WSPR (PRONOUNCED WHISPER)

Weak Signal Propagation Reporter

WSPR

- Uses HF radio with upper sideband capability
- Computer
  - sound card
  - Internet connection
- Started in April 2008

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)

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 (6 digit)
  - Frequency (MHz)
  - Frequency drift (Hz/min)
  - Time, date – UTC
  - Time offset (seconds)
  - Signal to noise ratio (dB)

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), plus 112 Error Correction Code (ECC) = 162 bits
  - 162-bit pseudo-random sync vector
  - continuous phase 4-FSK, tone separation 1.46 Hz
  - 1.46 baud
- Bandwidth is 6 Hz

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
  - at times there are thousands of attempts on one signal
- Minimum S/N for reception
  - around –28 dB on the WSJT scale
    - 2500 Hz reference bandwidth

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

Transmit Power

dBm	Watt	dBm	Watt
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

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, 10 Meters
  - Less than the bandwidth of one RTTY signal
- Each WSPR signal is 6 Hz wide
- Many signals in each band
  - Have spotted as many as 10 during one 2 minute transmit cycle

Coordinated Hopping

- Coordinated hopping enables a sizable group of stations around the world to move together from band to band, thereby maximizing the chances of identifying open propagation paths.

Band	160	80	60	40	30	20	17	15	12	10
Minute	00	02	04	06	08	10	12	14	16	18
	20	22	24	26	28	30	32	34	36	38
	40	42	44	46	48	50	52	54	56	58

Richard, AI4RY Setup

- Previous
  - Elecraft K2
    - Running 1 W down to 1 mW (with step attenuator)
  - Stealth antennas
    - End fed 20M, 30M outside antenna
    - DX-EE inverted vee attic antenna
      - 40M, 20M, 15M, 10M
  - Using WSPR exclusively from April 2009 to 2011
    - Other than lightning damage
- Current
  - Software Defined Radio receiver – SDR-IQ
  - Pixel Pro-1B Loop Antenna at 5 feet high – receive only

John Pratt, KC4RSN

Flex 1500 SDR

Icom IC-718

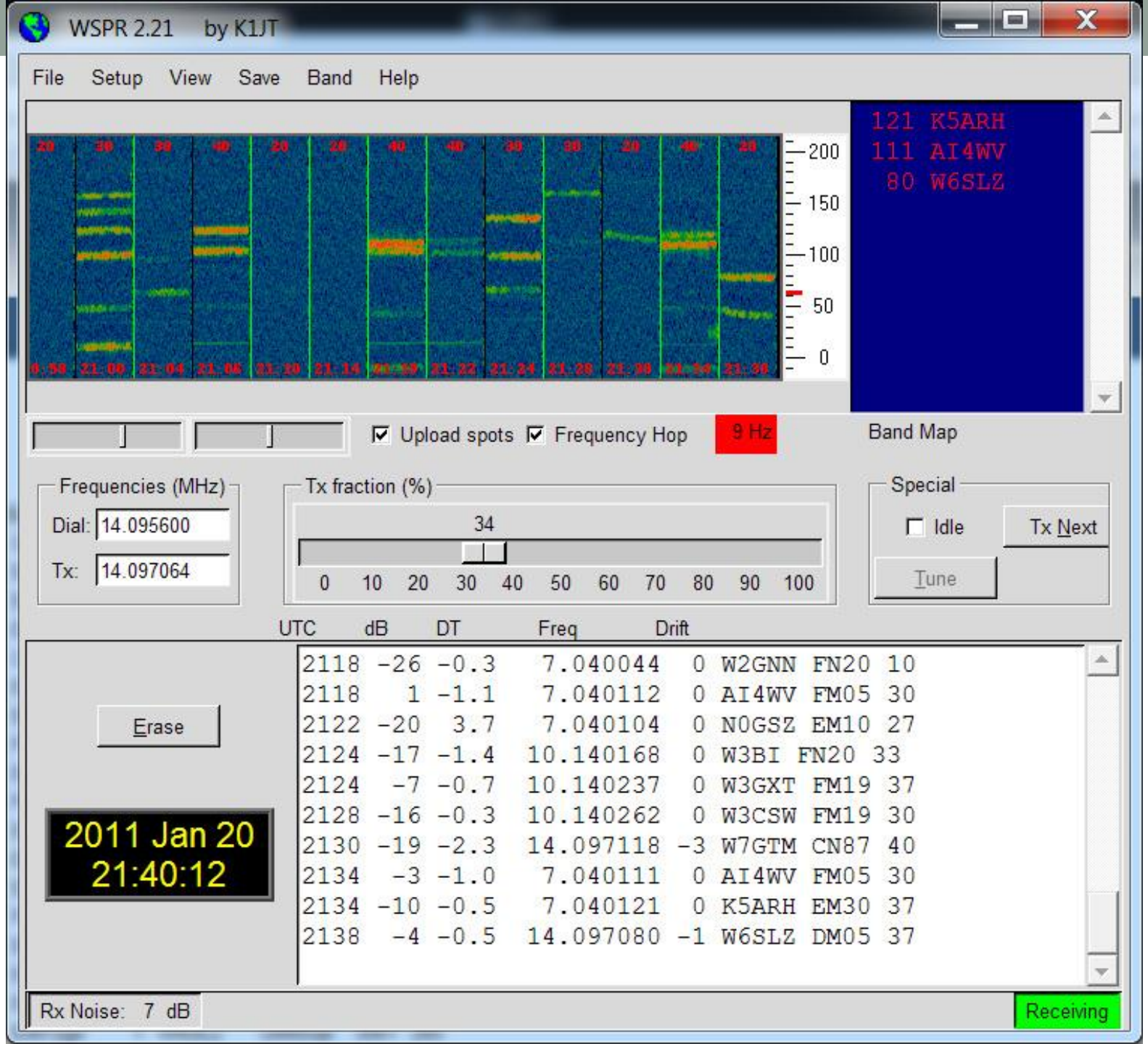
NooElec Mini+ 0.5PPM TCXO(R820T SDR&DVB-T USB), Upconverter V 1.2 (125MHZ)

