use AGC, unless the band is very quiet.
- ✓Filtering can help remove strong stations. Notch is very useful.



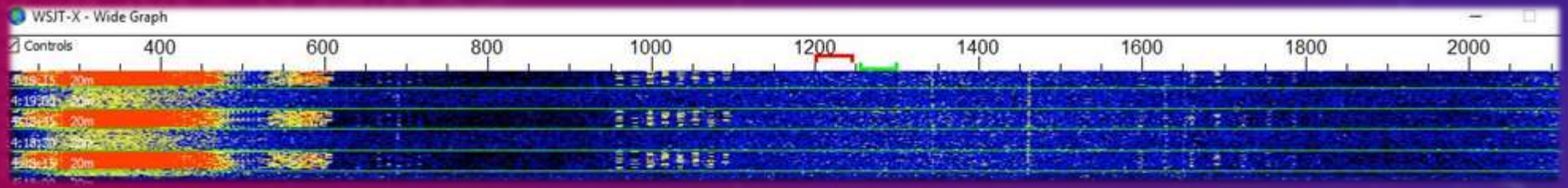
Audio Chain Discipline

Set levels once, then leave them alone!



- ✓TX: No compression, audio processing or DSP
- ✓RX: Turn off Noise Blanker and NR

- ➢On some rigs, the ALC meter is, in effect, a distortion meter
- ➢Watch ALC like a hawk
- ➢Some OMs do report good results with the rig's DSP NR



Wide and Raised Noise Floor

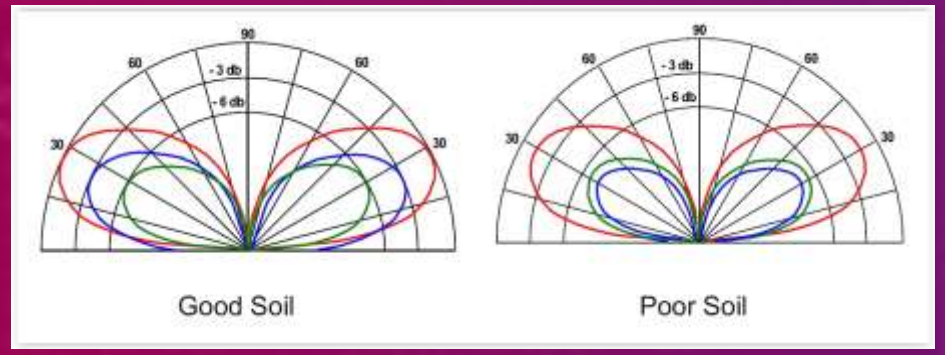
3rd Harmonic

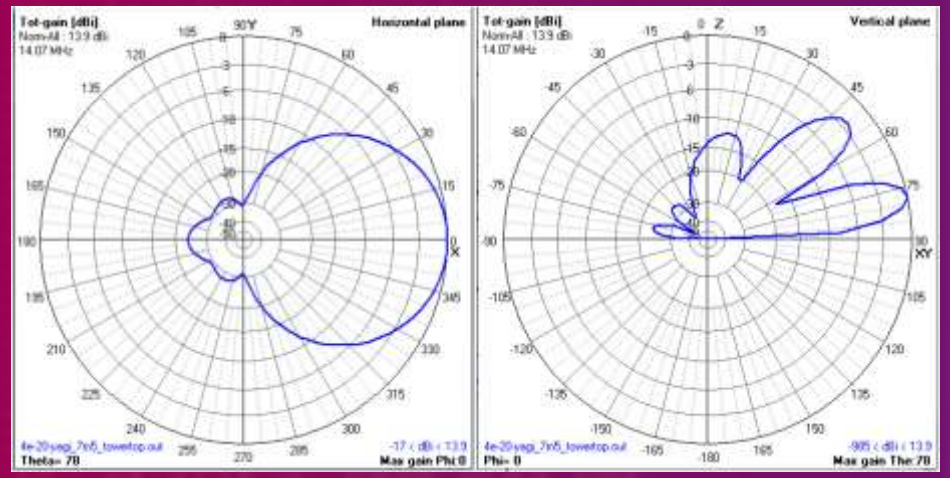
5th Harmonic

Things to Watch Out For:

- ✓Microphone! The Cough Gauge…
- ✓Computer Audio – don't TX: PC mic, announcements, Youtube, PC dongs etc.
- ✓Monitor your TX if possible to hear what is going out.
- ✓Make sure your clock is synced to UTC – 0.5s or better.
- ✓Transmitting at 100% duty cycle for 15 seconds may cook your finals. Check TRX manual.

Antenna Choices





- Dipoles (and Derivatives):
  - Need Height for best DX (>0.5 wave)!
  - Excellent DX when propagation cooperates
  - Weak at 90 degrees – orientation matters
- Verticals:
  - Strong low-angle radiation – DX
  - Omnidirectional & low gain
  - Susceptible to noise
- Beams:
  - Directionality & Gain help a lot

Height and location ALWAYS matter!

Software Stack

- Base Software (and Derivatives):
  - WSJT-X, WSJT-Z, WSJT-Improved
  - JTDX: Variant with helpful UI tweaks + GridTracker Features
  - MSHV: Make several QSOs in parallel (DXpeditions)
- Helper Applications:
  - GridTracker2
  - JTAlert
  - PSK Reporter (web browser)
  - MacLoggerDX / RUMlogNG
- Loggers:
  - Too many to list: Log4OM, N1MM, DX Lab Suite, *Ham Radio Deluxe, N3FJP*

Situational Awareness in DX Environment

Callsign	dB ▼	Calling	DXCC	State	Freq	Grid	LoTW	eQSL	OQRS	Age	Life	CQz	Cont	ITUz	Dist (mi)	DT
EA1DR	-1	CQ	Spain		1974	IN82	✓	✓		56s	3m 52s	14	EU	37	4034	0.10
F1PBZ	-1	JE4JPQ	France		807					26s	26s	14	EU	27		0.20
MØILT	-1	CQ	England		1570	IO80	✓	✓		1m 56s	3m 56s	14	EU	27	3854	0.10
EA5KB	-2	CQ	Spain		1441	IM99	✓	✓		26s	3m 53s	14	EU	37	4211	0.10
F6HRP	-3	CQ	France		1907	IN88	✓	✓		26s	1m 55s	14	EU	27	3895	0.40
F5RRS	-4	BI6PWL	France		1455	JN36	✓	✓		24s	3m 40s	14	EU	27	4380	0.20
ZA/IW2JOP	-5	RR73	Albania		2007		✓	✓		55s	3m 51s	15	EU	28		0.10
F5NNN	-5	M9NED	France		753	IN94	✓	✓		23s	3m 53s	14	EU	27	4077	-0.10
IU8HAO	-5	ZS1WC	Italy		2799	JM88	✓	✓	✓	26s	1m 23s	15	EU	28	5092	0.00
G8TJQ	-6	CQ	England		1826	IO90	✓	✓		56s	3m 56s	14	EU	27	3938	-0.20
E78W	-7	CQ	Bosnia-Herzegovina		2594	JN94	✓	✓		25s	1m 56s	15	EU	28	4955	0.30
OK1TNM	-7	CQ	Czech Republic		2810	JO70	✓	✓		24s	3m 52s	15	EU	28	4585	-0.50
SP5AA	-8	K5EK	Poland		1887	JO92	✓	✓		24s	1m 25s	15	EU	28	4669	0.10
HA1BF	-8	JH2XJV	Hungary		1419	JN86				23s	2m 22s	15	EU	28	4800	0.20
IIZWOG	-9	LY5J	Italy		2312					56s	3m 53s	15	EU	28		0.10
F5RAV	-9	HL5BMX	France		1083	JN09	✓	✓		1m 55s	3m 53s	14	EU	27	4045	0.00
ZV8PI	-10	CQ	Brazil		1002	GI84				56s	2m 56s	11	SA	13	3741	0.20
G6PWY	-10	N2XK	England		2602	IO94	✓	✓		24s	3m 53s	14	EU	27	3860	0.20
IU1UIC	-11	RR73	Italy		401		✓			56s	1m 23s	15	EU	28		0.10
DL9KM	-12	JE4JPQ	Germany		1358	JN68	✓	✓		24s	24s	14	EU	28	4570	0.10
LAØFA	-13	ZS1WC	Norway		2225	JO59	✓	✓		25s	1m 55s	14	EU	18	4181	0.30
IK4PLW	-13	CQ JA	Italy		1304	JN64	✓		✓	1m 24s	3m 55s	15	EU	28	4701	0.40
OM3LU	-14	CQ	Slovak Republic		2761	JN88	✓			24s	3m 52s	15	EU	28	4731	0.30
F5MXH	-15	BI6PWL	France		2217	JN07	✓	✓	✓	24s	3m 52s	14	EU	27	4092	0.20
DB8WK	-18	CQ	Germany		568	JO33	✓	✓		55s	3m 52s	14	EU	28	4190	0.70
IZØCKM	-19	SP9PLK	Italy		978			✓		25s	25s	15	EU	28		0.10
PD4SN	-19	AI2F	Netherlands		928					56s	56s	14	EU	27		0.20
EK/RX3DPK	-20	RR73	Armenia		1102		✓		✓	23s	23s	21	AS	29		0.10
HB9FAP	-20	EA9ABC	Switzerland		2066		✓	✓		26s	26s	14	EU	28		0.20
HG2DX	-20	JE4JPQ	Hungary		2938		✓	✓	✓	26s	26s	15	EU	28		0.20
PA3KUS	-20	JA6VQA	Netherlands		879	JO21	✓			55s	55s	14	EU	27	4161	0.50
OE9GWV	-21	EA8J	Austria		2664		✓	✓		25s	25s	15	EU	28		0.10
S56UVB	-21	I1APQ	Slovenia		1834	JN76	✓	✓	✓	1m 22s	3m 52s	15	EU	28	4718	0.20
MØIEP	-21	IK4LZH	England		759	IO91	✓	✓		1m 25s	3m 52s	14	EU	27	3917	0.10
IT9HJQ	-24	JL3OUW	Italy		2563					1m 24s	1m 24s	15	EU	28		0.10
LZ4VR	-24	JP7AWQ	Bulgaria		1051	KN13	✓			1m 24s	1m 24s	20	EU	28	5159	0.10

AI2F

Reading the Bands

- Who and where is DX?
- Where is *your* signal decoded?
- Do I need it?

