Frequency Accurate
WSPR and FST4W Transmissions
using the
QDX and RFZero

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Project Goals

Broaden geographic coverage of FST4W 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 $350) beacon design

Easy "Plug and Play" installation and configuration
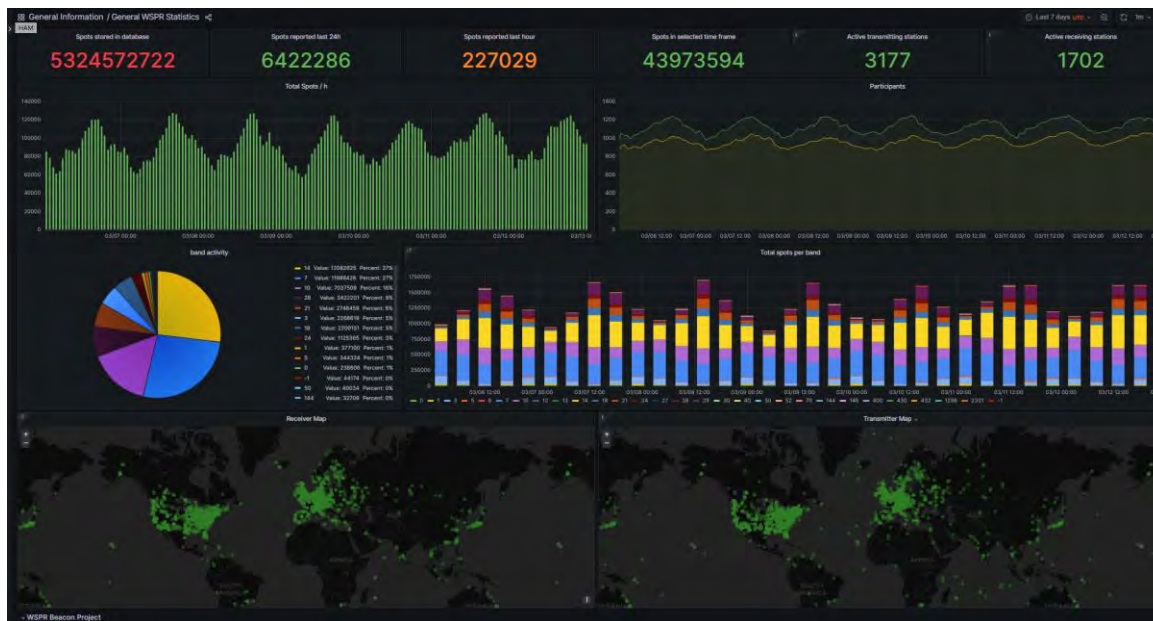
Easy upgrade for existing WSPR beacon sites

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

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Worldwide WSPR paths

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

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Many FST4W receive sites are already active
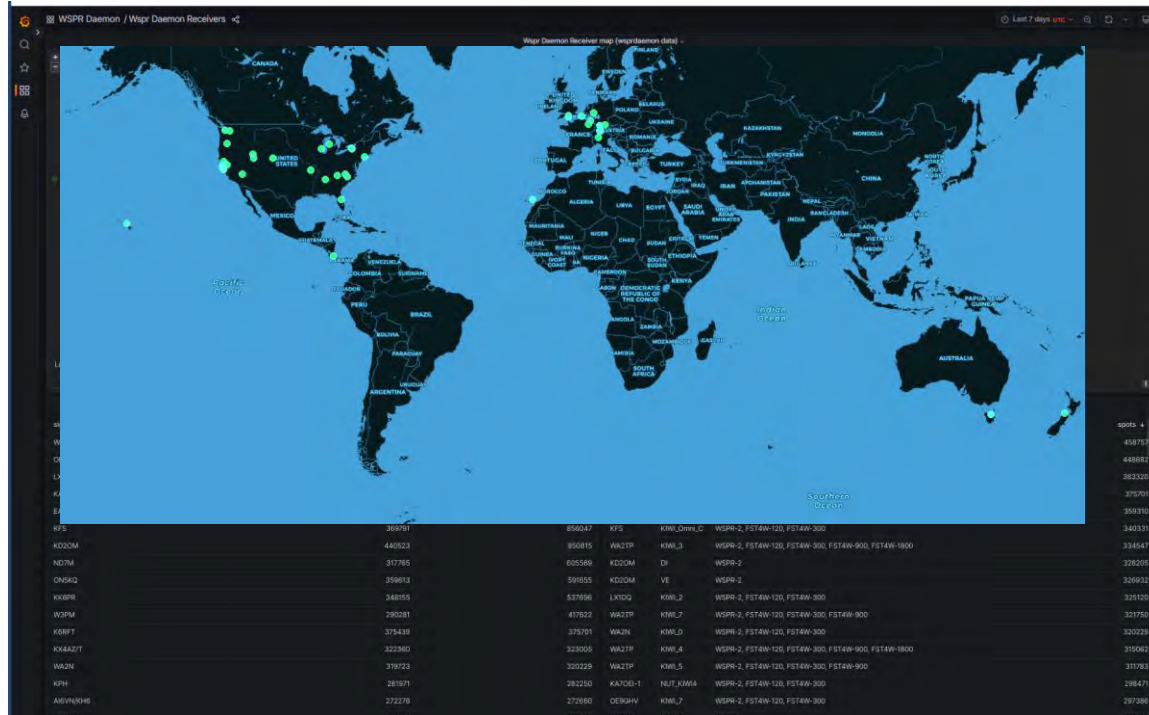
In last 7 days