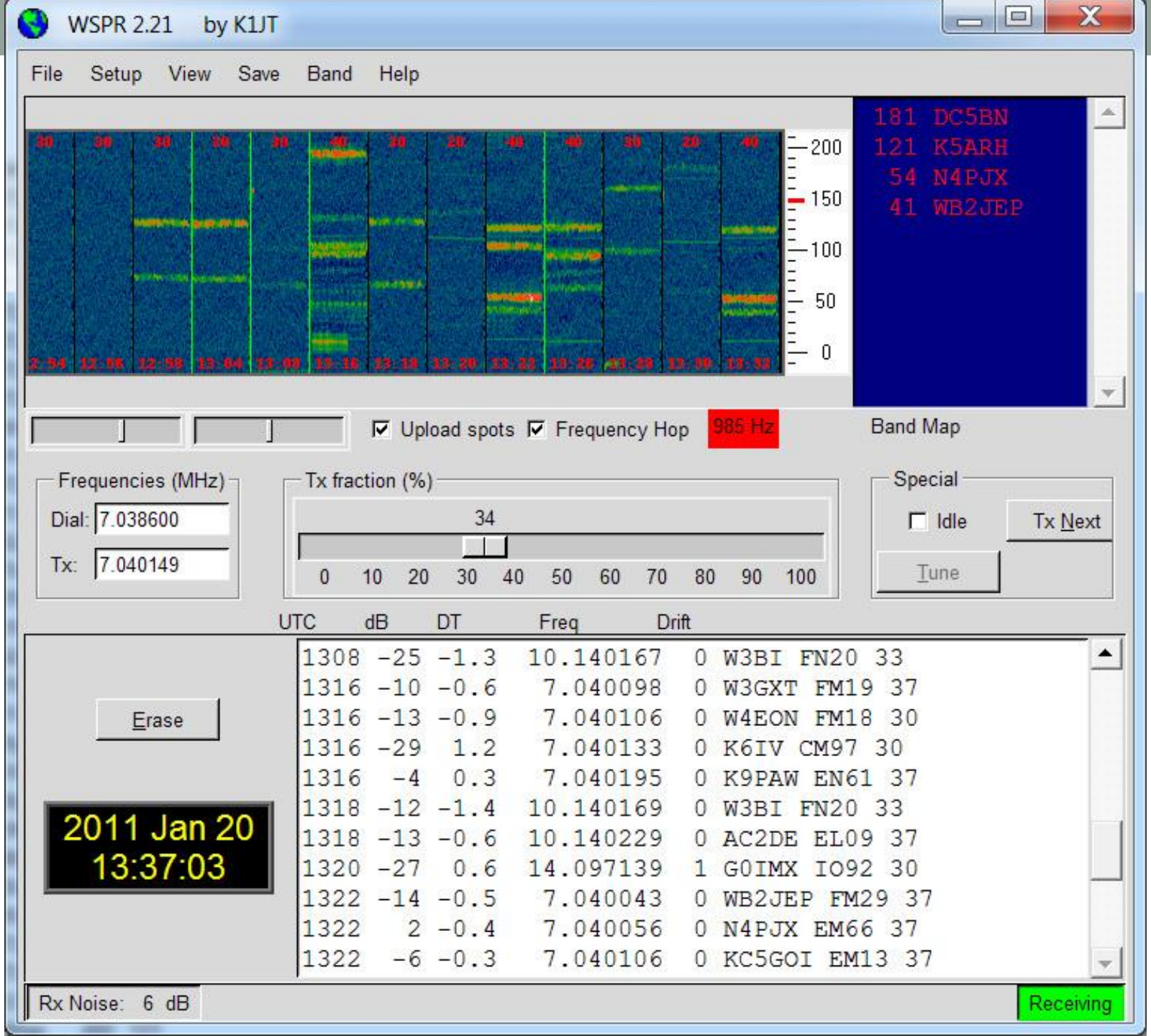
Inverted L (base tuned) 80-10 Meters

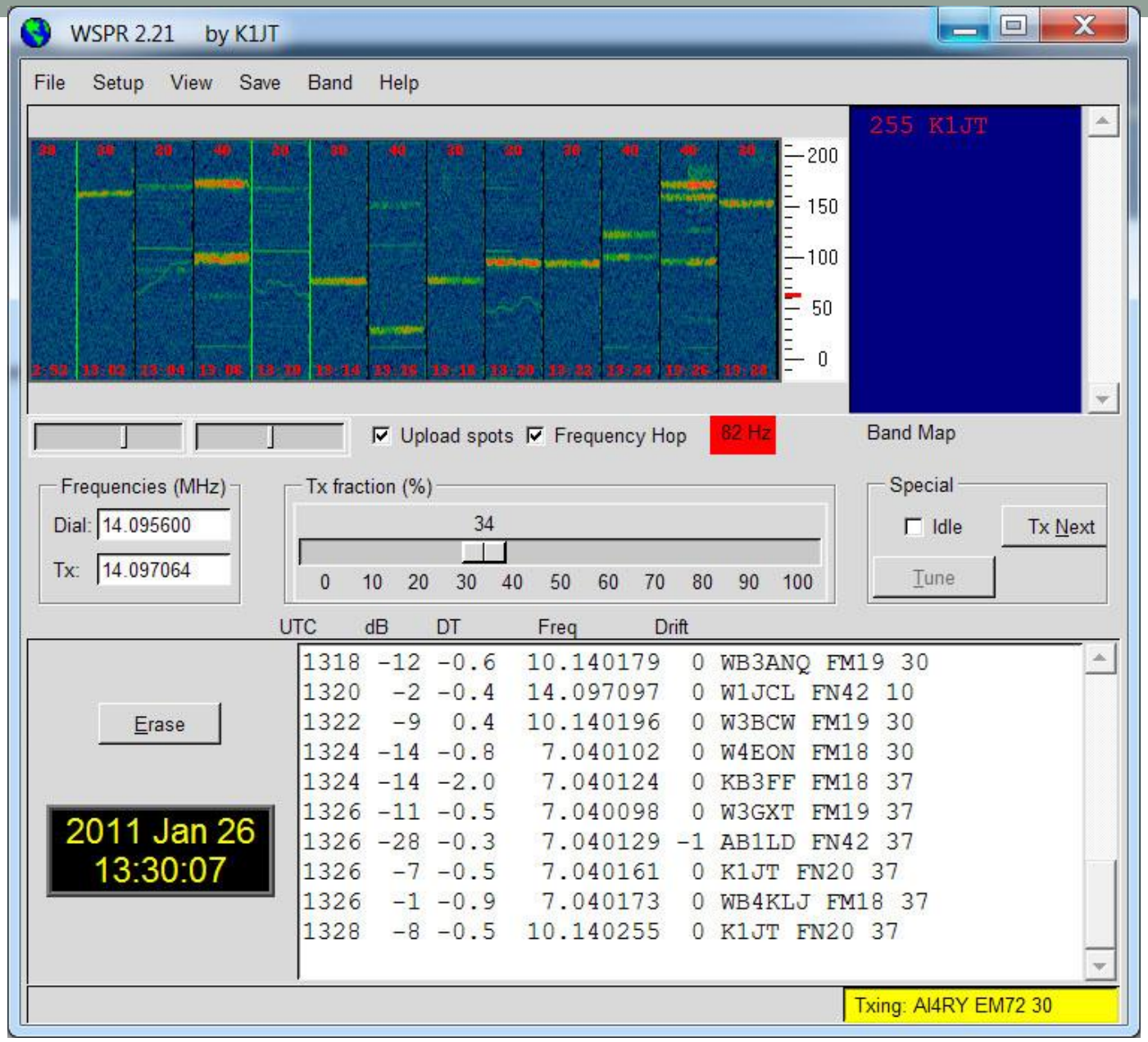
Magloop 20/30 Meters

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


WSPR 2.21 by K1JT
File Setup View Save Band Help
200
150
100
50
0
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
Tx Next
Tune
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
Erase
2011 Jan 20
21:40:12
Rx Noise: 7 dB
Receiving

