

GPSDOs - Past and Present

A landscape photograph showing a snow-dusted field in the foreground with patches of green grass. In the background, a large, rounded hill (Caer Carradoc) is visible under a bright sky with a sun flare and a contrail.

Dave Robinson G4FRE

MMRT

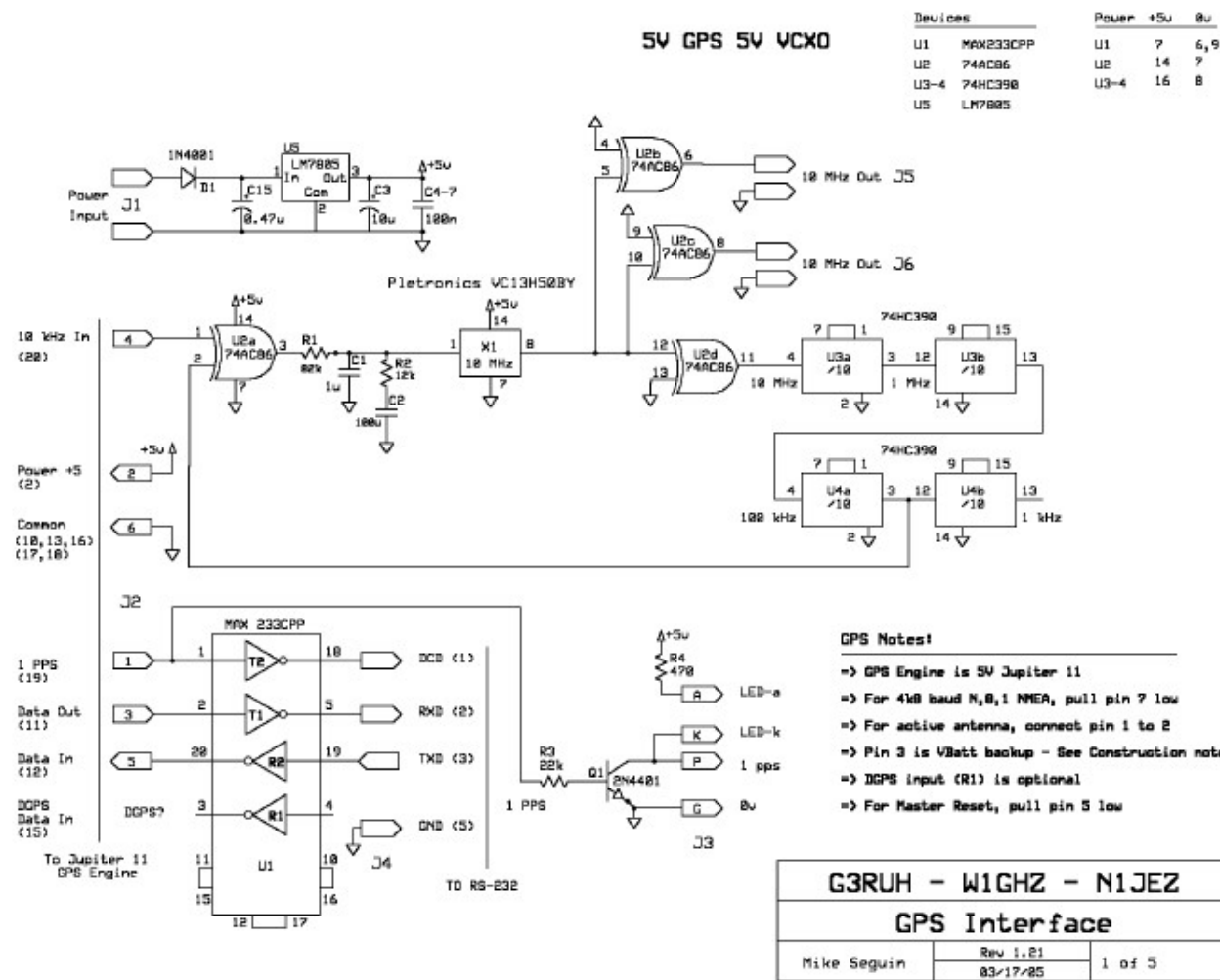
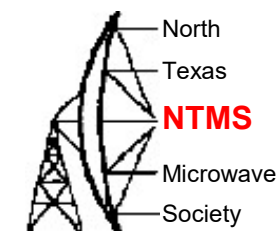
22 Nov 2025

Caer Carradoc from the North

You can never have enough GPSDO!



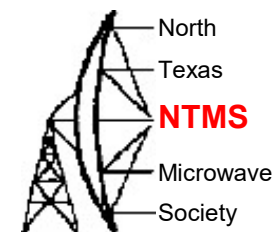
N1JEZ (2005)



Locks to 100kHz
output from Jupiter
GPS
No CPU!

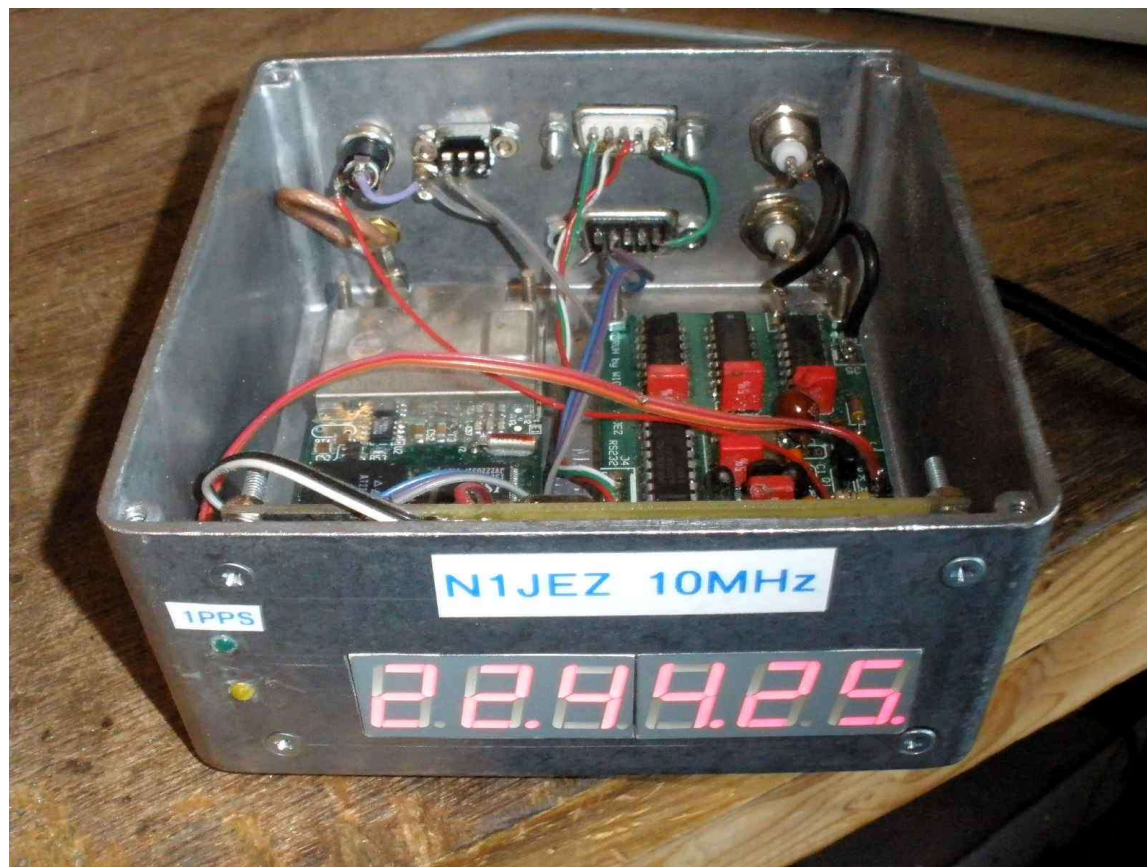
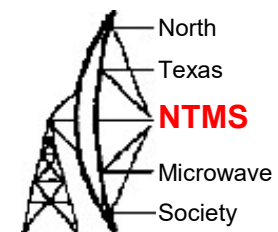
W5HN

N1JEZ Built

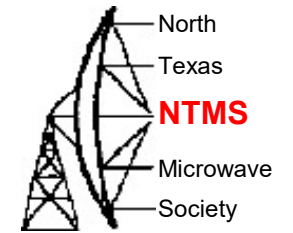


W5HN

N1JEZ CLOCK



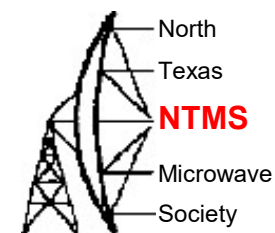
HP Z3801



- Made by HP for CDMA cell sites. Lots on USA surplus market around 2004(\$75)



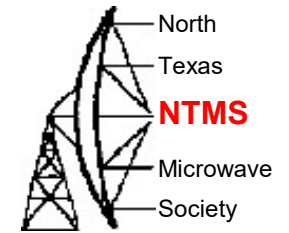
Jackson Labs



- 2012 TAPR Bulk Purchase \$335!