Use companion tools to visualize activity

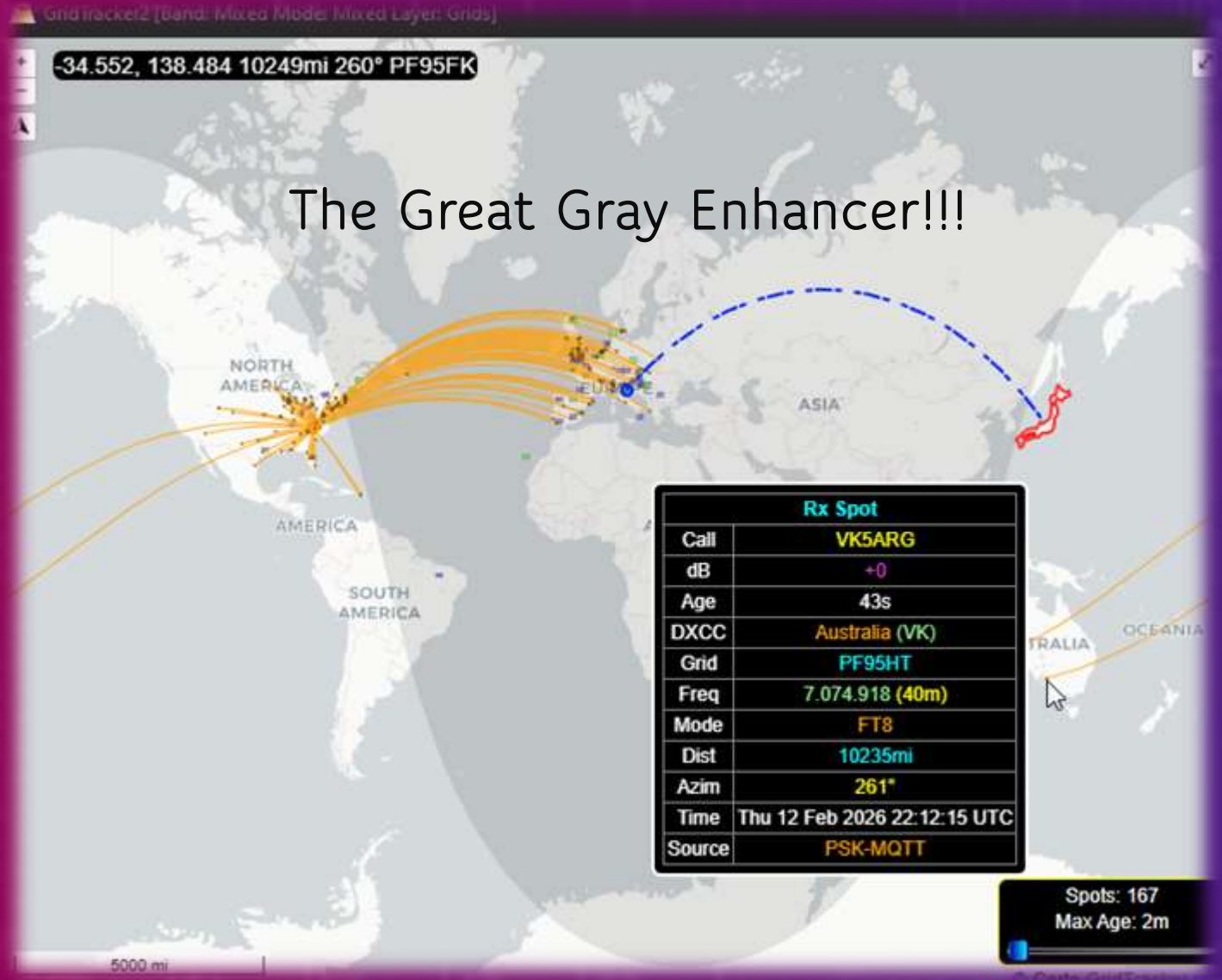
GridTracker Companion Software:

- Real-time map of stations you are working and hearing, and how they may hear you!
- Highlights DX entities, grids, and band activity
- Keeps track of stations, countries, continents worked/confirmed for awards.
- Excellent situational awareness during pileups
- Helps confirm propagation direction and timing
- Understanding FT8 DX pileups

- Key point:

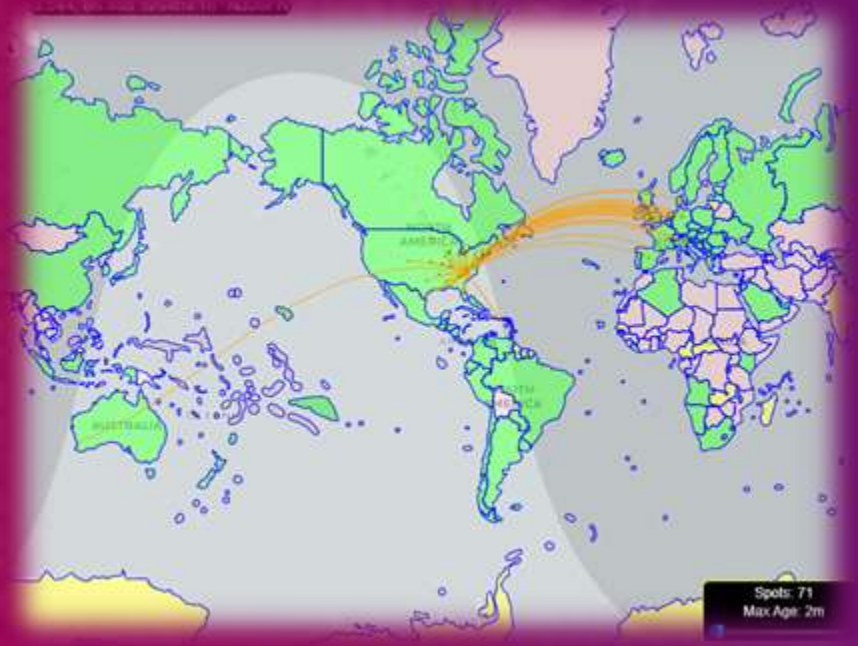
  Successful FT8 DX operators watch the band as much as they transmit

Propagation and GrayLine Matter



Great Expectations

- FT8 delivers real DX results without exotic stations
- FT8 rewards *smart operating*, not big spending or endless hours on the radio



What Is Achievable (Real Example):

- Using 25W of power, and 40m EFHW at 35ft
- Ops as a Technician (One month, 10m Experiment)
  - ✓ DXCC credits completed in under one month
  - ✓ Worked All States (WAS) credits

QRZ awards:

- ✓ Continents of the World
- ✓ Master of Europe
- ✓ Master of NA
- ✓ US Counties
- ✓ Grids[2]

NEXT: FT8 Setup and Demonstration – KR4DrH

FT8
Hardware and Software Setup

William Breinich – KR4DRH

Before we begin…

- Generally, setups will be similar in function, but hardware may vary. Use this as a guide, not as an absolute.
- Don't get frustrated! Help is available! YouTube, forums, and fellow hams! It may not work right at first, this is common. You will get there!
- The specific screenshots in this presentation will be Windows based, though setup should be similar in other operating systems.
- Other digital modes possible once you have the hardware set up properly (Winlink, VarAC, JS8Call, etc)

Radio and Computer Connection

To make it all work, your computer and radio need to communicate

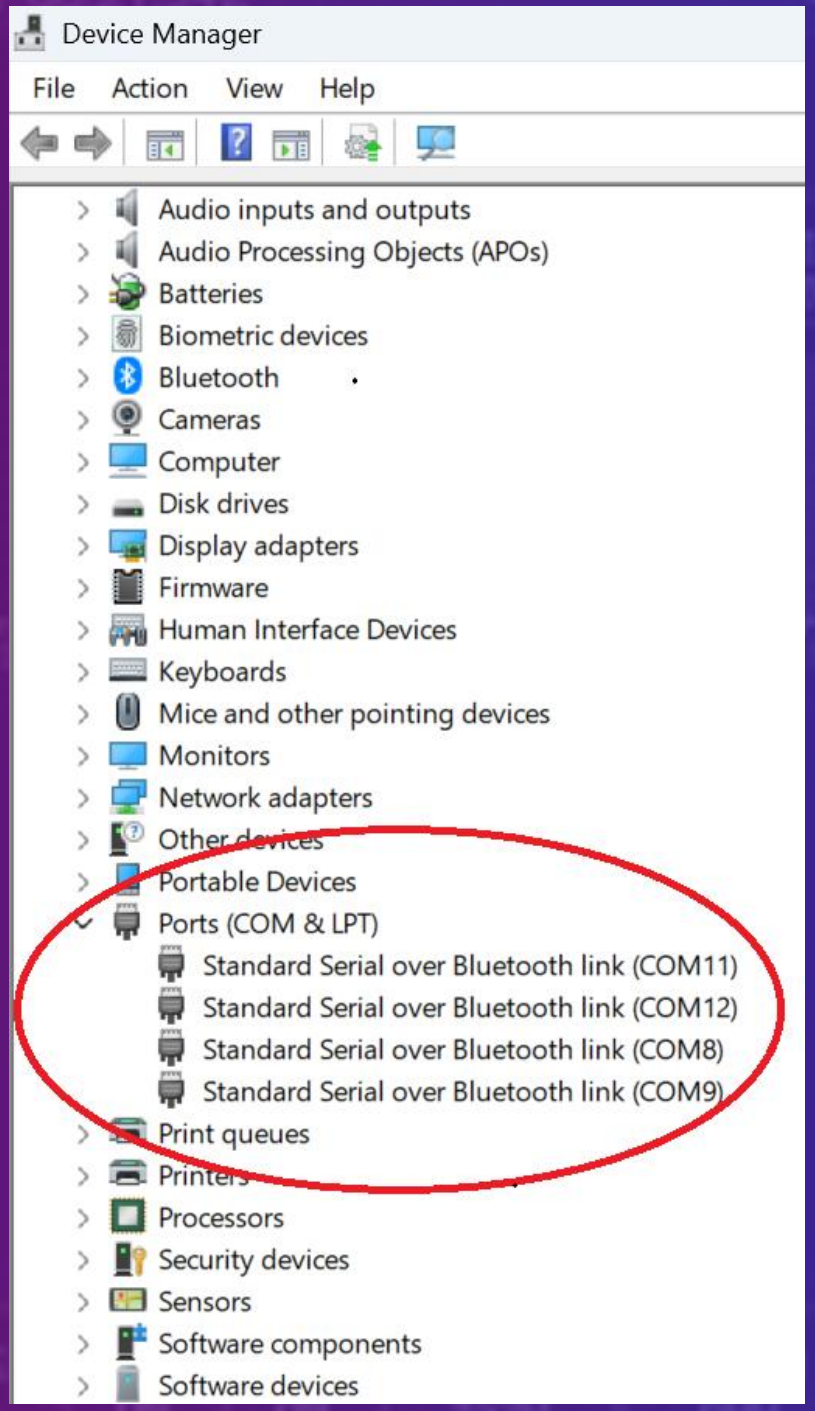
This communication is handled in two parts

- *Audio passed back and forth between the radio and computer*
- *Computer Aided Transceiver (CAT control) allows the computer to control the radio.*

