

WSPR (pronounced whisper)

Weak Signal Propagation Reporter

WSPR

- Uses HF radio with USB
 - Computer
 - sound card
 - Internet connection
 - Started in April 2008
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Key Folks

- Joe Taylor, K1JT
 - Developed WSPR, moonbounce, meteor scatter
 - Professor of Astronomy at UMass
 - Professor of Physics at Princeton
 - Awarded Nobel Prize in Physics in 1993 for discovery of the first orbiting pulsar
 - Bruce Walker, W1BW
 - Developed and maintains WSPRnet.org database, etc
 - Degree in physics from MIT
 - Career - high performance scientific computing
 - Primary radio interests are very low power (QRPp) operation on HF and software-defined radios (SDRs)
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WSPR

- Transmission of beacon-like signal
 - Callsign
 - Maidenhead grid location (4 digit)
 - Transmitted power (in dBm)
 - Receives (spots) other beacons - reporting
 - Callsign of receiving station
 - Grid location of receiver
 - Frequency (MHz)
 - Frequency drift (Hz/min)
 - Time, date – UTC
 - Time offset (seconds)
 - Signal to noise ratio (dB)
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WSPR Transmissions

- ❑ Start at the even minutes plus 1 sec
 - ❑ Last for 110.6 seconds
 - ❑ Transmission consists of 162 bits
 - 50 data - callsign (28), locator (15), power (7)
 - Forward Error Correction
 - continuous phase 4-FSK, tone separation 1.46 Hz
 - 1.46 baud
 - ❑ Bandwidth is 6 Hz
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WSPR Reception/Decoding

- ❑ Xmtr/Rcvr clocks should be within about +/-1 second
 - ❑ Frequency should not change more than +/- 1 Hz/minute
 - ❑ Filter bandwidth is about 1.5 Hz
 - ❑ Decoding is complex and occurs after the complete transmission
 - ❑ Minimum S/N for reception
 - around -28 dB on the WSJT scale
 - ❑ 2500 Hz reference bandwidth
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Power and Decibels (dB)

- ❑ 0 dBm = 1 milliwatt (0.001 watt)
 - ❑ 3 dB represents doubling/halving of power
 - ❑ 10 dB represents ten times increase/decrease in power
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Transmit Power

<u>dBm</u>	<u>Watt</u>	<u>dBm</u>	<u>Watt</u>
0	0.001	20	0.1
3	0.002	23	0.2
7	0.005	27	0.5
10	0.01	30	1
13	0.02	33	2
17	0.05	37	5

Weak-signal S/N Limits

Bandwidth ($B = 2500$ Hz)

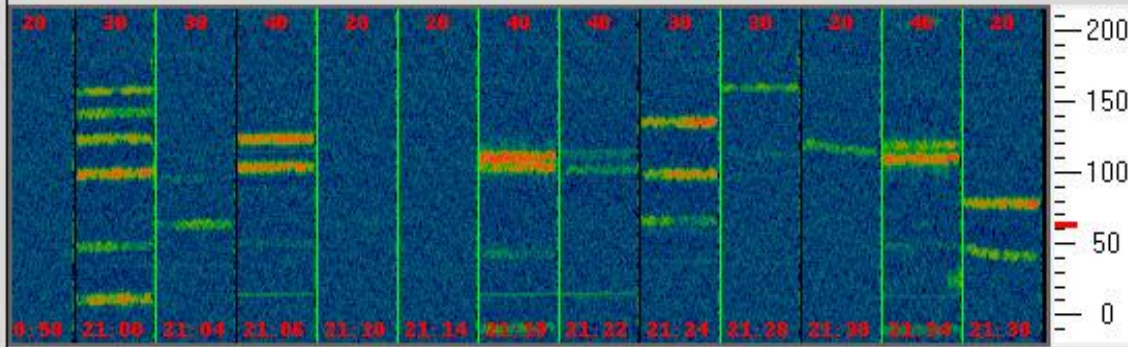
- SSB ~ 0 dB
 - CW, "ear and brain" -15 dB
 - WSPR -28 dB
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WSPR Bands