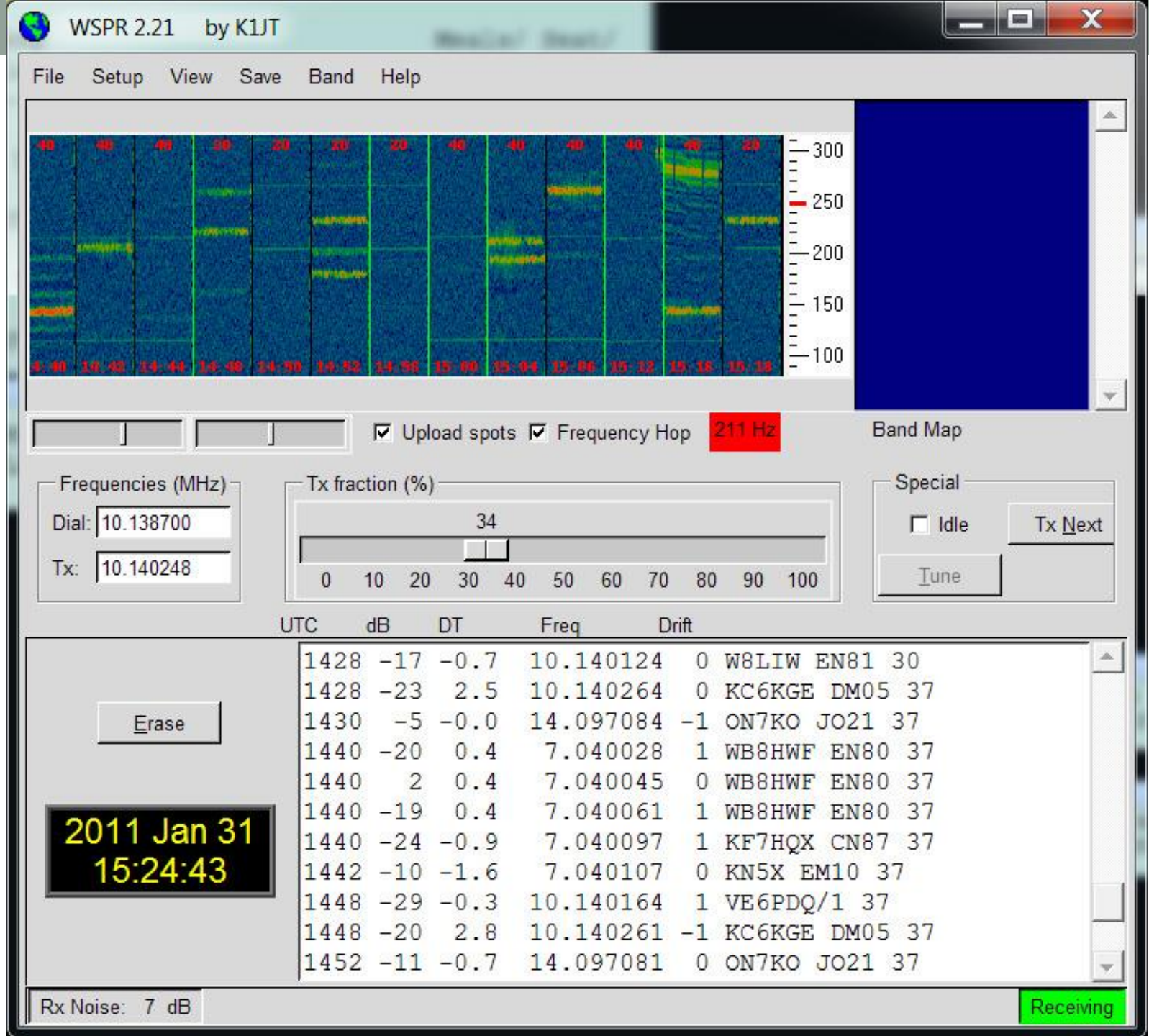

WSPR 2.21 by K1JT
File Setup View Save Band Help
200
150
100
50
0
181 DC5BN
121 K5ARH
54 N4PJX
41 WB2JEP
Upload spots
Frequency Hop
985 Hz
Band Map
Frequencies (MHz)
Dial: 7.038600
Tx: 7.040149
Tx fraction (%)
34
0 10 20 30 40 50 60 70 80 90 100
Special
Idle
Tx Next
Tune
UTC dB DT Freq Drift
1308 -25 -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
Erase
2011 Jan 20
13:37:03
Rx Noise: 6 dB
Receiving

