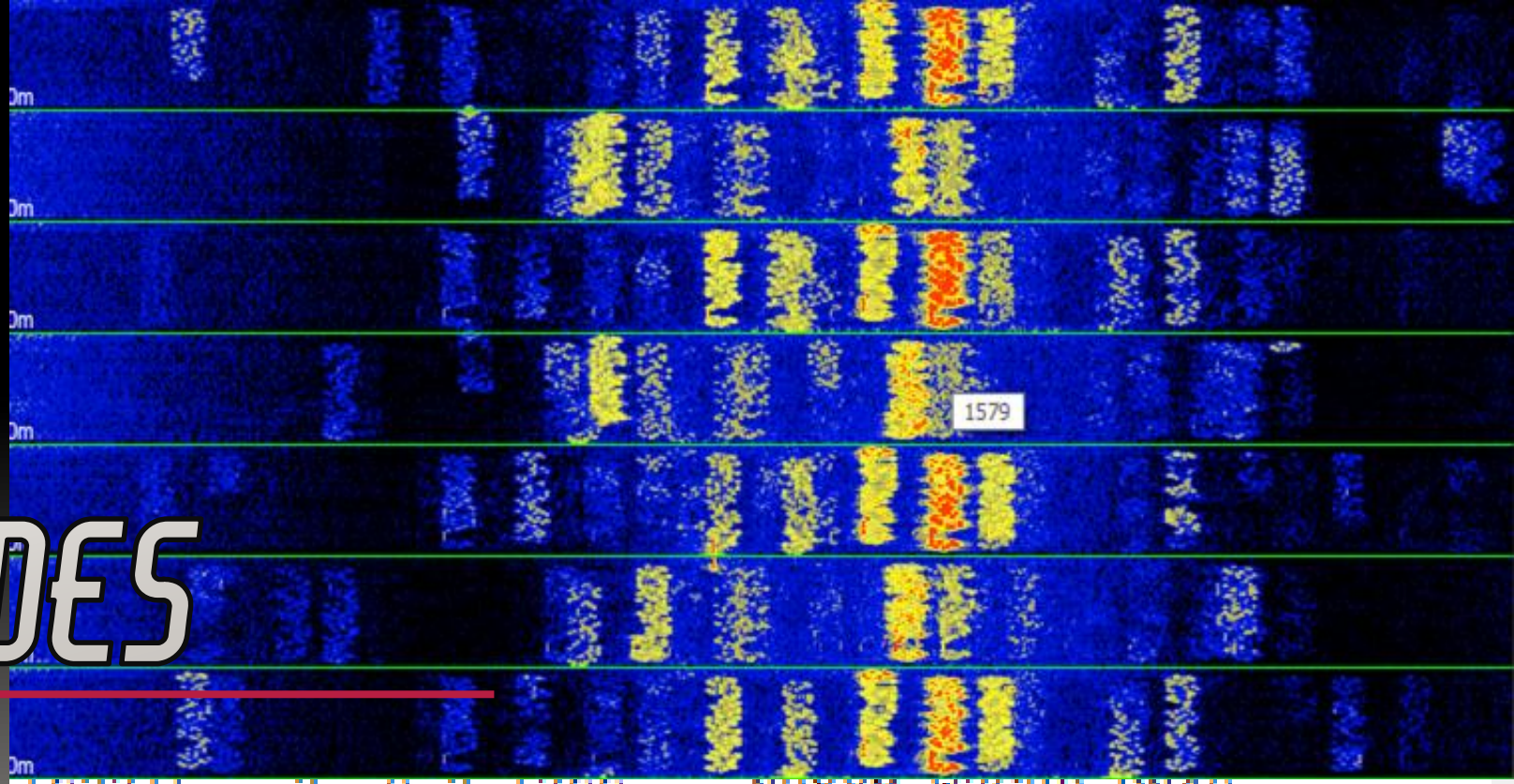
GETTING STARTED WITH

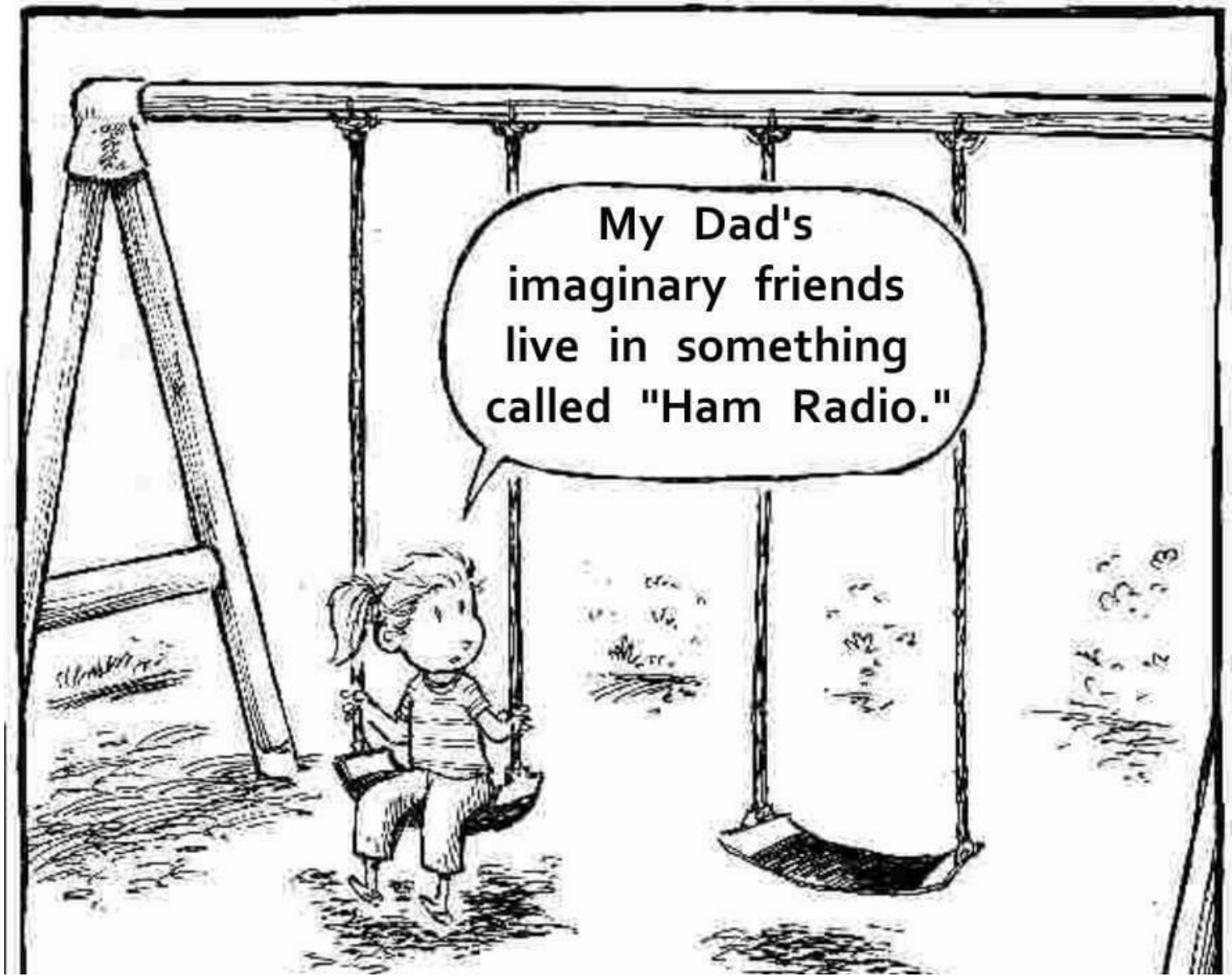
DIGITAL MODES

In Amateur Radio




```
193715   -3 -0.3 1799 ~  N8XYM W7CHP DN40
193715   10 -0.5 1339 ~  N7WFK KD4MZM RR73
193715  -11  0.3 2065 ~  N8XYM VE4ZIM EN29
193715  -12  0.2  839 ~  N2ZXO NR0Q -18
193715  -12  0.1 1058 ~  DG3KCW EA5KB +02
193715  -18 -0.7 2321 ~  R2FAQ KC1DFB FN43
193715  -15  0.1  732 ~  K3WHD W5GND EM13
193715  -11  0.1  442 ~  CQ WA2NBG FM02      U.S.A
193715    3  0.1 1318 ~  AA5RV N0DMP DM78
193715  -10 -0.5 1834 ~  BG5UEZ AI7PZ DN06
```

By W8RNO


My Dad's imaginary friends live in something called "Ham Radio."

WHY USE DIGITAL?