Jackson Labs Encapsulation

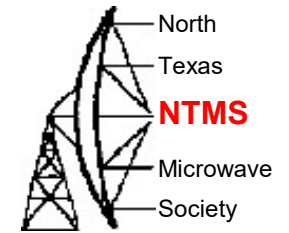


- Jackson Module + Puck antenna+ 8.4V Battery pack all inside PLASTIC BOX

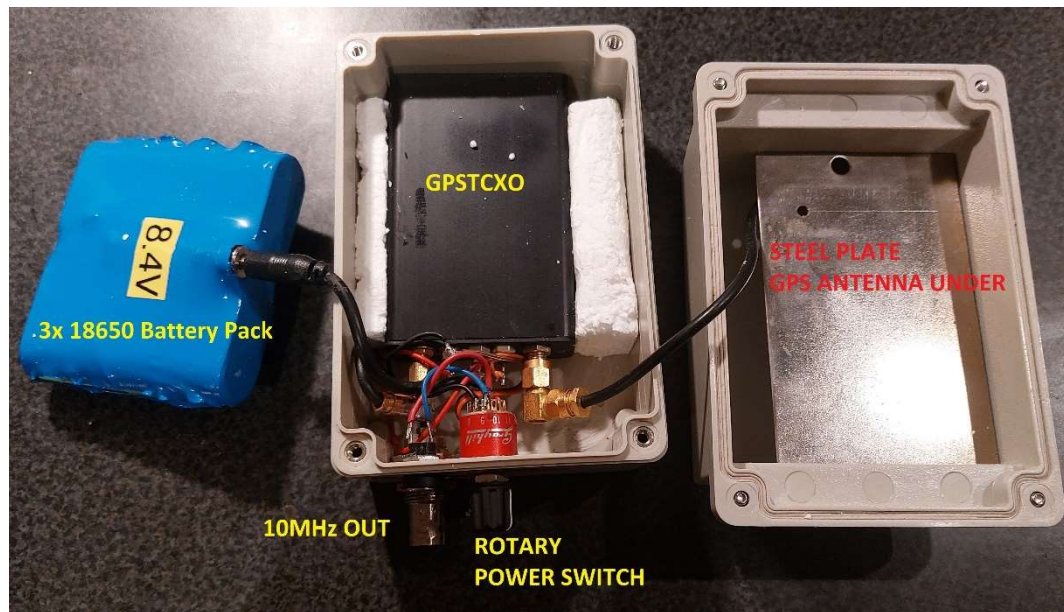


24GHz Trophy IO82TD

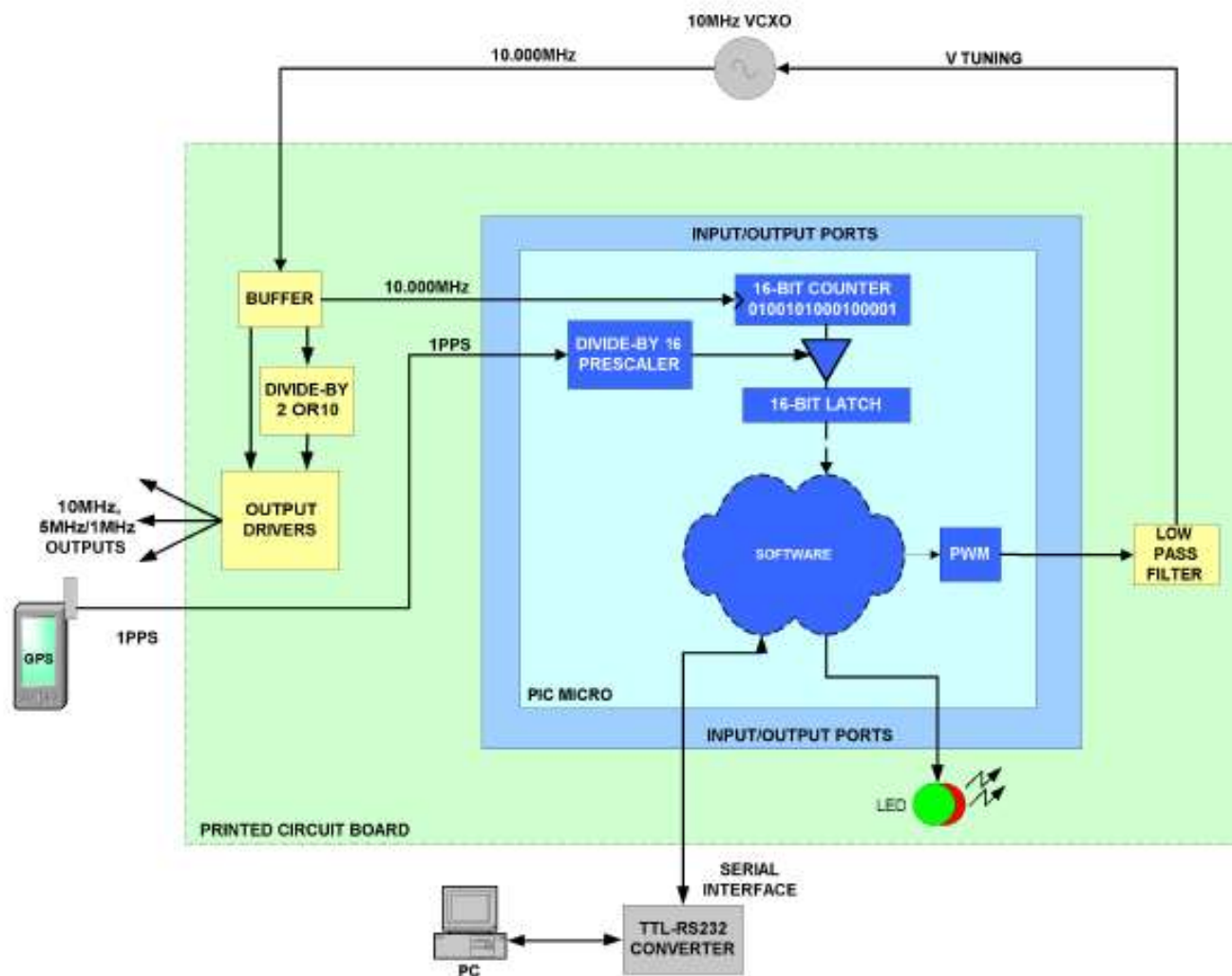
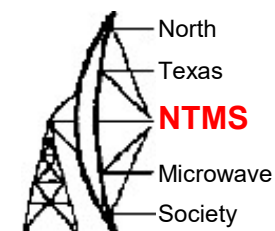
Jackson Labs Encapsulation



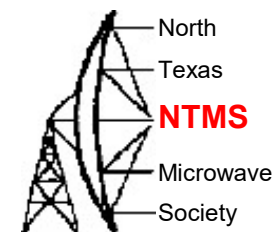
- Jackson Module + Puck antenna+ 8.4V Battery pack all inside PLASTIC BOX



VE2ZAZ Mk1

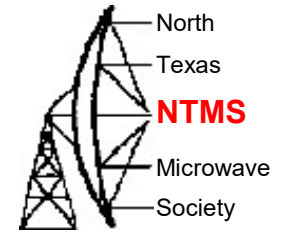


VE2ZAZ Mk1



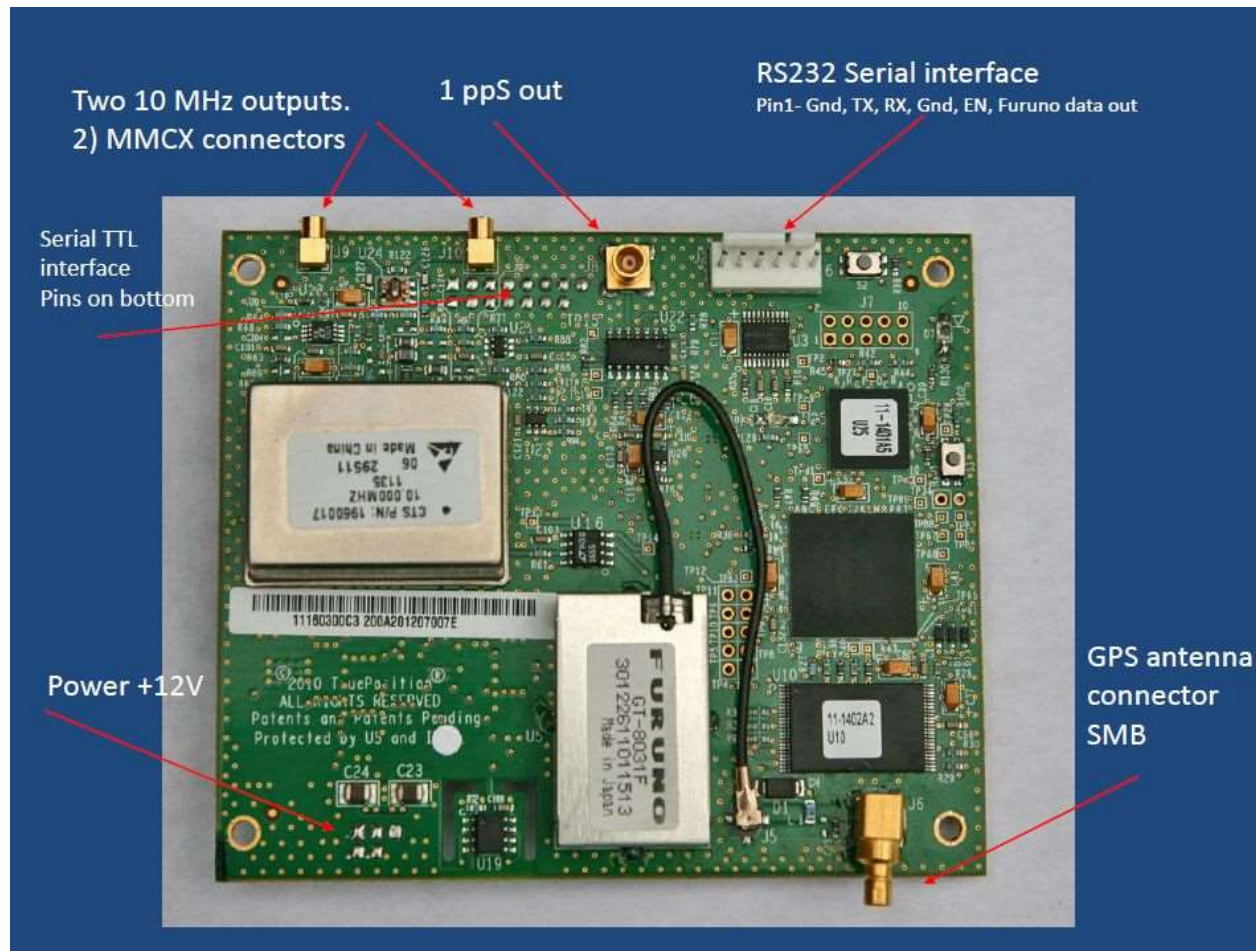
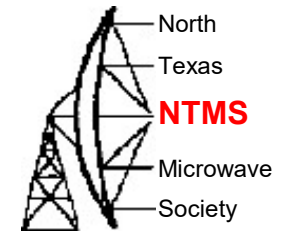
PIC Controller using 1PPS from GPS

True Position

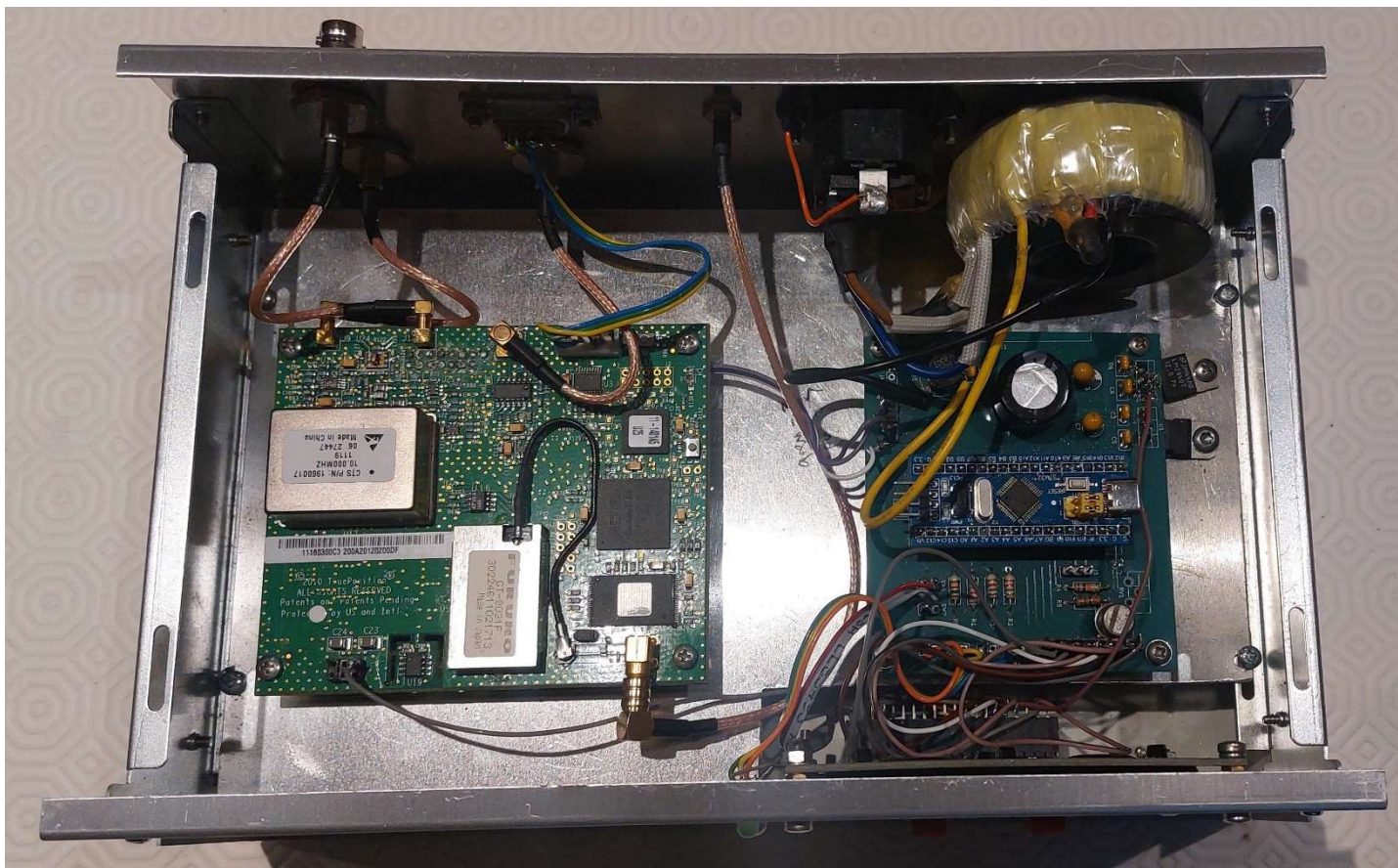
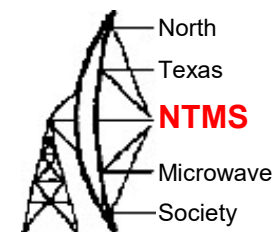


- Designed for Japan CDMA Base stations
- USA surplus market 2016.
- Custom Protocol
- Packrats did a controller design with Arduino. Source code unavailable.
- YATPGPSDO Source code available

Trueposition module



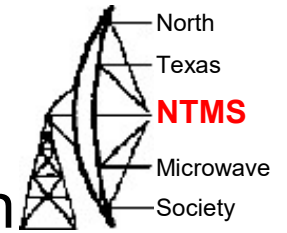
YAGPSDO



Note LINEAR PSU

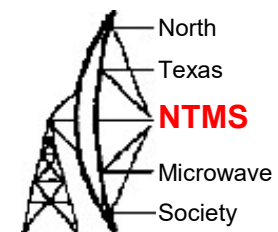
Trimble Thunderbolt

Can be controlled by KE5FX Lady Heather or Tboltmon Software

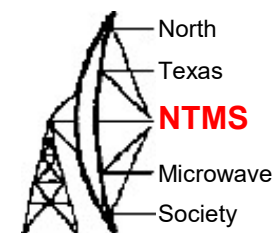


Built M1DST Netduino+ controller which has the bonus of having an NTP time Server

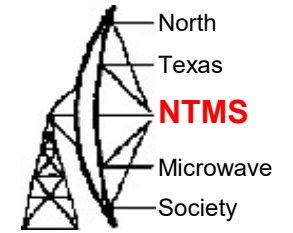
M1DST Netduino



W5HN



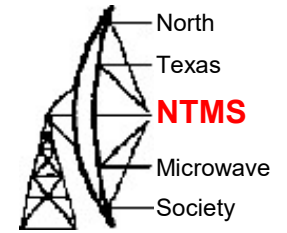
Enough History!



Enough History!

