

WSPR in the Northwoods

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What is WSPR & Why?

- ▶ Weak Signal Propagation Reporter
- ▶ Active worldwide
- ▶ Aid Hams and other radio operators in determining real-time propagation
- ▶ Aid the scientific community through HamSci
 - ▶ <https://hamsci.org/publications/high-resolution-wspr-transmissions-ionospheric-research>
 - ▶ Data used from the recent eclipse

WSPR Specifications & Characteristics from the ARRL

- ▶ From arrl.org/wspr:
 - ▶ narrowband digital transmission protocol called MEPT_JT on the HF and MF frequency bands.
 - ▶ 1. Transmitted message: callsign + 4-character-locator + dBm Example: "K1JT FN20 30"
 - ▶ 2. Message length after lossless compression: 28 bits for callsign, 15 for locator, 7 for power level ==> 50 bits total.
 - ▶ 3. Forward error correction (FEC): long-constraint convolutional code, $K=32$, $r=1/2$.
 - ▶ 4. Number of channel symbols: $n_{sym} = (50+K-1)*2 = 162$.
 - ▶ 5. Keying rate: $12000/8192 = 1.46$ baud.
 - ▶ 6. Modulation: continuous phase 4-FSK. Tone separation 1.46 Hz.
 - ▶ 7. Synchronization: 162-bit pseudo-random sync vector.
 - ▶ 8. Data structure: each channel symbol conveys one sync bit and one data bit.
 - ▶ 9. Duration of transmission: $162*8192/12000 = 110.6$ s.
 - ▶ 10. Transmissions start two seconds into an even UTC minute: i.e., at hh:00:02, hh:02:02, ...
 - ▶ 11. Occupied bandwidth: about 6 Hz
 - ▶ 12. Minimum S/N for reception: around -27 dB on the WSJT scale (2500 Hz reference bandwidth).