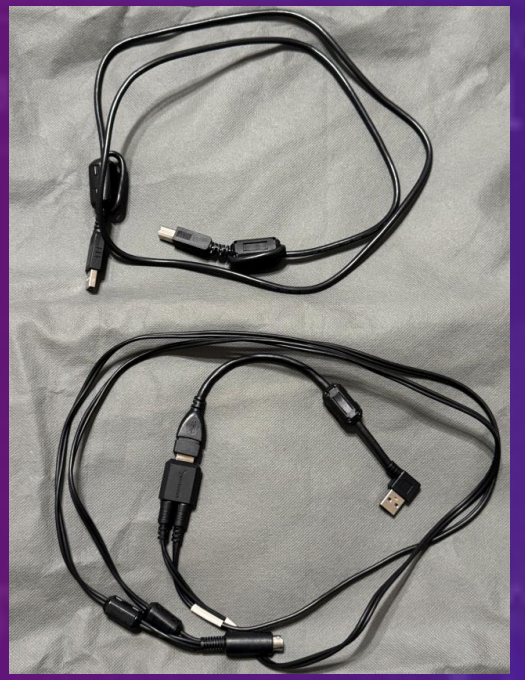
Find your COM Ports

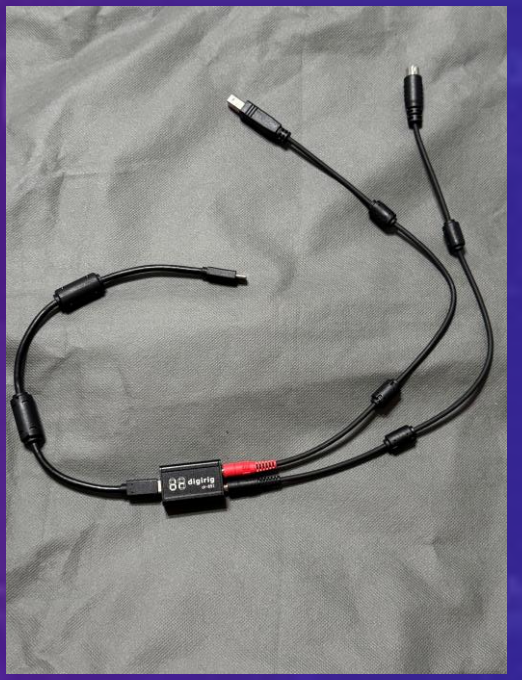
Do this first!

- You will need to know what port your radio uses
- Search for Device Manager – open the ports section
- Note the ones present before you connect the radio – setup in WSJT-X is easier this way.
- Notice the ones that appear after you connect, these are the ones that you will need to know for setup
- Try to use the same USB port(s) each time. Else the COM port numbers may change.
- You may need to download some radio specific software. This is dependent on the radio and connection method – consult the manual.



Connection Options





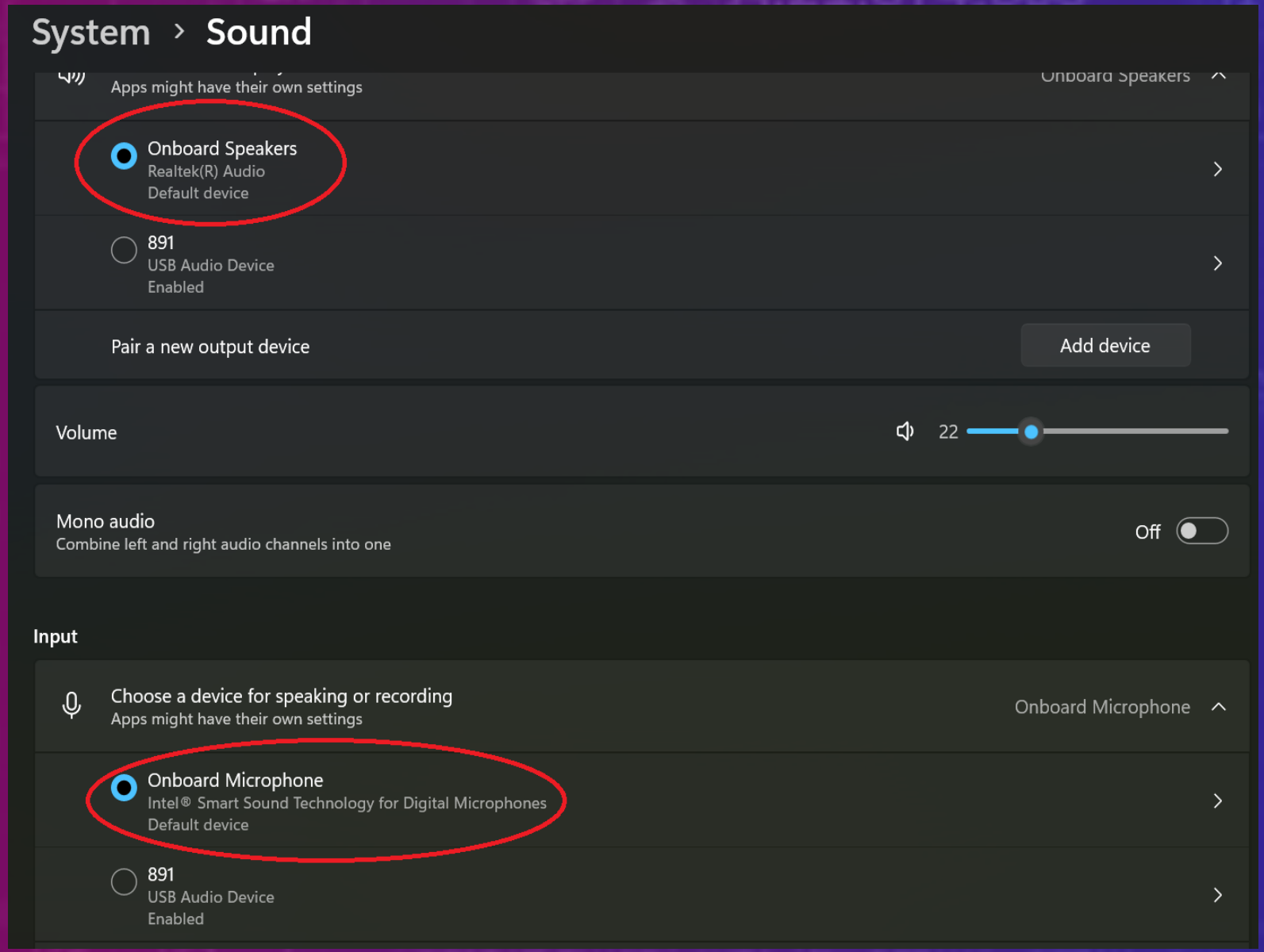
Multiple Options

- Cable(s) – some radios just need a single USB cable (FT-991, IC-7300). Some can use two cables, one for CAT control, one for audio.
- Digirig/SignaLink – CAT control and audio with one connection - for radios that don't have an internal sound card (FT-891 or IC-718)
- Wireless (such as IC-705)

Rigs can often use multiple ways to connect. Find what works best for you and the rig you have.

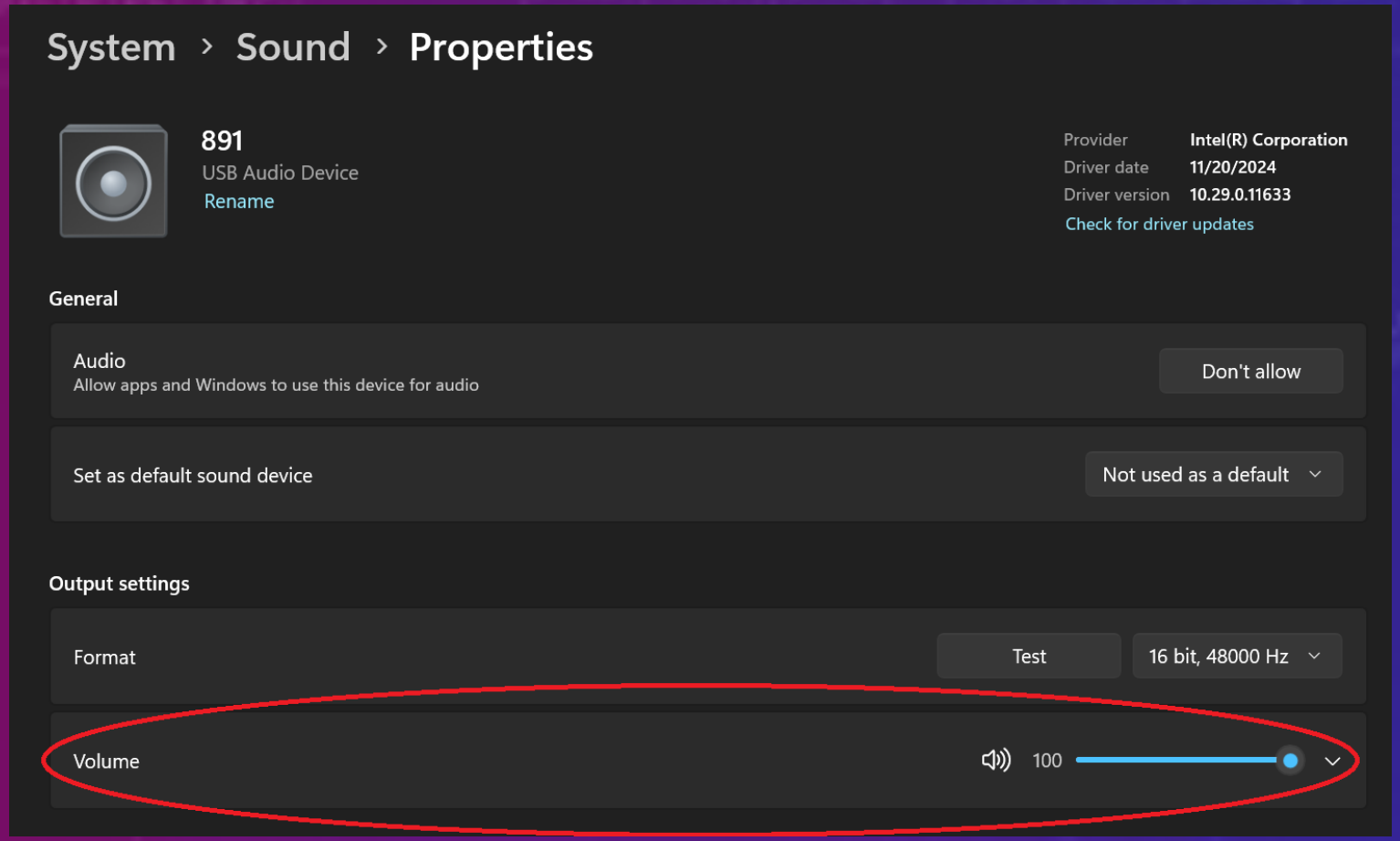
Sound Settings – Default Device

- Audio devices not hooked to radio should be set as the default
  - otherwise system sounds can play over the air
- Right click speaker in system tray on bottom right, click Sound settings
- Here you can see the onboard speaker and microphone are the default devices – correct
- If the device hooked to the radio is the default, click on the circle beside it – it will be made default. Do for both output an input.