- 200 Hz band segments
 - 1400–1600 Hz of an SSB signal
 - 600, 160, 80, 60, 40, 30, 20, 17, 15, 12, 10, 6, 4, 2 Meter bands
 - Mostly 40, 30, 20 Meters
 - Each WSPR signal is 6 Hz wide
 - Many signals in each band
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WSPR Band – 20 Meter

- 20 Meters – 14000 – 14350
 - 350KHz
 - WSPR Band - 200 Hz
 - WSPR Signal – 6 Hz
 - Have received as many as 9 spots at one time
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121 K5ARH
 111 AI4WV
 80 W6SLZ

Upload spots Frequency Hop **9 Hz** Band Map

Frequencies (MHz)
 Dial: 14.095600
 Tx: 14.097064

Tx fraction (%)
 34
 0 10 20 30 40 50 60 70 80 90 100

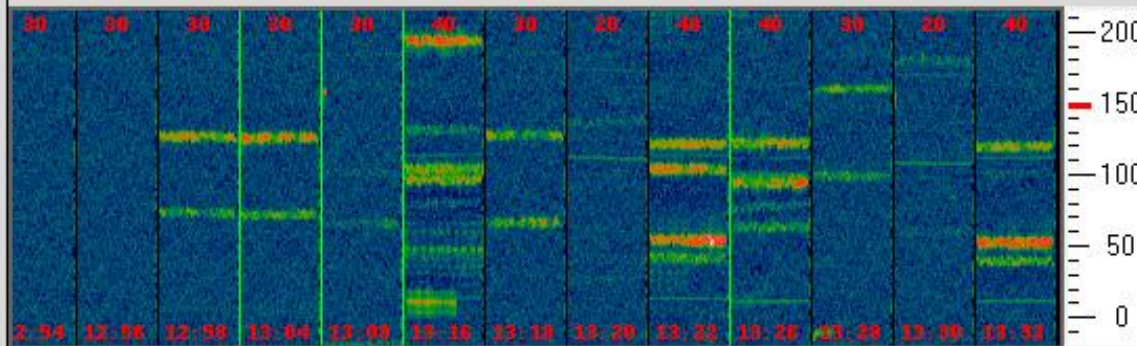
Special
 Idle

**2011 Jan 20
 21:40:12**

UTC	dB	DT	Freq	Drift			
2118	-26	-0.3	7.040044	0	W2GNN	FN20	10
2118	1	-1.1	7.040112	0	AI4WV	FM05	30
2122	-20	3.7	7.040104	0	N0GSZ	EM10	27
2124	-17	-1.4	10.140168	0	W3BI	FN20	33
2124	-7	-0.7	10.140237	0	W3GXT	FM19	37
2128	-16	-0.3	10.140262	0	W3CSW	FM19	30
2130	-19	-2.3	14.097118	-3	W7GTM	CN87	40
2134	-3	-1.0	7.040111	0	AI4WV	FM05	30
2134	-10	-0.5	7.040121	0	K5ARH	EM30	37
2138	-4	-0.5	14.097080	-1	W6SLZ	DM05	37