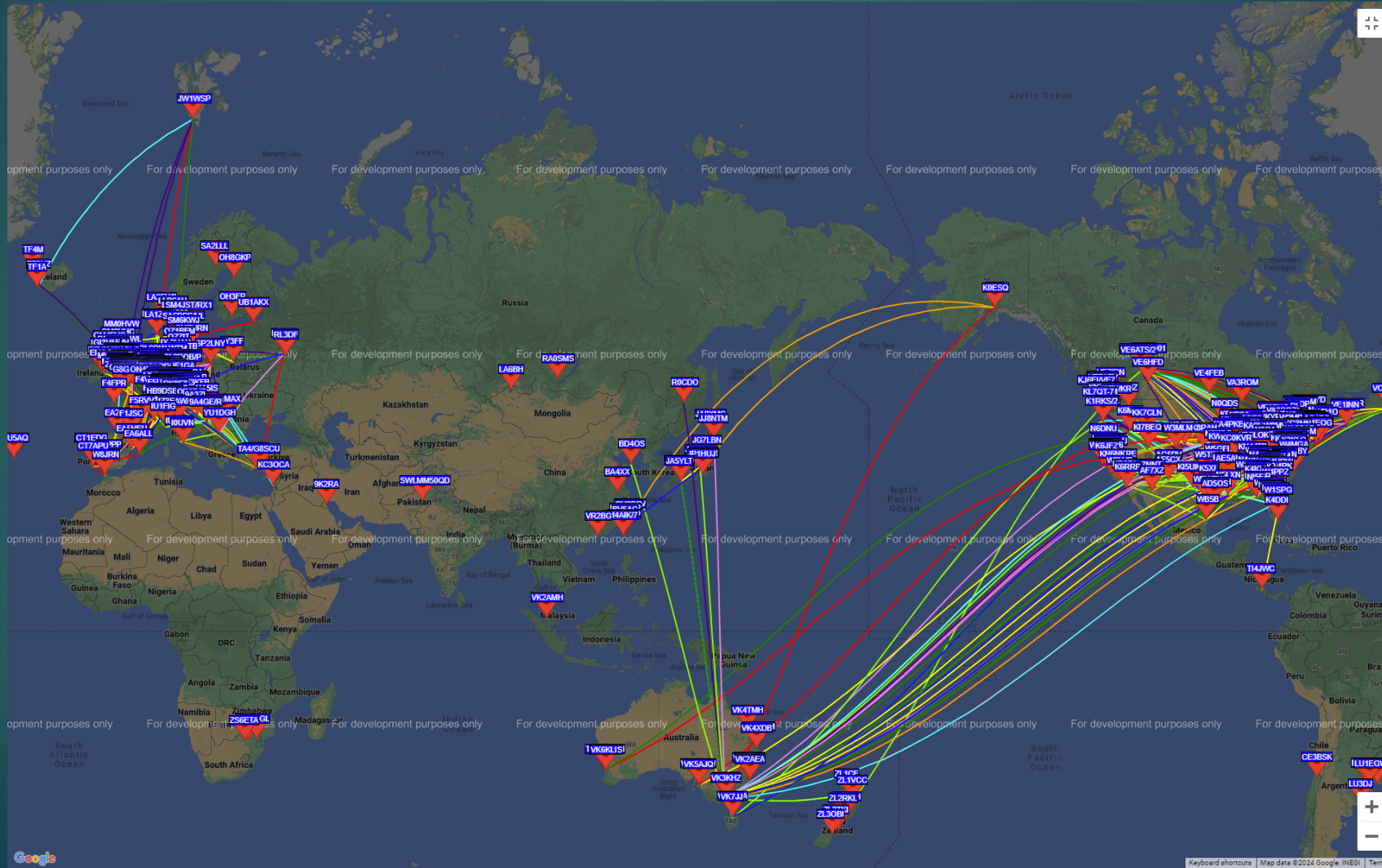
WSPR Frequencies

- ▶ USB dial (MHz):
- ▶ 2200m: 0.136
- ▶ 630m: 0.4742
- ▶ 160m: 1.8366
- ▶ 80m: 3.5686
- ▶ 60m: 5.2872, 5.3647
- ▶ 40m: 7.0386
- ▶ 30m: 10.1387
- ▶ 20m: 13.5539, 14.0956
- ▶ 17m: 18.1046
- ▶ 15m: 21.0946
- ▶ 12m: 24.9246
- ▶ 10m: 28.1246
- ▶ 6m: 50.293
- ▶ 4m: 70.091
- ▶ 2m: 144.489
- ▶ 70cm: 432.300
- ▶ 23cm: 1296.500