- Requires less RF power than other modes
- Excellent wat for “Mic Shy” operators to make contacts
- Great for weak signals during bad propagation

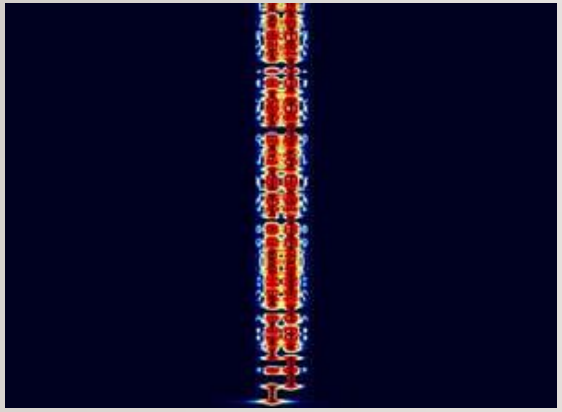
MOST COMMON DIGITAL MODES

- RTTY
- PSK31
- FT8
- JS8Call

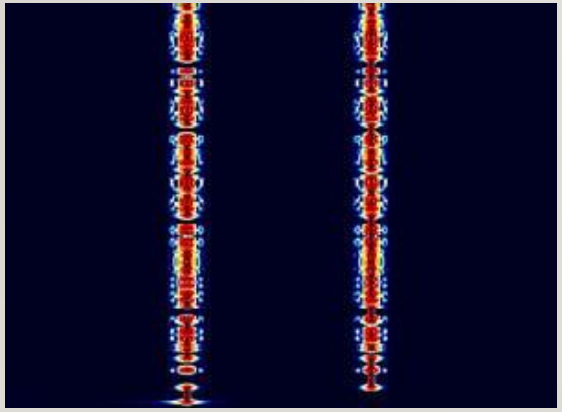
RTTY – RADIO TELETYPE

- FSK – Frequency Shift Keying (Modulates the Carrier Frequency)
  - Frequency shift modulation; carrier shifts between two frequencies, a high and a low
  - Difference between two frequencies is called the SHIFT, usually 170Hz.
  - Lower frequency is called the SPACE, upper frequency is called the MARK
  - 250Hz Bandwidth, 45.45 Baud (About 60 words per minute
- Baudot Code
  - Like binary code, it uses data bits
  - Only uses 5 data bits, plus a start and stop bit

RTTY – RADIO TELETYPE



RTTY 45.45 Baud, 170Hz Shift



RTTY 45.45 Baud, 850Hz Shift

PSK31 – PHASE SHIFT KEYING

- PSK – Modulates the Carrier Phase 180 Degrees
- 60Hz Bandwidth, 31 Baud (About 50 words per minute)
- Every transmission begins with a series of 0's to allow the receiving station to sync
- Uses Varicode
  - Different amount of bits per character
  - Like morse code, common letters use less bits
  - Two 0's indicate end of character

A 1111101	d 101101
B 11101011	e 11
f 111101	s 10111
g 1011011	t 101
h 101011	u 110111
i 1101	v 1111011
j 111101011	w 1101011
k 10111111	x 11011111

Varicode Sample

EXAMPLE PSK31 QSO IN FLDIGI

fldigi ver4.1.23 - W8RNO

File Op Mode Configure View Logbook Help

14070.000

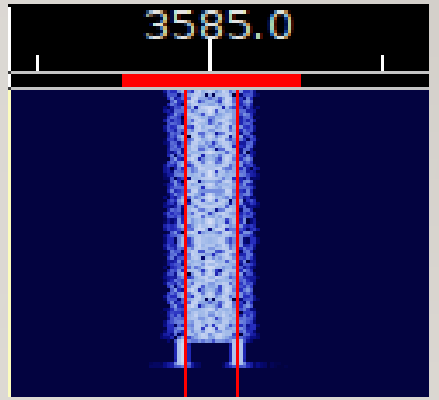
Freq 14071.046 On Off 2116 In 599 Out 599 Cnty/Cntry Notes

Call Op Az

PSK 2800 Qth St Pr L

14072.08 9uf de wc0g I need to get going john. thamks for the qso. 73 and have a ggod evening.AA9UF de WC0G 73 John and thanks for PS

14071.54 CQ CQ de WA0WUY CQ CQ CQ de WA0WUY pse K



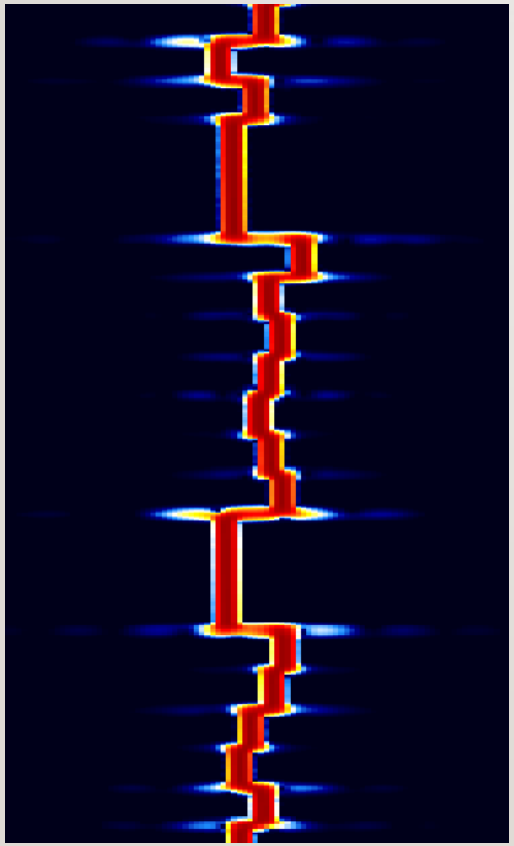
FT8 – FRANK & TAYLOR 8

- Created by Steve Franke (K9AN) and Joe Taylor (K1JT)
- The most popular digital mode on HF
- Sends in 15 second increments at 23.5 baud, about 5 words per minute
- 12.64 seconds of transmission time, 2.36 seconds of decode time.
- Each transmission can have up to 13 characters
- Can decode messages with a SNR as low as -20dB
- 50Hz bandwidth, Frequency Shift Keying

FT8 QSO EXAMPLE

A Typical FT8 QSO	
Characters Sent / Received	**Interpretation**
"CQ KI7PO DN06"	CQ call from radio operator "KI7PO" along with his Maidenhead grid square locator code.
"KI7PO IZ1M JN35"	Radio operator "IZ1M" replies with his callsign and grid square locator.
"IZ1M KI7PO -10"	KI7PO responds with a signal report *(in the form of a WSJT-X dB reading instead of in a more conventional, though more subjective, rstS reading)*
"KI7PO IZ1M R-12"	IZ1M confirms signal report & replies with his own report
"IZ1M KI7PO RRR"	KI7PO tells IZ1M, "Reception Report Received" *(This can also be shortened to "RR73" indicating, "Report Received 73," which would be a completed QSO)*
"KI7PO IZ1M 73"	IZ1M says "Best regards" ("73")
"IZ1M KI7PO 73"	KI7PO says "Best regards" ("73") *(not used if KI7PO's third transmission was "RR73")*