Rx Noise: 7 dB

Receiving

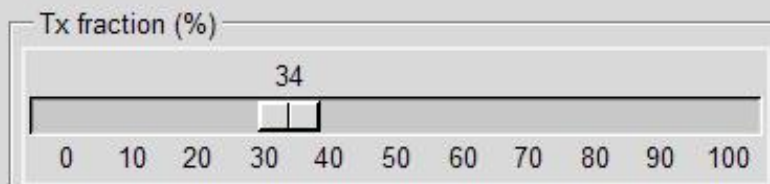


181 DC5BN
 121 K5ARH
 54 N4PJX
 41 WB2JEP

Upload spots Frequency Hop **985 Hz**

Band Map

Frequencies (MHz)
 Dial: 7.038600
 Tx: 7.040149



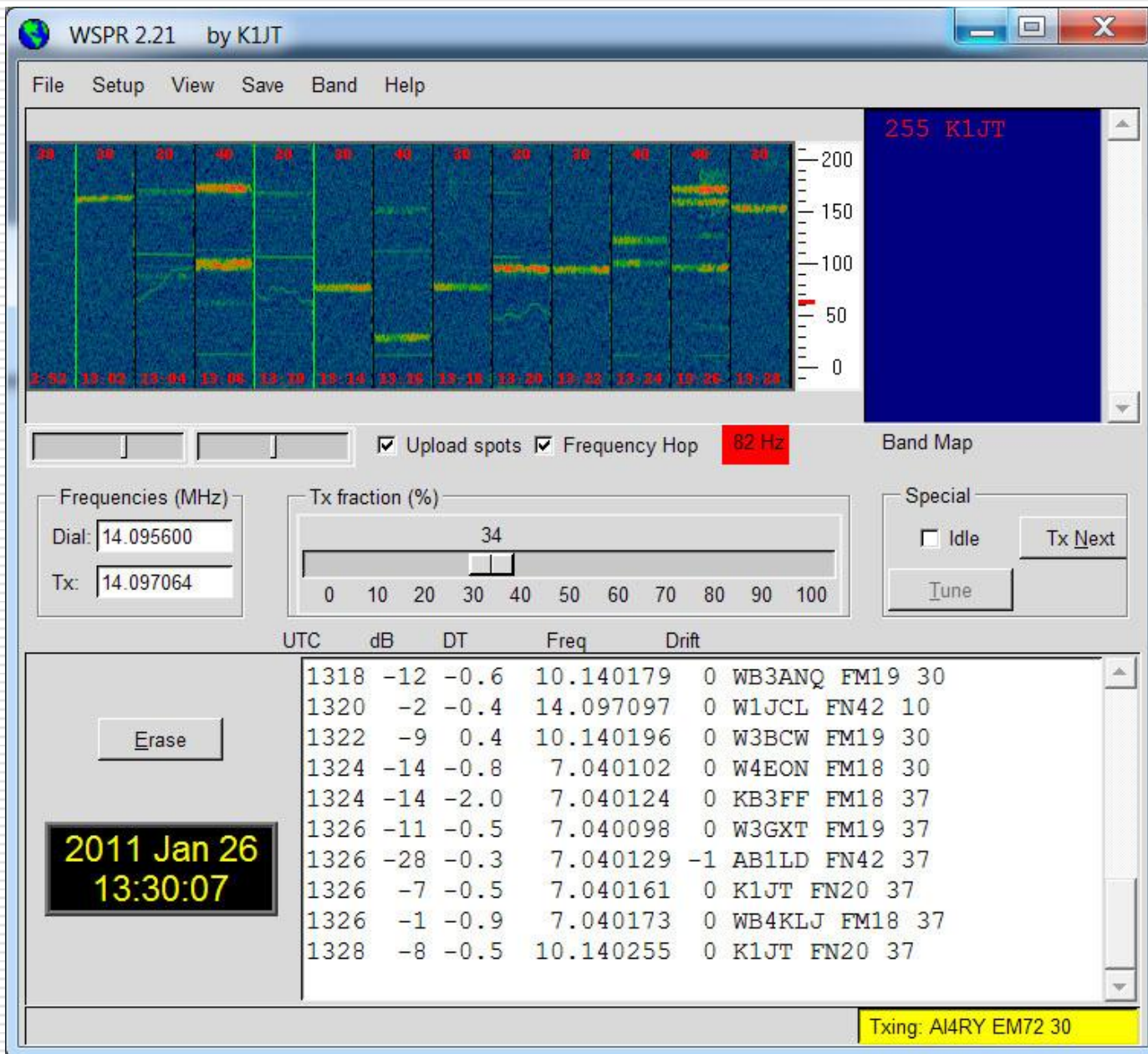
Special
 Idle

UTC	dB	DT	Freq	Drift	
1308	-25	-1.3	10.140167	0	W3BI FN20 33
1316	-10	-0.6	7.040098	0	W3GXT FM19 37
1316	-13	-0.9	7.040106	0	W4EON FM18 30
1316	-29	1.2	7.040133	0	K6IV CM97 30
1316	-4	0.3	7.040195	0	K9PAW EN61 37
1318	-12	-1.4	10.140169	0	W3BI FN20 33
1318	-13	-0.6	10.140229	0	AC2DE EL09 37
1320	-27	0.6	14.097139	1	G0IMX IO92 30
1322	-14	-0.5	7.040043	0	WB2JEP FM29 37
1322	2	-0.4	7.040056	0	N4PJX EM66 37
1322	-6	-0.3	7.040106	0	KC5GOI EM13 37