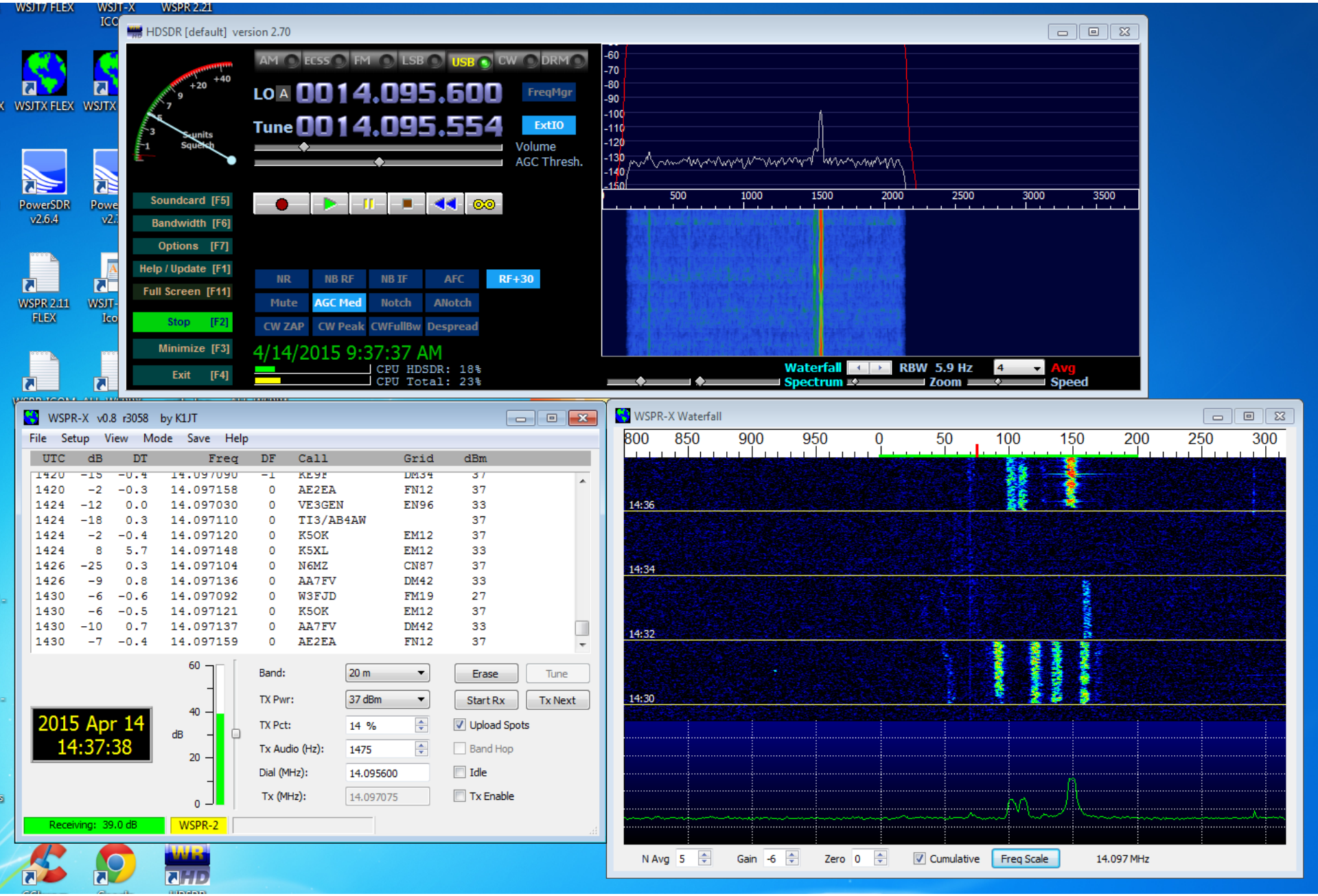


13:21 on 20M - switched from inside to outside antenna - dropped noise at 110 and 170

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


WSPR 2.21 by K1JT
File Setup View Save Band Help
300
250
200
150
100
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


HDSDR [default] version 2.70
AM ECSS FM LSB USB CW DRM
LO A 0014.095.600
Tune 0014.095.554
FreqMgr
ExtIO
Volume
AGC Thresh.
Soundcard [F5]
Bandwidth [F6]
Options [F7]
Help / Update [F1]
Full Screen [F11]
Stop [F2]
Minimize [F3]
Exit [F4]
NR NB RF NB IF AFC RF+30
Mute AGC Med Notch ANotch
CW ZAP CW Peak CWFullBw Despread
4/14/2015 9:37:37 AM
CPU HDSDR: 18%
CPU Total: 23%
Waterfall RBW 5.9 Hz Avg
Spectrum Zoom Speed
WSPR-X v0.8 r3058 by K1JT
File Setup View Mode Save Help
UTC dB DT Freq DF Call Grid dBm
1420 -2 -0.3 14.097158 0 AE2EA FN12 37
1424 -12 0.0 14.097030 0 VE3GEN EN96 33
1424 -18 0.3 14.097110 0 TI3/AB4AW 37
1424 -2 -0.4 14.097120 0 K5OK EM12 37
1424 8 5.7 14.097148 0 K5XL EM12 33
1426 -25 0.3 14.097104 0 N6MZ CN87 37
1426 -9 0.8 14.097136 0 AA7FV DM42 33
1430 -6 -0.6 14.097092 0 W3FJD FM19 27
1430 -6 -0.5 14.097121 0 K5OK EM12 37
1430 -10 0.7 14.097137 0 AA7FV DM42 33
1430 -7 -0.4 14.097159 0 AE2EA FN12 37
2015 Apr 14
14:37:38
Band: 20 m
TX Pwr: 37 dBm
TX Pct: 14 %
Tx Audio (Hz): 1475
Dial (MHz): 14.095600
Tx (MHz): 14.097075
Erase Tune
Start Rx Tx Next
Upload Spots
Band Hop
Idle
Tx Enable
Receiving: 39.0 dB
WSPR-2
WSPR-X Waterfall
14:36
14:34
14:32
14:30
N Avg 5 Gain -6 Zero 0 Cumulative Freq Scale 14.097 MHz

WSPRnet

Weak Signal Propagation Reporter Network

Search

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My account | Log out

Frequencies

USB dial (MHz): 0.136, 0.4742, 1.8366, 3.5926, 5.2872, 7.0386, 10.1387, 14.0956, 18.1046, 21.0946, 24.9246, 28.1246, 50.293, 70.091, 144.489, 432.300, 1296.500