39 Transmit sites

40 Receive sites

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Low cost FST4W transmit demo

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
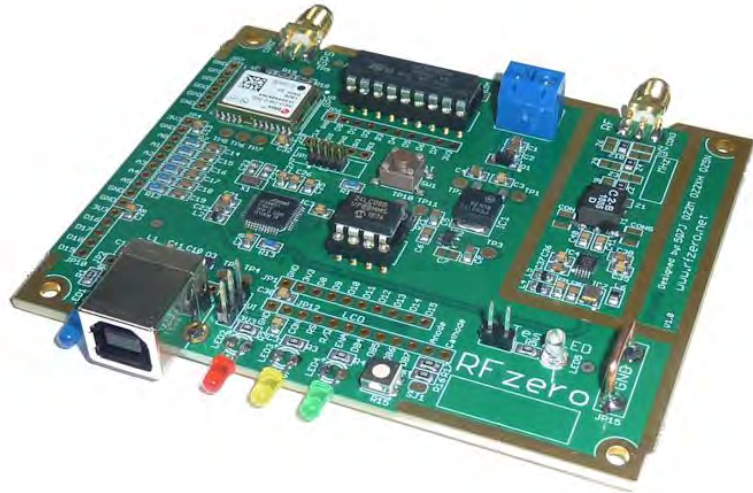
$80 total

QDX modified for GPSDO input

Remove capacitor

Add SMA pigtail

Fed 25 MHz by Mini Bodnar

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RFZero stand alone WSPR/FST4W transmitter

A single board GPS Referenced 20 mW transmitter

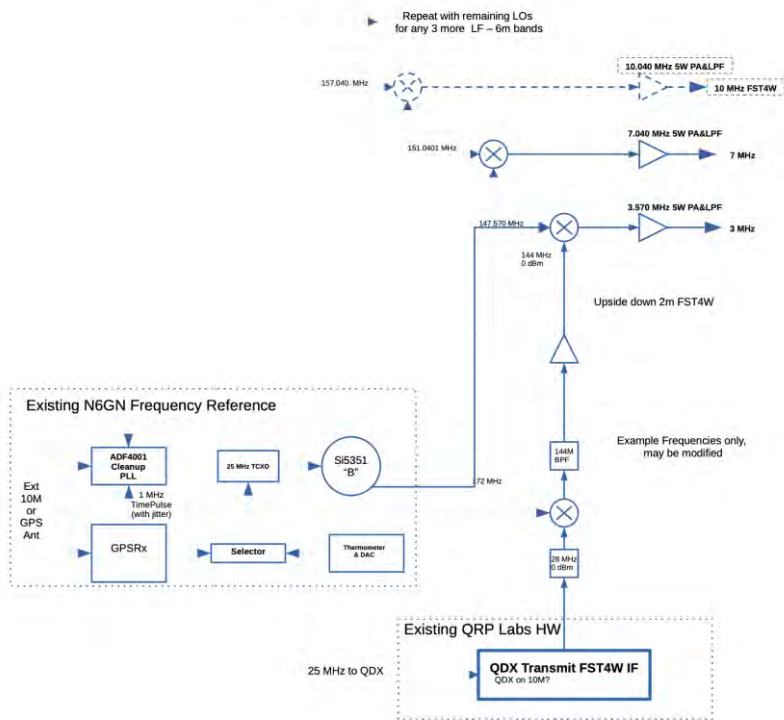Attach GPS antenna, HF antenna, and apply power

BUT, filter needed

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

Expanded Capabilities

MultiBand FST4W Transmitter Converter

Build an inexpensive custom designed multi band output converter

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

Make "Time of Flight" measurements from RFZero transmissions

The Spreading Budget

Limitations of WSPR-2 spot reports

The 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 now reports spot mode, but doesn't report spectral spread values

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Advantages of FST4W spot reports

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

```
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

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 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
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