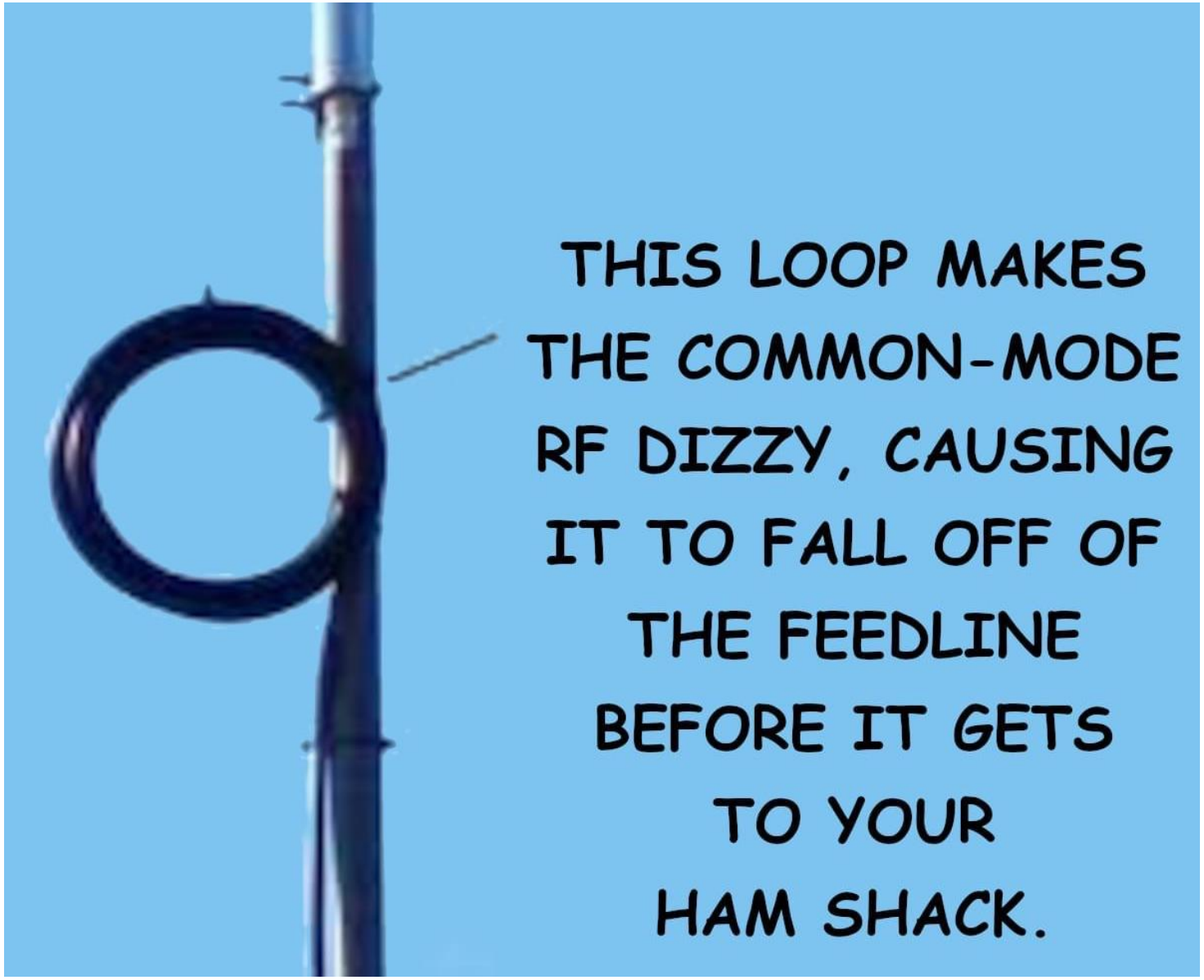
FT8 SOUND AND WATERFALL



FT8 Signal

JS8

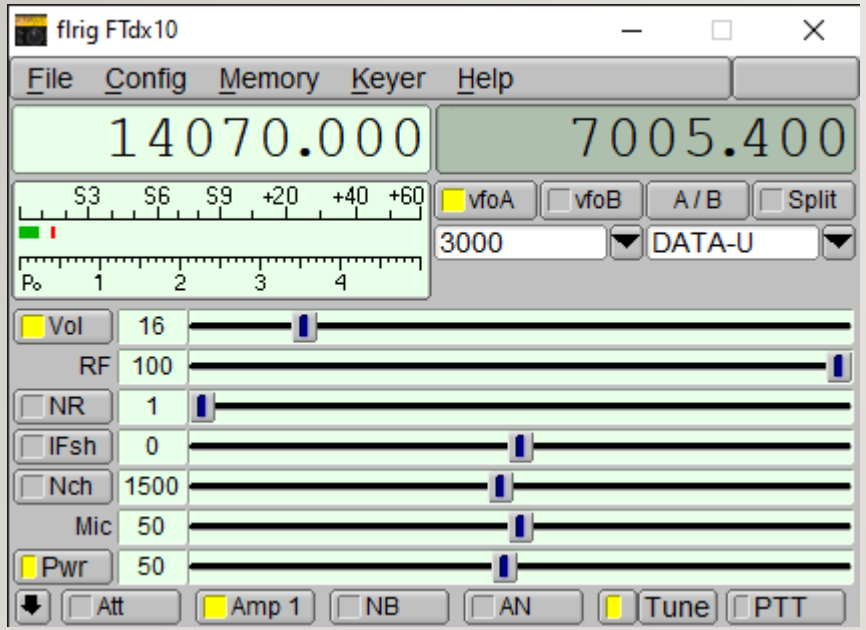
- Based off of FT8
- Same operating principles, but meant for standard QSO's
- Open Source and Free

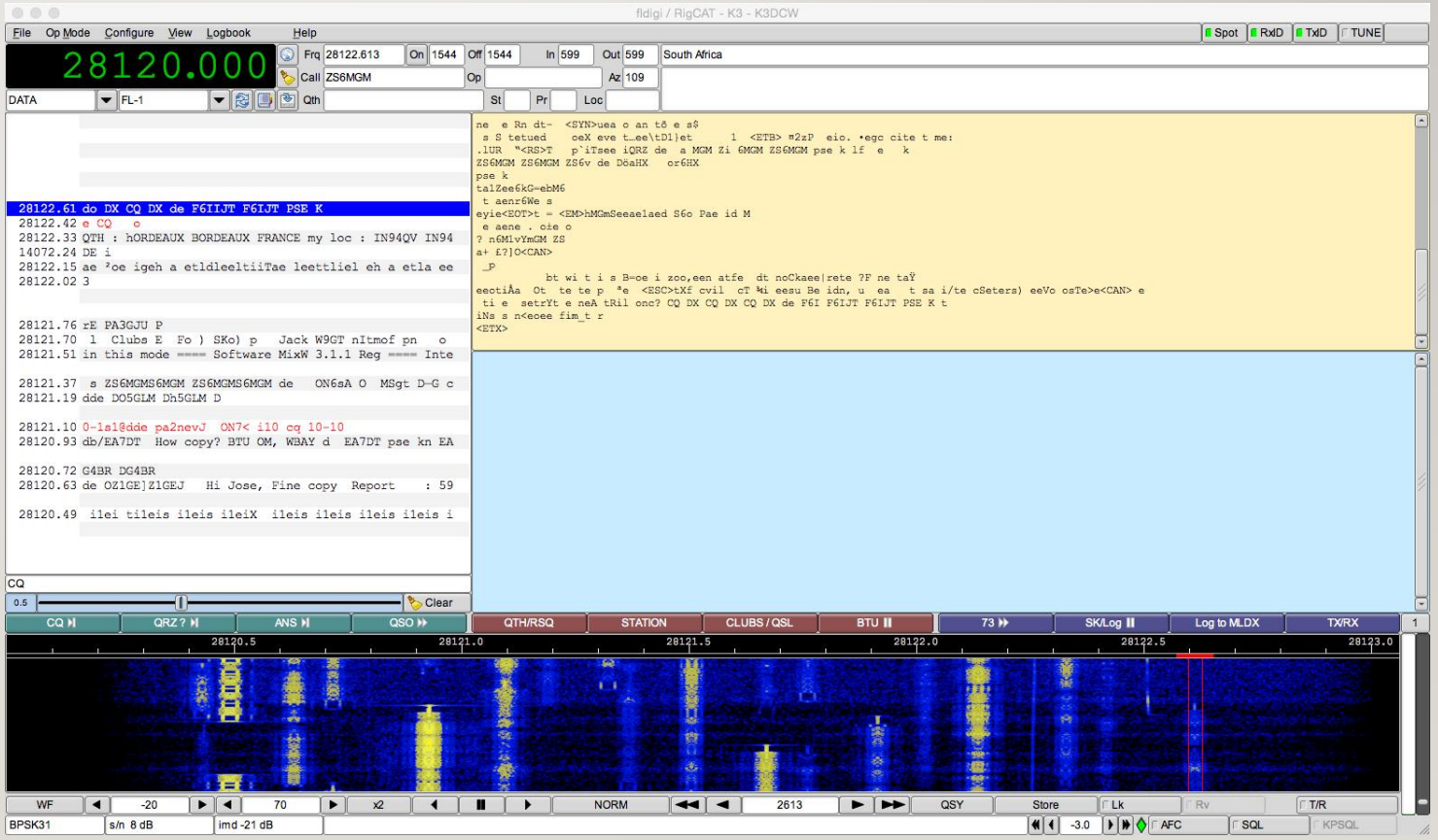

THIS LOOP MAKES
THE COMMON-MODE
RF DIZZY, CAUSING
IT TO FALL OFF OF
THE FEEDLINE
BEFORE IT GETS
TO YOUR
HAM SHACK.

DIGITAL SOFTWARE

- FLDigi
- WSJT-X
- JS8Call

FLDIGI – FAST LIGHT DIGITAL





FLDIGI

- Free to download and use, open source
- Multiple modes, including CW, PSK31, RTTY, and MT63
- Comes with a suite of software, such as FLRig and FLMsg
- Works any many operating systems, even Raspberry Pi

FLDIGI

QSO I had in FLDigi using BPSK31 on 20M

N0AN de W8RNO

we had quite some weather here a few days ago as well. i believe a tornado touched down about 20 miles north of here. My club has a 40M yagi on their tower that was damaged by winds a few months ago, and it took us a while to find a climber. they are sure expensive. the beam has been repaired and we're waiting for the climber to come back out.

i haven't had any damage other then a newly planted tree falling over.