Spot Count

278,213,132 total spots
337,052 in the last 24 hours
11,698 in the last hour

Navigation

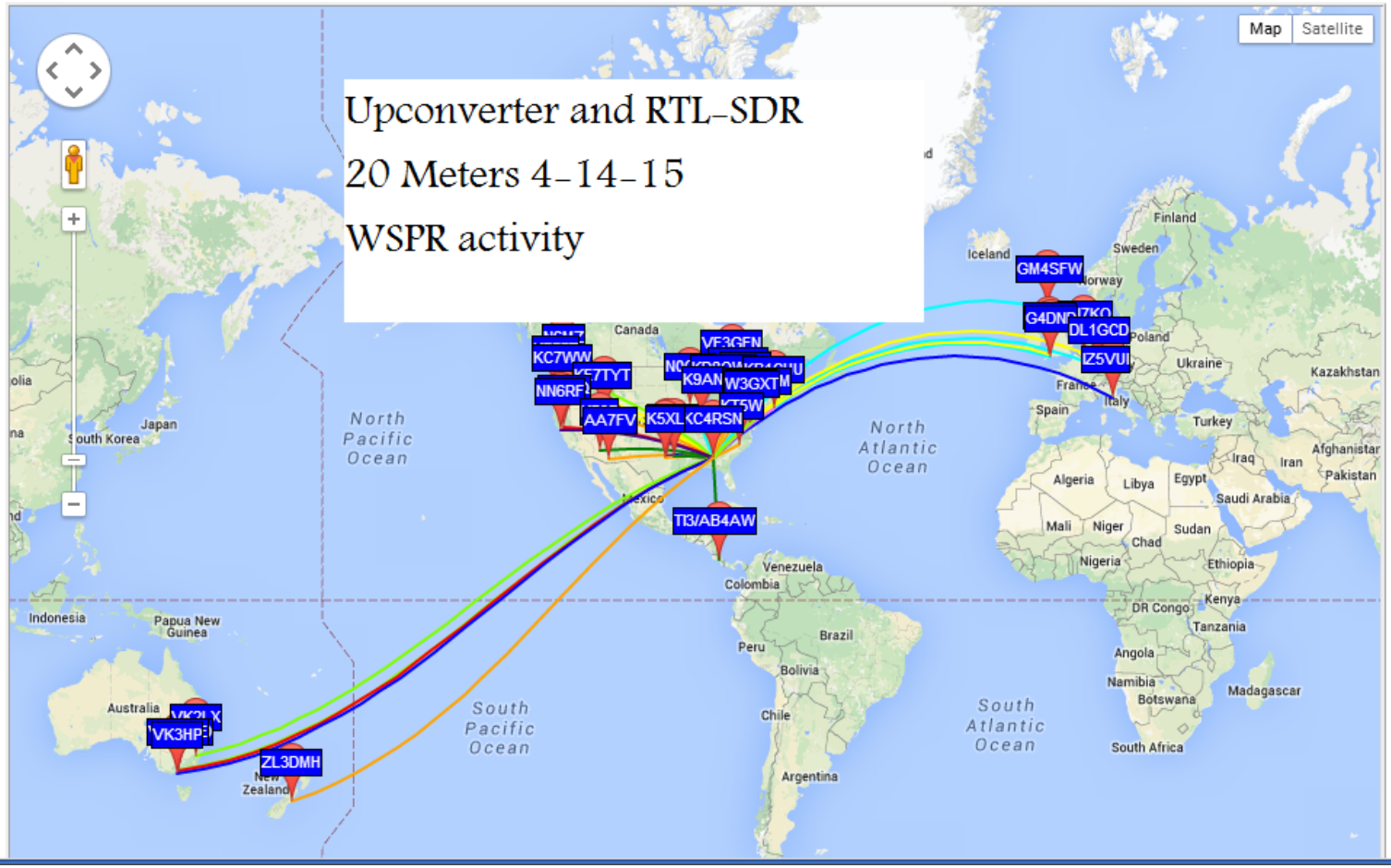
- Add content
- Forums

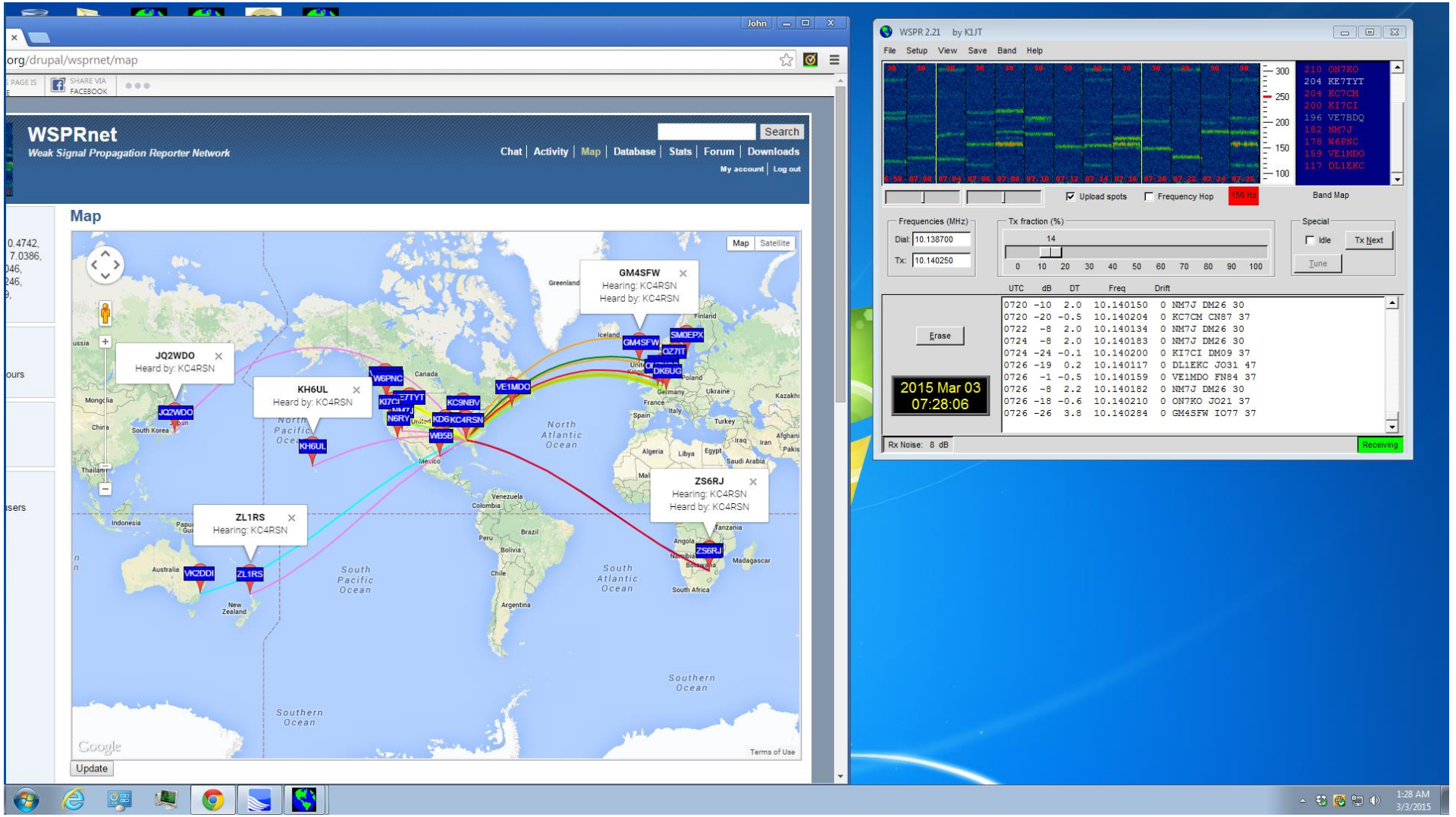
Who's online

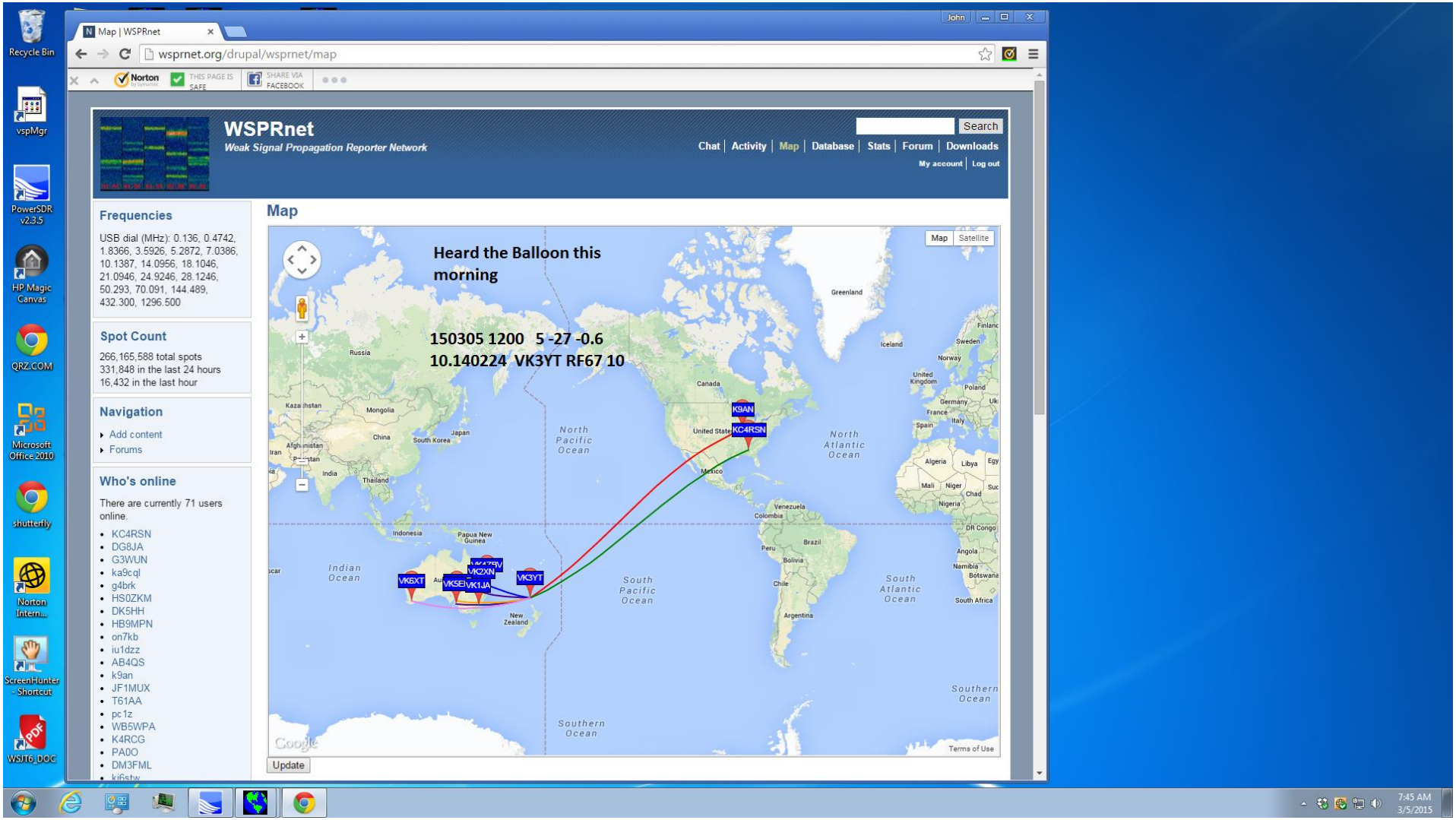
There are currently 80 users online.

- DM3FML
- PE0CWK
- RX3DHR
- KC4RSN
- K1BZ
- G4CMY
- W3DS
- K4RCG
- KF3EI
- on7ko
- wa2hip

Map




WSPRnet
Weak Signal Propagation Reporter Network
Search
Chat | Activity | Map | Database | Stats | Forum | Downloads
My account | Log out
Map
Map
Satellite
GM4SFW
Hearing: KC4RSN
Heard by: KC4RSN
JQ2WDO
Heard by: KC4RSN
KH6UL
Heard by: KC4RSN
ZL1RS
Hearing: KC4RSN
ZS6RJ
Hearing: KC4RSN
Heard by: KC4RSN
North Pacific Ocean
North Atlantic Ocean
South Pacific Ocean