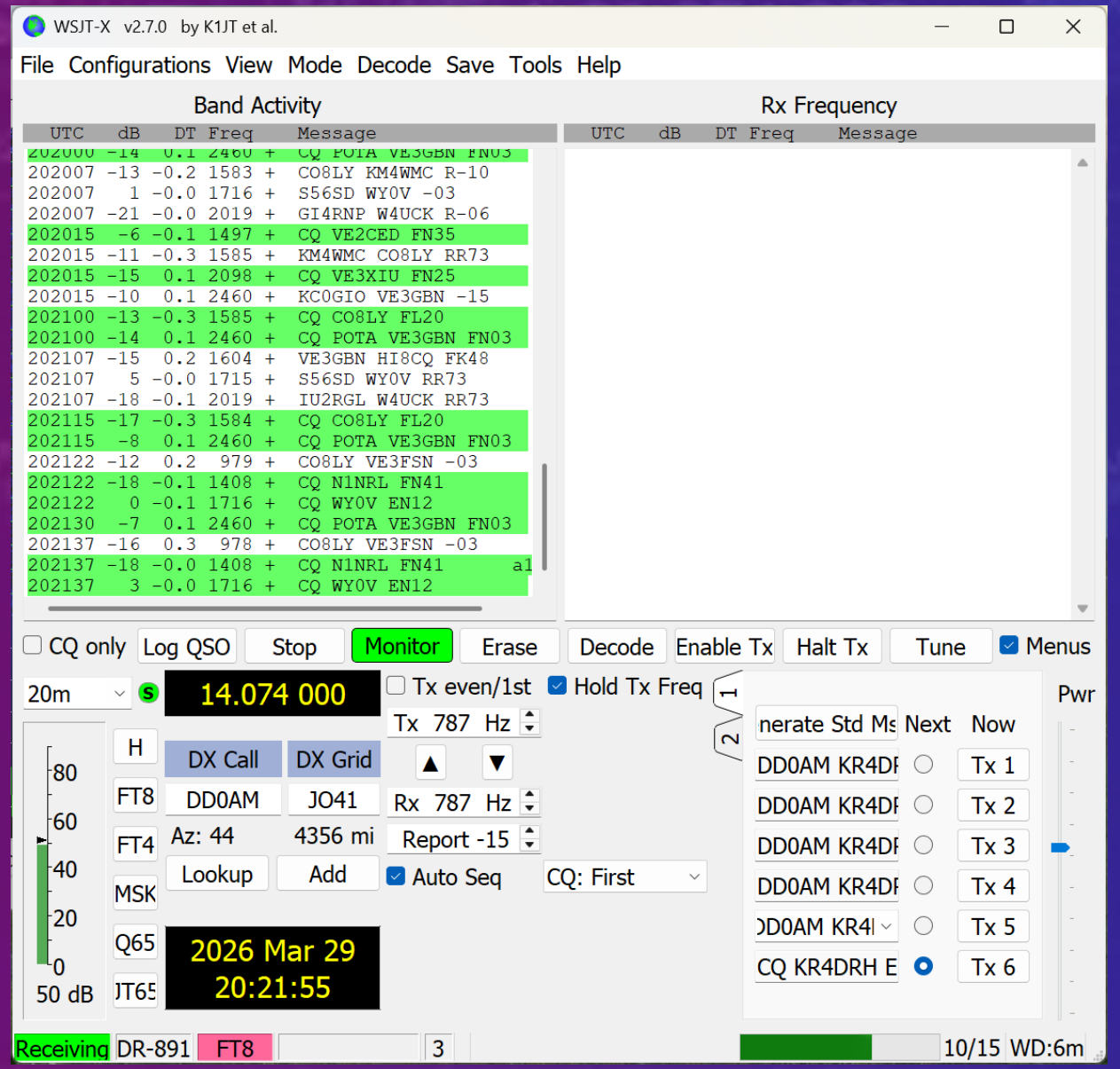
Sound Settings – Volume Levels

- Check the volume settings on both the speakers and microphone
- 80-100 for Speakers – provided ALC can be controlled
- Adjust input volume so WSJT-X receive meter stays in the green (will also depend on certain radio settings)
- Also make sure any enhancements for speakers and microphones are turned off



WSJT-X

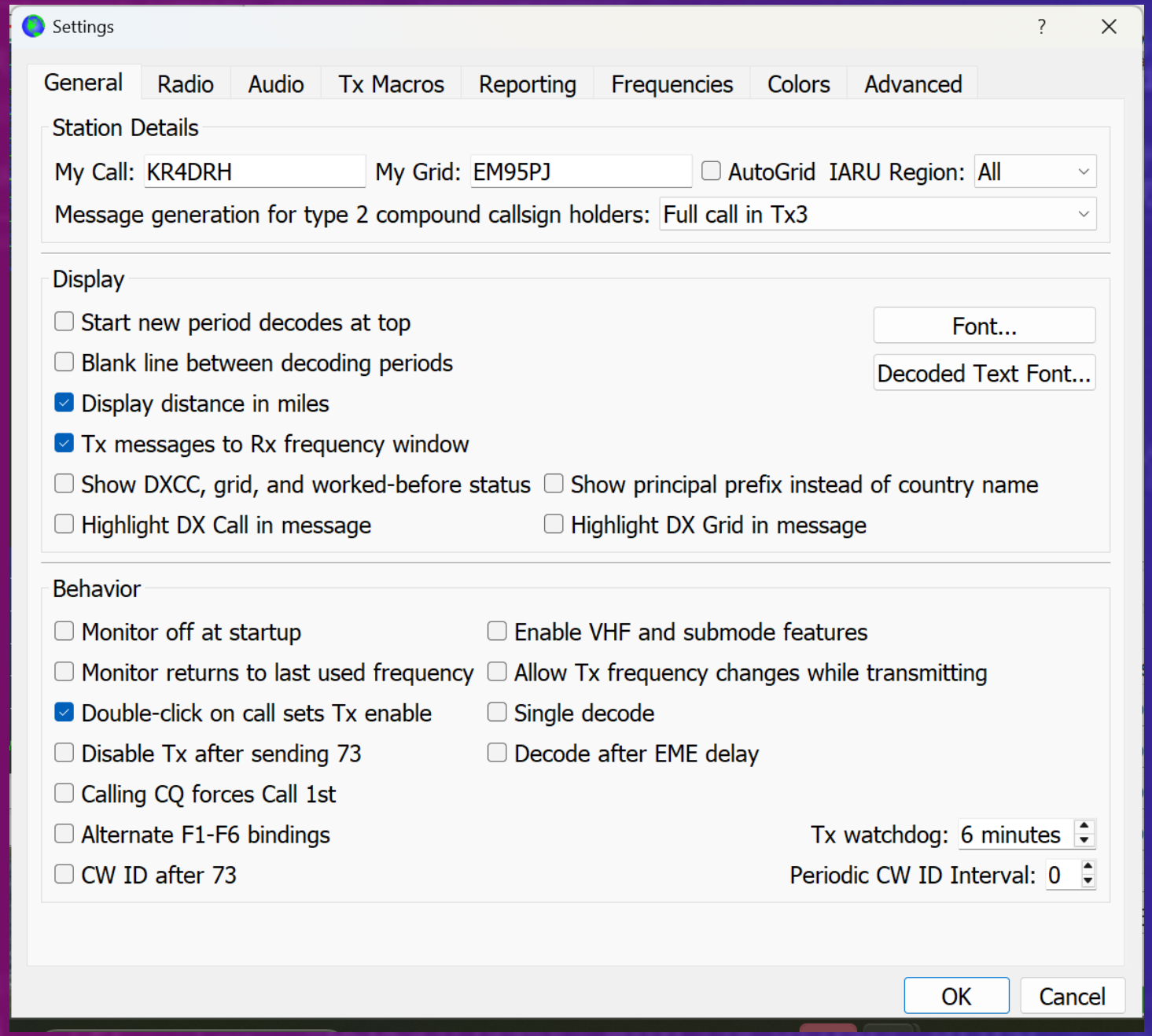
- Allows for several modes of operation including FT8/4 and WSPR
- Available for Windows, MacOS, Linux
- WSJT-X 2.7 used for this presentation
  - 3.0 just released in the last few days
  - Some enhancements, but the ideas from here still apply in the new version
- https://wsjt.sourceforge.io/wsjtx.html



WSJT-X

General Tab

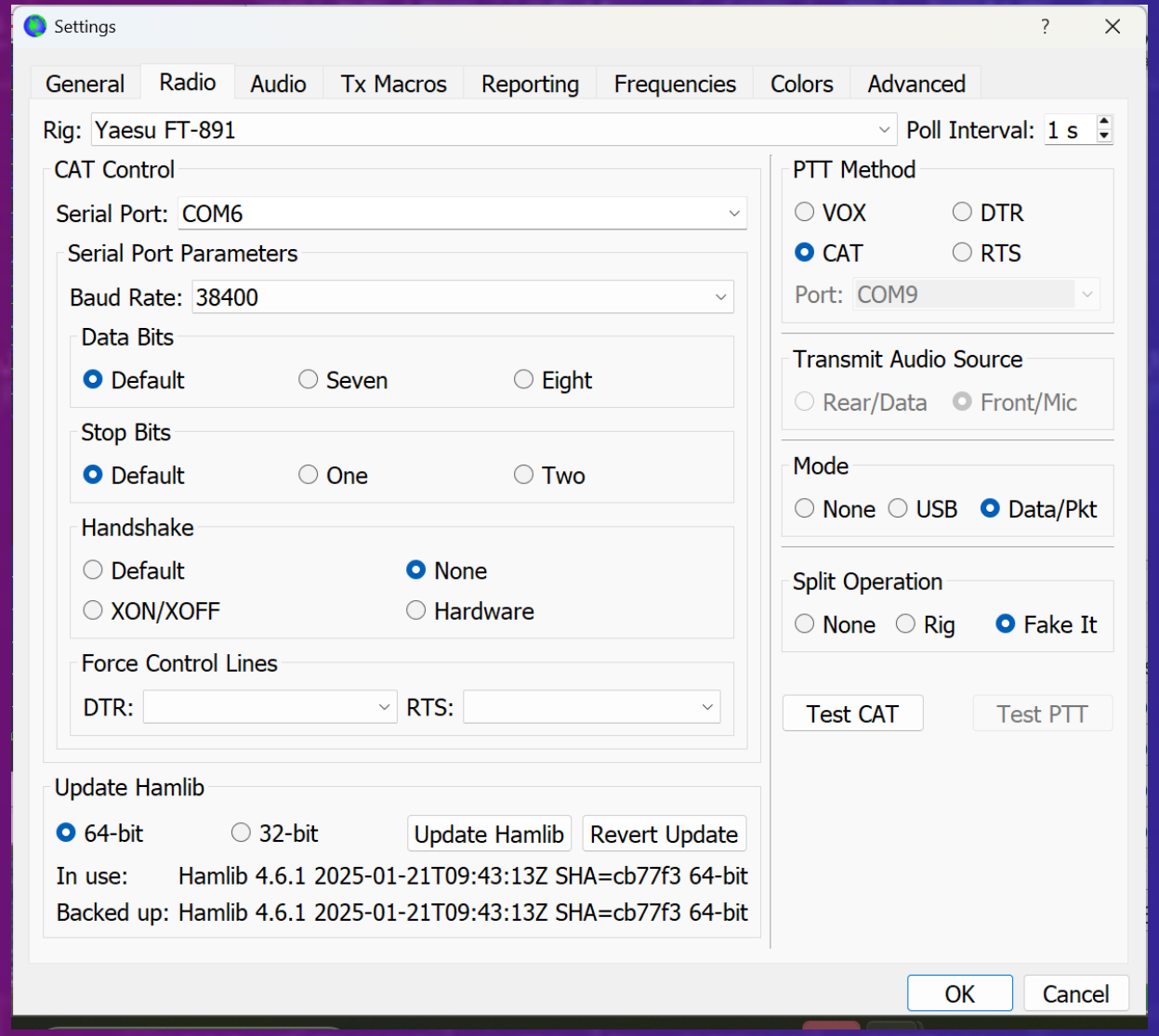
- Enter Call
- Enter Grid
- Most here are preference