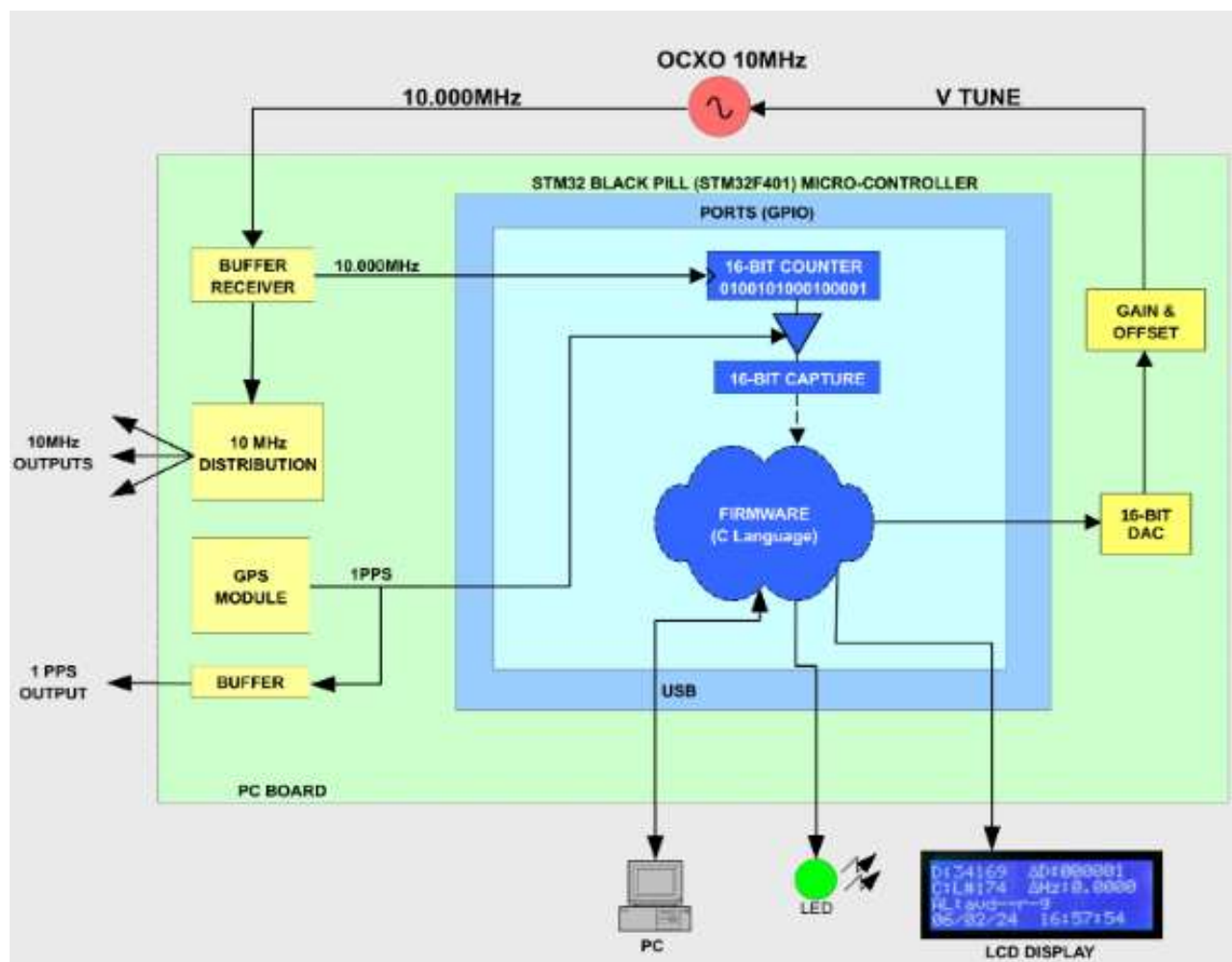
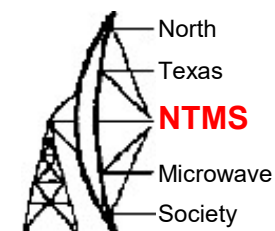
Lets look at what is around to build today!

VE2ZAZ Mk 2



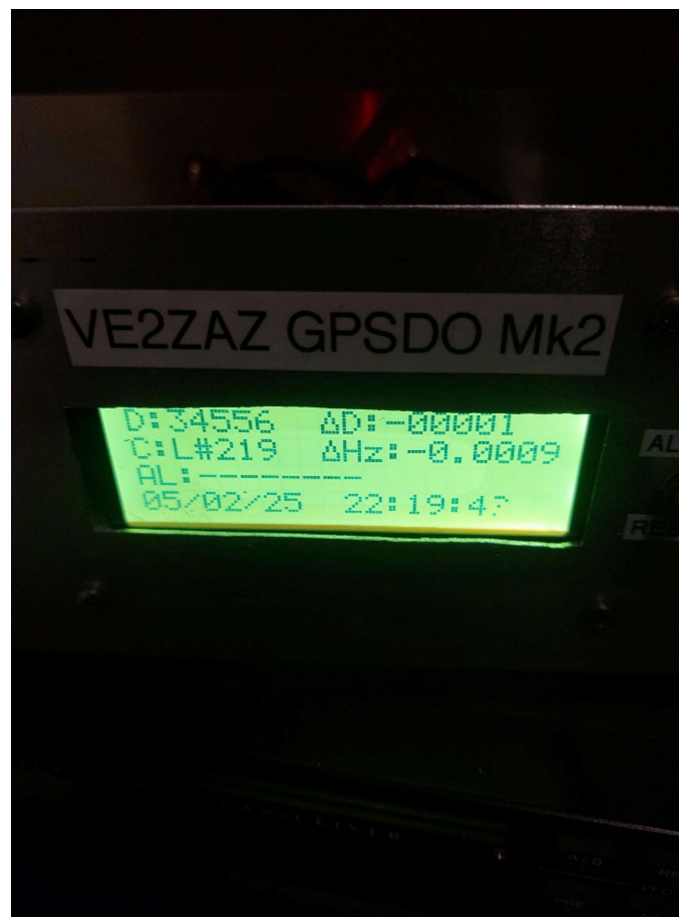
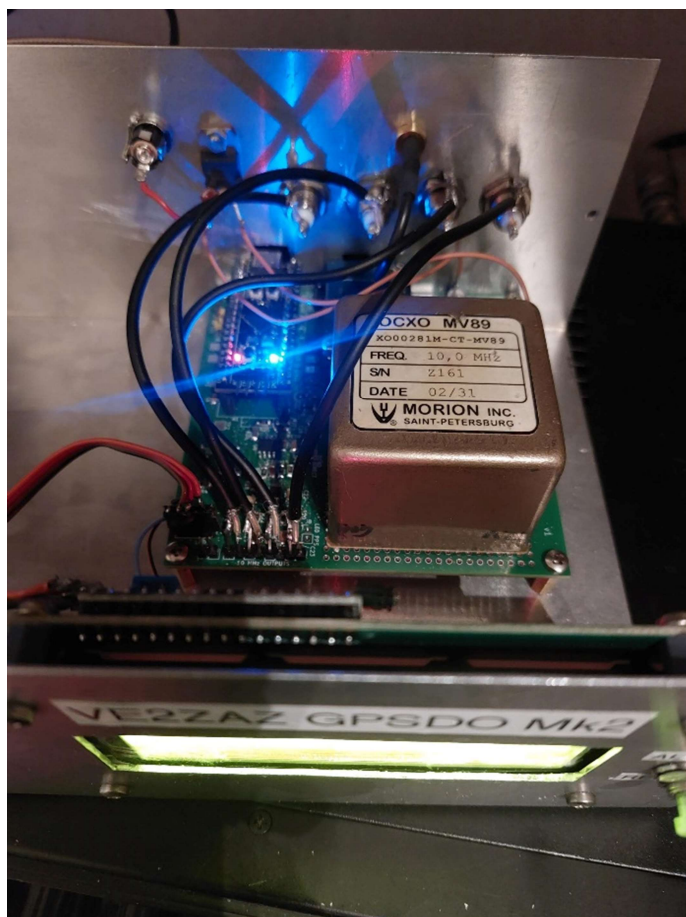
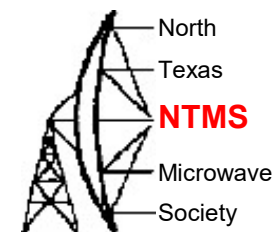
- Neo M-7 GPS
- STM32 Black Pill (STM32F401C) Controller
- 16 Bit DAC (DAC80501)
- Can accommodate a variety of 10MHz OCXO
- PCB Gerbers available

VE2ZAZ Mk2

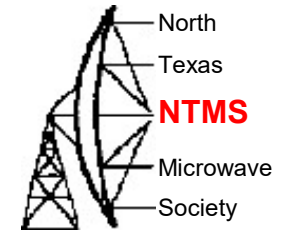


W5HN

VE2ZAZ Mk2

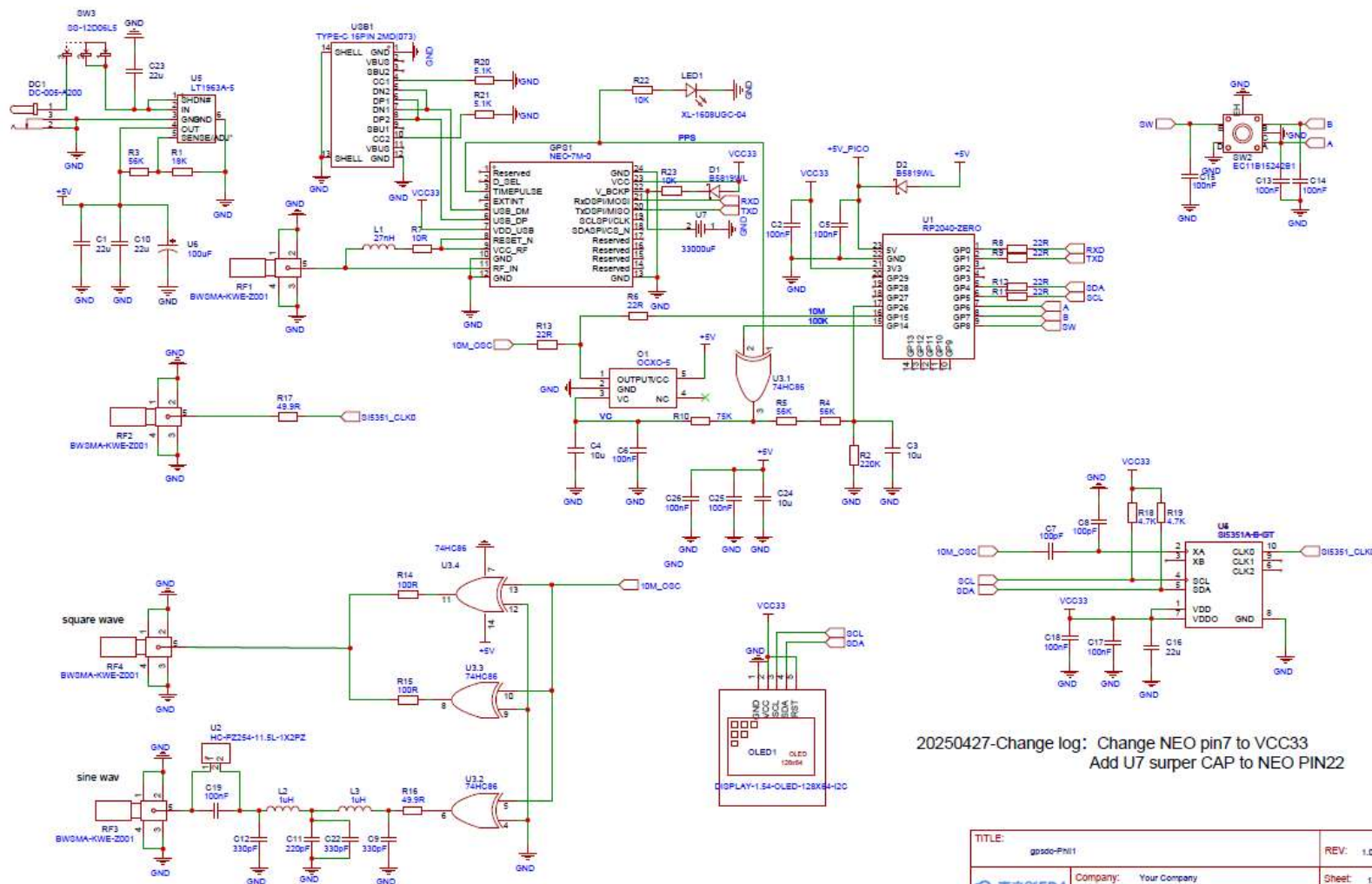
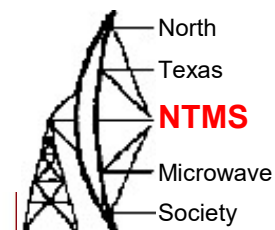