<< W8RNO, Marysville, Ohio >>
Age: 39
Rig: Yaesu FTDX10
Pwr: 50W
Ant: Emcomm II EFHW
OS: Win 10
Soft: Fldigi 4.1.23
btu Hasan N0AN de W8RNO k
W8RNO, Christopher de N0AN

Very good print, signals are stable . Earlier there was a lot of qsb, but since we started things are good. Let me check somehing Christopher.....ok it is misleading on the front panel of the 7300...the power appears to be fluctuating...or at least the Vcc is but the power supply is rock solid.

btu Christopher W8RNO de N0AN k
N0AN de W8RNO

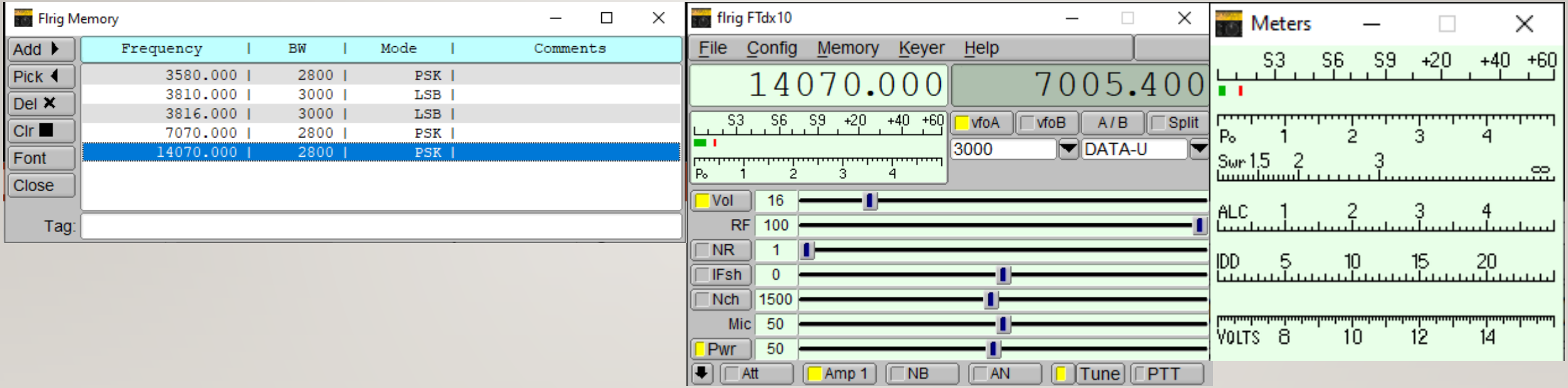
thats odd the vcc would be fluctuating. do you have meters on the power supply that would indicate any changes in power? btu Hasan N0AN de W8RNO kInteresting the cable connectors on the pwoer supply are downright hot, indicating resistance. I better check things out.

tnx fer QSO Christopher
May you and yours go under the protection of God.
(in Arabic: "fi amaniah")

4/2/2023 23:06Z W8RNO de N0AN sk
N0AN de W8RNO
good timing there hasan, the wife just called down to say dinner is ready. I would definitely check the connectors on the power supply. maybe there is some corrosion or loose connection causing resistance. Pleasure chatting with you my friend, 73 and god bless.