South Atlantic Ocean
Southern Ocean
Update
WSPR 2.21 by K1JT
File Setup View Save Band Help
Upload spots
Frequency Hop
Band Map
Frequencies (MHz)
Dial: 10.138700
Tx: 10.140250
Tx fraction (%)
Special
Idle
Tx Next
Tune
Erase
2015 Mar 03
07:28:06
UTC dB DT Freq Drift
0720 -10 2.0 10.140150 0 NM7J DM26 30
0720 -20 -0.5 10.140204 0 KC7CM CN87 37
0722 -8 2.0 10.140134 0 NM7J DM26 30
0724 -8 2.0 10.140183 0 NM7J DM26 30
0724 -24 -0.1 10.140200 0 KI7CI DM09 37
0726 -19 0.2 10.140117 0 DL1EKC JO31 47
0726 -1 -0.5 10.140159 0 VE1MDO FN84 37
0726 -8 2.2 10.140182 0 NM7J DM26 30
0726 -18 -0.6 10.140210 0 ON7KO JO21 37
0726 -26 3.8 10.140284 0 GM4SFW IO77 37
Rx Noise: 8 dB
Receiving
210 ON7KO
204 KE7TYT
204 KC7CM
200 KI7CI
196 VE7BDQ
182 NM7J
178 W6PNC
159 VE1MDO
117 DL1EKC

