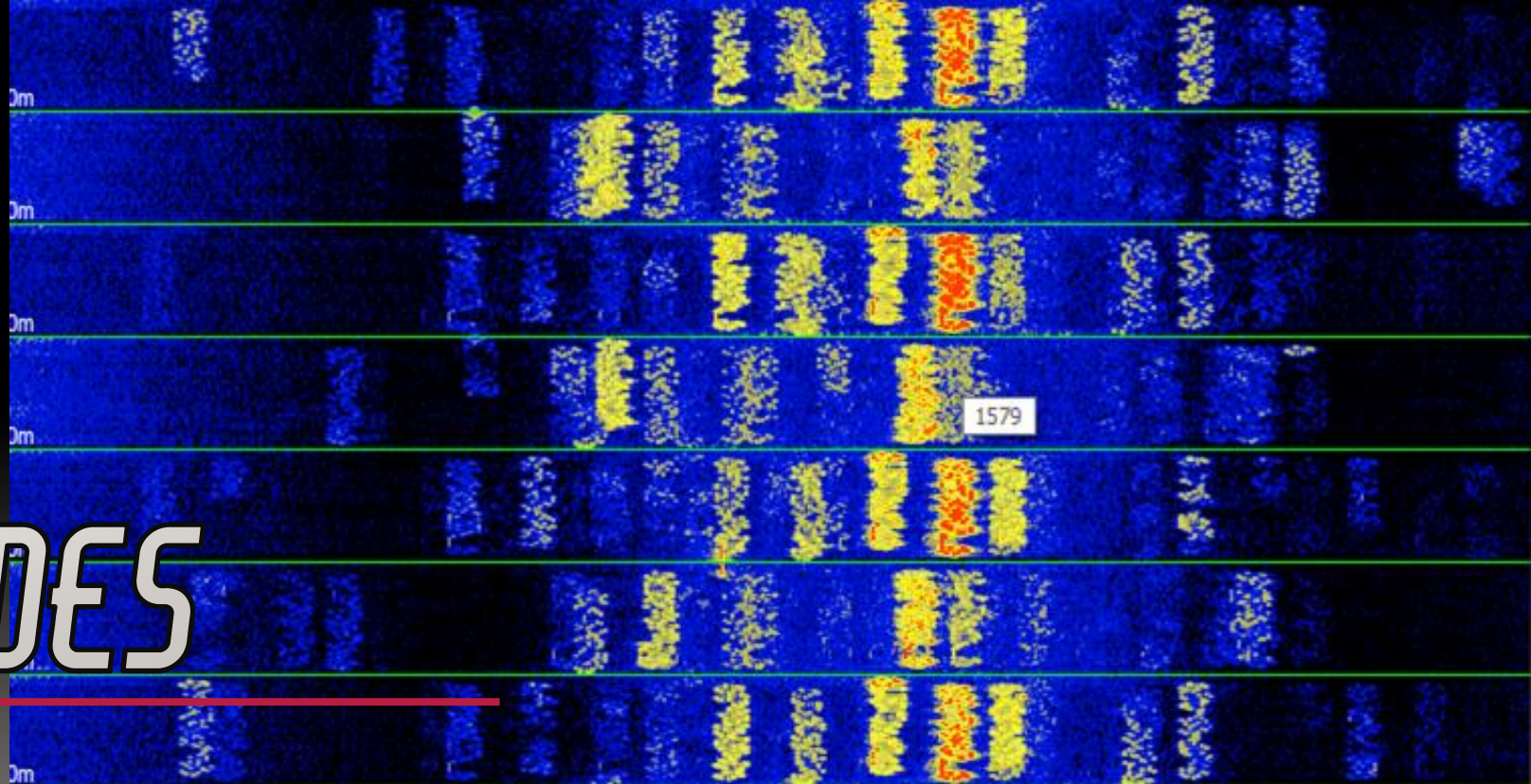


GETTING STARTED WITH

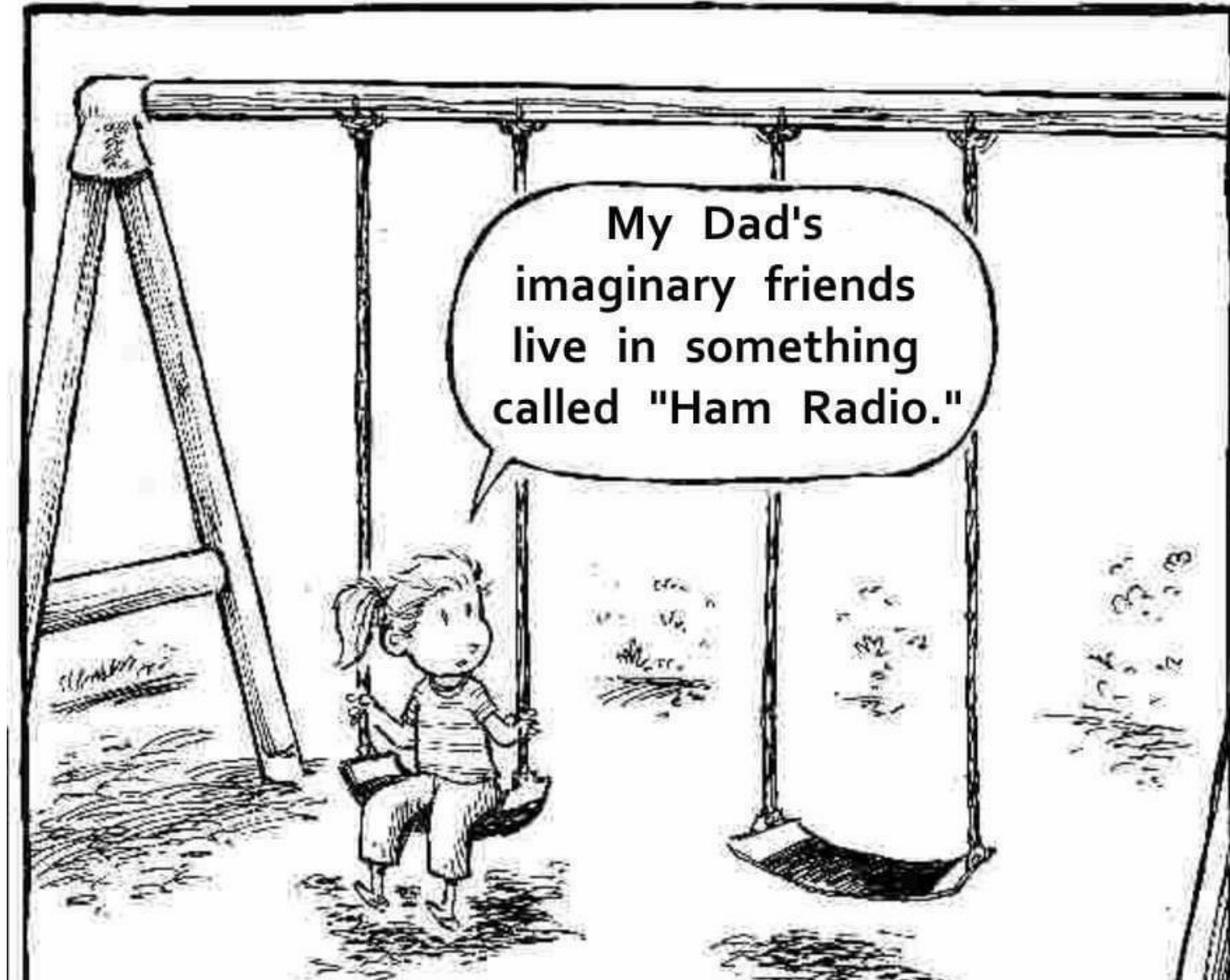
DIGITAL MODES

In Amateur Radio

By W8RNO



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	
193715	-17	0.1	1953	~	AA5RV	AG7IG	DN17	



WHY USE DIGITAL?

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

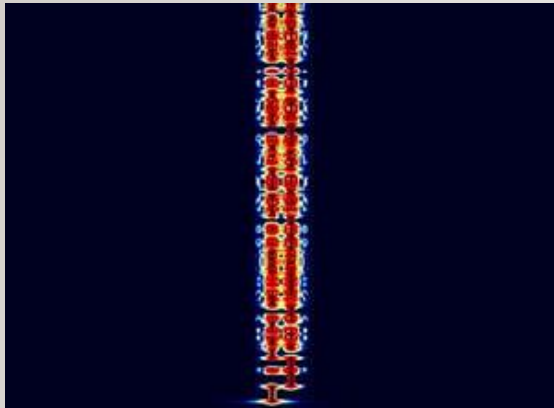
MOST COMMON DIGITAL MODES

- RTTY
- PSK31
- FT8
- JS8Call

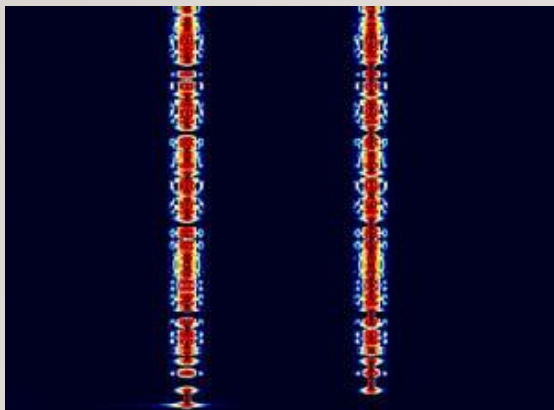
RTTY – RADIO TELETYPE

- 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

PSK 2800

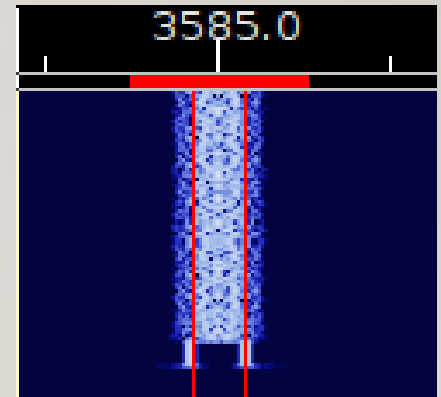
Freq 14071.046 On Off 2116 In 599 Out 599 Cnty/Cntry Notes

Call Op Az

Qth St Pr L