VK6PH



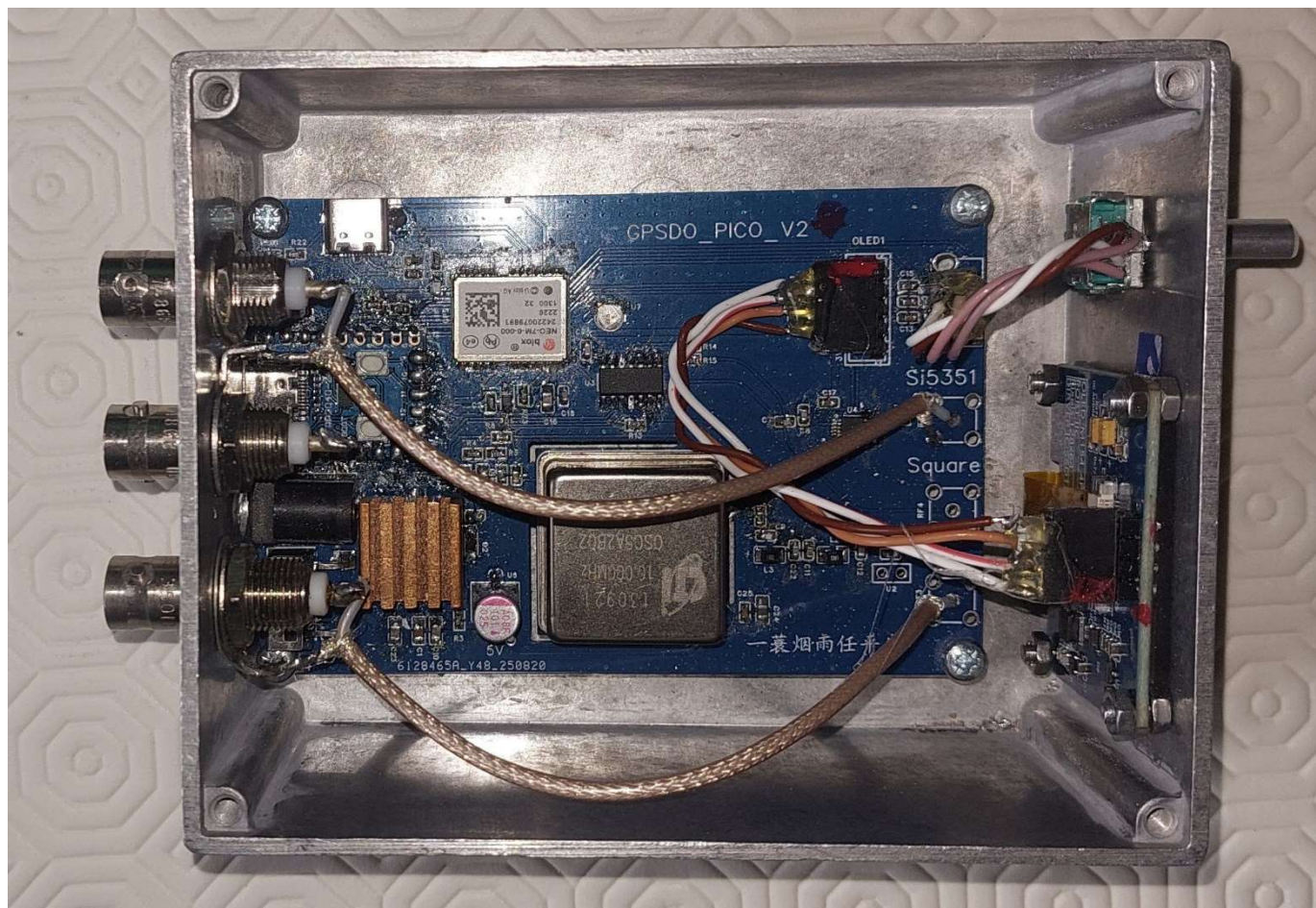
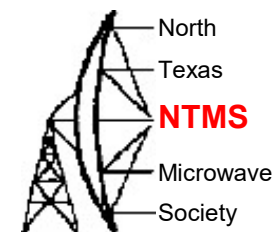
- Radio Communication September 2025
- Neo M-7 GPS
- Pi Pico Zero Controller
- PCB Gerbers available

VK6PH

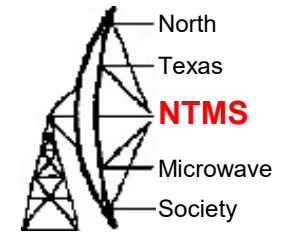


TITLE:	gp200-Pin1	REV:	1.0
Company:	Your Company	Sheet:	1/1
Date:	2024-08-26	Drawn By:	—秦 賴南任平生

VK6PH

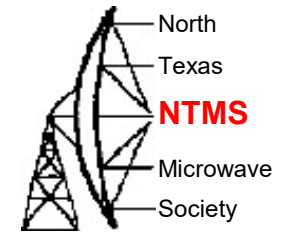


W5HN

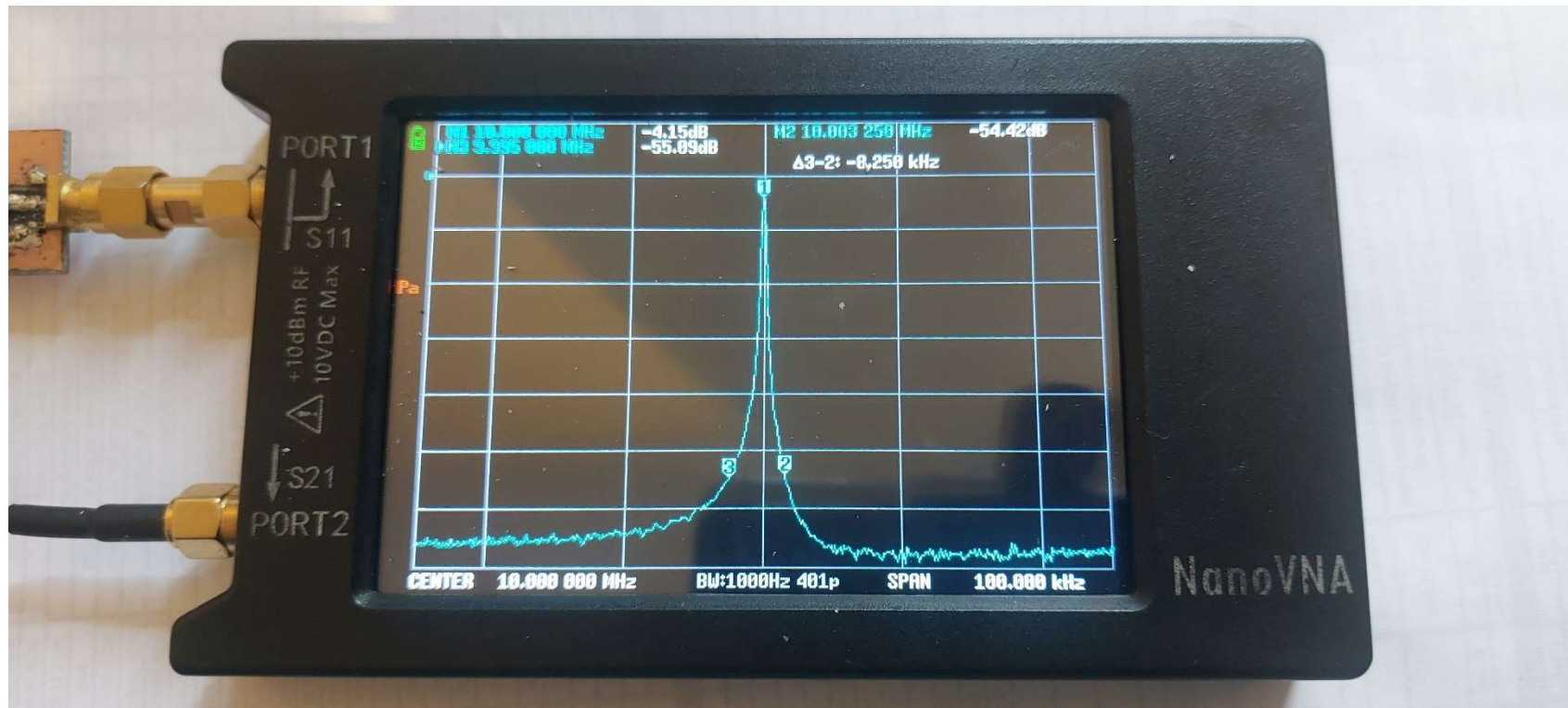


How do they perform?

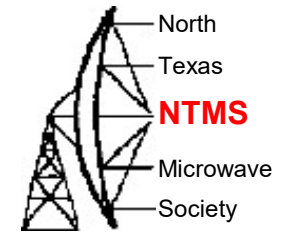
NANOVNA



- Many will have one, but it can be re-tasked (and put back again)!



TINYPFA

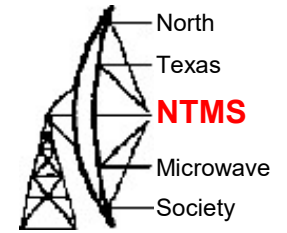


- Can measure/output Frequency and phase difference between **two similar frequency** sources



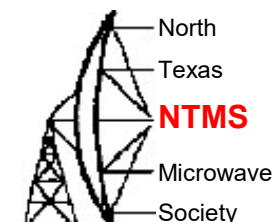
- What can we measure?

ADEV: A measure of oscillator Stability

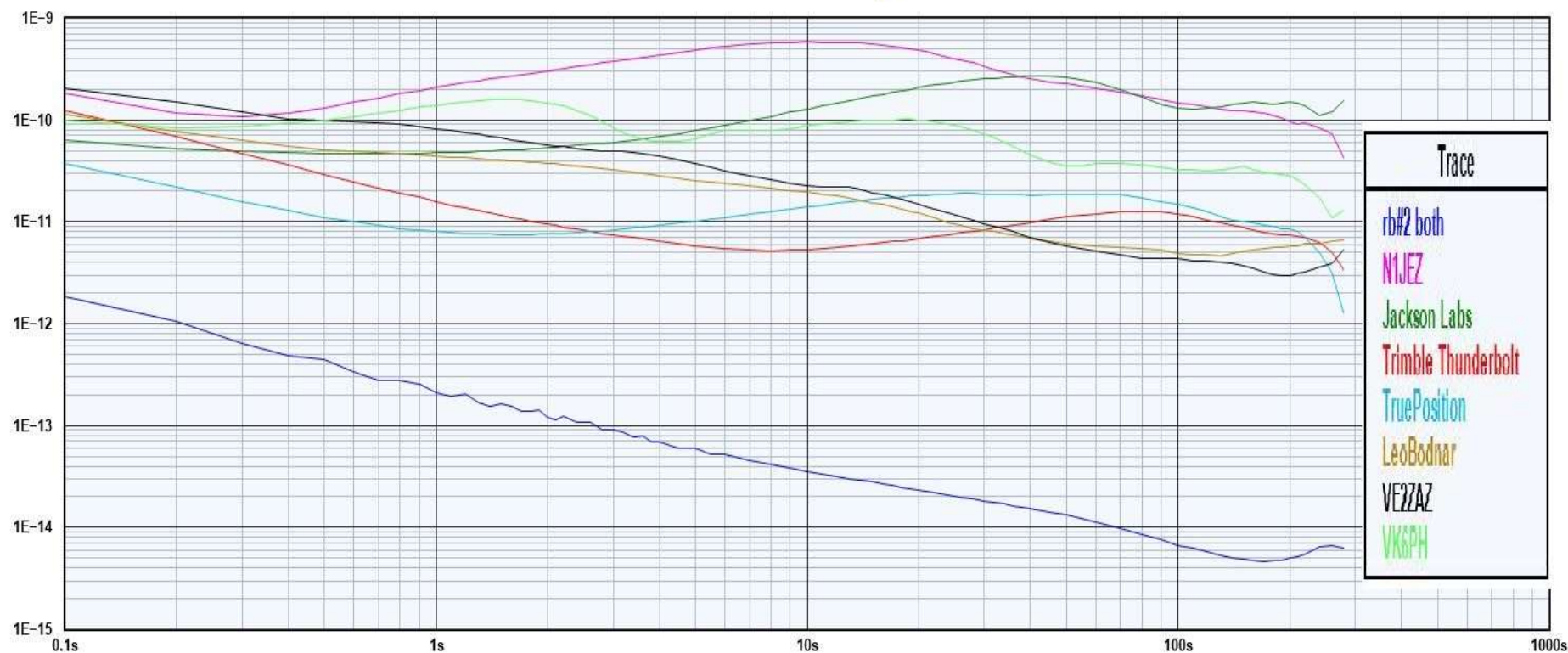


- Allan variance is defined as one half of the time average of the squares of the differences between successive readings of the frequency deviation sampled over the sampling period
- An Allan deviation of 2×10^{-10} at observation time 1 s (i.e. $\tau = 1$ s) should be interpreted as there being an instability in frequency between two observations 1 second apart with a relative root mean square (RMS) value of 2×10^{-10} . For a 10 MHz clock, this would be equivalent to 2 mHz RMS movement. If locked and multiplied to 10GHz signal, this would be equivalent to 2 Hz RMS movement.
- Data from TINYPFA can be displayed by KE5FX Timelab software

My GPSDO Comparisons

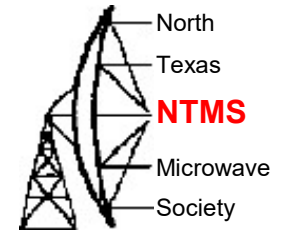


Allan Deviation $\sigma_y(\tau)$



VE2ZAZ performance close to Bodnar

But how do they do on the air?