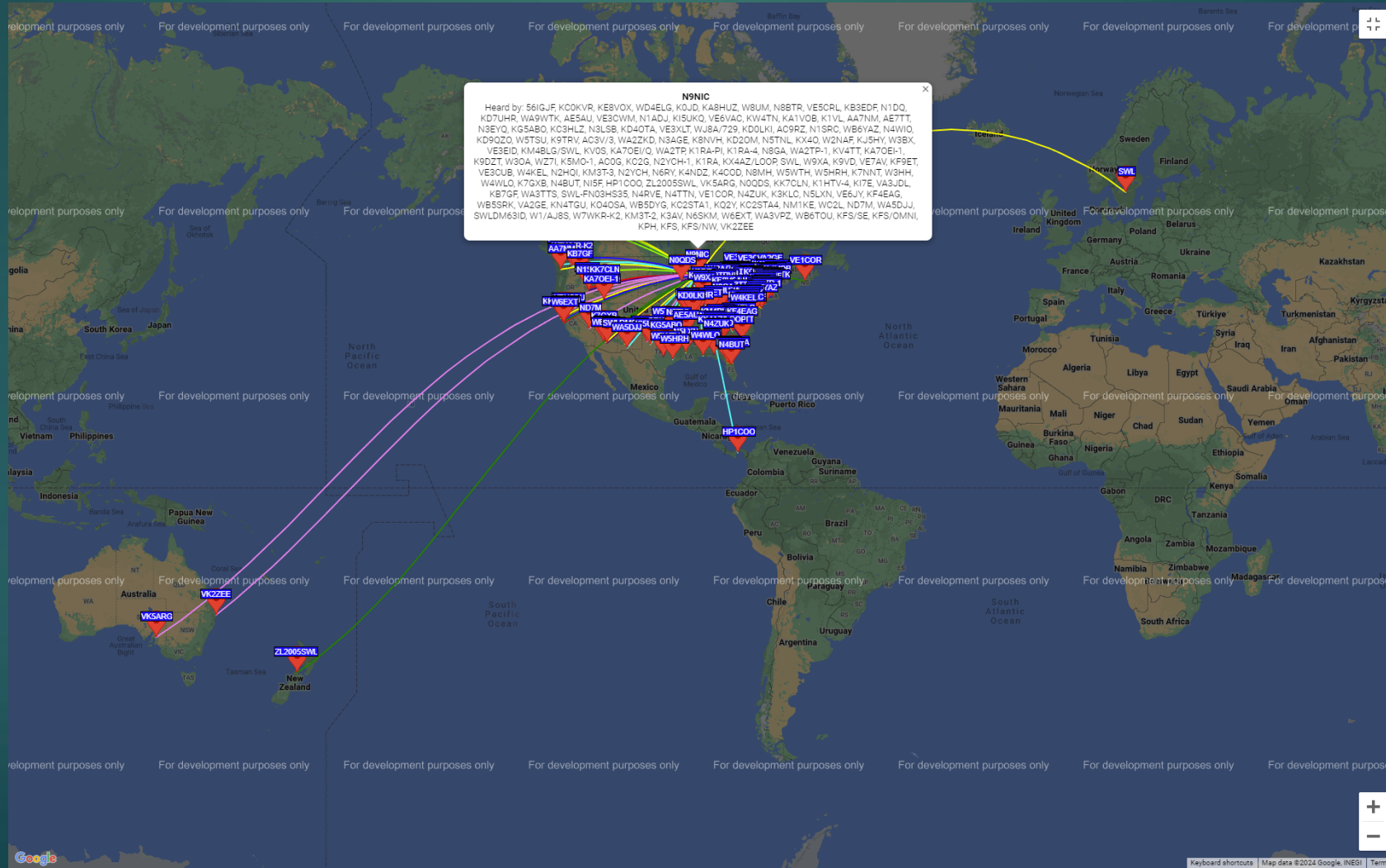
Where is WSPR Data

- ▶ WSPR Net: <https://wspnnet.org>
- ▶ WSPR Rocks!: <https://wspn.rocks>
- ▶ WSJT-X Software: <https://wsjt.sourceforge.io/wsjtx.html>