**2011 Jan 20
 13:37:03**

Rx Noise: 6 dB

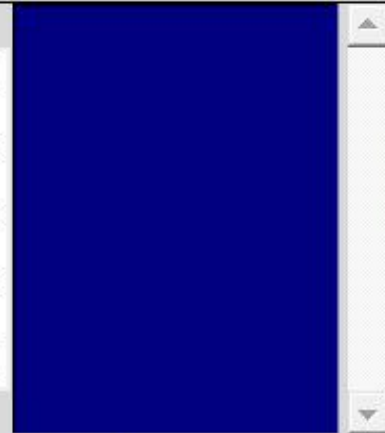
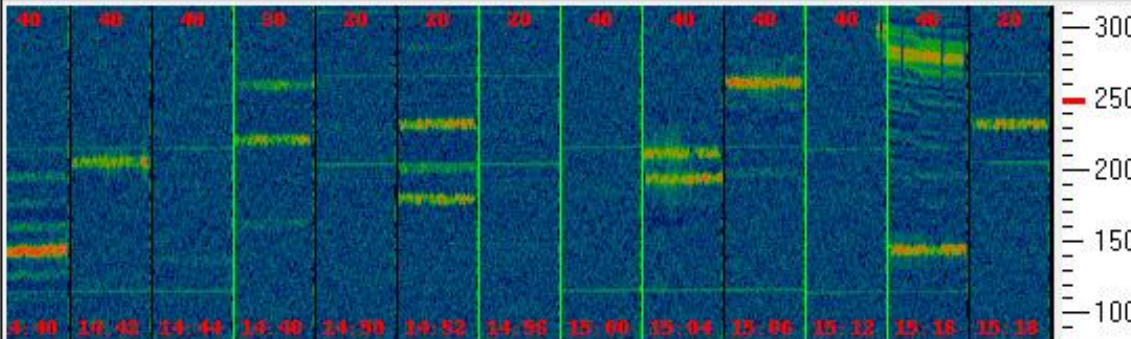
Receiving



13:21 on 20M - switched from inside to outside antenna - dropped noise at 110 and 170

13:25 on 40M - switched from inside to outside antenna - signal at 100 and 120 dropped - noise dropped at 005

13:27 on 40M - switched from outside to inside antenna - four signals increased - noise at 005 increased



Upload spots Frequency Hop **211 Hz**

Band Map

Frequencies (MHz)

Dial: 10.138700

Tx: 10.140248

Tx fraction (%)

34

0 10 20 30 40 50 60 70 80 90 100

Special

Idle

Tx Next

Tune

UTC dB DT Freq Drift

1428	-17	-0.7	10.140124	0	W8LIW EN81 30
1428	-23	2.5	10.140264	0	KC6KGE DM05 37
1430	-5	-0.0	14.097084	-1	ON7KO JO21 37
1440	-20	0.4	7.040028	1	WB8HWF EN80 37
1440	2	0.4	7.040045	0	WB8HWF EN80 37
1440	-19	0.4	7.040061	1	WB8HWF EN80 37
1440	-24	-0.9	7.040097	1	KF7HQX CN87 37
1442	-10	-1.6	7.040107	0	KN5X EM10 37
1448	-29	-0.3	10.140164	1	VE6PDQ/1 37
1448	-20	2.8	10.140261	-1	KC6KGE DM05 37
1452	-11	-0.7	14.097081	0	ON7KO JO21 37