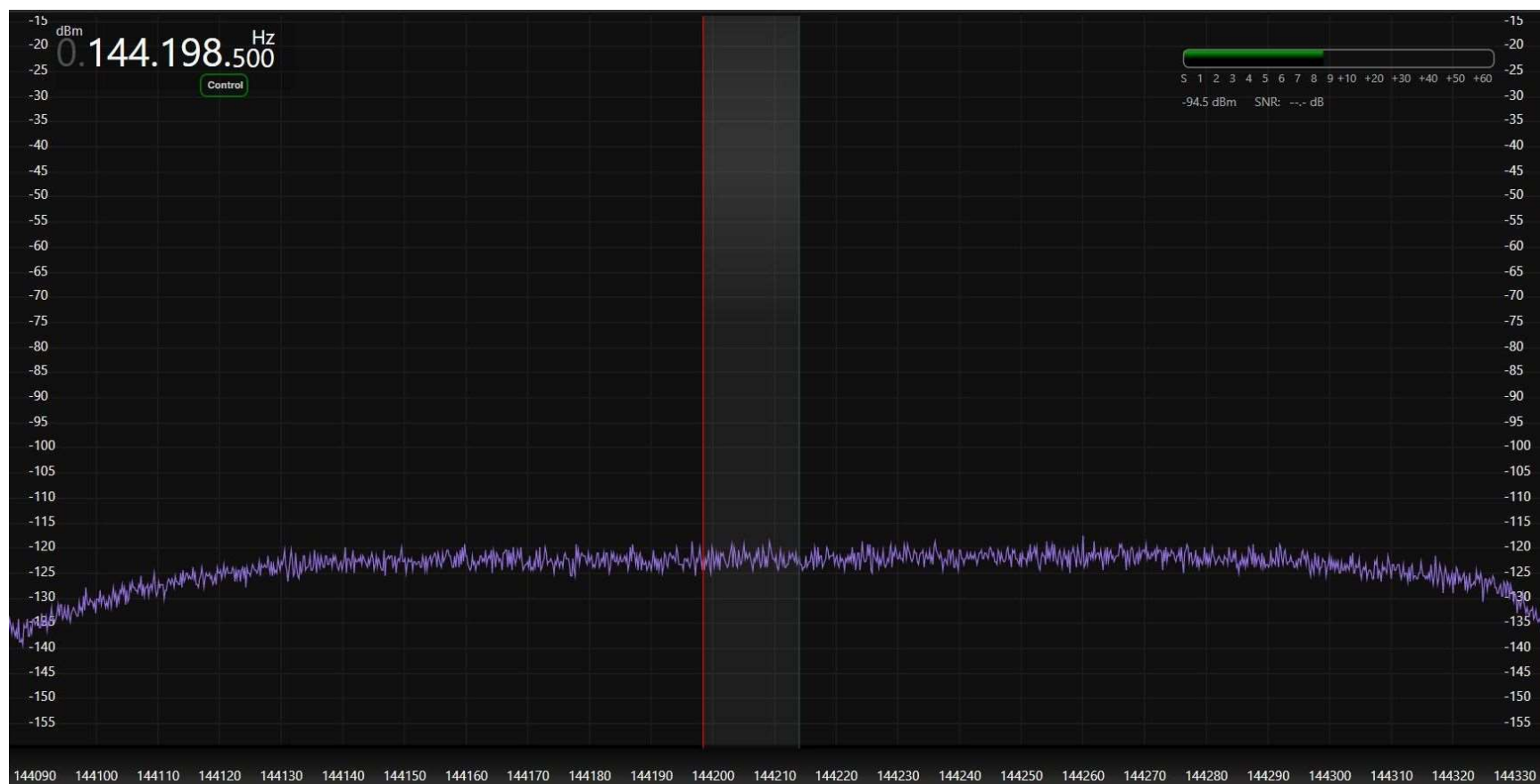
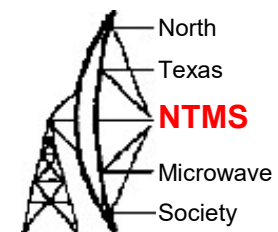


- ZLPLL as source on 10368.2MHz with MV85 reference
- DB6NT 10GHz Transverter 144 MHz IF
- NRSP-ST SDR



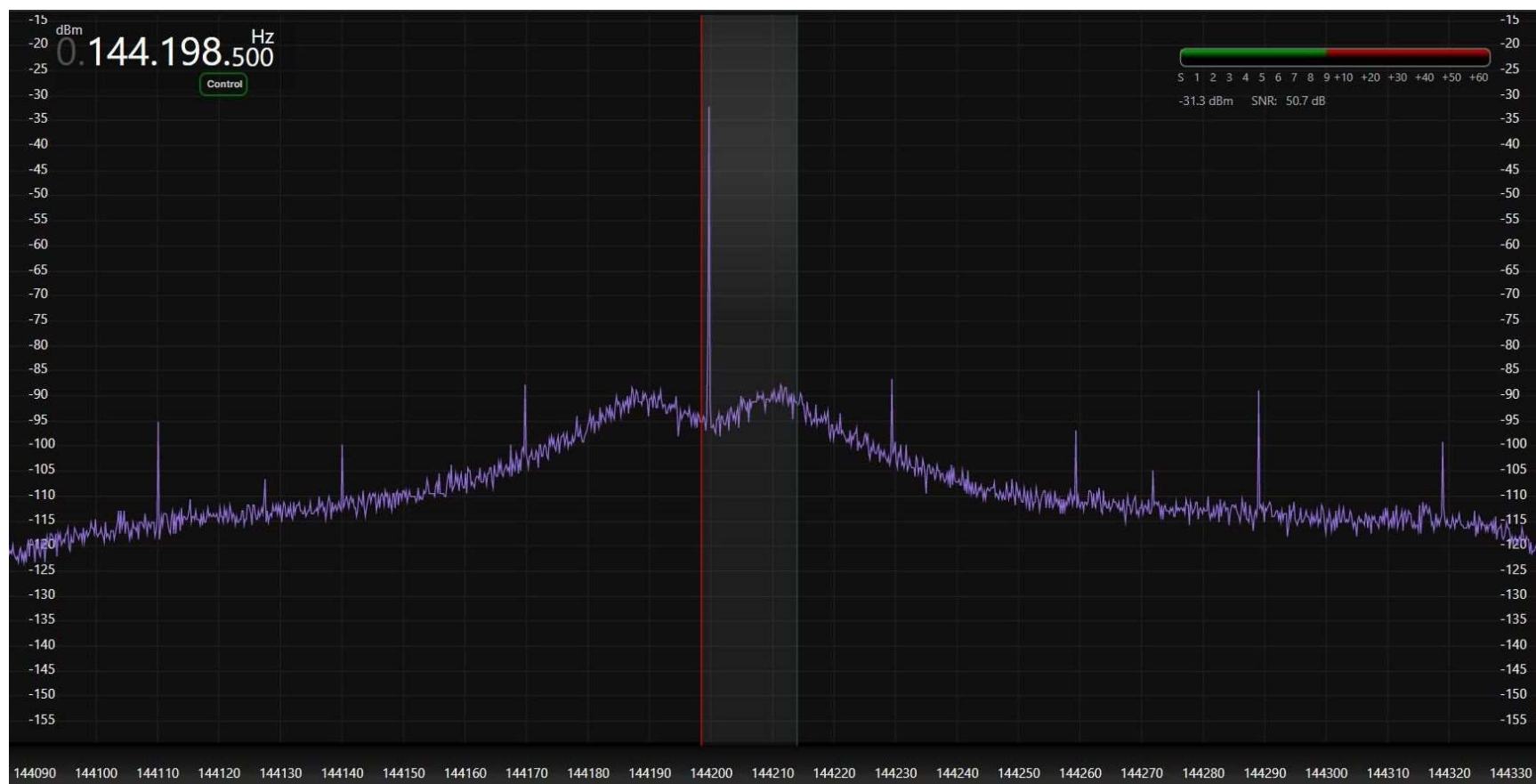
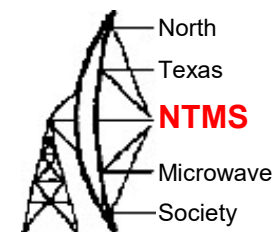
W5HN

ZLPLL OFF



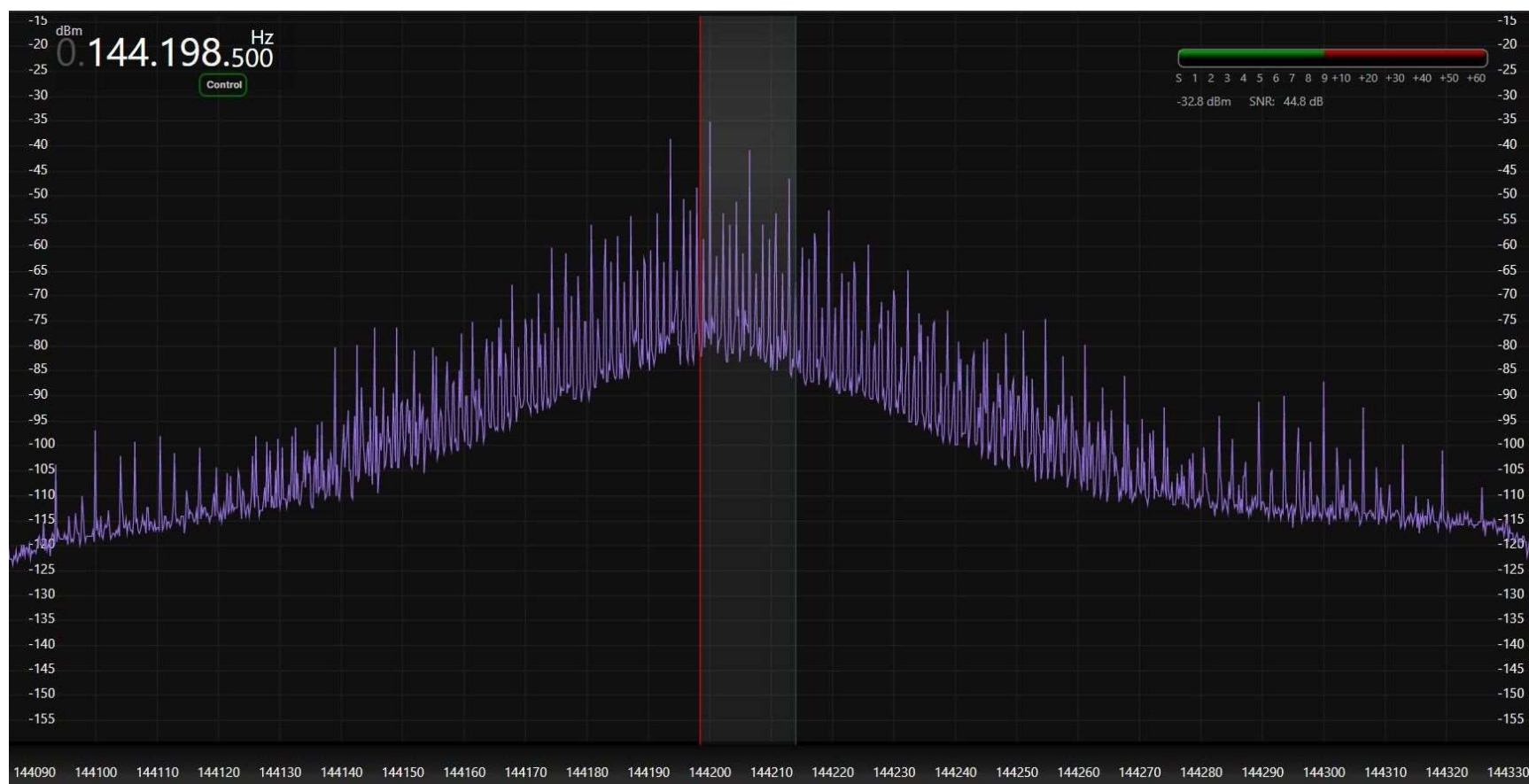
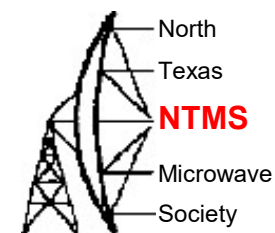
W5HN

ZLPLL CTI 10MHz Ref



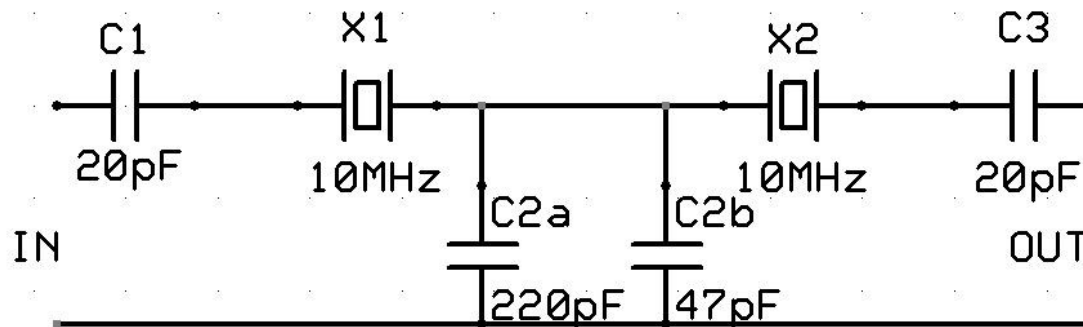
W5HN

VK6PH as 10MHz reference



Oh Dear!

