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GPSDOs - Past and Present

Dave Robinson G4FRE, WW2R

8 Nov 2025

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You can never have enough GPSDO!

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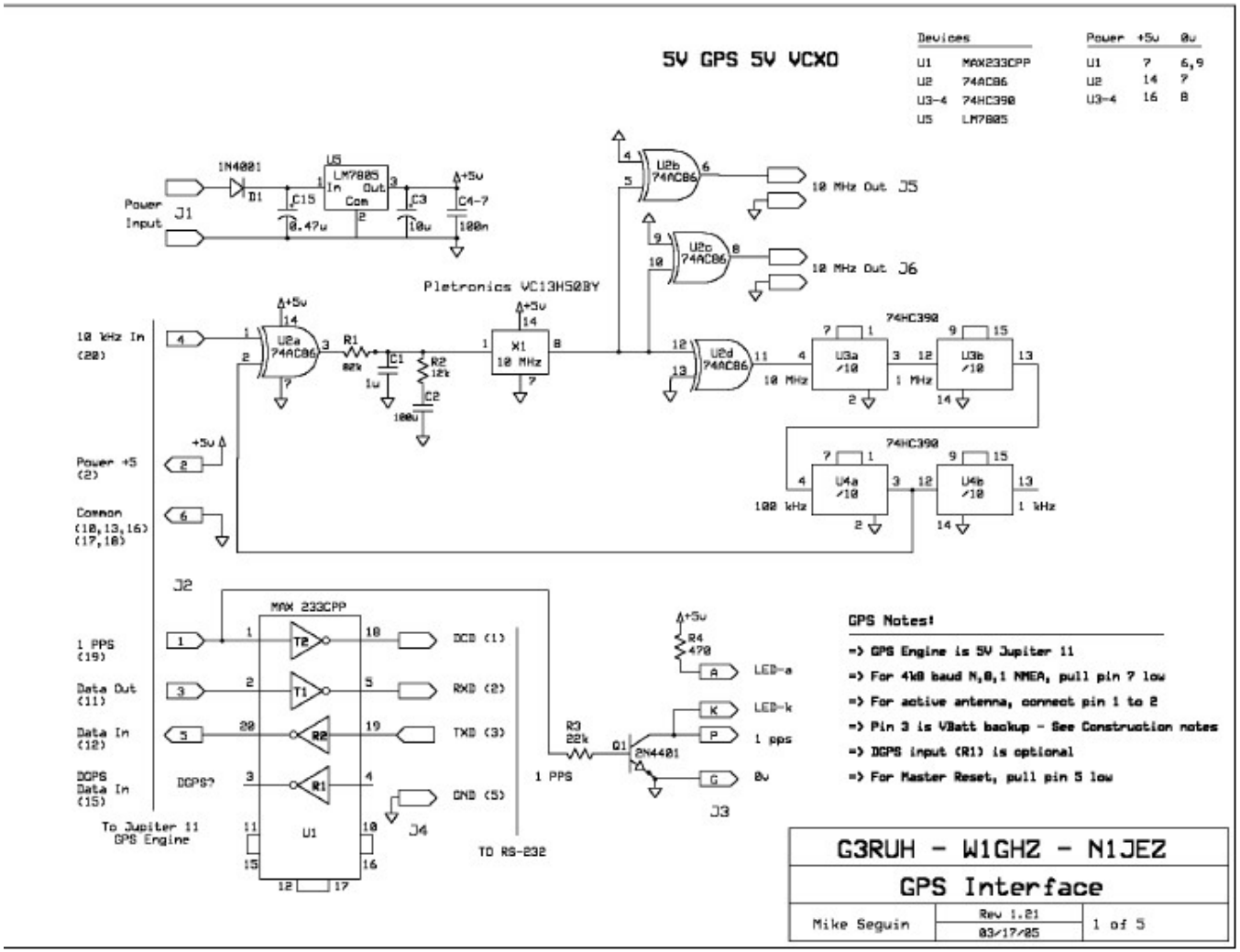
N1JEZ (2005)



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Locks to 100kHz output from Jupiter GPS
No CPU!