WSJT-X

Radio Tab

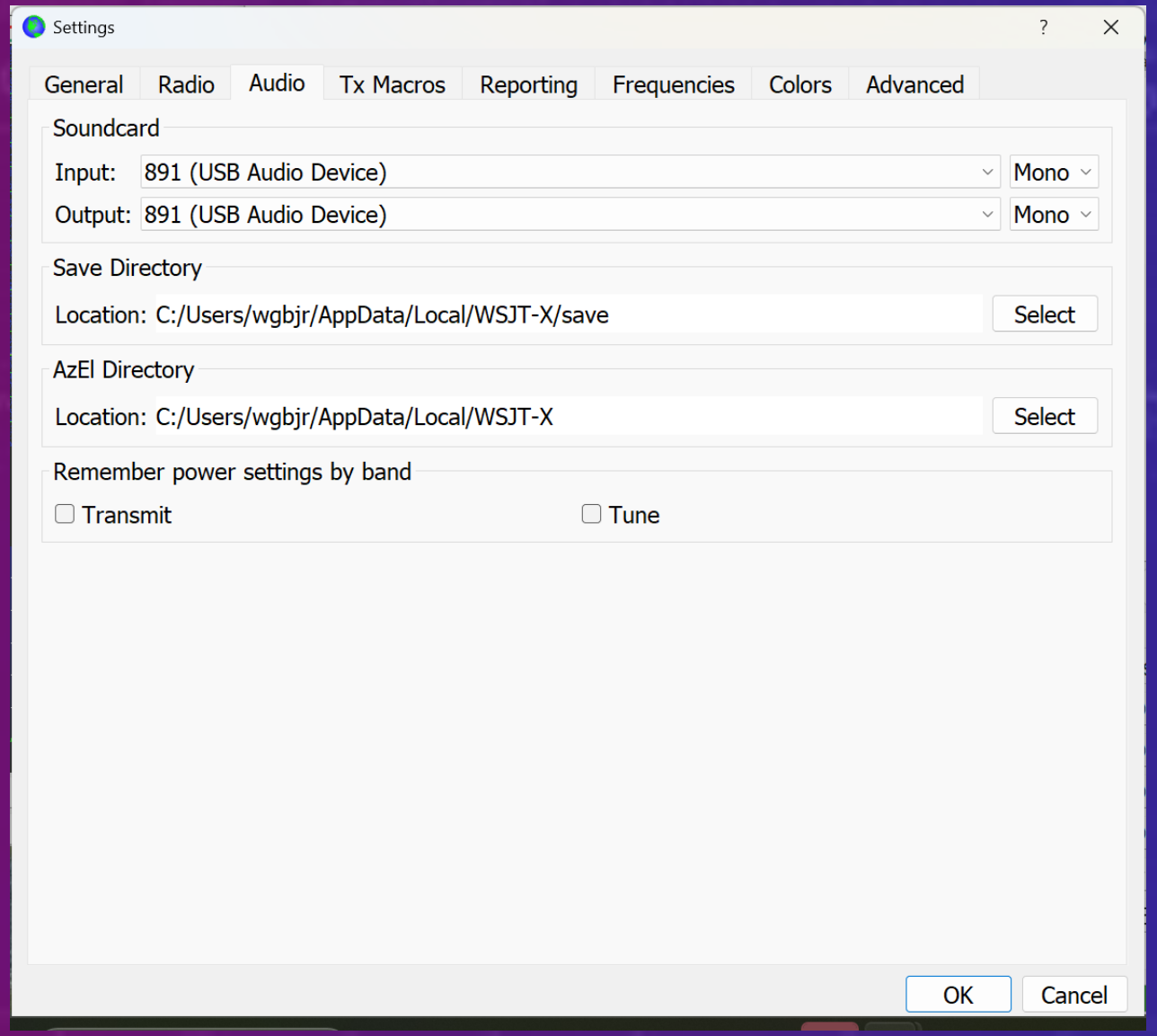
- These options vary based on the radio you choose
- This is where you enter the COM port(s)
- Baud rate must match your radio's setting
- PTT – will depend on setup
  - Signalink can use VOX
- Mode will be rig specific – many radios have a Data/Pkt mode, but not all
- Split operation – If your radio has two VFOs, use Rig, otherwise use Fake It. This results in a cleaner transmitted signal – strongly recommended
- Test CAT and Test PTT



WSJT-X

Audio Tab

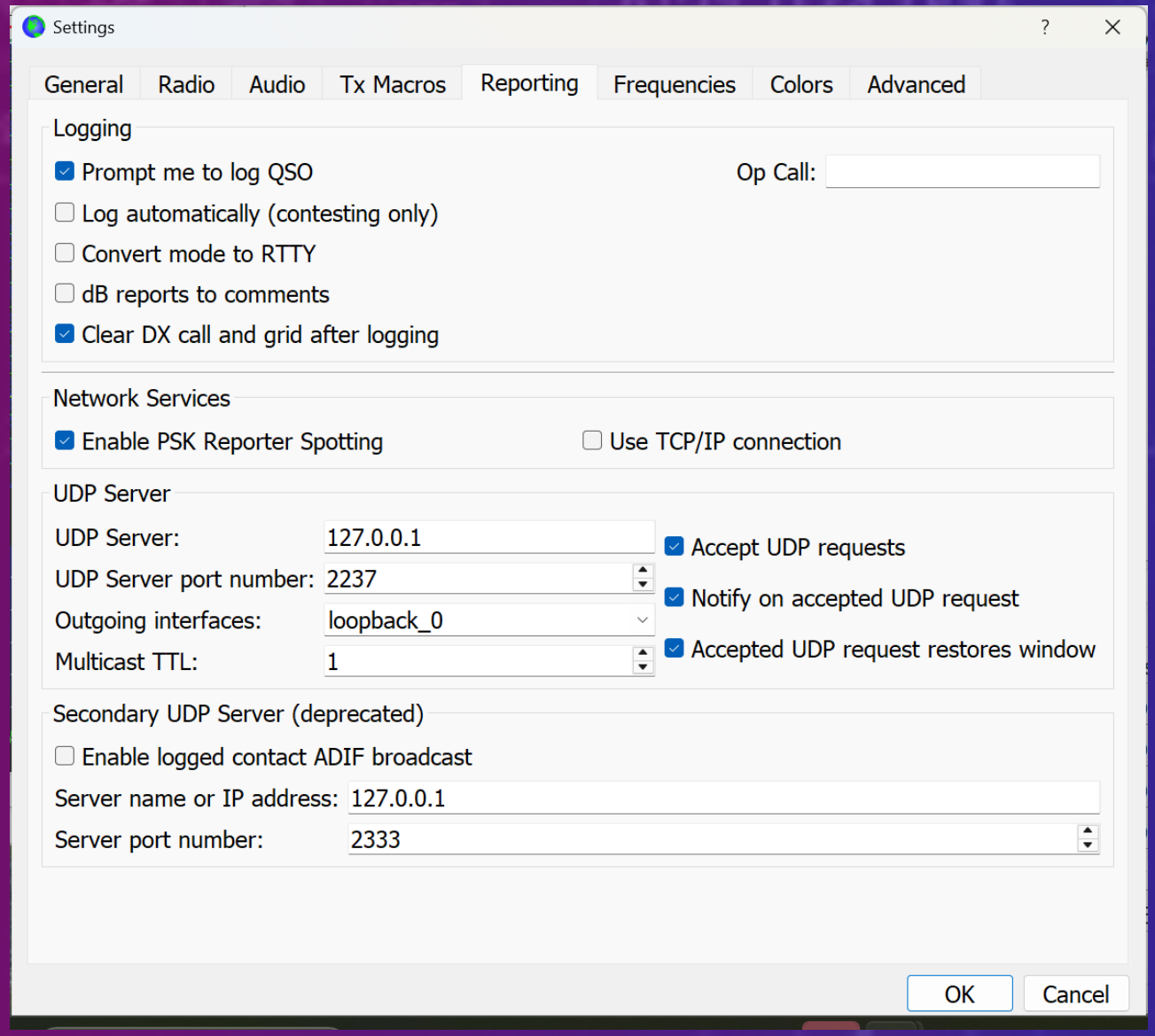
- Select the soundcard you have added for digital modes
- Remember that a second soundcard is best so system sounds aren't broadcasted by the radio