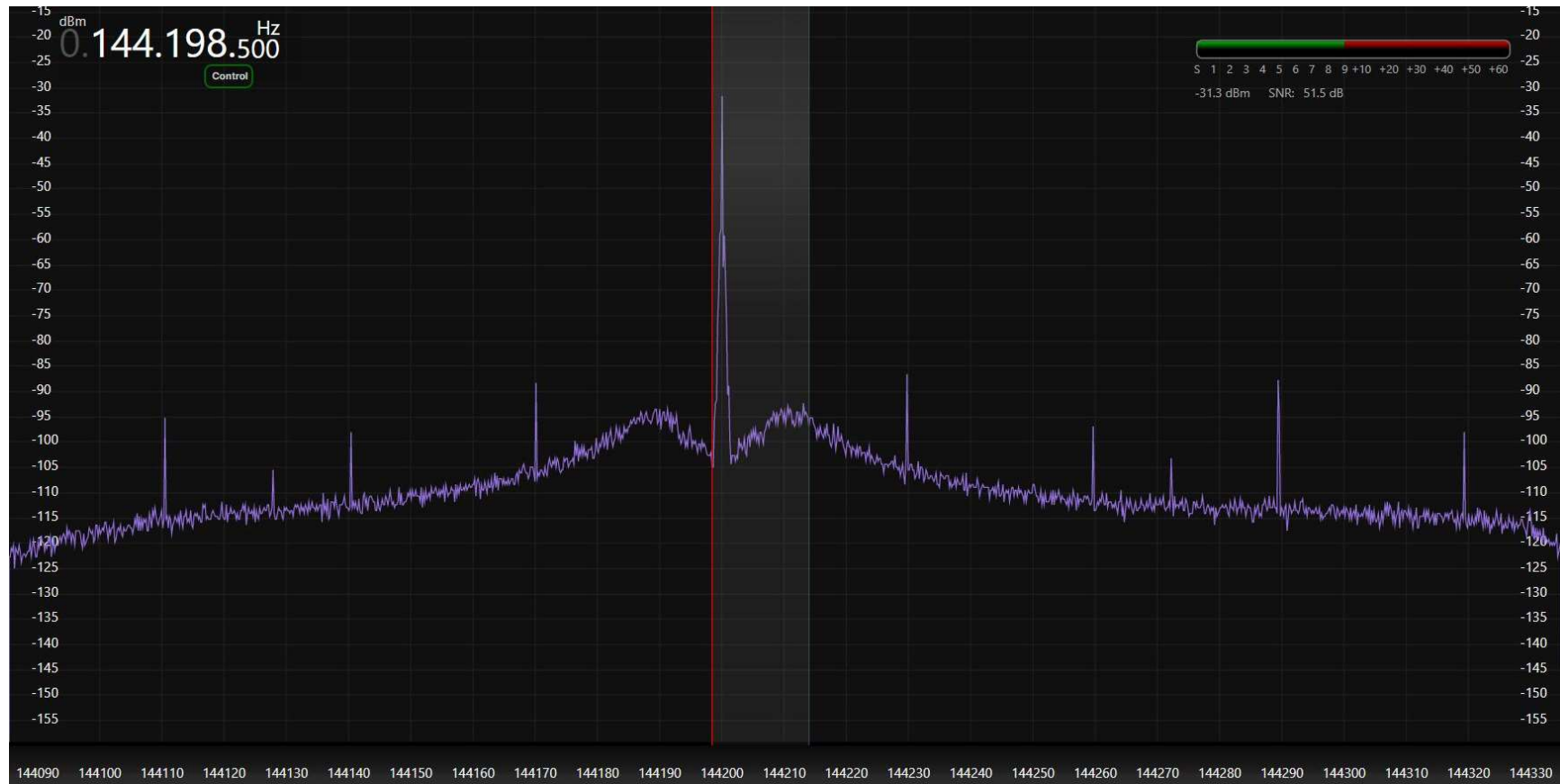
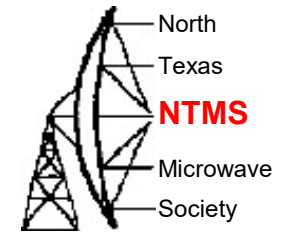
- Built 10MHz 2 crystal filter



Bought 50 XTALS from China, selected 10 with same series resonance using Nanovna.

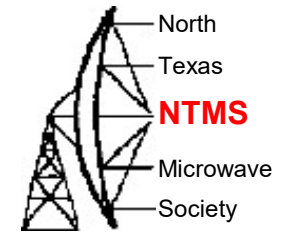
W5HN

VK6PH Ref with XTAL Filter



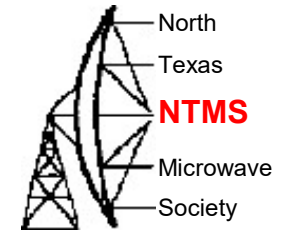
All my GPSDO (and Rubidiums) will have crystal filters!

Links



- N1JEZ https://g4fre.com/n1jez_construction.pdf
- VE2ZAZ V1 https://ve2zaz.net/GPS_Std/GPS_Std.htm
- VE2ZAZ V2 https://ve2zaz.net/GPS_Std_Modernized/GPS_Std.htm
- M1DST Thunderbolt <https://github.com/m1dst/Trimble-Thunderbolt-Monitor>
- Trueposition GPSDO
<https://www.packratvhf.com/attachments/article/160/A-Packrat-GPS-Receiver-Project.pdf>
- Yet another GPSDO
<https://diysquared.blogspot.com/2021/02/yatg-yet-another-trueposition-gpsdo.html>
- VK6PH <https://github.com/raspsdr/gpsdo>
- TinyPFA <https://www.tinydevices.org/wiki/pmwiki.php?n=TinyPFA.Homepage>
- Timelab software <https://www.miles.io/timelab/beta.htm>
- Filter PCB Gerbers http://g4fre.com/g4fre_xtalfilter.zip

Wavelab Investigation

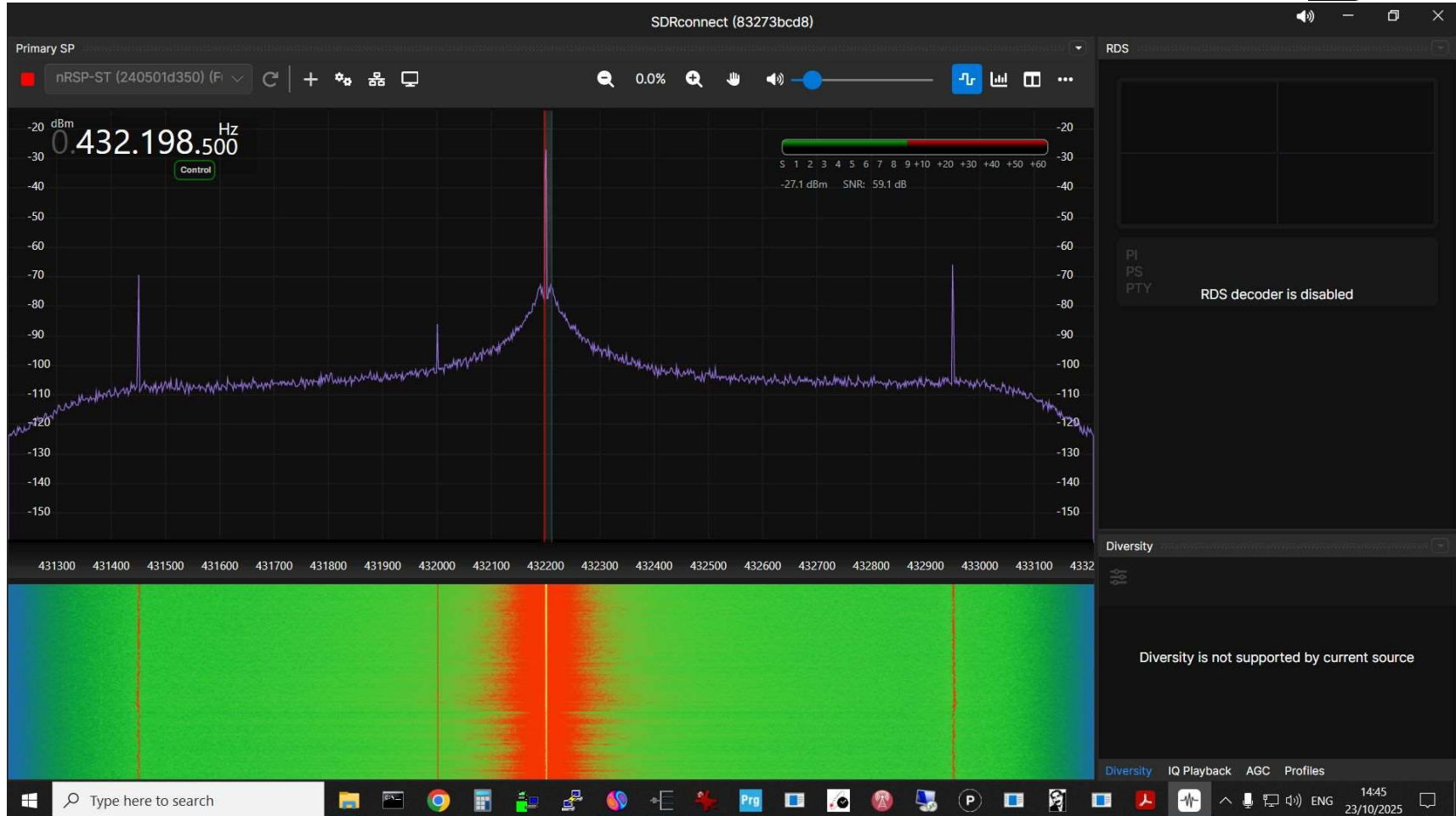
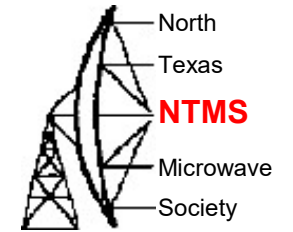


- ZLPLL as source on 24048.2MHz
- DB6NT 24GHz XV 432 MHz IF
- WAVELAB 24 GHz XV 144 MHz IF with onboard ENE3311E Oscillator
- NRSP-ST SDR



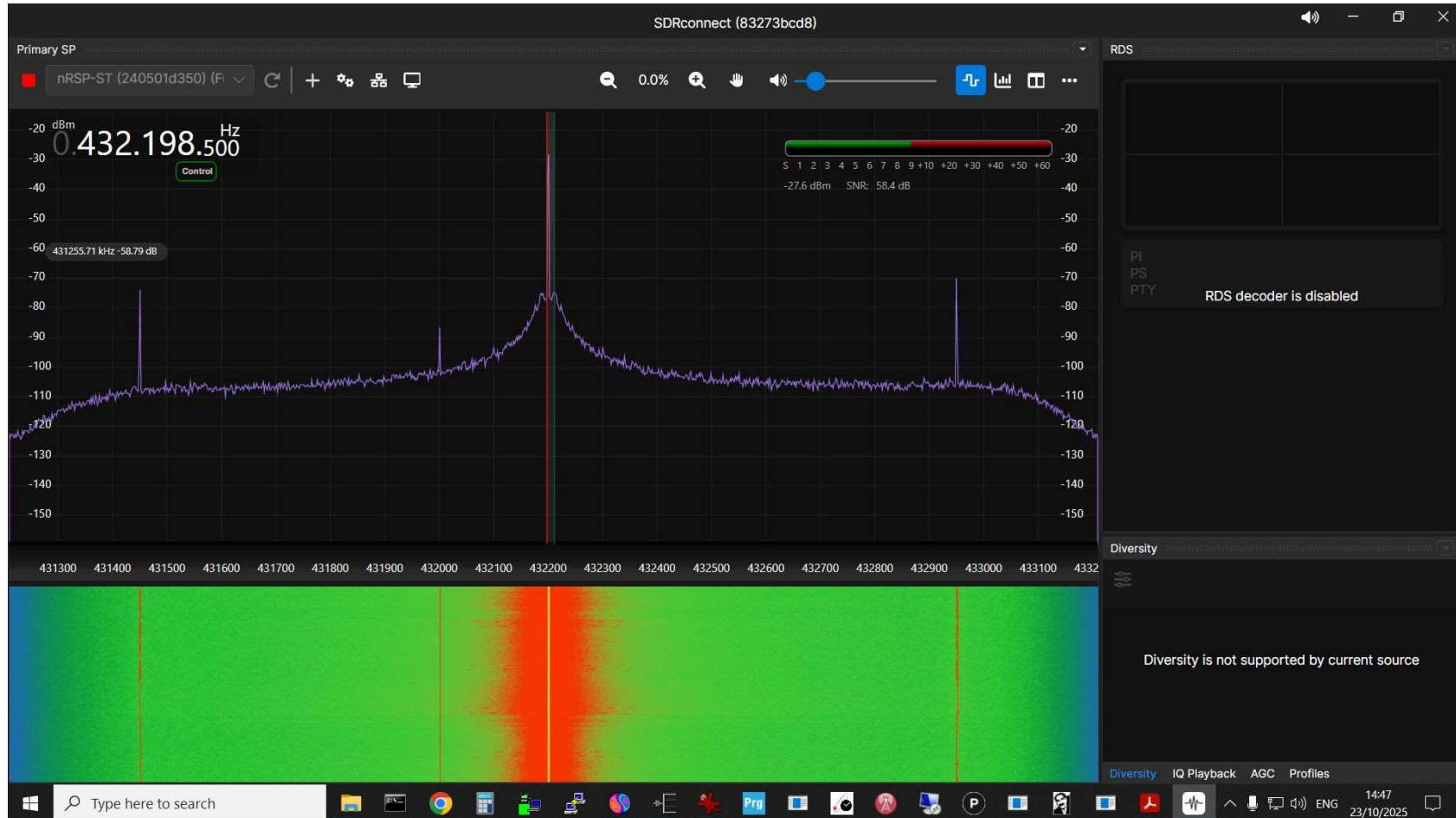
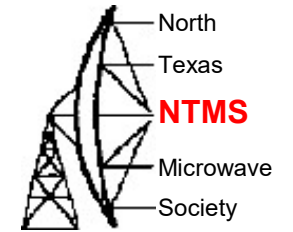
W5HN