de W8RNO k

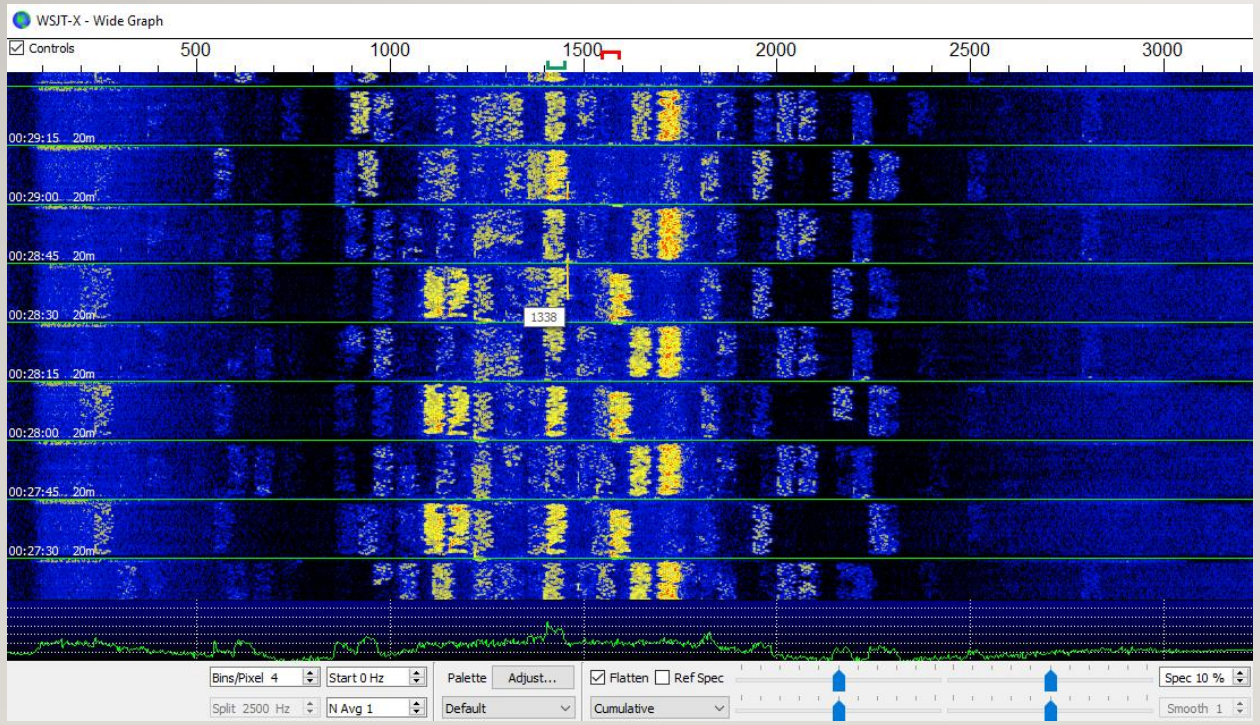
FLDIGI - FLRIG

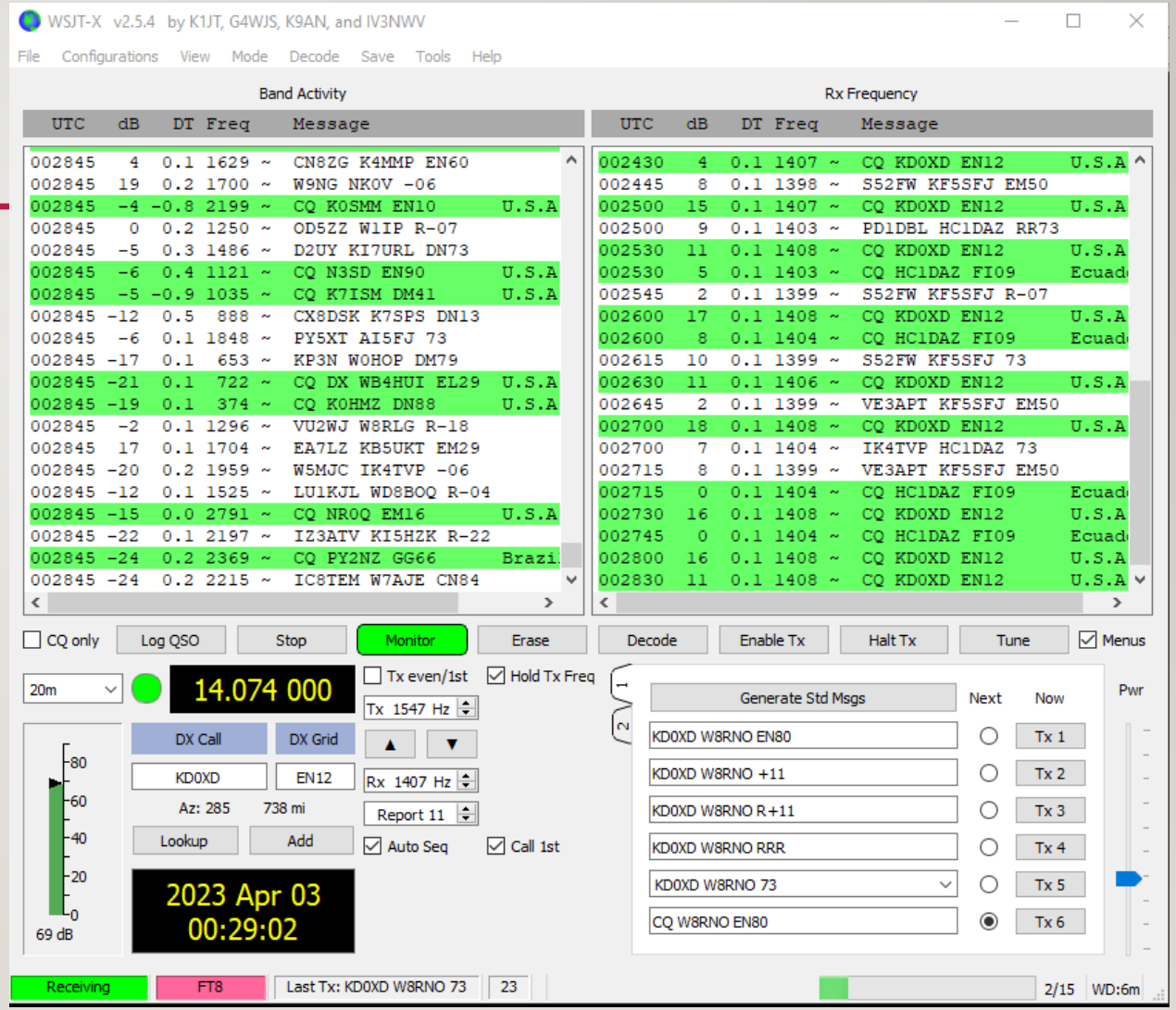


WSJT-X – WEAK SIGNAL COMMUNICATION BY K1JT

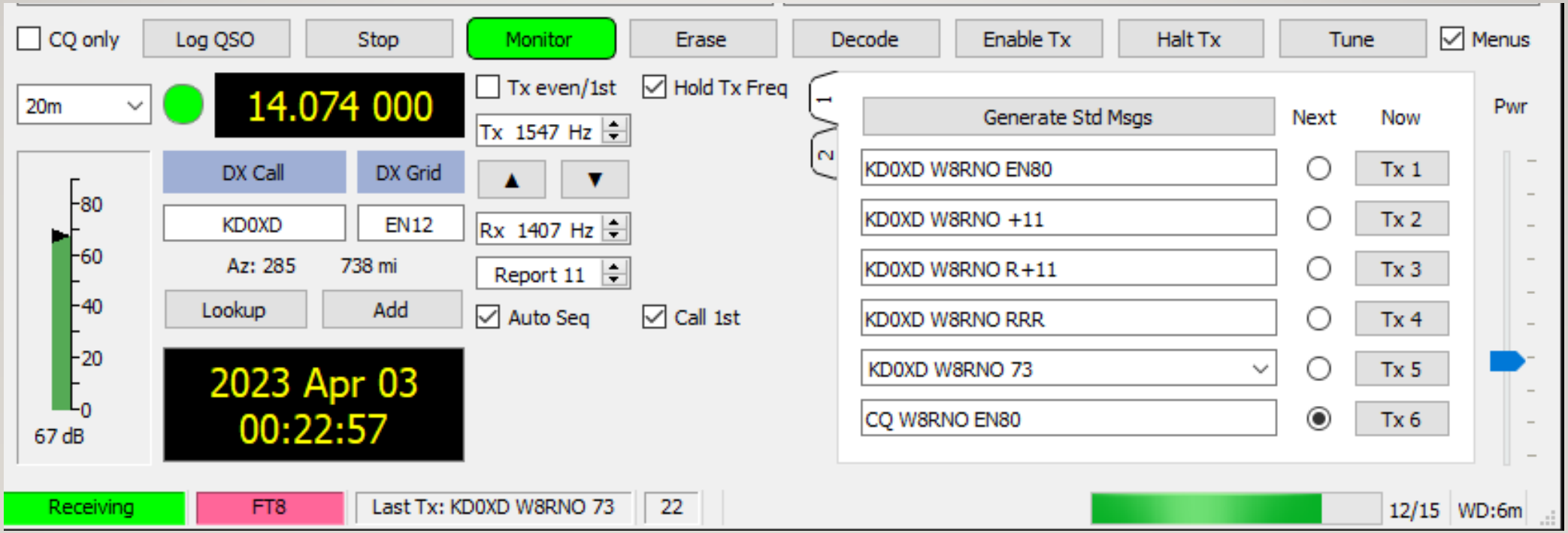
- Primarily used for FT8, but does other modes
- Automated QSO's an CQ answering
- Automatic logging
- Best to have time sync software
- Automatic reporting to PSKReporter

WSJT-X


WSJT-X - Wide Graph
Controls
500
1000
1500
2000
2500
3000
00:29:15 20m
00:29:00 20m
00:28:45 20m
00:28:30 20m
00:28:15 20m
00:28:00 20m
00:27:45 20m
00:27:30 20m
1338
Bins/Pixel 4
Start 0 Hz
Palette
Adjust...
Flatten
Ref Spec
Spec 10 %
Split 2500 Hz
N Avg 1
Default
Cumulative
Smooth 1

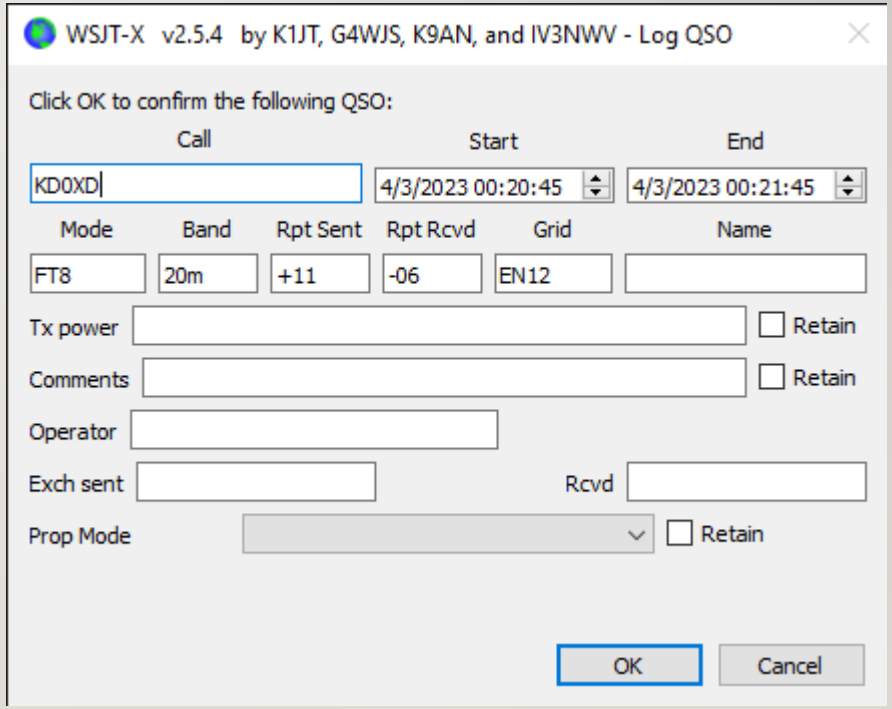

WSJT-X v2.5.4 by K1JT, G4WJS, K9AN, and IV3NWV
File Configurations View Mode Decode Save Tools Help
Band Activity
UTC dB DT Freq Message
002845 4 0.1 1629 ~ CN8ZG K4MMP EN60
002845 19 0.2 1700 ~ W9NG NK0V -06
002845 -4 -0.8 2199 ~ CQ K0SMM EN10 U.S.A
002845 0 0.2 1250 ~ OD5ZZ W1IP R-07
002845 -5 0.3 1486 ~ D2UY KI7URL DN73
002845 -6 0.4 1121 ~ CQ N3SD EN90 U.S.A
002845 -5 -0.9 1035 ~ CQ K7ISM DM41 U.S.A
002845 -12 0.5 888 ~ CX8DSK K7SPS DN13
002845 -6 0.1 1848 ~ PY5XT AI5FJ 73
002845 -17 0.1 653 ~ KP3N W0HOP DM79
002845 -21 0.1 722 ~ CQ DX WB4HUI EL29 U.S.A
002845 -19 0.1 374 ~ CQ K0HMZ DN88 U.S.A
002845 -2 0.1 1296 ~ VU2WJ W8RLG R-18
002845 17 0.1 1704 ~ EA7LZ KB5UKT EM29
002845 -20 0.2 1959 ~ W5MJC IK4TVP -06
002845 -12 0.1 1525 ~ LU1KJL WD8BOQ R-04
002845 -15 0.0 2791 ~ CQ NR0Q EM16 U.S.A
002845 -22 0.1 2197 ~ IZ3ATV KI5HZK R-22
002845 -24 0.2 2369 ~ CQ PY2NZ GG66 Brazi
002845 -24 0.2 2215 ~ IC8TEM W7AJE CN84
Rx Frequency
UTC dB DT Freq Message
002430 4 0.1 1407 ~ CQ KD0XD EN12 U.S.A
002445 8 0.1 1398 ~ S52FW KF5SFJ EM50
002500 15 0.1 1407 ~ CQ KD0XD EN12 U.S.A
002500 9 0.1 1403 ~ PD1DBL HC1DAZ RR73
002530 11 0.1 1408 ~ CQ KD0XD EN12 U.S.A
002530 5 0.1 1403 ~ CQ HC1DAZ FI09 Ecuad
002545 2 0.1 1399 ~ S52FW KF5SFJ R-07
002600 17 0.1 1408 ~ CQ KD0XD EN12 U.S.A
002600 8 0.1 1404 ~ CQ HC1DAZ FI09 Ecuad
002615 10 0.1 1399 ~ S52FW KF5SFJ 73
002630 11 0.1 1406 ~ CQ KD0XD EN12 U.S.A
002645 2 0.1 1399 ~ VE3APT KF5SFJ EM50
002700 18 0.1 1408 ~ CQ KD0XD EN12 U.S.A
002700 7 0.1 1404 ~ IK4TVP HC1DAZ 73
002715 8 0.1 1399 ~ VE3APT KF5SFJ EM50
002715 0 0.1 1404 ~ CQ HC1DAZ FI09 Ecuad
002730 16 0.1 1408 ~ CQ KD0XD EN12 U.S.A
002745 0 0.1 1404 ~ CQ HC1DAZ FI09 Ecuad
002800 16 0.1 1408 ~ CQ KD0XD EN12 U.S.A
002830 11 0.1 1408 ~ CQ KD0XD EN12 U.S.A
CQ only
Log QSO
Stop
Monitor
Erase
Decode
Enable Tx
Halt Tx
Tune
Menus
20m
14.074 000
Tx even/1st
Hold Tx Freq
Tx 1547 Hz
DX Call
DX Grid
KD0XD
EN12
Az: 285 738 mi
Rx 1407 Hz
Report 11
Lookup
Add
Auto Seq
Call 1st
2023 Apr 03
00:29:02
69 dB
Generate Std Msgs
Next
Now
Pwr
KD0XD W8RNO EN80
KD0XD W8RNO +11
KD0XD W8RNO R+11
KD0XD W8RNO RRR
KD0XD W8RNO 73
CQ W8RNO EN80
Tx 1
Tx 2
Tx 3
Tx 4
Tx 5
Tx 6
Receiving
FT8
Last Tx: KD0XD W8RNO 73
23
2/15
WD:6m