14072.08 9uf de wc0g I need to get going john. thanks 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



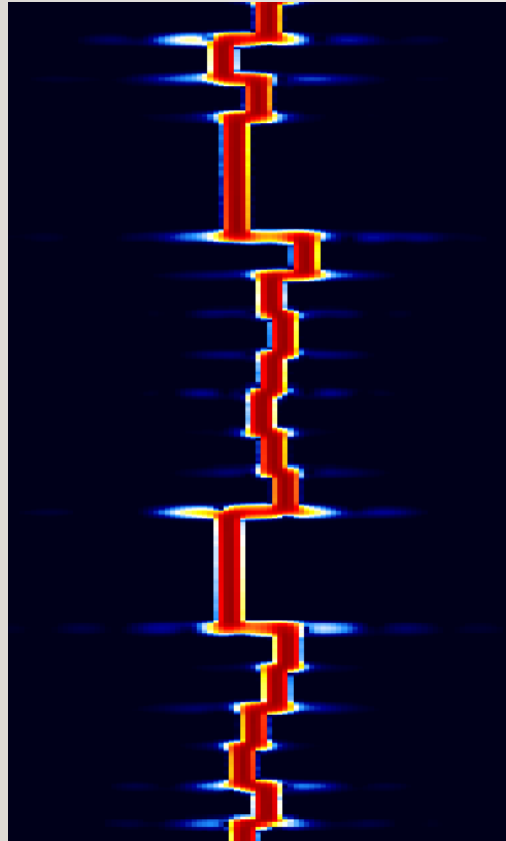
FT8 – FRANK & TAYLOR 8

- 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 <i>(in the form of a WSJT-X dB reading instead of in a more conventional, though more subjective, rstS 📍 reading)</i>
"KI7PO IZ1M R-12"	IZ1M confirms signal report & replies with his own report
"IZ1M KI7PO RRR"	KI7PO tells IZ1M, "Reception Report Received" <i>(This can also be shortened to "RR73" indicating, "Report Received 73," which would be a completed QSO)</i>
"KI7PO IZ1M 73"	IZ1M says "Best regards" ("73")
"IZ1M KI7PO 73"	KI7PO says "Best regards" ("73") <i>(not used if KI7PO's third transmission was "RR73")</i>