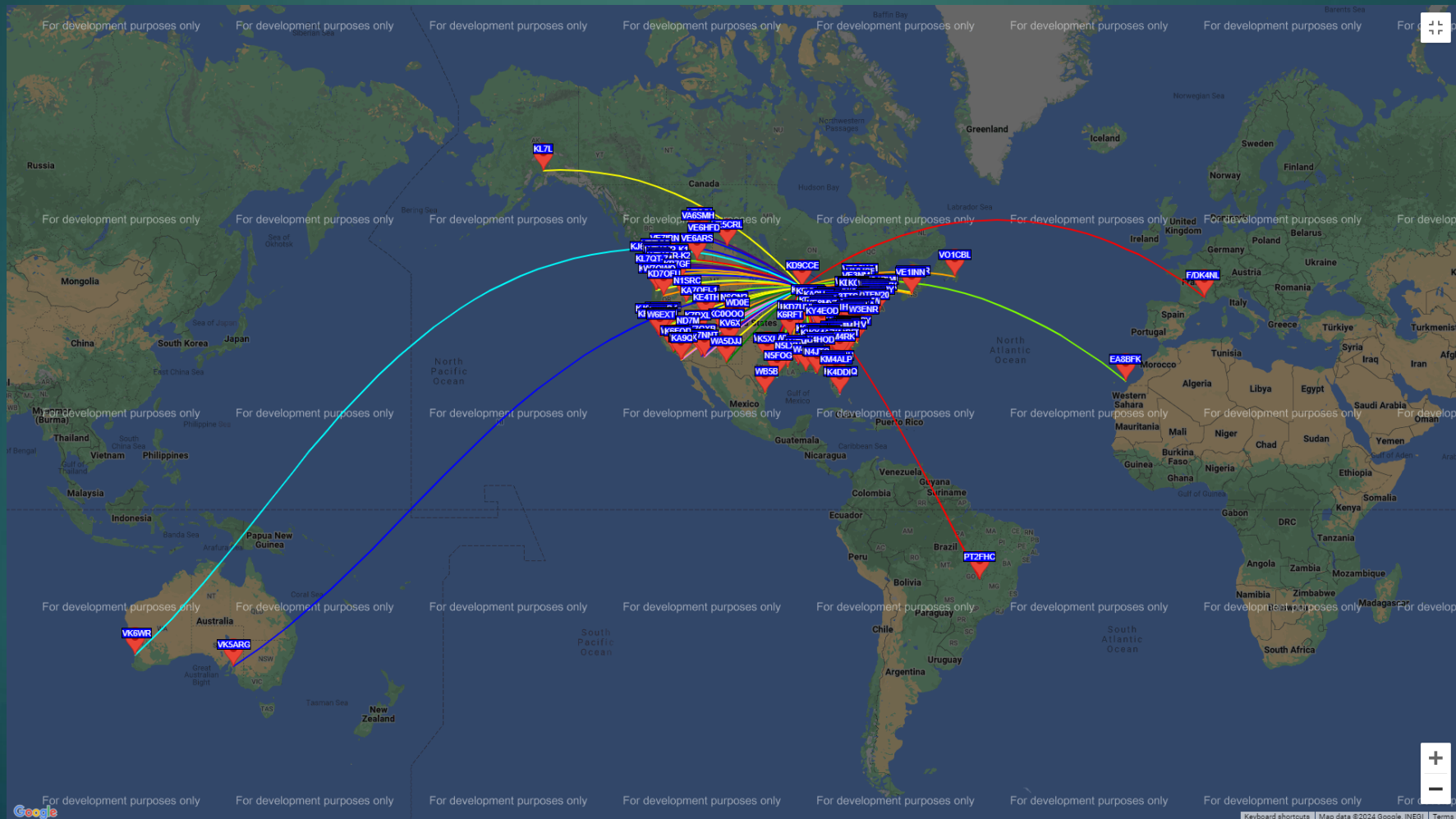
WSPRNet – All Stations - 20 meters (1hr period 5/24/2024 @8am Wisconsin time)



WSPRNet - N9NIC transmitter (1hr period 5/24/204 @8am Wisconsin time)



WSPRNet - KD9CCE Receiver (24hr period - 5/31/2024)



WSJT-X Software

- Use your HF radio and computer
- Real-time visualization
- Allows for more control
- Operate in both transmit & receive modes

- Considerations:
 - Ties up expensive equipment or isn't online 24/7
 - Allows use of antenna tuner
 - If you can only put up one antenna this may be your only option

UTC	dB	DT	Freq	Drift	Call	Grid	dBm	mi
1110					Receiving WSPR			40m
1112	-22	0.4	14.097074	3	DL6JH	JN48	33	537
1112	-10	0.7	14.097099	0	DH6AT	JO62	43	679
1112	-9	0.4	14.097166	0	LA3JJ	JO59	37	812

Hardware - Transmitter

- ▶ <https://zachteck.com>
 - ▶ 80m thru 6m with automatic band switching
 - ▶ 200 milliwatts! – no need for big expensive coax
 - ▶ SMA connector
 - ▶ USB powered
 - ▶ Built-in CPU so no computer required
 - ▶ GPS and antenna – necessary for time synch and location although the location can be manually entered



Hardware - Transmitter Antenna

- ▶ Needs to be resonant on each band (can't use a tuner)
 - ▶ EFHW 80-10 (best choice – simple and effective)
 - ▶ <https://myantennas.com/wp/product/efhw-8010/>
 - ▶ <https://www.vibroplex.com/contents/en-us/p3471.html>
 - ▶ Mono band or trapped dipole
 - ▶ Mono band or Trapped Vertical
 - ▶ Fan Dipole



Zachtech software

ZachTek WSPR Transmitter Configuration Version 1.10

Device name:

WSPR Beacon | Signal Generator | Boot Configuration | Serial Port

WSPR Configuration

Call Sign: Prefix Call Sign Suffix /

Band selection

LP	Band	Progress
<input type="checkbox"/>	2190m	
<input type="checkbox"/>	630m	
<input type="checkbox"/>	160m	
<input type="checkbox"/>	80m	
<input checked="" type="checkbox"/>	40m	
<input type="checkbox"/>	30m	
<input type="checkbox"/>	20m	
<input type="checkbox"/>	17m	
<input type="checkbox"/>	15m	
<input type="checkbox"/>	12m	
<input type="checkbox"/>	10m	
<input type="checkbox"/>	6m	
<input type="checkbox"/>	4m	

Pause after last band (optional):

Transmit Schedule, transmit every ..