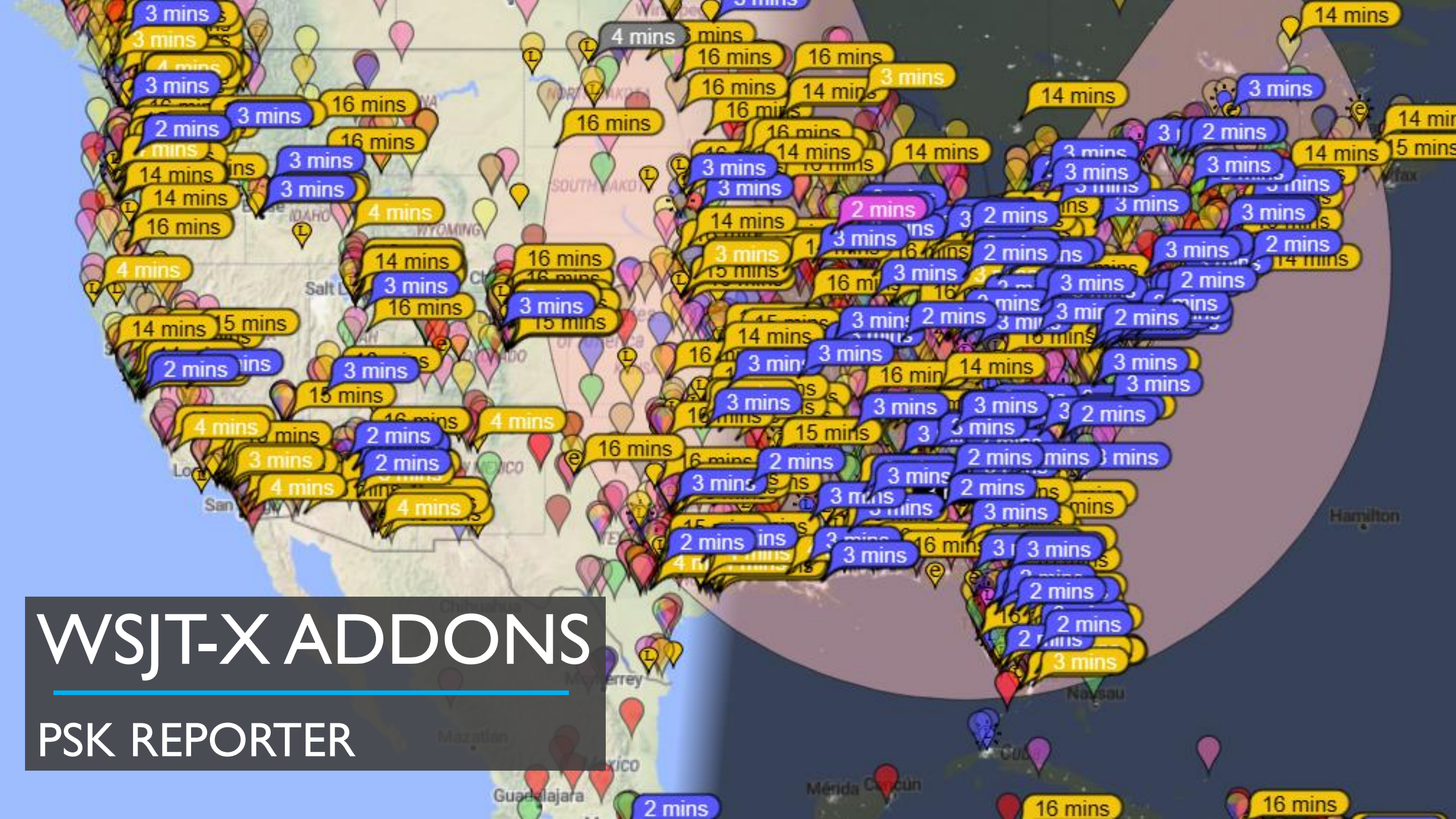
WSJT-X

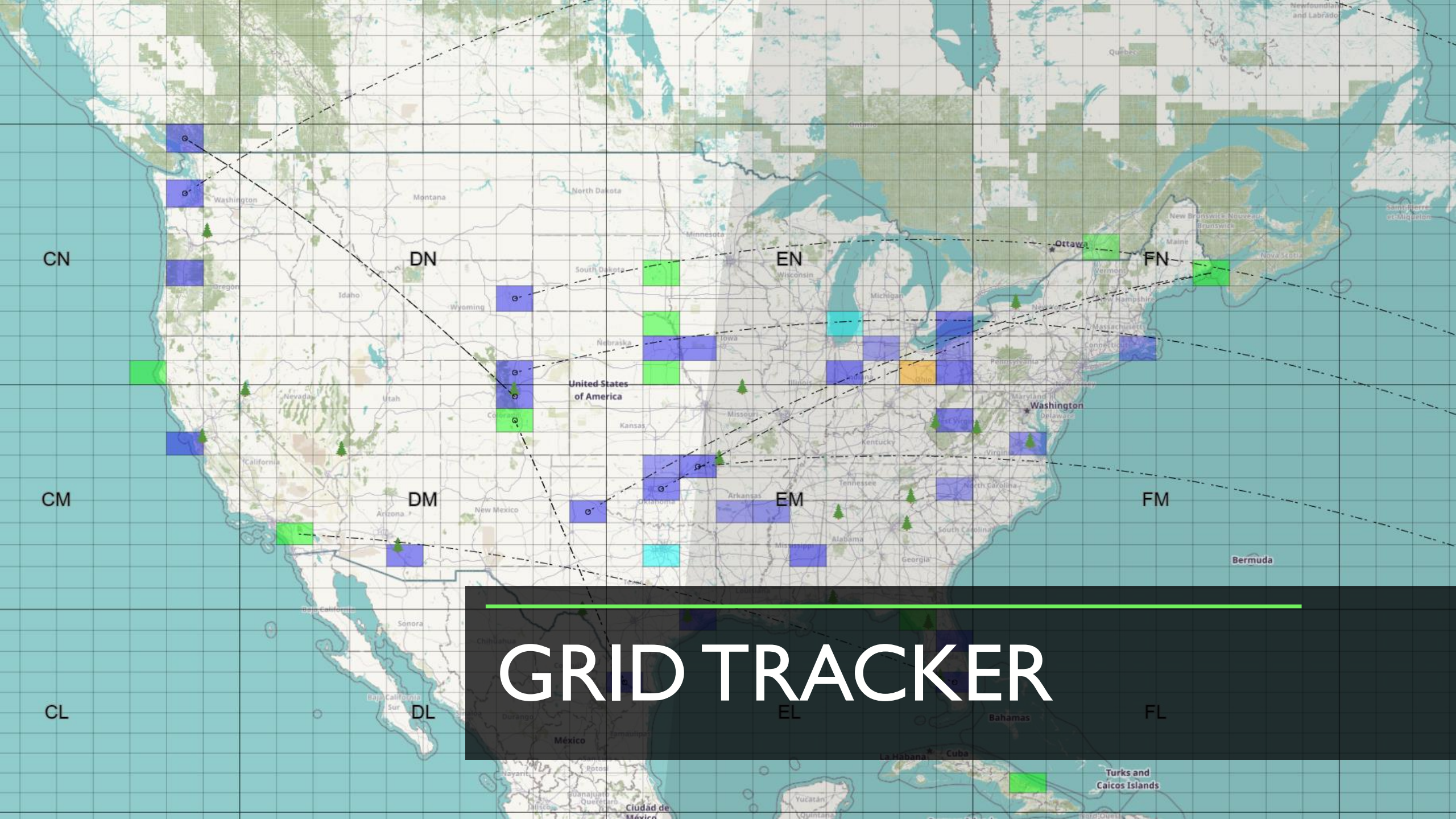

CQ only
Log QSO
Stop
Monitor
Erase
Decode
Enable Tx
Halt Tx
Tune
Menus
20m
14.074 000
Tx even/1st
Hold Tx Freq
Tx 1547 Hz
DX Call
DX Grid
KD0XD
EN12
Az: 285
738 mi
Rx 1407 Hz
Report 11
Lookup
Add
Auto Seq
Call 1st
2023 Apr 03
00:22:57
80
60
40
20
0
67 dB
Generate Std Msgs
Next
Now
Pwr
KD0XD W8RNO EN80
KD0XD W8RNO +11
KD0XD W8RNO R+11
KD0XD W8RNO RRR
KD0XD W8RNO 73
CQ W8RNO EN80
Tx 1
Tx 2
Tx 3
Tx 4
Tx 5
Tx 6
Receiving
FT8
Last Tx: KD0XD W8RNO 73
22
12/15
WD:6m