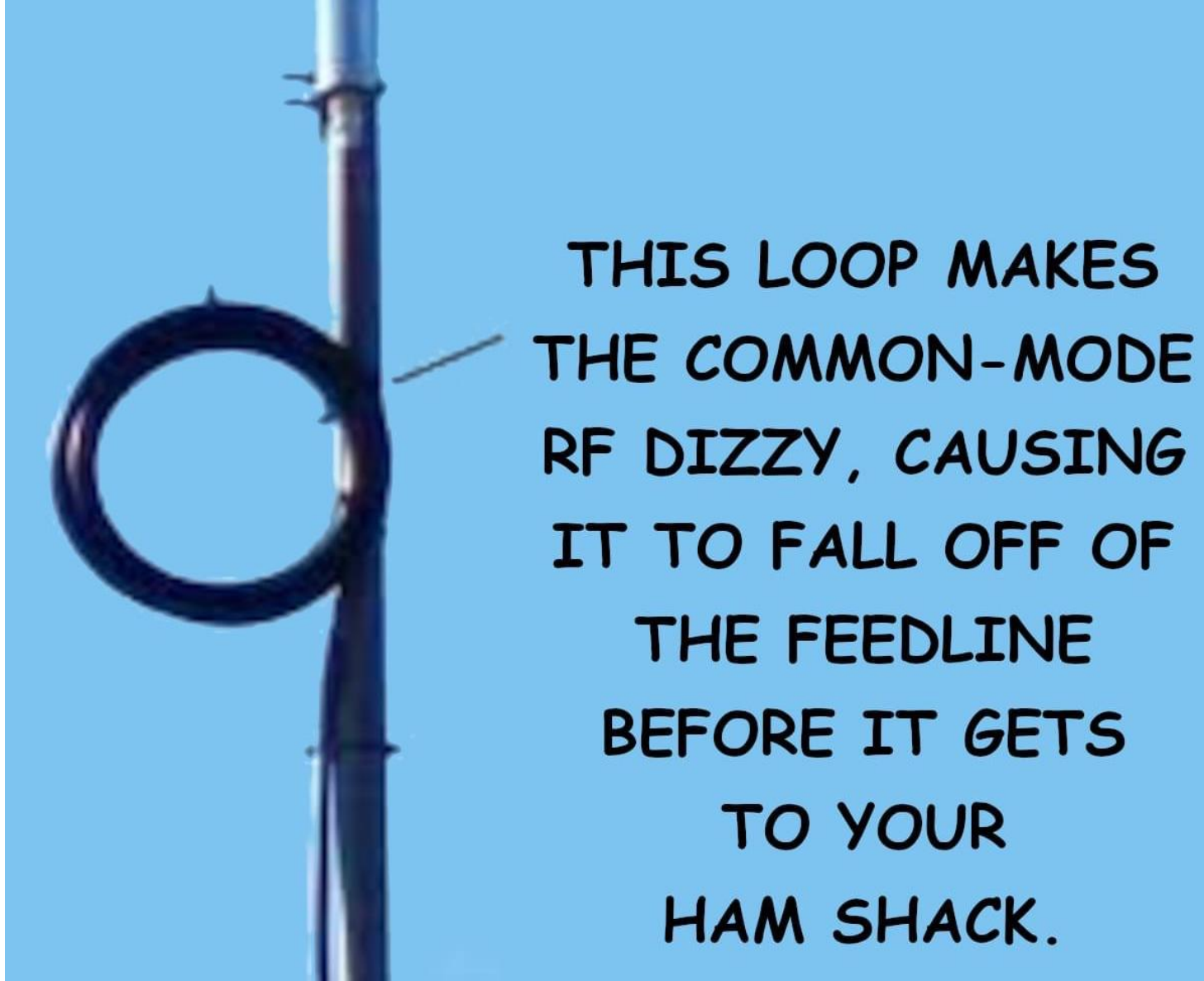
FT8 SOUND AND WATERFALL



FT8 Signal

JS8

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

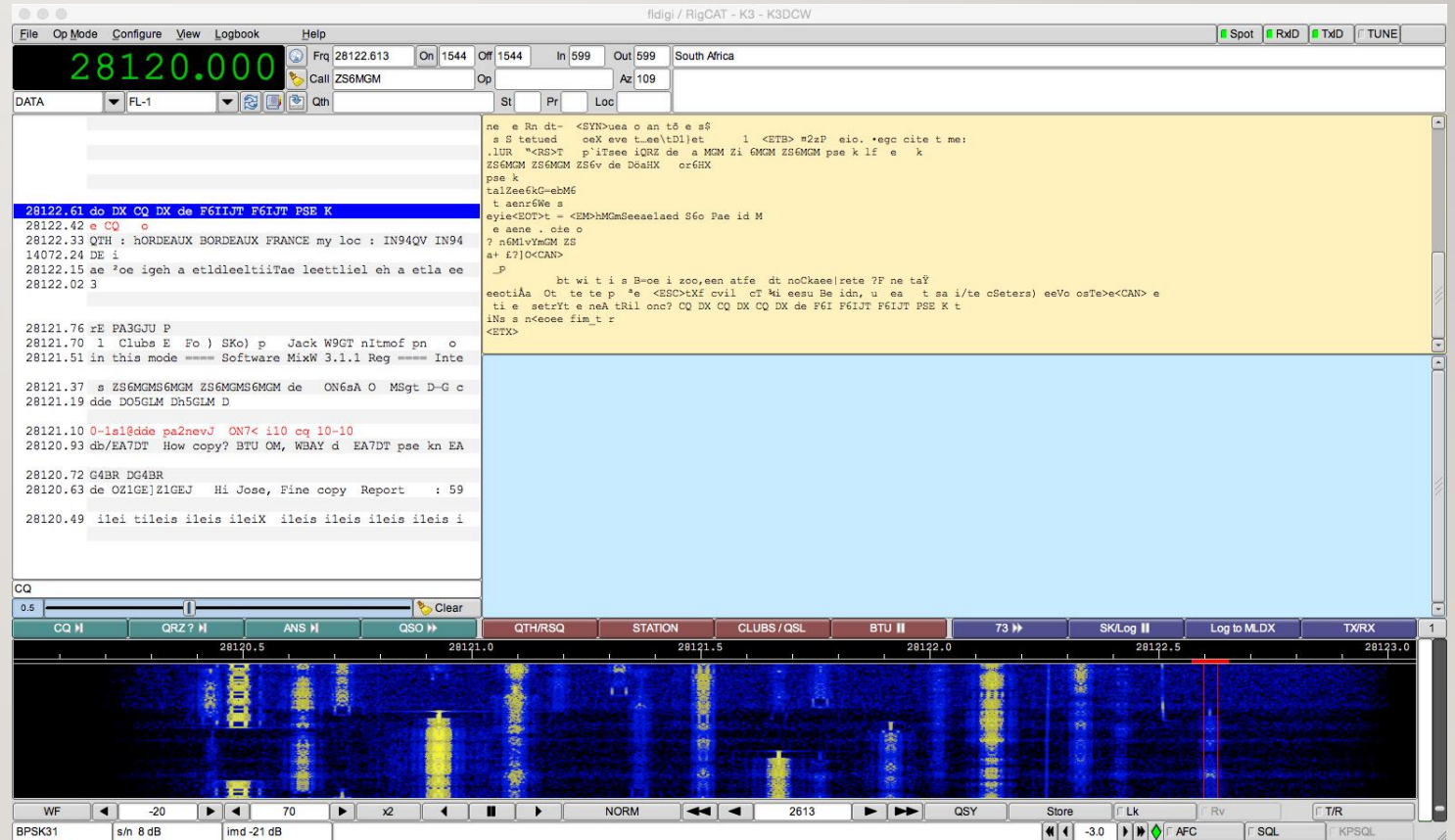
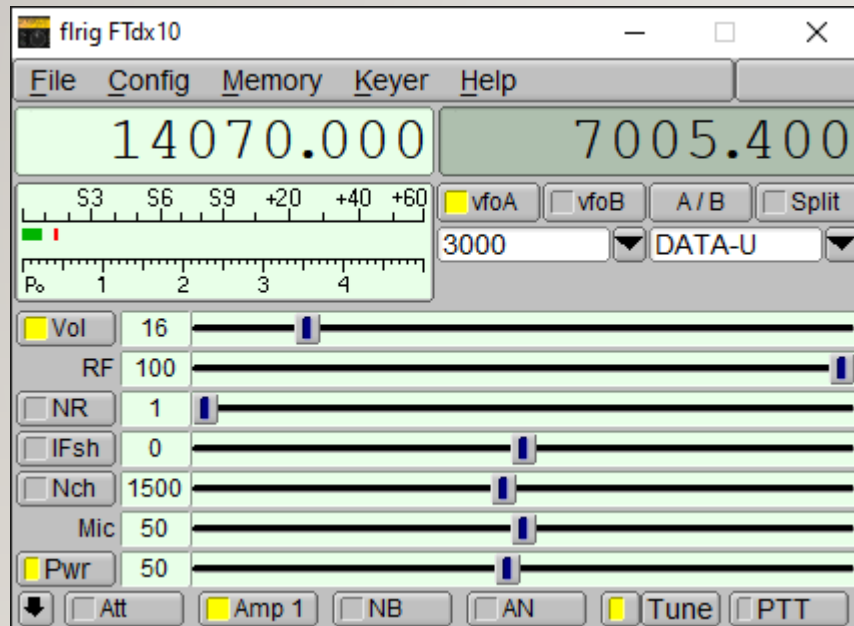