WSJT-X

Reporting Tab

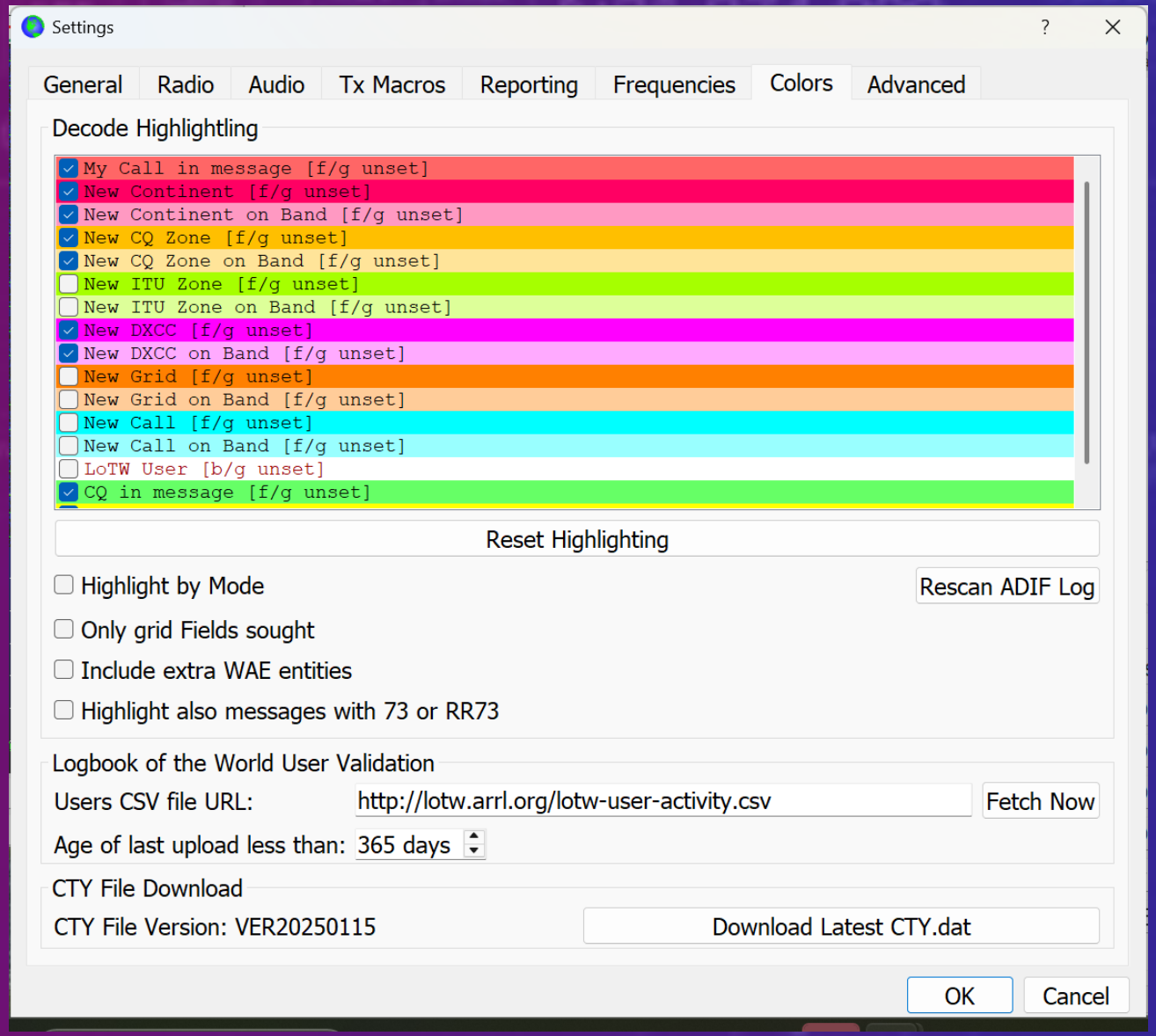
- Prompt for QSO log, Clear DX – required for GridTracker
- PSK Spotting is useful to everyone
- UDP Server is how GridTracker is linked to WSJT-X – this port number must match the one used in GridTracker



WSJT-X

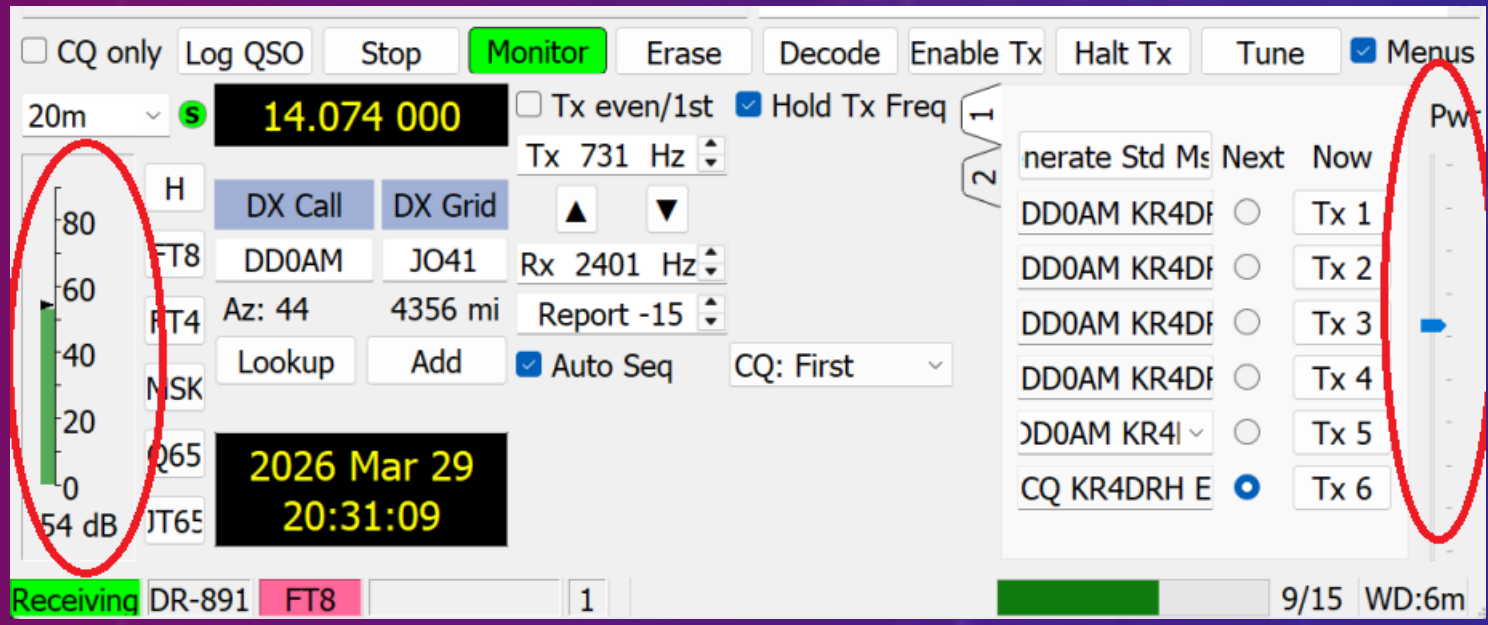
Frequencies, Colors, Advanced

- Mostly personal preference
- All other options explained in the user manual
- https://wsjt.sourceforge.io/wsjtx-doc/wsjtx-main-2.7.0.html



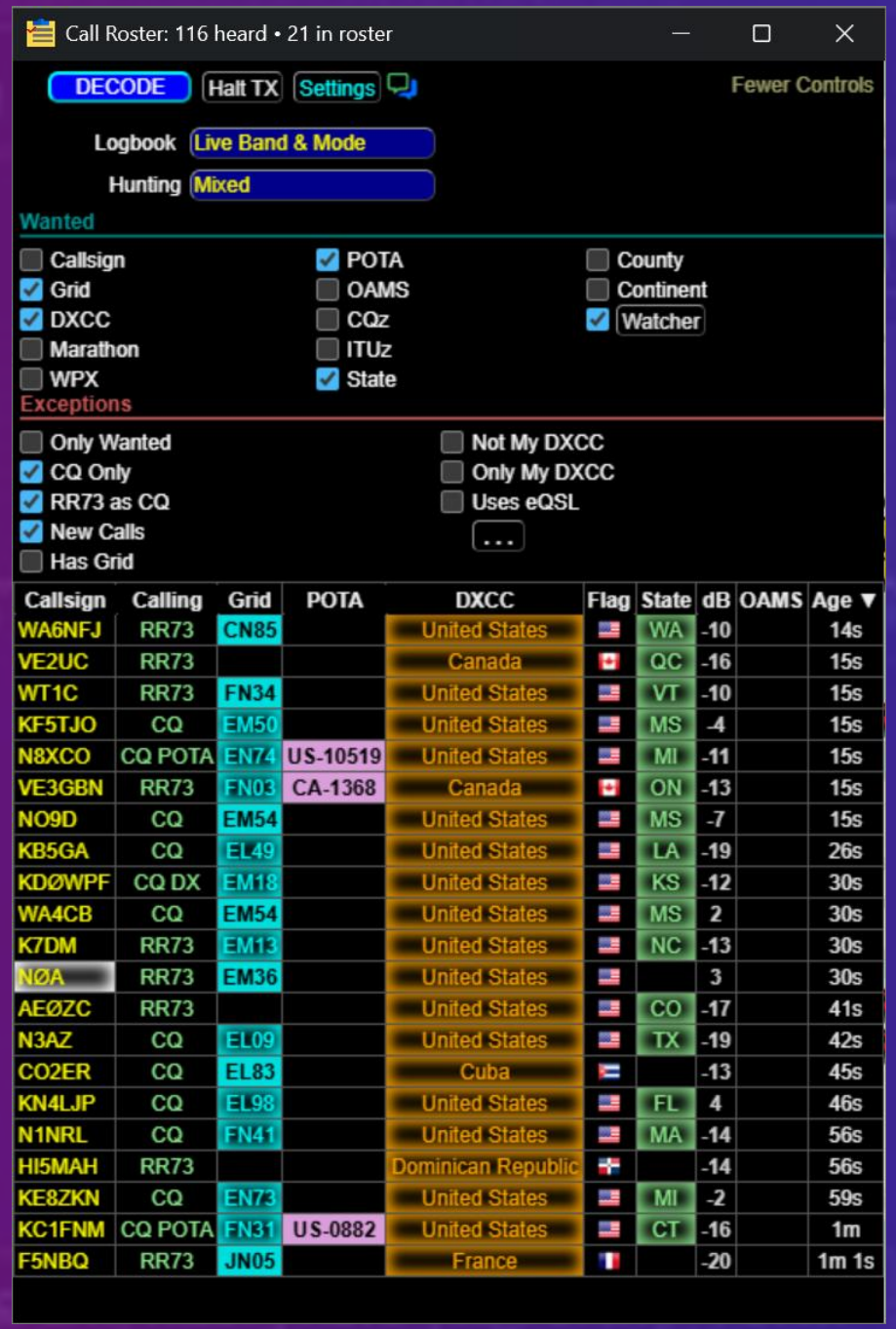
Audio Levels

- Audio levels are important
- Incoming audio (receive level) on the left. Keep in the green.
- Audio output level adjusted on the right
- Check radio's ALC during a tune to make sure the signal is clean, Too much ALC means a distorted signal.