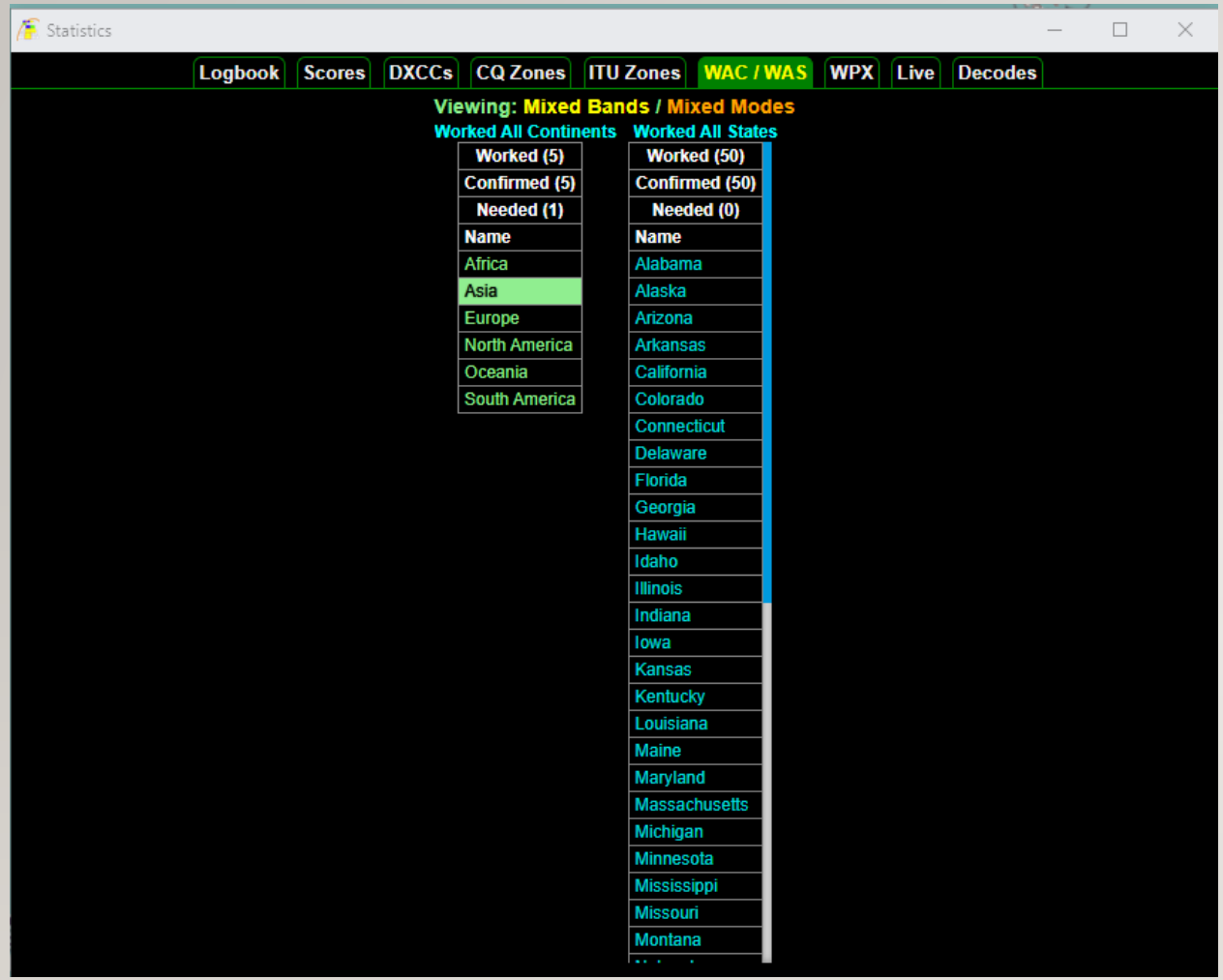
WSJT-X QSO AND LOG

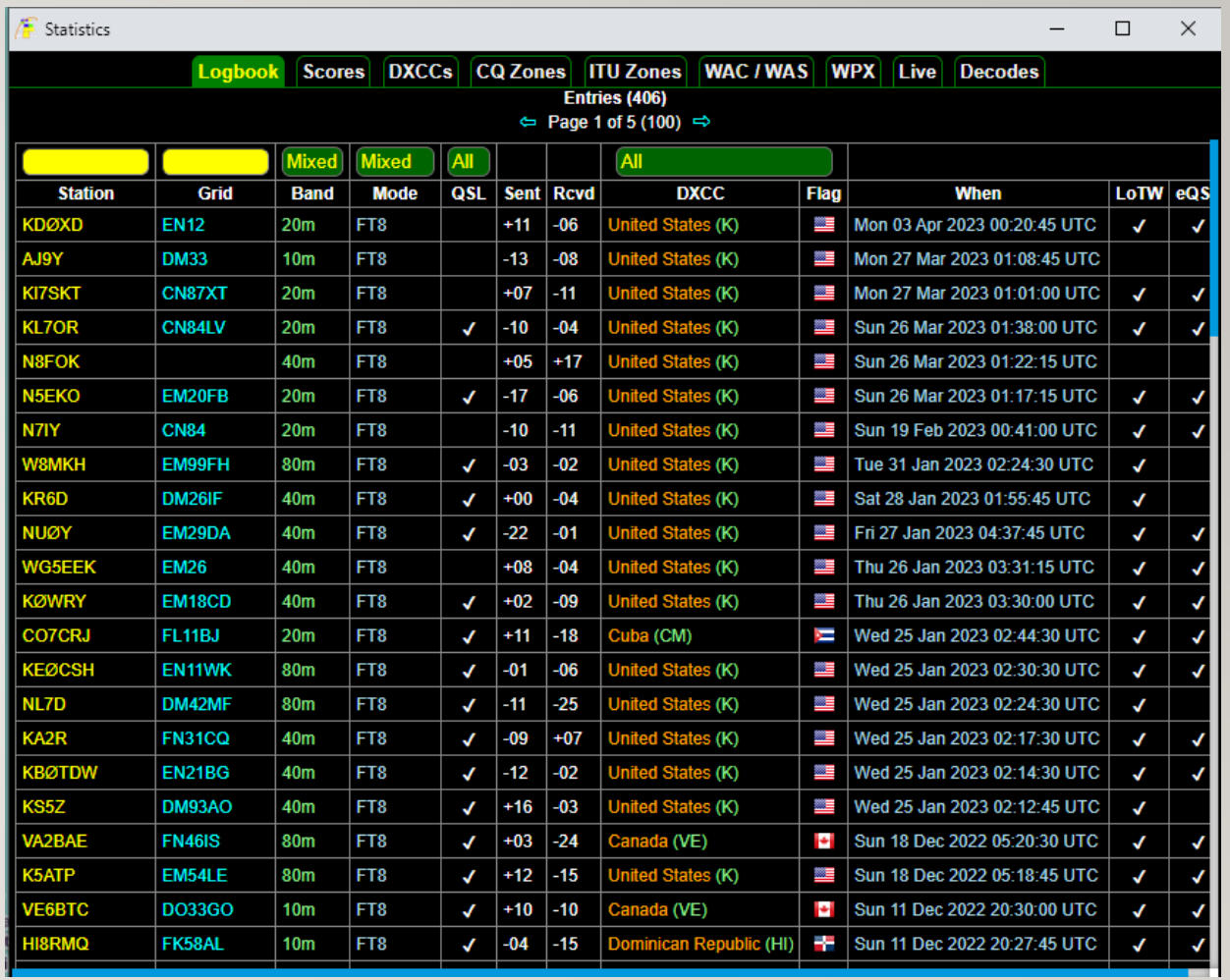
```
002030    7 -0.3 1408 ~  CQ KD0XD EN12          U.S.A
002045   Tx      1547 ~  KD0XD W8RNO EN80
002100   11  0.1 1408 ~  W8RNO KD0XD -06
002115   Tx      1547 ~  KD0XD W8RNO R+11
002130   11  0.1 1407 ~  W8RNO KD0XD RR73
002145   Tx      1547 ~  KD0XD W8RNO 73
```




