

# Frequency Accurate WSPR/FST4W Transmissions using the QRP Labs QDX and RFZero

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With thanks to Gwyn Griffiths G3ZIL, Glenn Elmore N6GN, Paul Elliot WB6CXC, Elmer Musser N3AGE, and the members of the Wsprdaemon community

This work could not have been presented without the help of Hans Summers of QRP Labs and Bo Hansen of RFZero, and of course Joe Taylor and the WSJTx developers

# Project Goals

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Broaden geographic coverage of ionospheric studies

Exploit existing WSPR/FST4W protocols with improved transmitters and receivers

Many capable receive sites are already in operation

Offer low cost (less than \$200) beacon design

Easy “Plug and Play” installation and configuration

Easy upgrade for existing WSPR beacon sites

Low power and fan-less design

Auto-recovery from power outages for remote deployments

# Worldwide WSPR operators

From: <https://wspr.live/gui/d/TZTyor97k/general-wspr-statistics?orgId=1&refresh=1m>

Over the last 7 days there have been 3100 WSPR transmit and 1700 WSPR receive sites

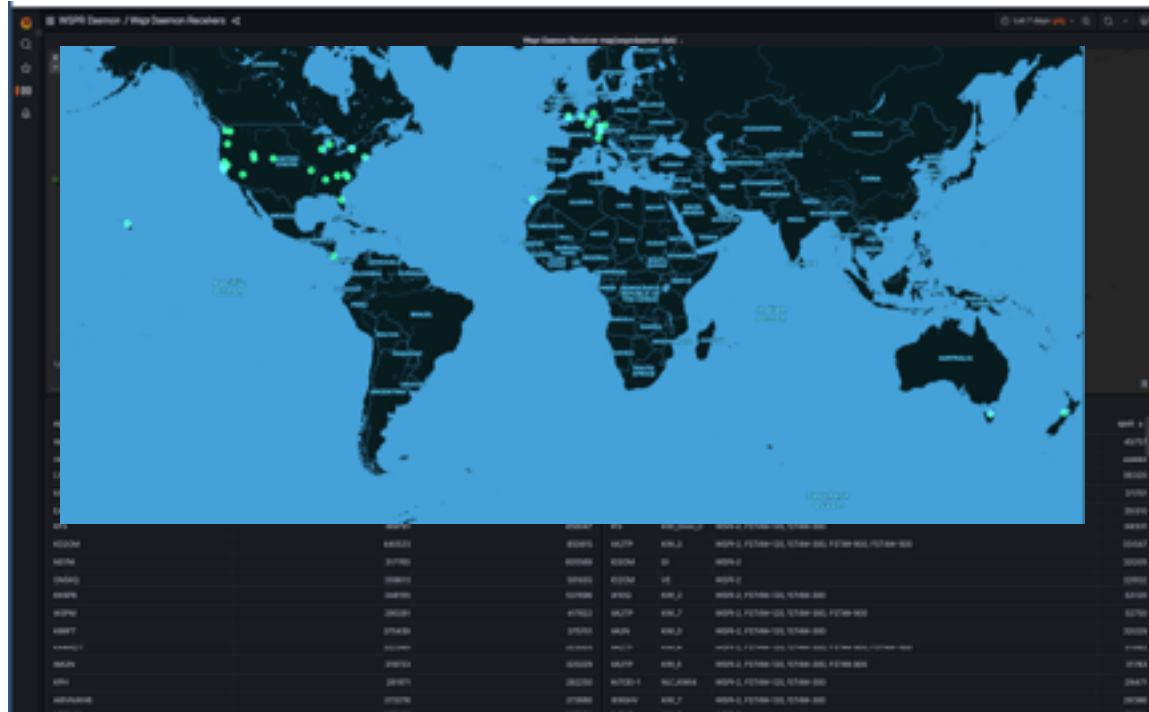


# Worldwide WSPR paths

From: <https://wsp.live/gui/d/BpzJBzRVk/live-world-view?orgId=1&refresh=1m>



# Many FST4W receive sites already active



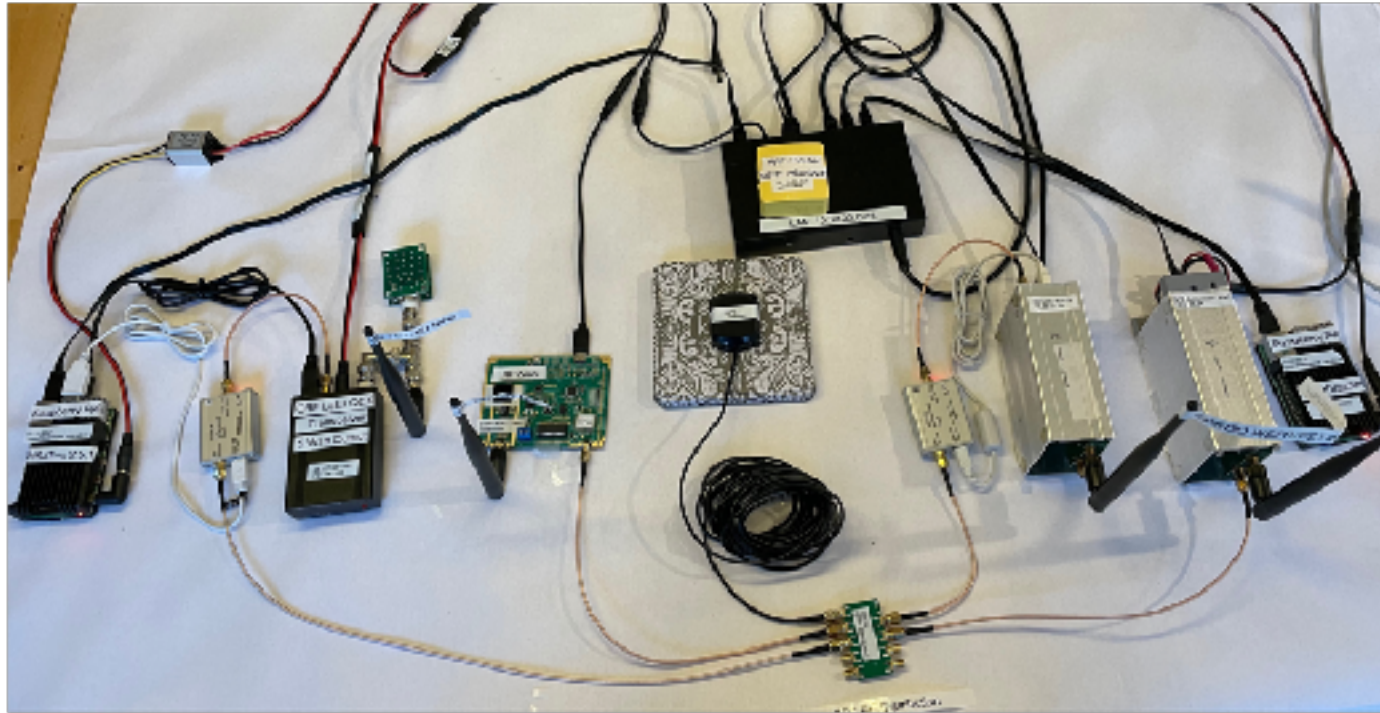
Last 7 days

39 Transmit sites

40 Receive sites



# Low cost FST4W transmit sites



Demonstration at HamSCI

WSJTx- > QDX

5 bands 80-20M

6 bands 20-10M

5 Watts

Approx. \$350 total

RFZero

20 mW

No Filters

Stand alone

\$80 total

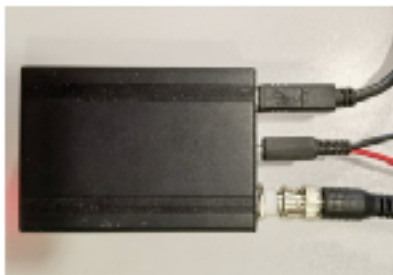
# QDX must be modified to be fed by GPSDO



Remove capacitor

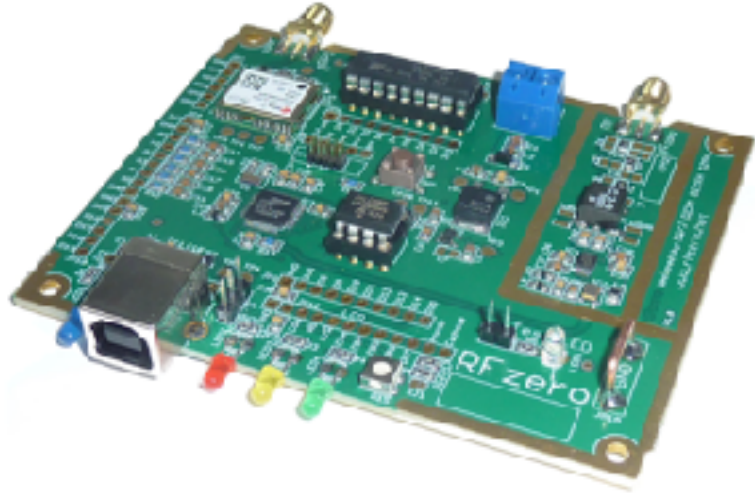
Add SMA pigtail

Fed 25 MHz by Mini Bodnar



# RFZero stand alone WSPR/FST4W transmitter

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A single board GPS Referenced 20 mW transmitter