GridTracker

- Companion app for WSJT-X
- Not required, but very useful
- Shows contacts, past and present, on a map
- Ability to filter contacts so only desired stations or locations show
- Very useful when you're seeking certain contacts or DX entities
- https://gridtracker.org/

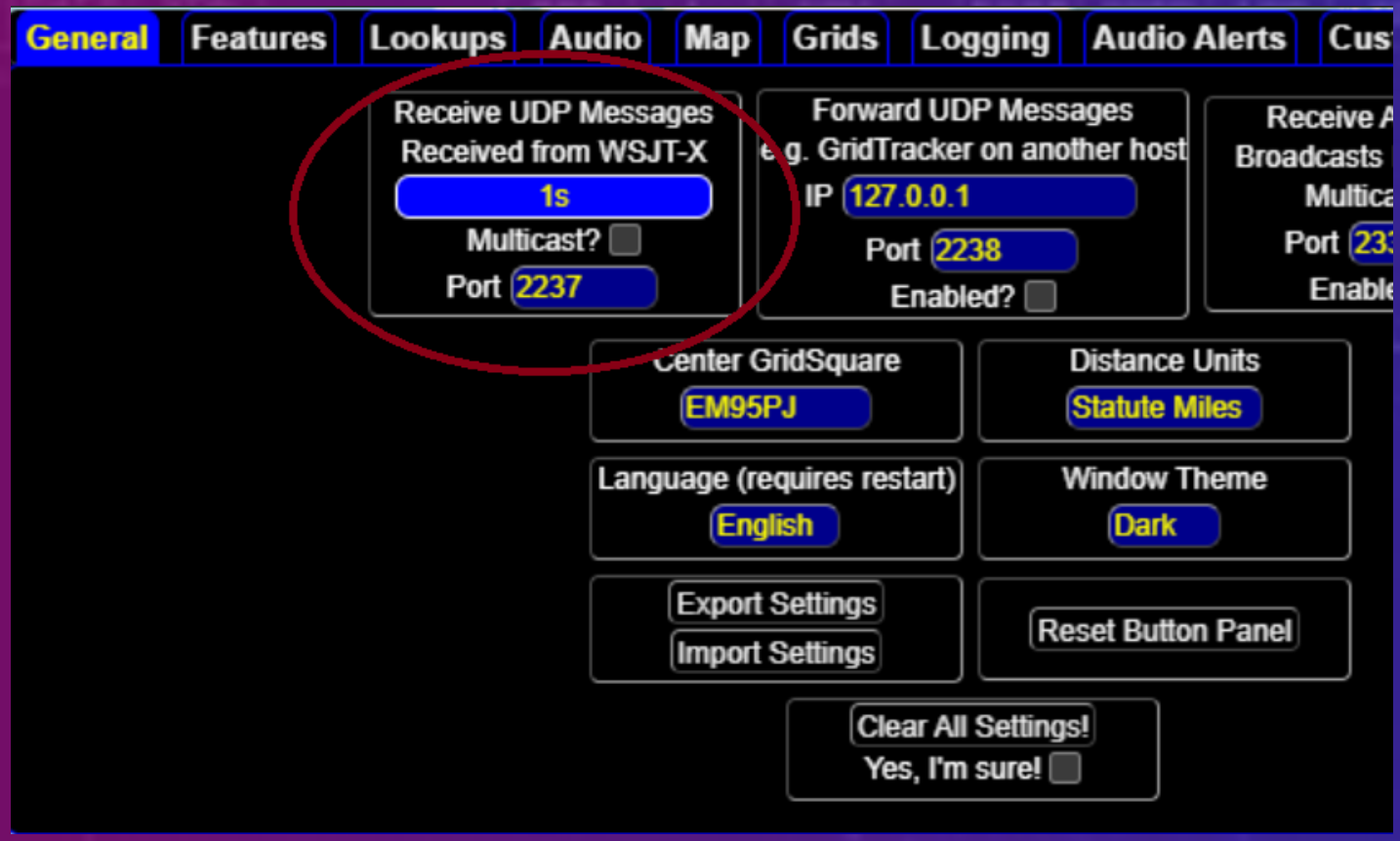


Callsign	Calling	Grid	POTA	DXCC	Flag	State	dB	OAMS	Age ▼
WA6NFJ	RR73	CN85		United States		WA	-10		14s
VE2UC	RR73			Canada		QC	-16		15s
WT1C	RR73	FN34		United States		VT	-10		15s
KF5TJO	CQ	EM50		United States		MS	-4		15s
N8XCO	CQ POTA	EN74	US-10519	United States		MI	-11		15s
VE3GBN	RR73	FN03	CA-1368	Canada		ON	-13		15s
NO9D	CQ	EM54		United States		MS	-7		15s
KB5GA	CQ	EL49		United States		LA	-19		26s
KDØWPF	CQ DX	EM18		United States		KS	-12		30s
WA4CB	CQ	EM54		United States		MS	2		30s
K7DM	RR73	EM13		United States		NC	-13		30s
NØA	RR73	EM36		United States			3		30s
AEØZC	RR73			United States		CO	-17		41s
N3AZ	CQ	EL09		United States		TX	-19		42s
CO2ER	CQ	EL83		Cuba			-13		45s
KN4LJP	CQ	EL98		United States		FL	4		46s
N1NRL	CQ	FN41		United States		MA	-14		56s
HI5MAH	RR73			Dominican Republic			-14		56s
KE8ZKN	CQ	EN73		United States		MI	-2		59s
KC1FNM	CQ POTA	FN31	US-0882	United States		CT	-16		1m
F5NBQ	RR73	JN05		France			-20		1m 1s

GridTracker

General Tab

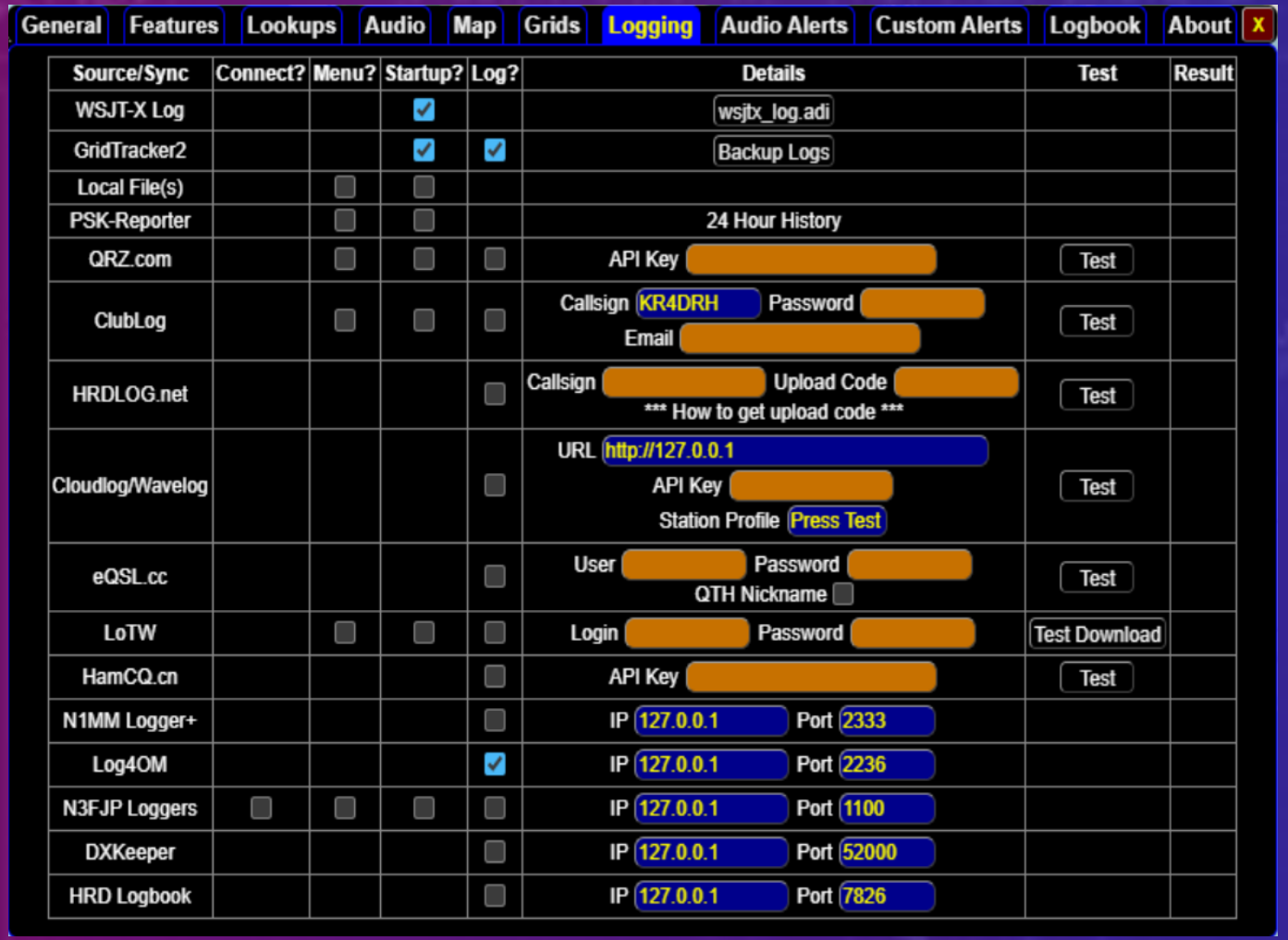
- Set port number to match same one from WSJT-X options
- Also set your grid just below it



GridTracker

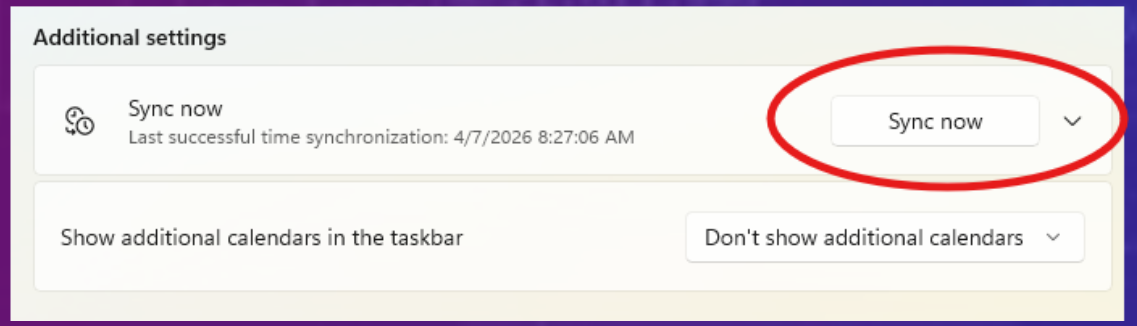
Logging Tab

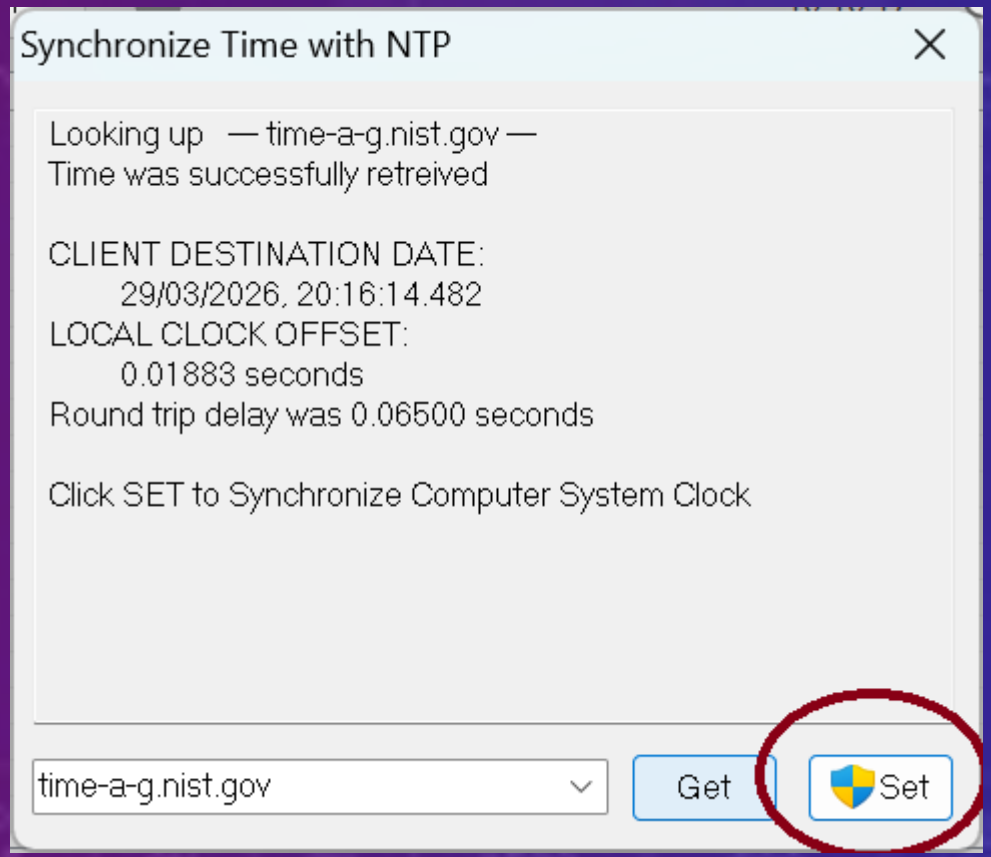
- These are all optional, your choice
- Remember, WSJT-X keeps a log too
- This one shows Log4OM being used
- You can see it uses the log in WSJT-X