2 minutes (Default) 10 minutes 20 minutes Band coordinated schedule

Location


Auto (GPS) Manual

Send a more precise location

Reported power

Normal mode dBm Encode Altitude as power

Device Status

 Hardware: 1.5 Firmware: 1.10

Current output frequency: MHz kHz Hz

Transmitter Output: On Off

Program running: WSPR Beacon Signal Generator Idle

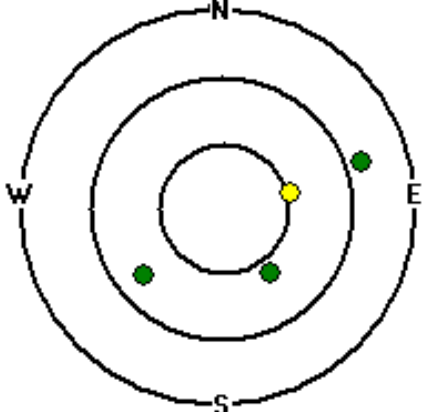
GPS Information

Signal Quality:

Position Lock:

UTC Time: 19:19:23 Position: JO66JA

Az/EI plot of GPS Satellites



ZachTek WSPR Mini transmitter
Firmware version 1.10
Configuration saved
Configuration saved

Debug view

Read progress:

(Re)Read Settings

Save Settings

Hardware - Receiver

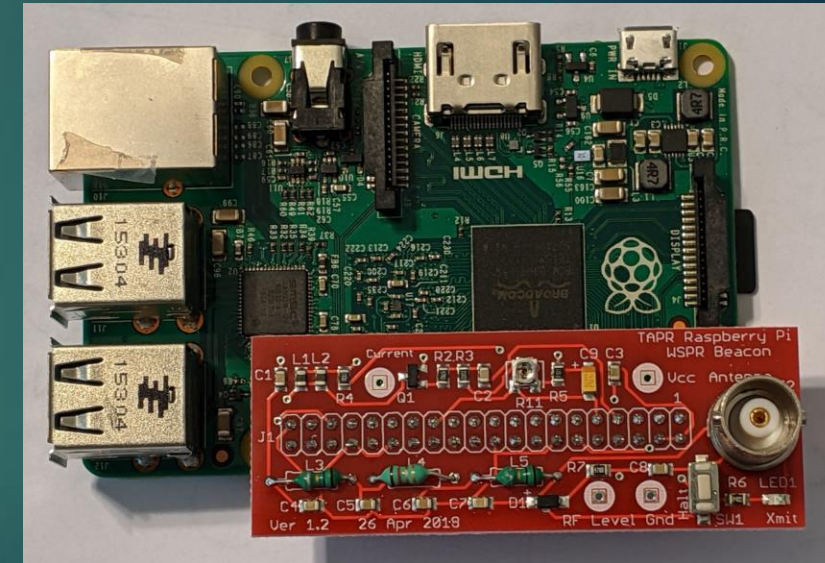
- ▶ [WSPR Receiver](#) | ZachTek, [openWSPR receiver \(remotegqth.com\)](#), or [WSPR – TAPR](#)



Single Band
Very narrow band pass filter
Needs a computer
\$87



Multi-Band capable but
operator must select
No special filtering, Fully
automatic with built in computer
\$135



Single Band kit with very narrow filter
User supplies Raspberry Pi and SD
Card
Fully automatic but requires
\$32

Hardware - Receiver Antenna

- ▶ Anything you want, but the longer the better.

Conclusion

WSPR is a great way to contribute to the Amateur Radio hobby and the scientific community on a 24/7 basis.