THIS LOOP MAKES
THE COMMON-MODE
RF DIZZY, CAUSING
IT TO FALL OFF OF
THE FEEDLINE
BEFORE IT GETS
TO YOUR
HAM SHACK.

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 on many operating systems, even Raspberry Pi

FLDIGI

QSO I had in FLDigi using BPSK3I on 20M

NOAN 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 than 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 NOAN de W8RNO k

W8RNO, Christopher de NOAN

Very good print, signals are stable . Earlier there was a lot of qsb, but since we started things are good. Let me check something 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 NOAN k

NOAN 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 NOAN 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 NOAN sk

NOAN 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

Flrig Memory

Frequency	BW	Mode	Comments
3580.000	2800	PSK	
3810.000	3000	LSB	
3816.000	3000	LSB	
7070.000	2800	PSK	
14070.000	2800	PSK	

Tag:

flrig FTdx10

File Config Memory Keyer Help

14070.000 7005.400

S3 S6 S9 +20 +40 +60

vfoA vfoB A/B Split

3000 DATA-U

Po 1 2 3 4

Vol 16

RF 100

NR 1

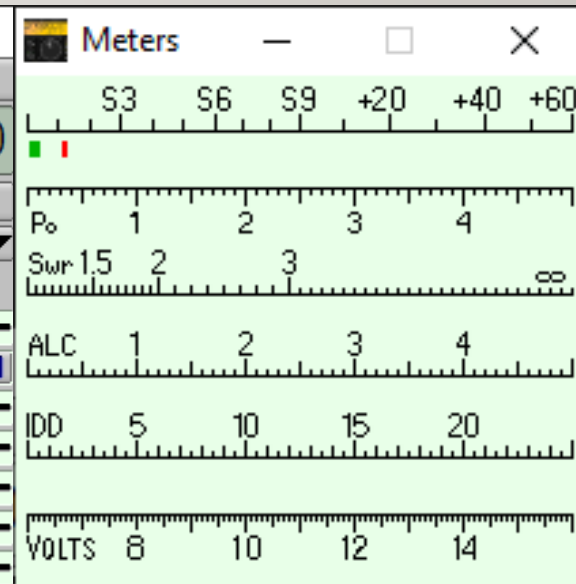
IFsh 0

Nch 1500

Mic 50

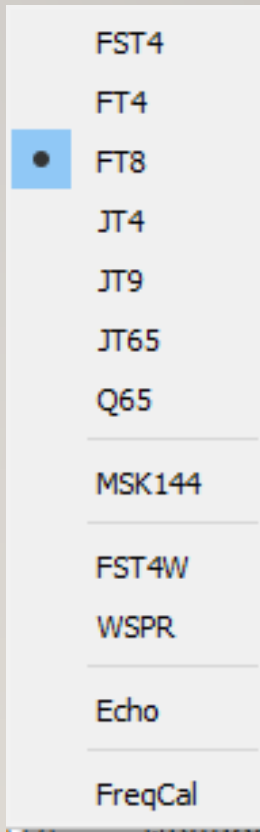
Pwr 50

Att Amp 1 NB AN Tune PTT



WSJT-X – WEAK SIGNAL COMMUNICATION BY KIJT

- 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 v2.5.4 by K1JT, G4WJS, K9AN, and IV3NWW