Attach GPS antenna, HF antenna, and apply power

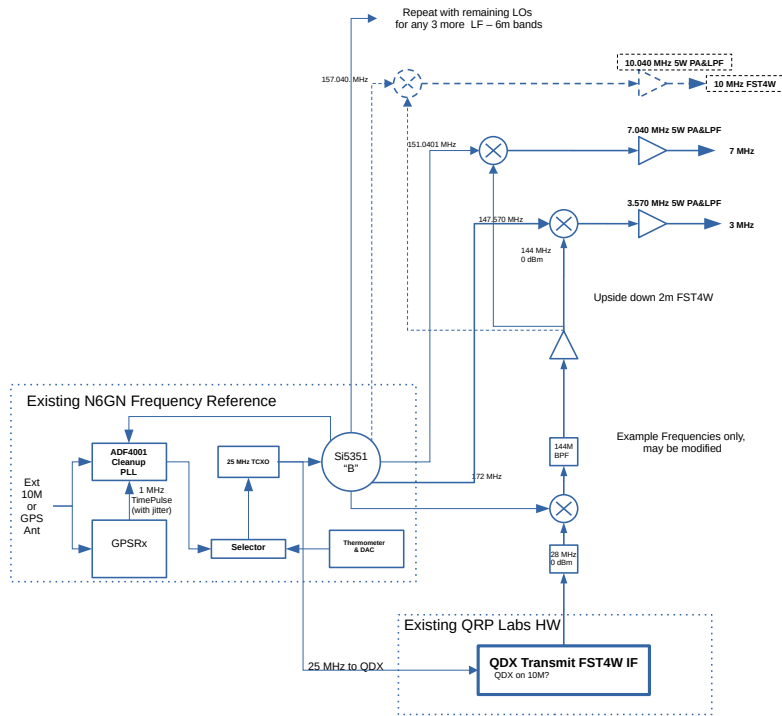
BUT, filter needed

Multiband and higher output power possible, but requires additional HW and SW



# Further possibilities

MultiBand FST4W Transmitter Converter



Make “Time of Flight” measurements from RFZero transmissions

Build an inexpensive custom designed multi band output converter

Modify the WSJTx “wsprd” decoder to disable its drift compensation and output spectral spread

# Limitations of WSPR-2 spot reports

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The [wsprnet.org](http://wsprnet.org) database truncates spot reports to 1 Hz

Few WSPR beacons are GSPDO stabilized

The 'wsprd' decoder includes drift compensation

The 'wsprd' decoder doesn't report spectral spreading

[wsprnet.org](http://wsprnet.org) now reports spot mode, but doesn't report spectral spread values

# Advantages of FST4W spot reports

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The 'jt9' FST4W decoder command outputs spot frequencies with 0.1 Hz resolution

The 'jt9' FST4W decoder command outputs spectral spreading with 0.005 Hz or better resolution

Existing 50 Wsprdaemon receive sites record those measurements with full precision to publicly available SQL database at [wsprdaemon.org](http://wsprdaemon.org)

```
tutorial=> select time,rx_id,receiver,band,freq,mode,tx_call,tx_grid,"SNR",metric,c2_noise,rms_noise from wsprdaemon_spots_s where band='10' and tx_call='AI6VN' and rx_id='AI6VN/G' order by time desc limit 10;
```

time	rx_id	receiver	band	freq	mode	tx_call	tx_grid	SNR	metric	c2_noise	rms_noise
2023-03-12 23:32:00	AI6VN/G	KIWI_0	10	28.1261894	3	AI6VN	CM87	14.1	5	-121.7	-140.7
2023-03-12 23:30:00	AI6VN/G	KIWI_0	10	28.1261894	3	AI6VN	CM87	14.2	5	-121.9	-141.8
2023-03-12 23:28:00	AI6VN/G	KIWI_0	10	28.1261894	3	AI6VN	CM87	14.1	5	-121.8	-141.2