Erase

**2011 Jan 31
15:24:43**

Rx Noise: 7 dB

Receiving

System Requirements

- ❑ SSB receiver or transceiver and antenna
 - ❑ Computer running Windows, Linux, FreeBSD, or OS X
 - ❑ 1.5 GHz or faster CPU and at least 100 MB available RAM
 - ❑ Monitor with at least 800 x 600 resolution
 - ❑ Sound card supported by your operating system and capable of 48 kHz sample rate
 - ❑ If you will transmit as well as receive, an interface using a serial port to key your PTT line or a serial cable for CAT control. Linux and FreeBSD versions can also use a parallel port for PTT. Alternatively, you can use VOX control.
 - ❑ Audio connection(s) between receiver/transceiver and sound card
 - ❑ Means for synchronizing computer clock to UTC
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Software , Manual, QST Article

Download WSPR Software

- www.physics.princeton.edu/pulsar/K1JT/wspr.html

Download Manual

- www.physics.princeton.edu/pulsar/K1JT/WSPR_2.0_User.pdf

Nov 2010 QST Article

- www.physics.princeton.edu/pulsar/K1JT/WSPR_QST_Nov_2010.pdf
-

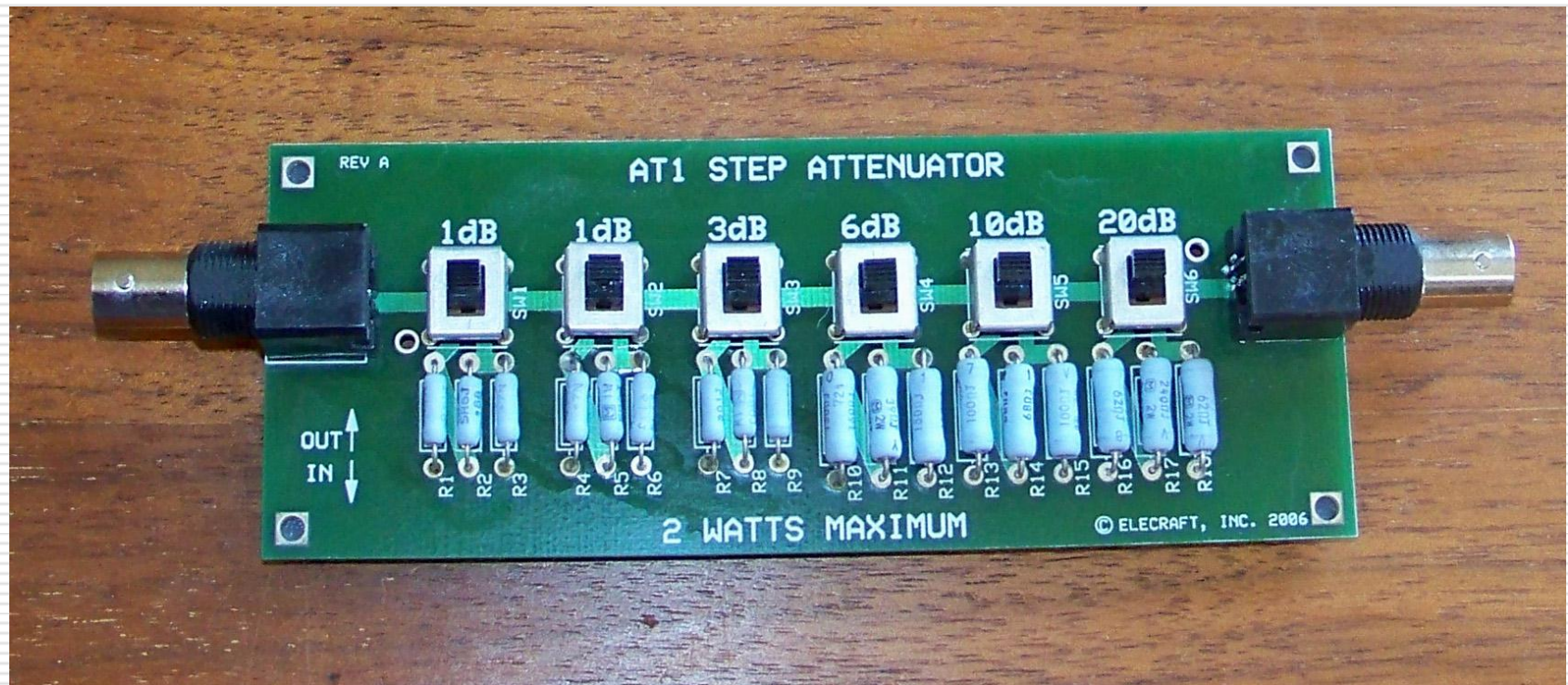
My Earlier Setup

- Elecraft K2
 - Running 1 W down to 1 mW (with step attenuator)
 - Signalink USB soundcard
 - Stealth antennas
 - End fed 20M, 30M outside antenna
 - DX-EE inverted vee attic antenna
 - 40M, 20M, 15M, 10M
 - Using WSPR exclusively since April 2009
 - Other than lightning damage
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41 dB Step Attenuator (2 watt)



Current Receiver (no xmtr)

- ❑ RFSpace – SDR-IQ
- ❑ Web connection possible
- ❑ Connections – USB port & antenna



Amplified Magnetic Loop Antenna

- Pixel Technologies RF PRO-1B
- Rotator
- About 5 feet above ground



How can you use WSPR?

- Look at propagation patterns
 - No radio involved
 - Use WSPR to optimize your setup
 - Compare reception with others locally
 - Look for and eliminate noise sources
 - Compare antennas
 - Let it run when not otherwise busy
 - Run it all the time
-

Demos

- WSPR software