File Configurations View Mode Decode Save Tools Help

Band Activity					Rx Frequency				
UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message
002845	4	0.1	1629	~ CN8ZG K4MMP EN60	002430	4	0.1	1407	~ CQ KDOXD EN12 U.S.A
002845	19	0.2	1700	~ W9NG NKOV -06	002445	8	0.1	1398	~ S52FW KF5SFJ EM50
002845	-4	-0.8	2199	~ CQ KOSMM EN10 U.S.A	002500	15	0.1	1407	~ CQ KDOXD EN12 U.S.A
002845	0	0.2	1250	~ OD5ZZ W1IP R-07	002500	9	0.1	1403	~ PD1DBL HC1DAZ RR73
002845	-5	0.3	1486	~ D2UY KI7URL DN73	002530	11	0.1	1408	~ CQ KDOXD EN12 U.S.A
002845	-6	0.4	1121	~ CQ N3SD EN90 U.S.A	002530	5	0.1	1403	~ CQ HC1DAZ FI09 Ecuad
002845	-5	-0.9	1035	~ CQ K7ISM DM41 U.S.A	002545	2	0.1	1399	~ S52FW KF5SFJ R-07
002845	-12	0.5	888	~ CX8DSK K7SPS DN13	002600	17	0.1	1408	~ CQ KDOXD EN12 U.S.A
002845	-6	0.1	1848	~ PY5XT AI5FJ 73	002600	8	0.1	1404	~ CQ HC1DAZ FI09 Ecuad
002845	-17	0.1	653	~ KP3N WOHOP DM79	002615	10	0.1	1399	~ S52FW KF5SFJ 73
002845	-21	0.1	722	~ CQ DX WB4HUI EL29 U.S.A	002630	11	0.1	1406	~ CQ KDOXD EN12 U.S.A
002845	-19	0.1	374	~ CQ KOHMHZ DN88 U.S.A	002645	2	0.1	1399	~ VE3APT KF5SFJ EM50
002845	-2	0.1	1296	~ VU2WJ W8RLG R-18	002700	18	0.1	1408	~ CQ KDOXD EN12 U.S.A
002845	17	0.1	1704	~ EA7LZ KB5UKT EM29	002700	7	0.1	1404	~ IK4TVP HC1DAZ 73
002845	-20	0.2	1959	~ WSMJC IK4TVP -06	002715	8	0.1	1399	~ VE3APT KF5SFJ EM50
002845	-12	0.1	1525	~ LU1KJL WD8BOQ R-04	002715	0	0.1	1404	~ CQ HC1DAZ FI09 Ecuad
002845	-15	0.0	2791	~ CQ NROQ EM16 U.S.A	002730	16	0.1	1408	~ CQ KDOXD EN12 U.S.A
002845	-22	0.1	2197	~ IZ3ATV KI5HZK R-22	002745	0	0.1	1404	~ CQ HC1DAZ FI09 Ecuad
002845	-24	0.2	2369	~ CQ PY2NZ GG66 Brazi	002800	16	0.1	1408	~ CQ KDOXD EN12 U.S.A
002845	-24	0.2	2215	~ IC8TEM W7AJE CN84	002830	11	0.1	1408	~ CQ KDOXD EN12 U.S.A

CQ only Log QSO Menus

20m

14.074 000

Tx even/1st Hold Tx Freq
 Tx 1547 Hz
 Rx 1407 Hz
 Report 11
 Auto Seq Call 1st

DX Call

DX Grid

KDOXD

EN12

Az: 285

738 mi

Lookup

Add

2023 Apr 03

00:29:02

Generate Std Msgs

Next

Now

Pwr

KDOXD W8RNO EN80	<input type="radio"/>	Tx 1
KDOXD W8RNO +11	<input type="radio"/>	Tx 2
KDOXD W8RNO R+11	<input type="radio"/>	Tx 3
KDOXD W8RNO RRR	<input type="radio"/>	Tx 4
KDOXD W8RNO 73	<input type="radio"/>	Tx 5
CQ W8RNO EN80	<input checked="" type="radio"/>	Tx 6

Receiving

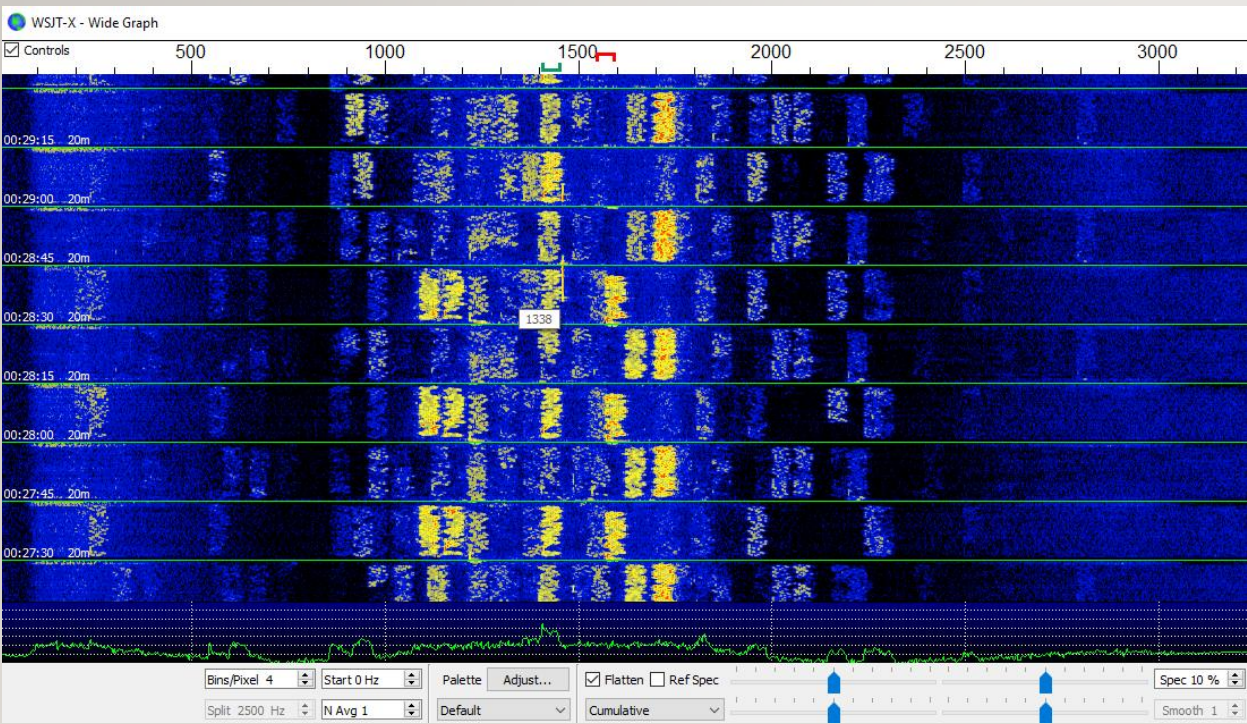
FT8

Last Tx: KDOXD W8RNO 73

23

2/15

WD:6m



WSJT-X

The screenshot displays the WSJT-X software interface. At the top, there is a menu bar with buttons for **CQ only**, **Log QSO**, **Stop**, **Monitor** (highlighted in green), **Erase**, **Decode**, **Enable Tx**, **Halt Tx**, **Tune**, and **Menus** (checked).

The main interface area includes:

- A frequency display showing **14.074 000** MHz.
- A signal strength indicator on the left showing **67 dB**.
- DX Call and DX Grid fields containing **KD0XD** and **EN12**.
- Azimuth and distance information: **Az: 285** and **738 mi**.
- Buttons for **Lookup** and **Add**.
- TX/RX frequency settings: **Tx 1547 Hz** and **Rx 1407 Hz**.
- Other settings: **Report 11**, **Auto Seq** (checked), and **Call 1st** (checked).
- A date and time display: **2023 Apr 03 00:22:57**.