Time Synchronization

- For FT8 to function, **your computer time must be synchronized to UTC time (within half a second ideal)**
- Mismatched times = mismatched cycles and bad/no decodes. You can see the time offset in WSJT-X. (DT)
- Windows has a built-in sync function you can use.
- Other options if Windows' sync doesn't work well
- JTSync is free, and easily allows you to synchronize your computer clock
- There are other fine programs
- https://www.dxshell.com/jtsync.html



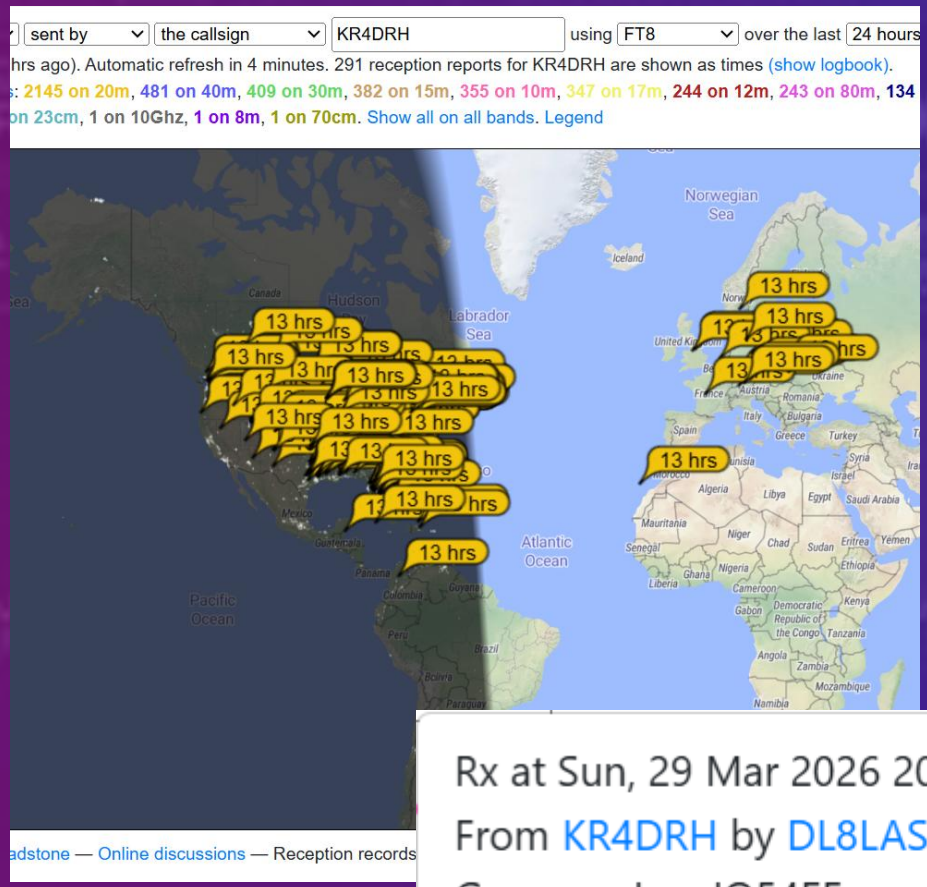


Logging

- Many different options
- Many can sync with WSJT-X or Gridtracker
- Choose one that works for you
- Not necessarily needed – WSJT-X keeps a log

PSKReporter

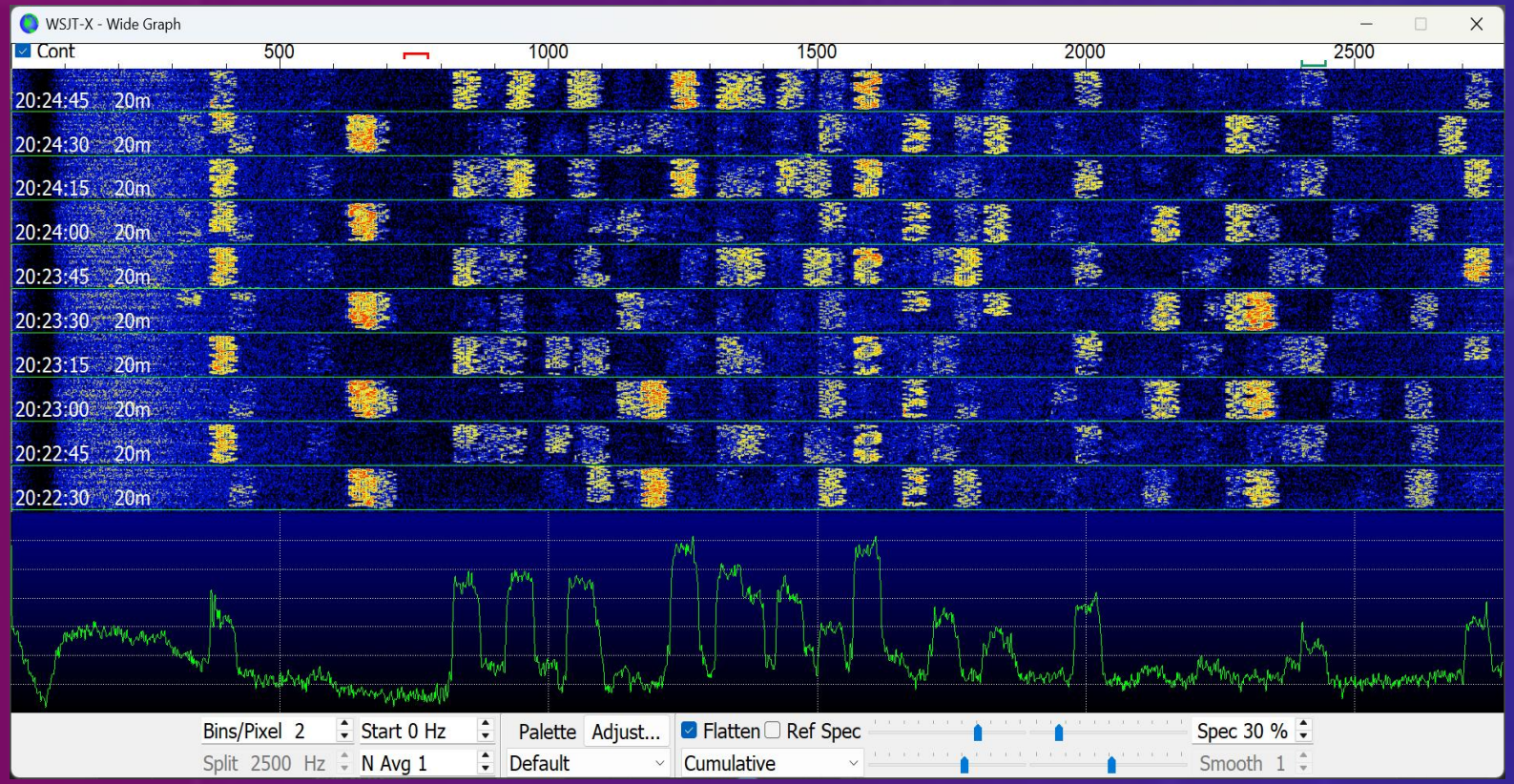
- Web based signal reports
- WSJT-X reports who you hear, others report when they hear you
- Useful to see how well you're getting out
- Can be loosely used to see if you'll reach a particular DX entity you're seeking



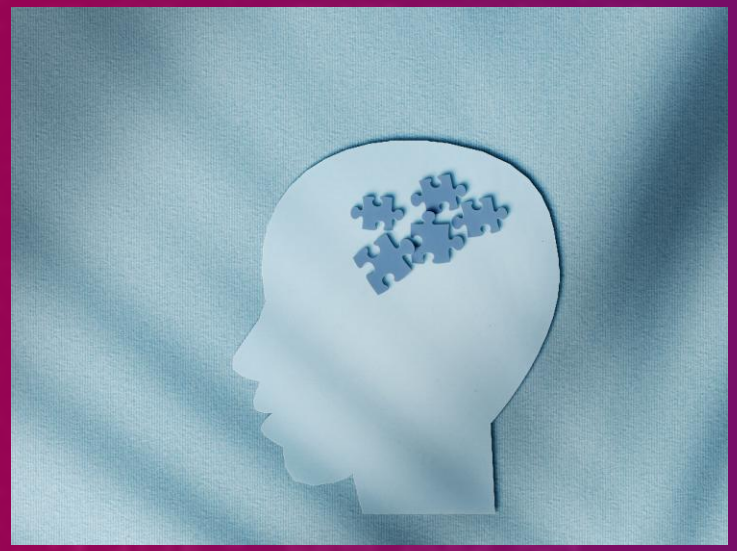
Rx at Sun, 29 Mar 2026 20:38:45 GMT
From KR4DRH by DL8LAS in Fed. Rep. of Germany Loc JO54EF
Frequency: 14.074.720 MHz (20m), FT8, -9dB
Distance: 6952 km bearing 41°
Using: STEMlab SDR FT8 TRX 1.0
Antenna: Vertical Active Loop
Rig: Icom IC-7850/7851

Success!

- CAT/PTT tests in WSJT-X work
- Seeing signals in the waterfall
- Seeing decodes in WSJT-X and/or GridTracker
- Tune results in clean signal – minimal ALC movement
- Stations respond to your CQ and/or you appear on PSK Reporter



Final thoughts…



Remember there are multiple hardware options available for connecting the radio to the computer

Other rig control software packages not even discussed (OmniRig, DXLab Commander for example)

Don't forget time syncing – you will not be able to send and receive properly if your system time is off

If the setup worked last time and doesn't this time, check sound settings in the operating system first! Windows can change the default sound device, especially if you use two devices (Digirig for HT's, cables for HF rigs), or you often disconnect the radio from the computer

Setup Questions

Next up - Demonstration!