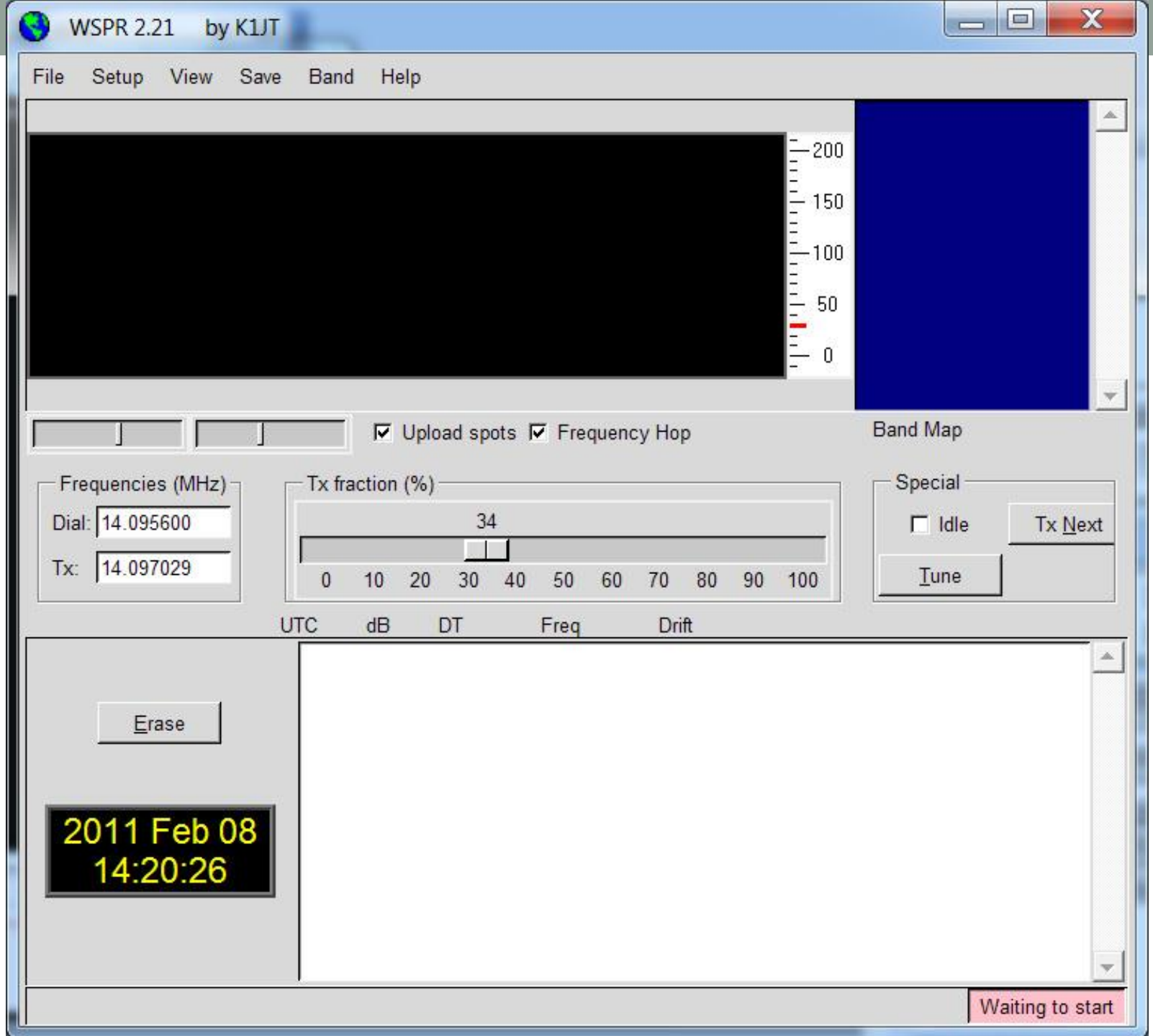

Map | WSPRnet
wsprnet.org/drupal/wsprnet/map
WSPRnet
Weak Signal Propagation Reporter Network
Search
Chat | Activity | Map | Database | Stats | Forum | Downloads
My account | Log out
Frequencies
USB dial (MHz): 0.136, 0.4742, 1.8366, 3.5926, 5.2872, 7.0386, 10.1387, 14.0956, 18.1046, 21.0946, 24.9246, 28.1246, 50.293, 70.091, 144.489, 432.300, 1296.500
Spot Count
266,165,588 total spots
331,848 in the last 24 hours
16,432 in the last hour
Navigation
Add content
Forums
Who's online
There are currently 71 users online.
KC4RSN
DG8JA
G3WUN
ka9cql
g4brk
HS0ZKM
DK5HH
HB9MPN
on7kb
iu1dzz
AB4QS
k9an
JF1MUX
T61AA
pc1z
WB5WPA
K4RCG
PA0O
DM3FML
Map
Heard the Balloon this morning
150305 1200 5 -27 -0.6
10.140224 VK3YT RF67 10
Map
Satellite
K9AN
KC4RSN
VK6XT
VK2XN
VK5EI
VK1JA
VK3YT
Update