On the right side, there is a list of messages with columns for **Next**, **Now**, and **Pwr**. The messages are:

Message	Next	Now	Pwr
Generate Std Msgs			
KD0XD W8RNO EN80	<input type="radio"/>	Tx 1	
KD0XD W8RNO +11	<input type="radio"/>	Tx 2	
KD0XD W8RNO R+11	<input type="radio"/>	Tx 3	
KD0XD W8RNO RRR	<input type="radio"/>	Tx 4	
KD0XD W8RNO 73	<input type="radio"/>	Tx 5	
CQ W8RNO EN80	<input checked="" type="radio"/>	Tx 6	

At the bottom, there is a status bar with **Receiving** (green), **FT8** (pink), **Last Tx: KD0XD W8RNO 73**, **22**, a green progress bar, **12/15**, and **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 v2.5.4 by K1JT, G4WJS, K9AN, and IV3NWW - Log QSO

Click OK to confirm the following QSO:

Call	Start	End
KD0XD	4/3/2023 00:20:45	4/3/2023 00:21:45

Mode	Band	Rpt Sent	Rpt Rcvd	Grid	Name
FT8	20m	+11	-06	EN12	

Tx power Retain

Comments Retain

Operator

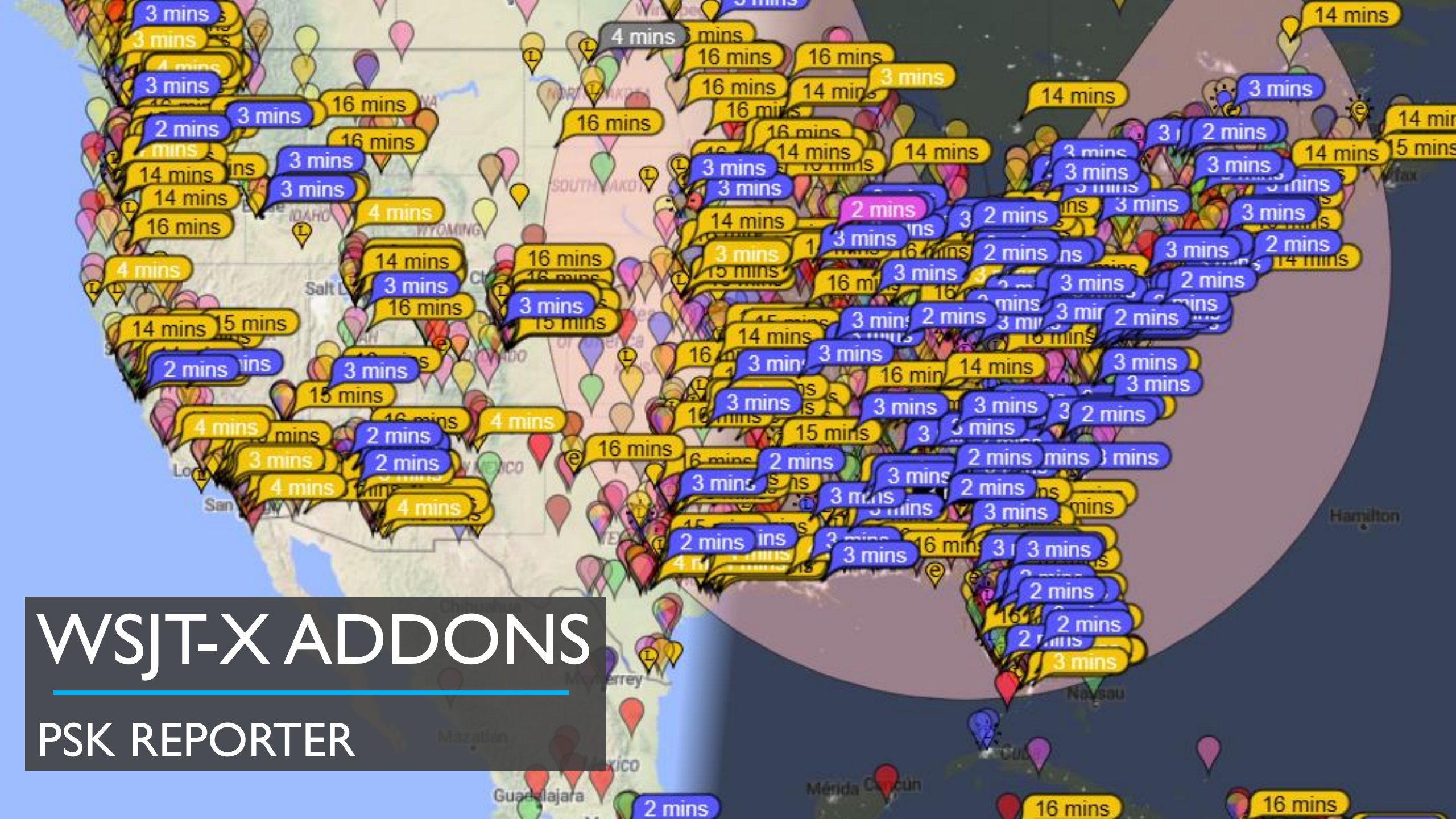
Exch sent Rcvd

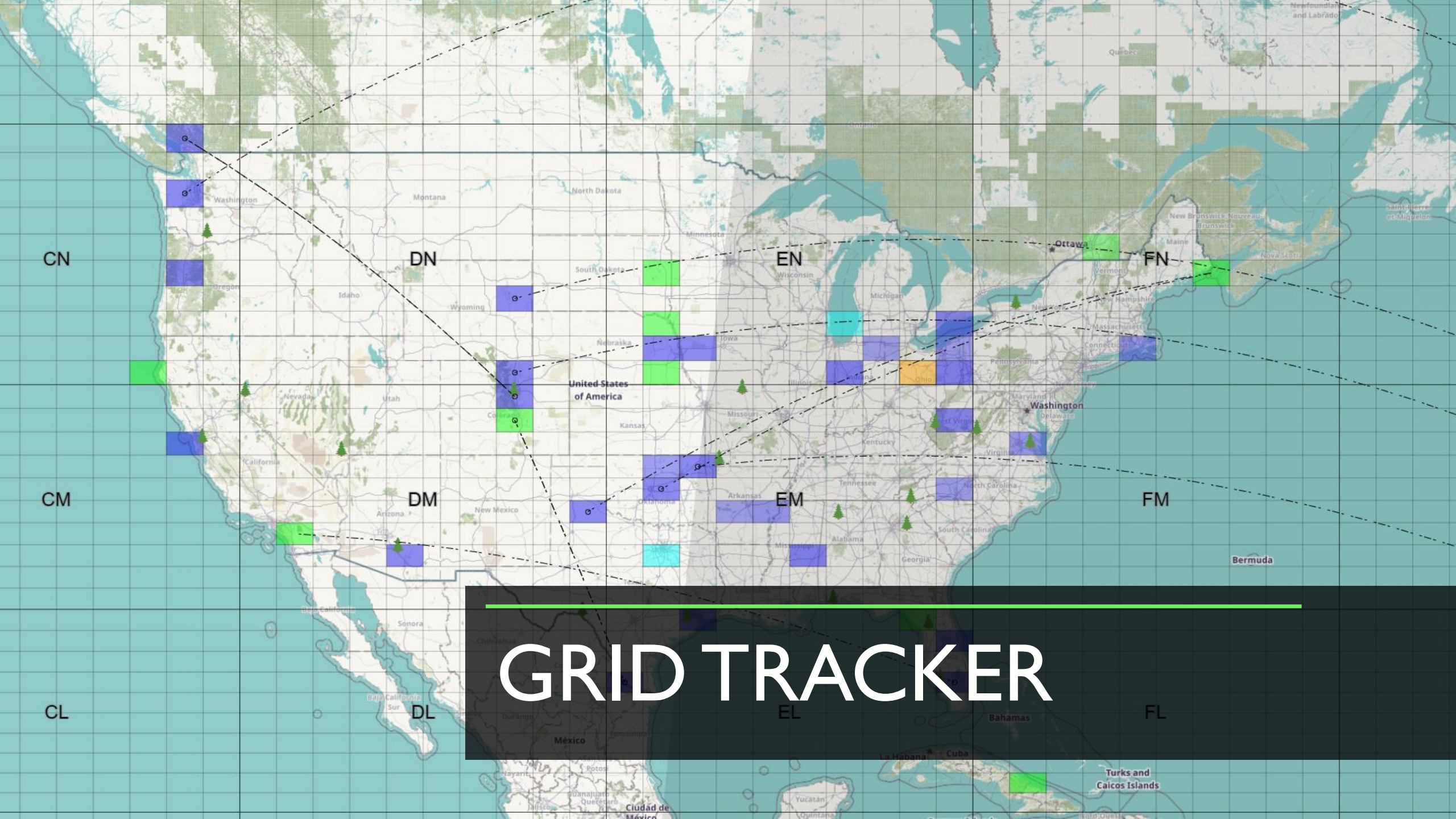
Prop Mode Retain

OK Cancel

WSJT-X ADDONS

PSK REPORTER





CN

CM

CL

DN

DM

DL

EN

EM

EL

FN

FM

FL

GRID TRACKER

Statistics

Logbook Scores DXCCs CQ Zones ITU Zones WAC / WAS WPX Live Decodes

Viewing: Mixed Bands / Mixed Modes
 Worked All Continents Worked All States

Worked (5)	Worked (50)
Confirmed (5)	Confirmed (50)
Needed (1)	Needed (0)
Name	Name
Africa	Alabama
Asia	Alaska
Europe	Arizona
North America	Arkansas
Oceania	California
South America	Colorado
	Connecticut
	Delaware
	Florida
	Georgia
	Hawaii
	Idaho
	Illinois
	Indiana
	Iowa
	Kansas
	Kentucky
	Louisiana
	Maine
	Maryland
	Massachusetts
	Michigan
	Minnesota
	Mississippi
	Missouri
	Montana

Statistics

Logbook Scores DXCCs CQ Zones ITU Zones WAC / WAS WPX Live Decodes

Entries (406)
 Page 1 of 5 (100)

Station	Grid	Band	Mode	QSL	Sent	Rcvd	DXCC	Flag	When	LoTW	eQS