WSJT-X ADDONS
PSK REPORTER


CN
DN
EN
FN
CM
DM
EM
FM
CL
DL
EL
FL
GRID TRACKER
United States of America
Washington
Ottawa
Bermuda
Bahamas
Cuba
La Habana
México
Ciudad de México
Turks and Caicos Islands





LOTW LOGGING

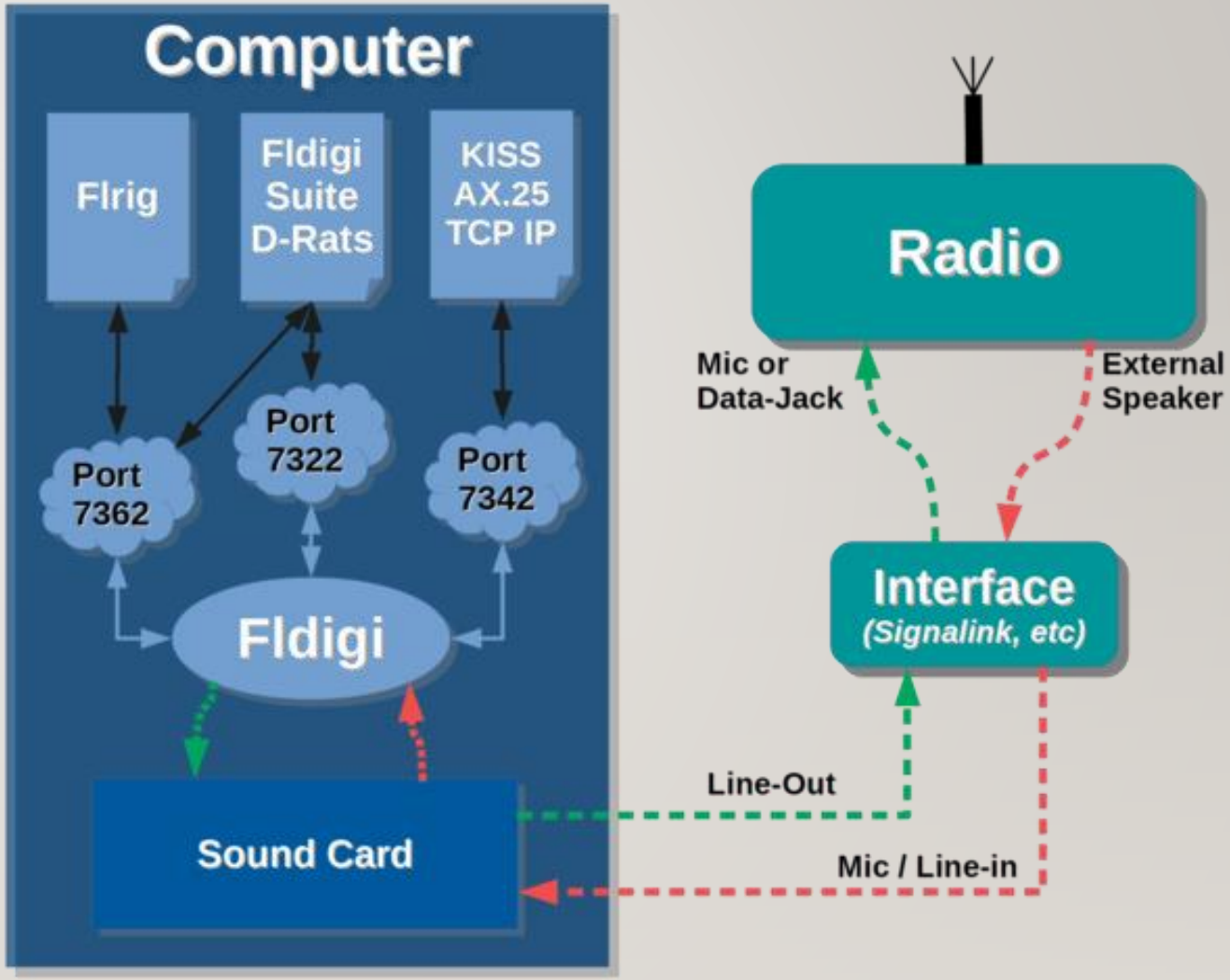
JS8CALL

JS8Call de KN4CRD (v2.2.0)
File Configurations Mode Log View Control Help
14.074 000
1600 Hz
W8RNO
01:39:54
2023 Apr 03
RX
TX
NORMAL+MULTI+AUTO+CONF+HB+ACK
SPOT
LOG
TUNE
Offset Age SNR Message(s)
1829 Hz 7m -10 dB OATDETMIO I TN .....
03:01:31 - (797) - KD2CNC: W8RNO HEARTBEAT SNR +07 ◊
03:01:31 - (851) - N6CYB: W8RNO HEARTBEAT SNR +04 ◊
03:01:31 - (1500) - KB7ITU: W8RNO HEARTBEAT SNR -04 ◊
03:02:27 - (1602) - KK5JB: K5HO .....THE TIME WITH KIDS. MINE IS OUT OF THE HOUSE. WE WILL BE A PARK GRAINGER LK THIS WKND. COME BY. WILSON FOX PARK. NICE CHATTING. CHECK OUT WC-ARES.ORG IF YOU ARE INTERESTED. NICE ACTIVE BUNCH. ON YOUR FINAL GOING TO TURN OFF RADIO BTU ◊
03:05:07 - (1602) - K5HO: KK5JB LOOKS LIKE WE DOUBLED! I WILL CHECK OUT WC-ARES.ORG! SOUNDS LIKE FUN. MY XYL IS CALLING SO GOOD TIMING! I HOPE U STAY DRY! 73 JOSE!! I WILL LOOK FOR YOU AGAIN HOPEFULLY SOON. ◊
03:07:07 - (1602) - KK5JB: K5HO 73 CHRIS. GD NGHT ◊
03:07:37 - (1602) - K5HO: KK5JB SK ◊
TYPE YOUR OUTGOING MESSAGES HERE.
Callsigns Age SNR Offset ✓ Name Comment
@ALLCALL
@UCARES
HB + ACK CQ REPLY SNR INFO STATUS Saved Directed Deselect Send Halt
CAT
68 dB
800 1000 1200 1400 1600 1800
01:39:45 20m
01:39:30 20m
01:39:15 20m
01:39:00 20m
01:38:45 20m
01:38:30 20m
01:38:15 20m
Control Display Timing
Offset
Offset: 1600 Hz
QSY
QSY
Center: 1500 Hz
Filter
Enable Filter
Center: 1500 Hz Sync
Width: 2000 Hz
Min: 500 Hz
Max: 2500 Hz
Decoding JS8
9/15

"What's your favorite band?"
"Seventeen Meters."

HOW DOES THE COMPUTER INTERFACE WITH THE RADIO?

- Sound Card generates tone
- Tone is sent to interface
- Interface keys radio and transfers tone



HOW DOES THE COMPUTER INTERFACE WITH THE RADIO?

- Many newer radios have built in soundcards. They simply connect to the computer via USB
- Add an external sound card to your computer with a digital interface (Signalink, RigExpert)
- Acoustic coupling

EXTERNAL SOUND CARD

Select playback device

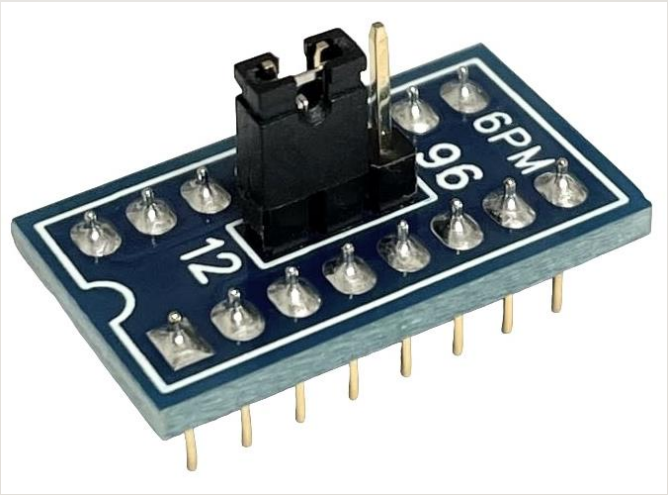
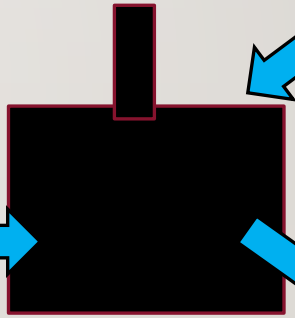
Speakers (3- USB AUDIO CODEC)

Wave Link Aux 2 (Elgato Wave:3)

Speakers (2- USB AUDIO CODEC)

Wave Link Aux 1 (Elgato Wave:3)

80



MY SIGNALINK AUDIO SETUP