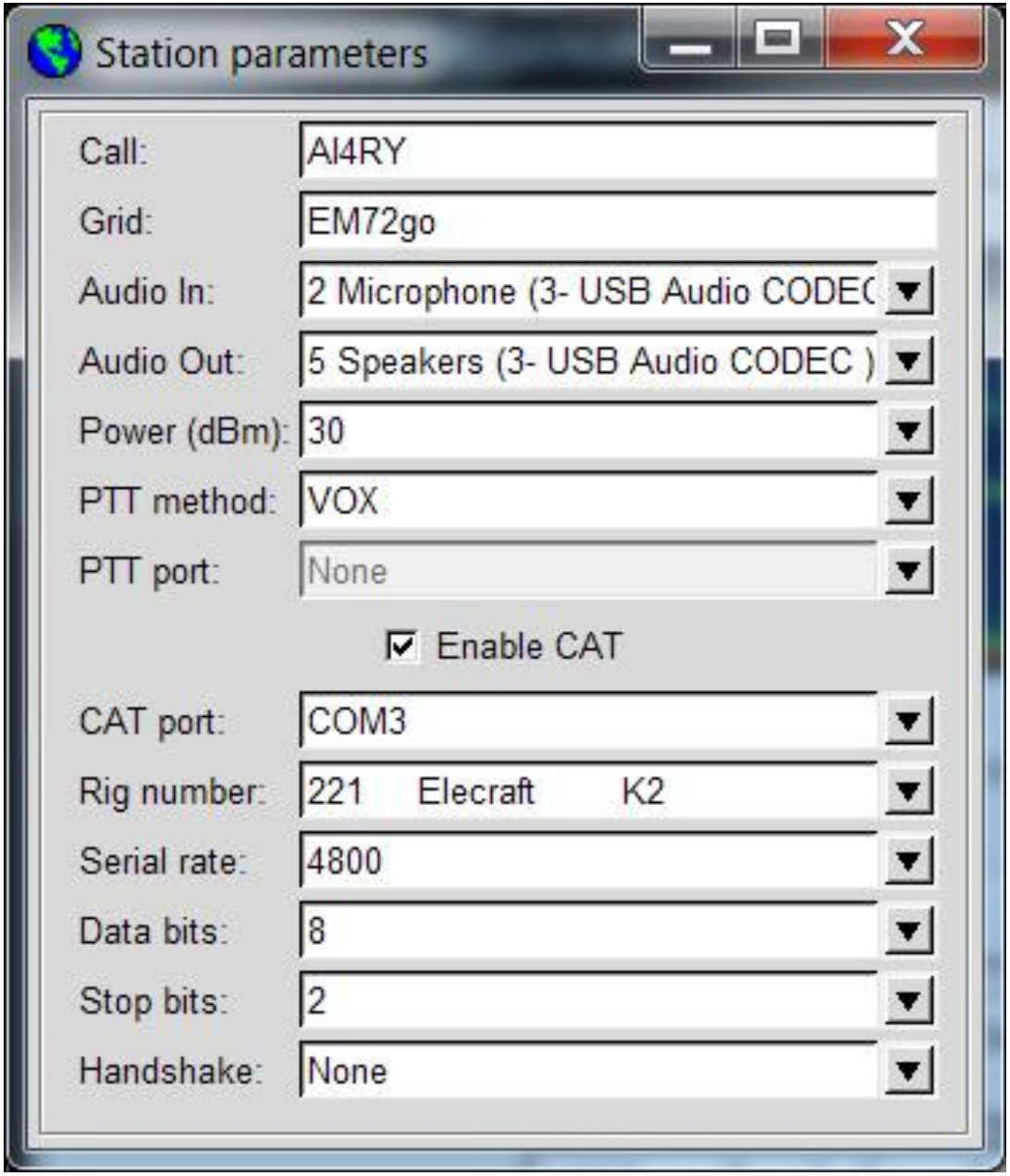
Software , Manual, QST Article

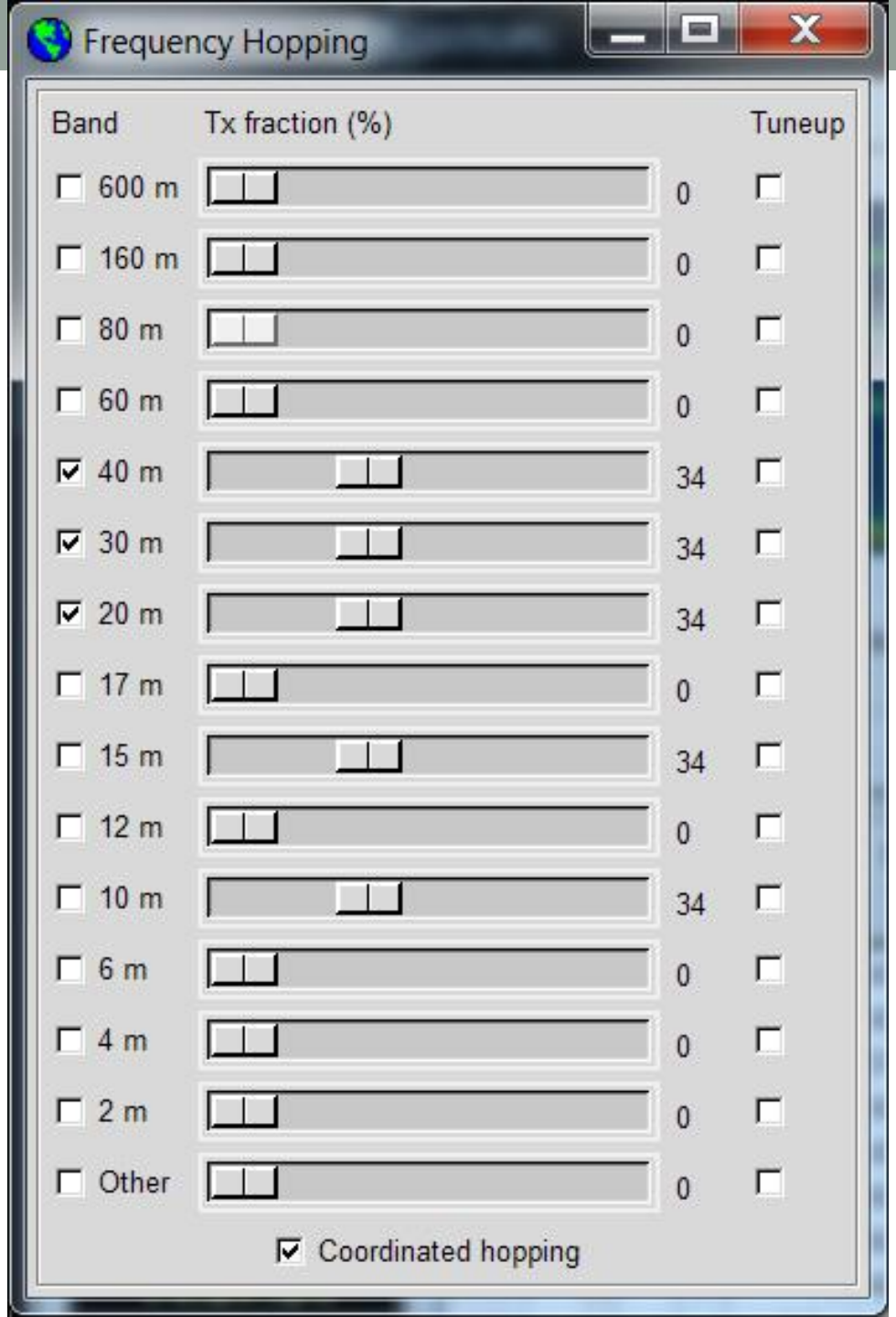
- Download WSPR Software
  - www.physics.princeton.edu/pulsar/K1JT/wspr.html
- Download Manual
  - www.physics.princeton.edu/pulsar/K1JT/WSPR_2.0_User.pdf
- Nov 2010 QST Article
  - www.physics.princeton.edu/pulsar/K1JT/WSPR_QST_Nov_2010.pdf

How can you use WSPR?

- Look at propagation patterns
  - No radio involved, just use WSPRnet
- 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


WSPR 2.21 by K1JT
File Setup View Save Band Help
200
150
100
50
0
Upload spots
Frequency Hop
Band Map
Frequencies (MHz)
Dial: 14.095600
Tx: 14.097029
Tx fraction (%)
34
0 10 20 30 40 50 60 70 80 90 100
Special
Idle
Tx Next
Tune
UTC dB DT Freq Drift
Erase
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
600 m
0
160 m
0
80 m
0
60 m
0
40 m
34
30 m
34
20 m
34
17 m
0
15 m
34
12 m
0
10 m
34
6 m
0
4 m
0
2 m
0
Other
0
Coordinated hopping