KDØXD	EN12	20m	FT8		+11	-06	United States (K)	🇺🇸	Mon 03 Apr 2023 00:20:45 UTC	✓	✓
AJ9Y	DM33	10m	FT8		-13	-08	United States (K)	🇺🇸	Mon 27 Mar 2023 01:08:45 UTC		
KI7SKT	CN87XT	20m	FT8		+07	-11	United States (K)	🇺🇸	Mon 27 Mar 2023 01:01:00 UTC	✓	✓
KL7OR	CN84LV	20m	FT8	✓	-10	-04	United States (K)	🇺🇸	Sun 26 Mar 2023 01:38:00 UTC	✓	✓
N8FOK		40m	FT8		+05	+17	United States (K)	🇺🇸	Sun 26 Mar 2023 01:22:15 UTC		
N5EKO	EM20FB	20m	FT8	✓	-17	-06	United States (K)	🇺🇸	Sun 26 Mar 2023 01:17:15 UTC	✓	✓
N7IY	CN84	20m	FT8		-10	-11	United States (K)	🇺🇸	Sun 19 Feb 2023 00:41:00 UTC	✓	✓
W8MKH	EM99FH	80m	FT8	✓	-03	-02	United States (K)	🇺🇸	Tue 31 Jan 2023 02:24:30 UTC	✓	
KR6D	DM26IF	40m	FT8	✓	+00	-04	United States (K)	🇺🇸	Sat 28 Jan 2023 01:55:45 UTC	✓	
NUØY	EM29DA	40m	FT8	✓	-22	-01	United States (K)	🇺🇸	Fri 27 Jan 2023 04:37:45 UTC	✓	✓
WG5EEK	EM26	40m	FT8		+08	-04	United States (K)	🇺🇸	Thu 26 Jan 2023 03:31:15 UTC	✓	✓
KØWRY	EM18CD	40m	FT8	✓	+02	-09	United States (K)	🇺🇸	Thu 26 Jan 2023 03:30:00 UTC	✓	✓
CO7CRJ	FL11BJ	20m	FT8	✓	+11	-18	Cuba (CM)	🇨🇺	Wed 25 Jan 2023 02:44:30 UTC	✓	✓
KEØCSH	EN11WK	80m	FT8	✓	-01	-06	United States (K)	🇺🇸	Wed 25 Jan 2023 02:30:30 UTC	✓	✓
NL7D	DM42MF	80m	FT8	✓	-11	-25	United States (K)	🇺🇸	Wed 25 Jan 2023 02:24:30 UTC	✓	
KA2R	FN31CQ	40m	FT8	✓	-09	+07	United States (K)	🇺🇸	Wed 25 Jan 2023 02:17:30 UTC	✓	✓
KBØTDW	EN21BG	40m	FT8	✓	-12	-02	United States (K)	🇺🇸	Wed 25 Jan 2023 02:14:30 UTC	✓	✓
KS5Z	DM93AO	40m	FT8	✓	+16	-03	United States (K)	🇺🇸	Wed 25 Jan 2023 02:12:45 UTC	✓	
VA2BAE	FN46IS	80m	FT8	✓	+03	-24	Canada (VE)	🇨🇦	Sun 18 Dec 2022 05:20:30 UTC	✓	✓
K5ATP	EM54LE	80m	FT8	✓	+12	-15	United States (K)	🇺🇸	Sun 18 Dec 2022 05:18:45 UTC	✓	✓
VE6BTC	DO33GO	10m	FT8	✓	+10	-10	Canada (VE)	🇨🇦	Sun 11 Dec 2022 20:30:00 UTC	✓	✓
HI8RMQ	FK58AL	10m	FT8	✓	-04	-15	Dominican Republic (HI)	🇩🇲	Sun 11 Dec 2022 20:27:45 UTC	✓	✓