 - Screen capture
 - WSPRnet.org
 - Online
-

File Setup View Save Band Help



Upload spots Frequency Hop
 Band Map

Frequencies (MHz)

Dial:

Tx:

Tx fraction (%)

34

0 10 20 30 40 50 60 70 80 90 100

Special

Idle

UTC dB DT Freq Drift

2011 Feb 08
 14:20:26



Waiting to start



Station parameters



Call: AI4RY

Grid: EM72go

Audio In: 2 Microphone (3- USB Audio CODEC) ▼

Audio Out: 5 Speakers (3- USB Audio CODEC) ▼

Power (dBm): 30 ▼

PTT method: VOX ▼

PTT port: None ▼

Enable CAT

CAT port: COM3 ▼

Rig number: 221 Elecraft K2 ▼

Serial rate: 4800 ▼

Data bits: 8 ▼

Stop bits: 2 ▼

Handshake: None ▼

Frequency Hopping

Band	Tx fraction (%)	Tuneup
<input type="checkbox"/> 600 m	<input type="checkbox"/>	0 <input type="checkbox"/>
<input type="checkbox"/> 160 m	<input type="checkbox"/>	0 <input type="checkbox"/>
<input type="checkbox"/> 80 m	<input type="checkbox"/>	0 <input type="checkbox"/>
<input type="checkbox"/> 60 m	<input type="checkbox"/>	0 <input type="checkbox"/>
<input checked="" type="checkbox"/> 40 m	<input checked="" type="checkbox"/>	34 <input type="checkbox"/>
<input checked="" type="checkbox"/> 30 m	<input checked="" type="checkbox"/>	34 <input type="checkbox"/>
<input checked="" type="checkbox"/> 20 m	<input checked="" type="checkbox"/>	34 <input type="checkbox"/>
<input type="checkbox"/> 17 m	<input type="checkbox"/>	0 <input type="checkbox"/>
<input type="checkbox"/> 15 m	<input checked="" type="checkbox"/>	34 <input type="checkbox"/>
<input type="checkbox"/> 12 m	<input type="checkbox"/>	0 <input type="checkbox"/>
<input type="checkbox"/> 10 m	<input checked="" type="checkbox"/>	34 <input type="checkbox"/>
<input type="checkbox"/> 6 m	<input type="checkbox"/>	0 <input type="checkbox"/>
<input type="checkbox"/> 4 m	<input type="checkbox"/>	0 <input type="checkbox"/>
<input type="checkbox"/> 2 m	<input type="checkbox"/>	0 <input type="checkbox"/>
<input type="checkbox"/> Other	<input type="checkbox"/>	0 <input type="checkbox"/>

Coordinated hopping