DB6NT XV Internal reference



W5HN

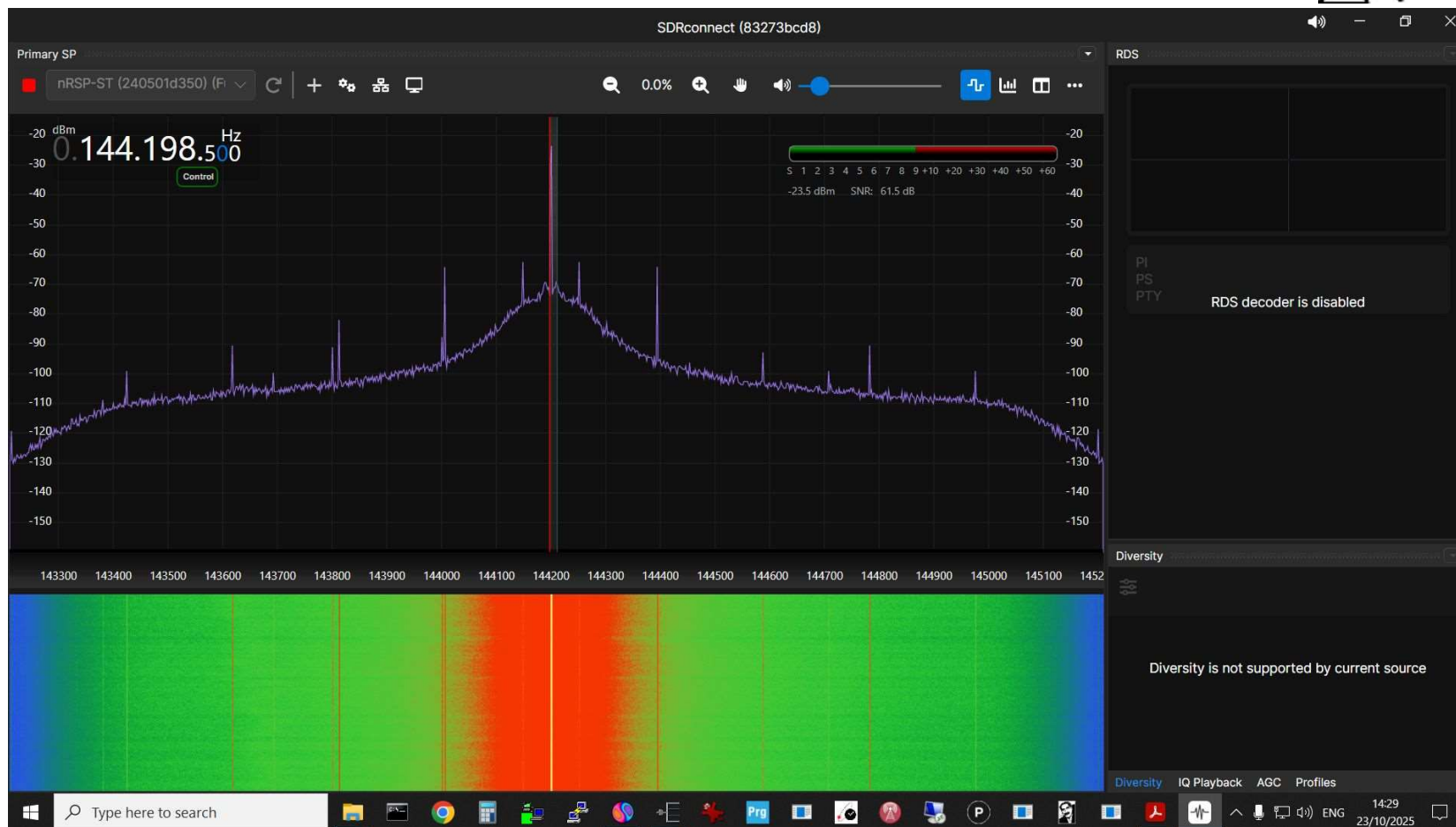
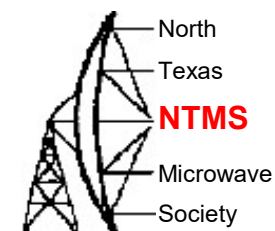
DB6NT XV Bodnar Reference



Little difference

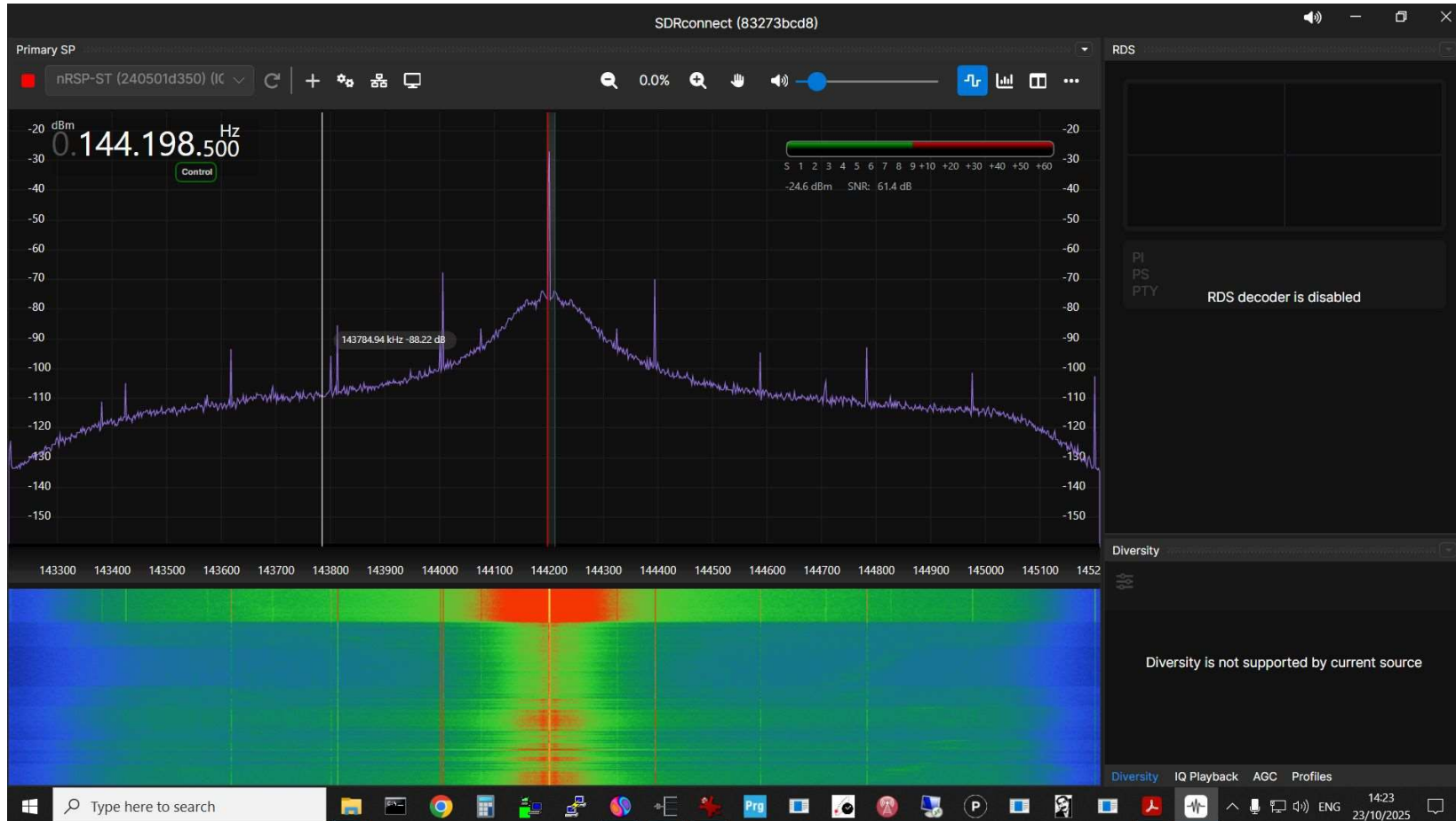
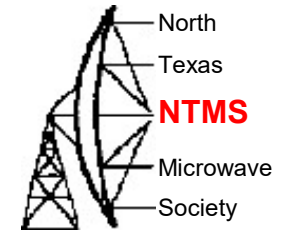
W5HN

Wavelab Bodnar no filter



W5HN

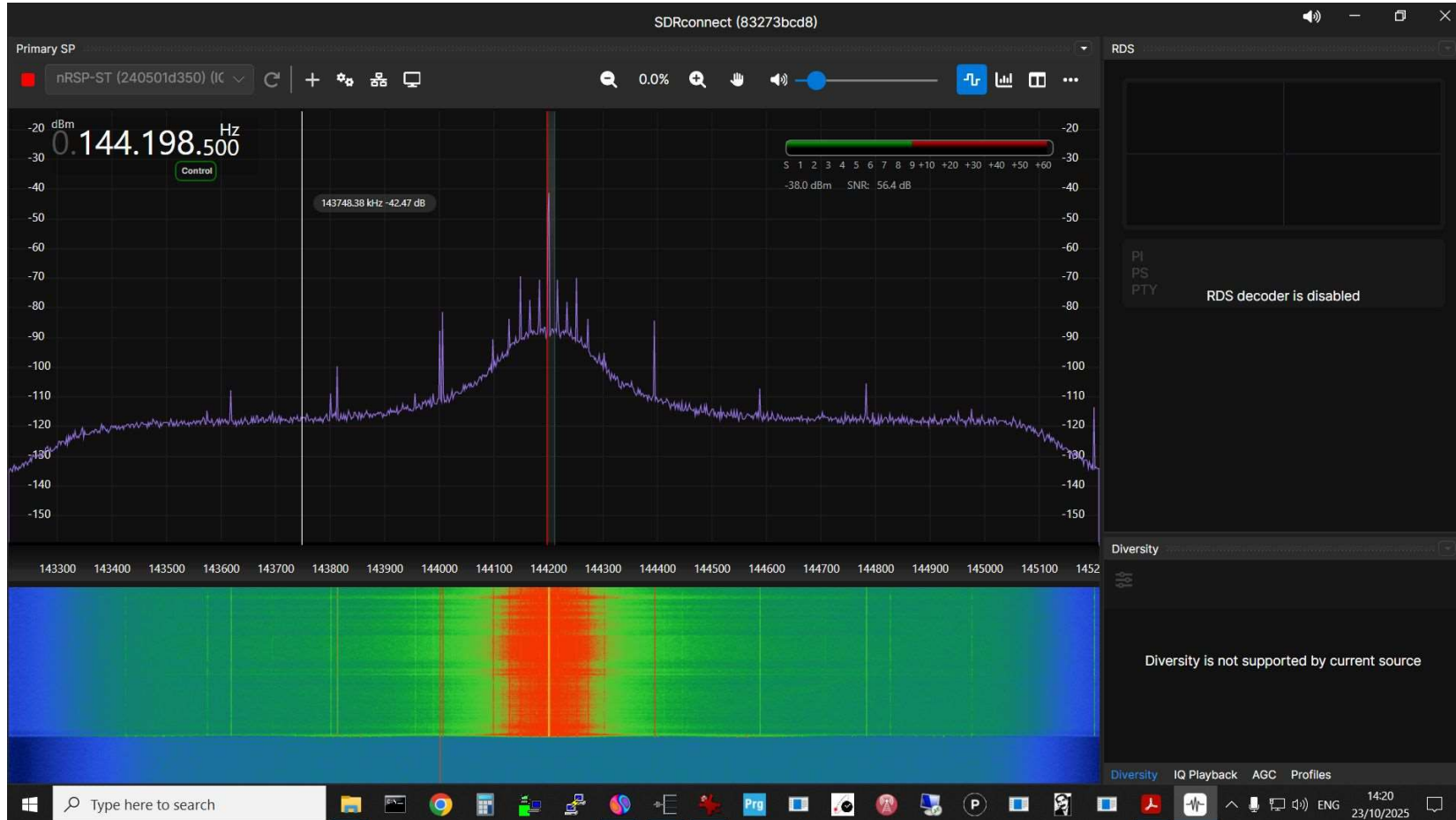
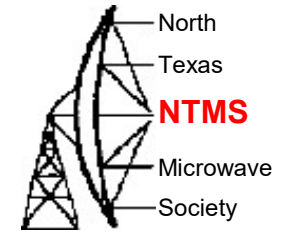
Wavelab Bodnar XTAL filter