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)	Callsigns	Age	SNR	Offset	Name	Comment
1829 Hz	7m	-10 dB	OATDETMIO I TN					@ALLCALL	
								@UCARES	

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: KSHOTHE 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) - KSHO: 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: KSHO 73 CHRIS. GD NIGHT
03:07:37 - (1602) - KSHO: KK5JB SK

TYPE YOUR OUTGOING MESSAGES HERE.

HB + ACK CQ REPLY SNR INFO STATUS Saved Directed Deselect Send Halt

CAT

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

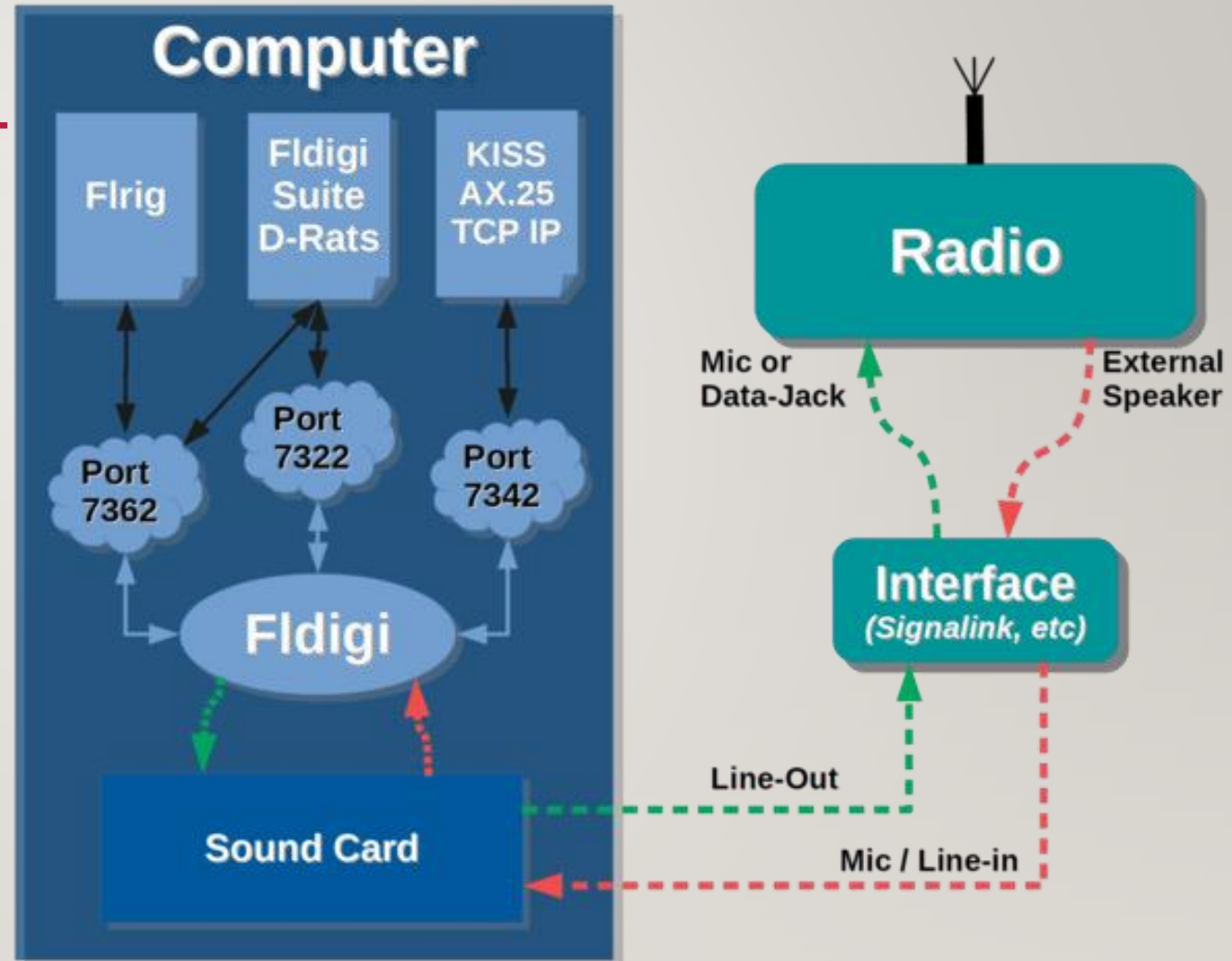
"What's your
favorite band?"

"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



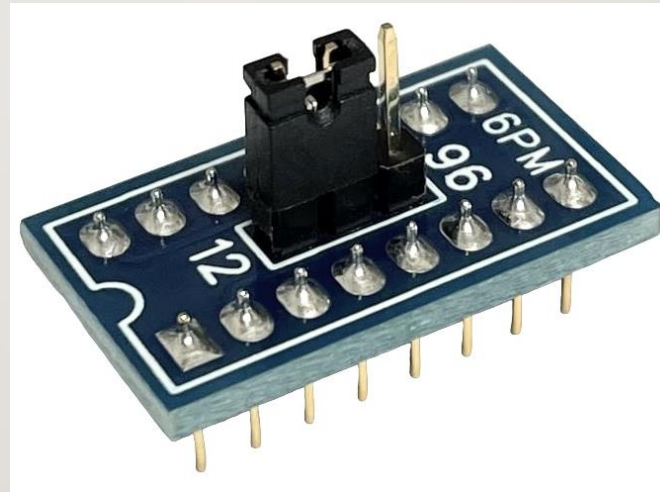
Select playback device

Speakers (3- USB AUDIO CODEC)

Wave Link Aux 2 (Elgato Wave:3)

Speakers (2- USB AUDIO CODEC)

Wave Link Aux 1 (Elgato Wave:3)



MY SIGNALINK AUDIO SETUP