Closein spurious reduced

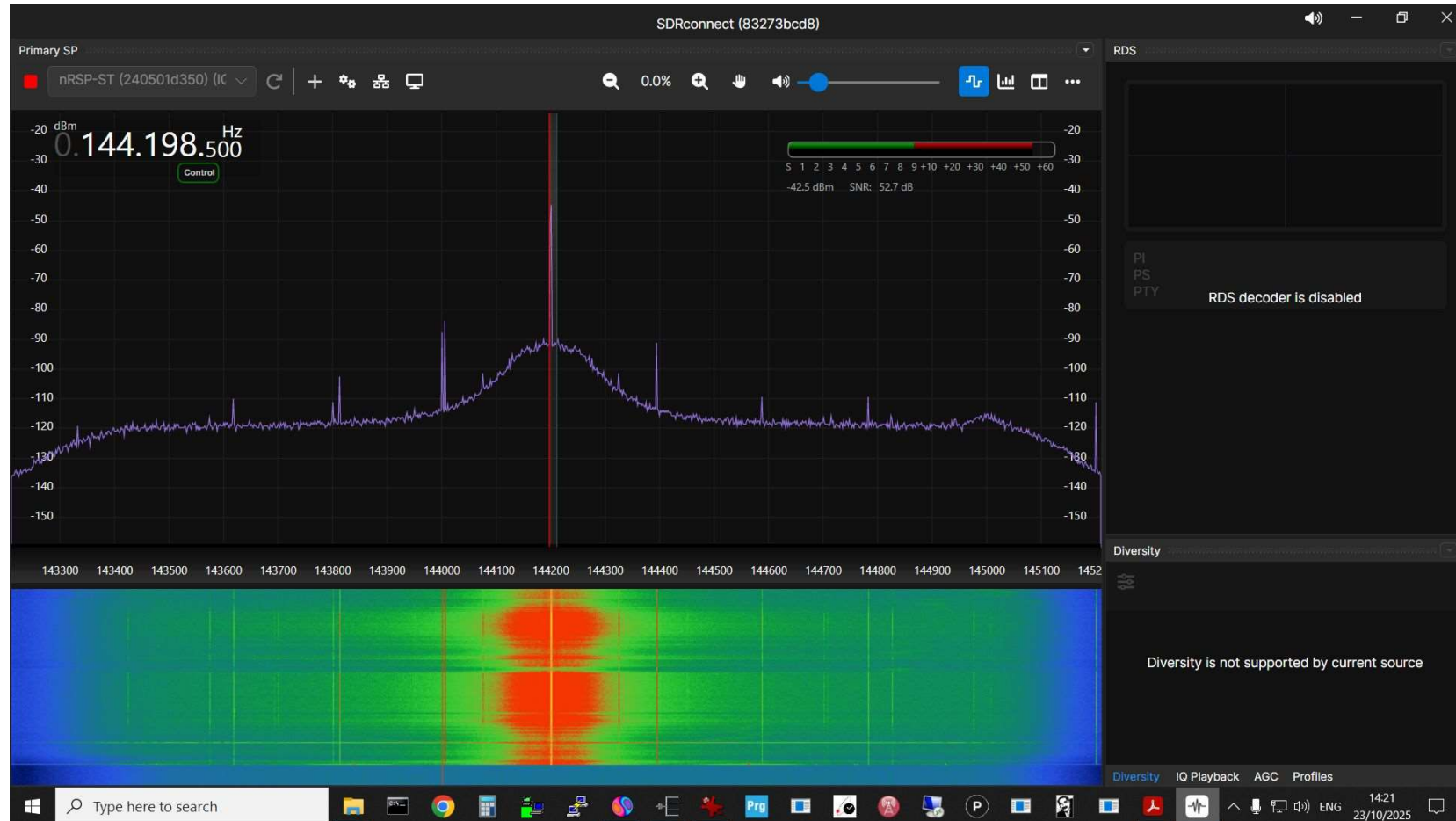
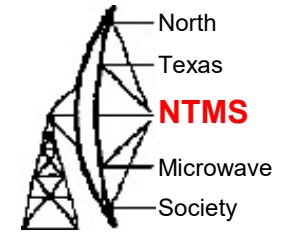
W5HN

Wavelab CTI Ref



W5HN

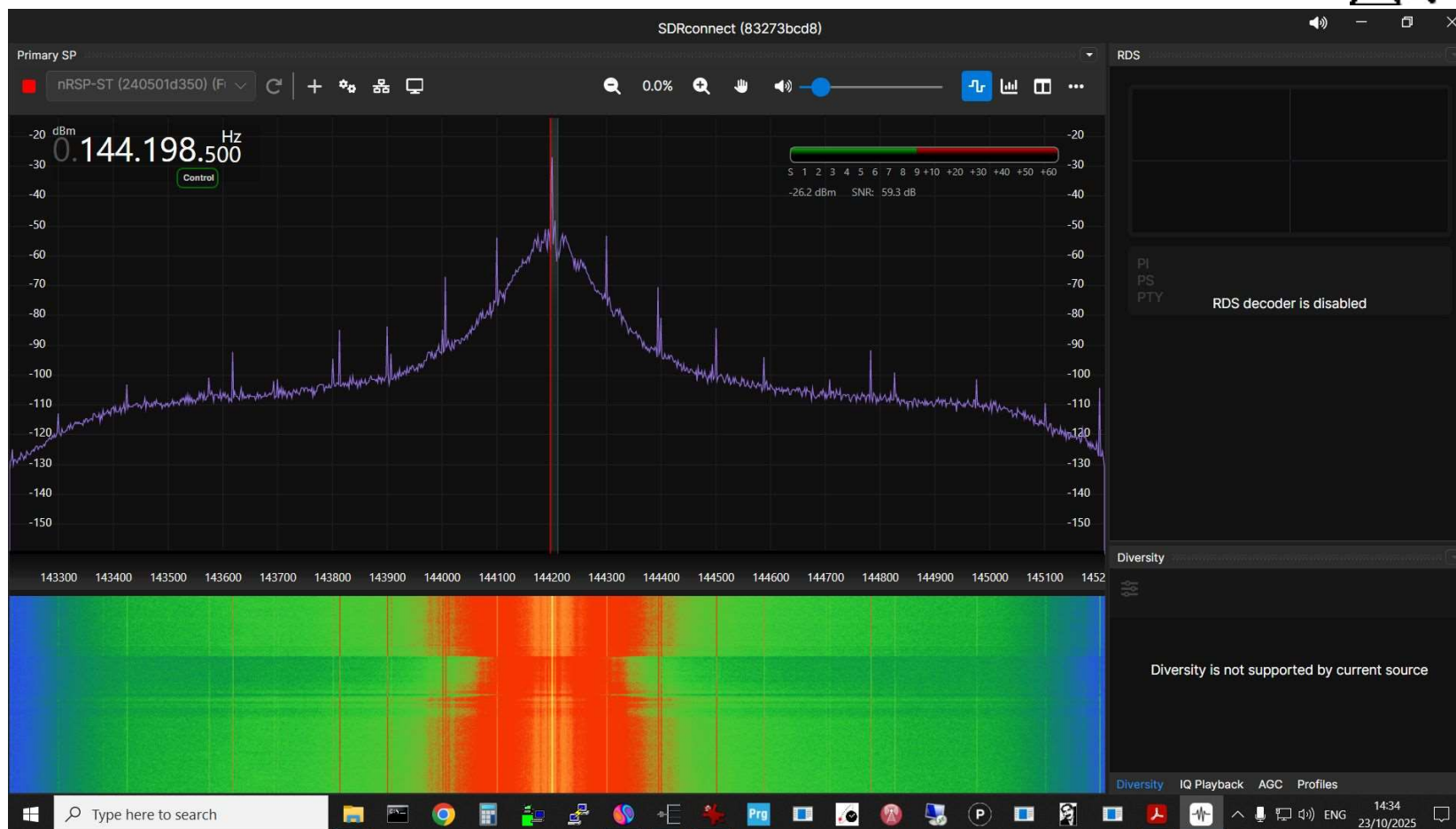
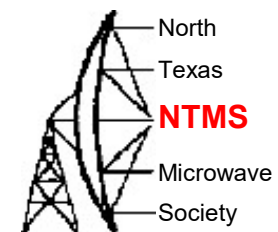
Wavelab CTI Ref + XTAL Filter



Closein spurious reduced

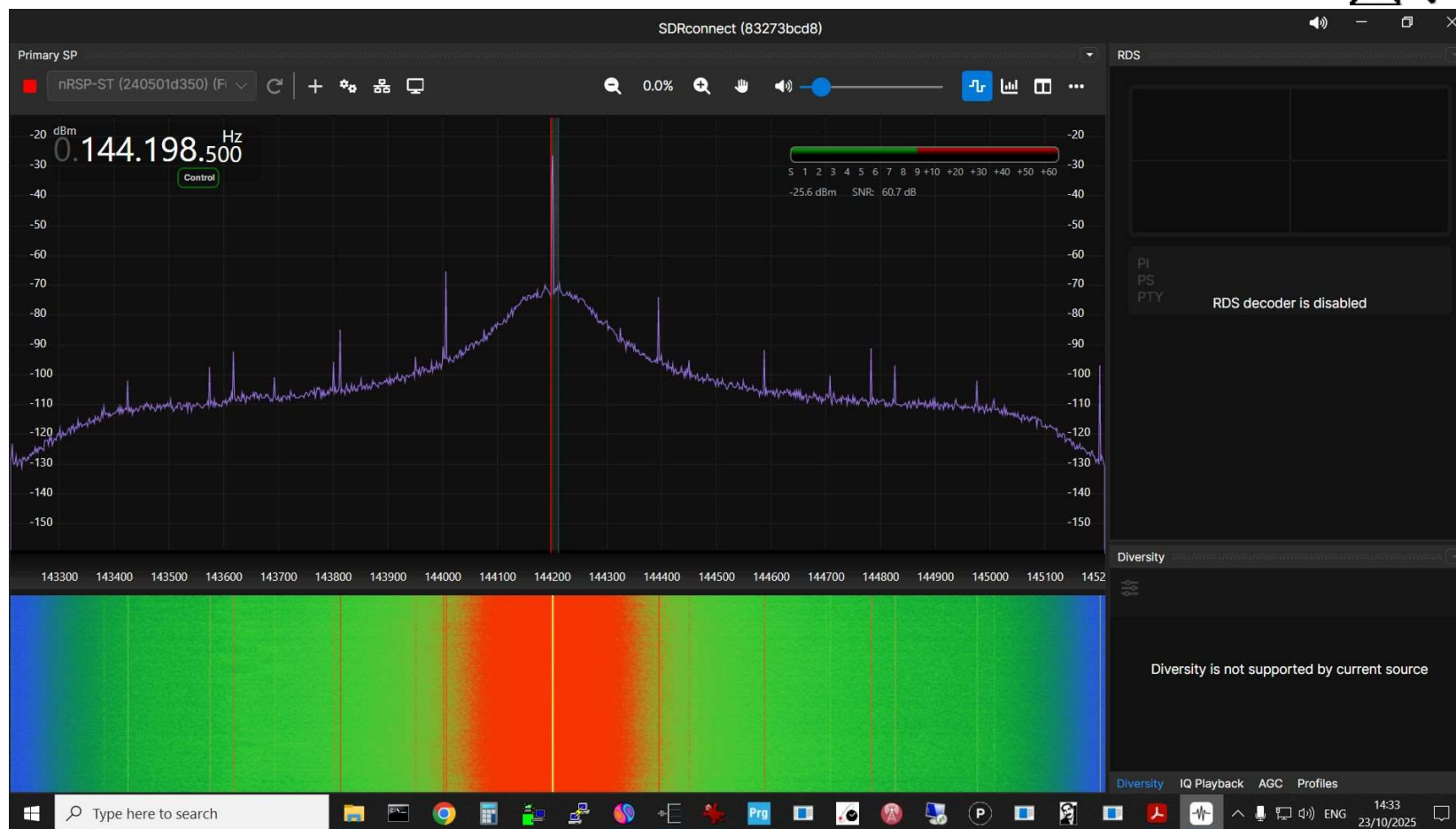
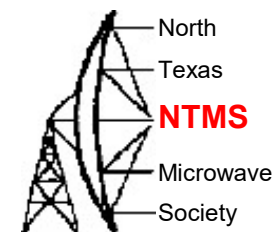
W5HN

VK6PH Ref No filter



W5HN

VK6PH Ref XTAL Filter



Closein spurious reduced