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N1JEZ Built

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N1JEZ CLOCK

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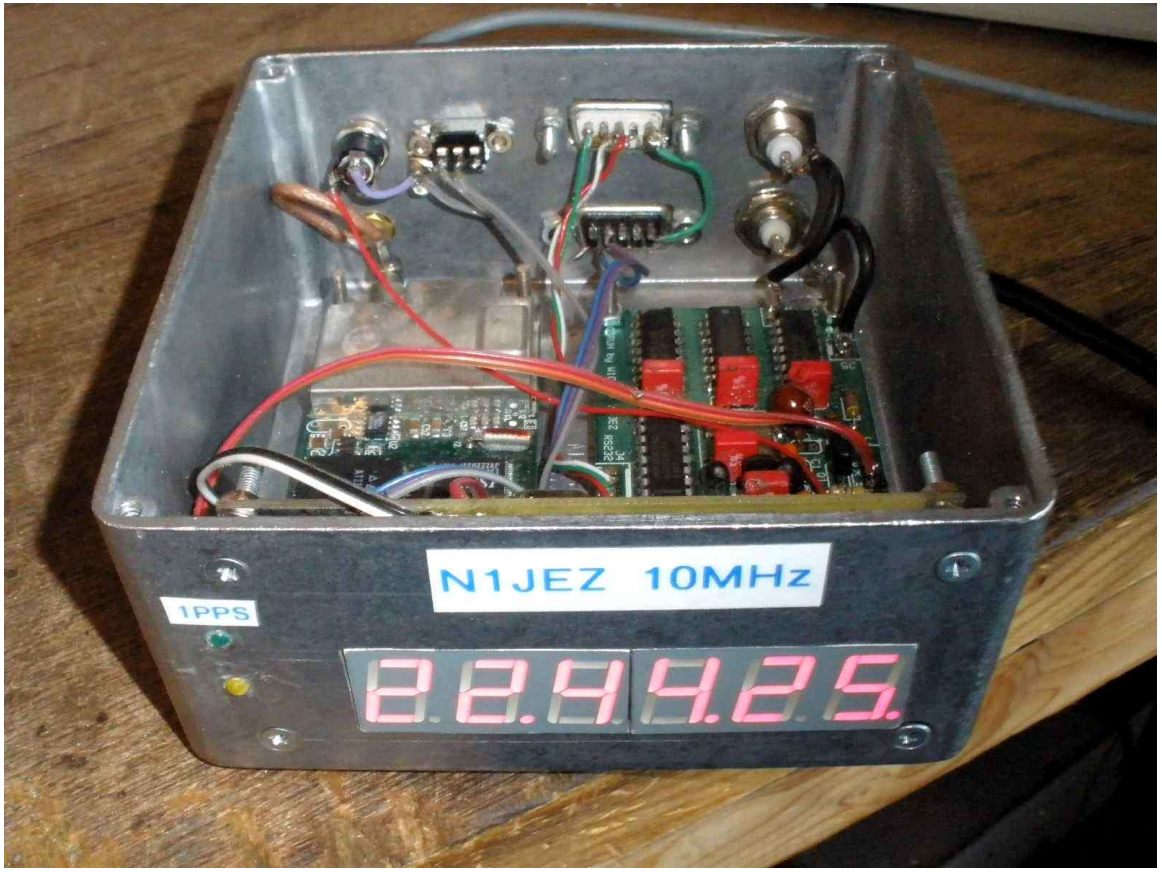

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HP Z3801

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

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Jackson Labs

- 2012 TAPR Bulk Purchase $335!

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Jackson Labs Encapsulation

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

24GHz Trophy IO82TD

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Jackson Labs Encapsulation

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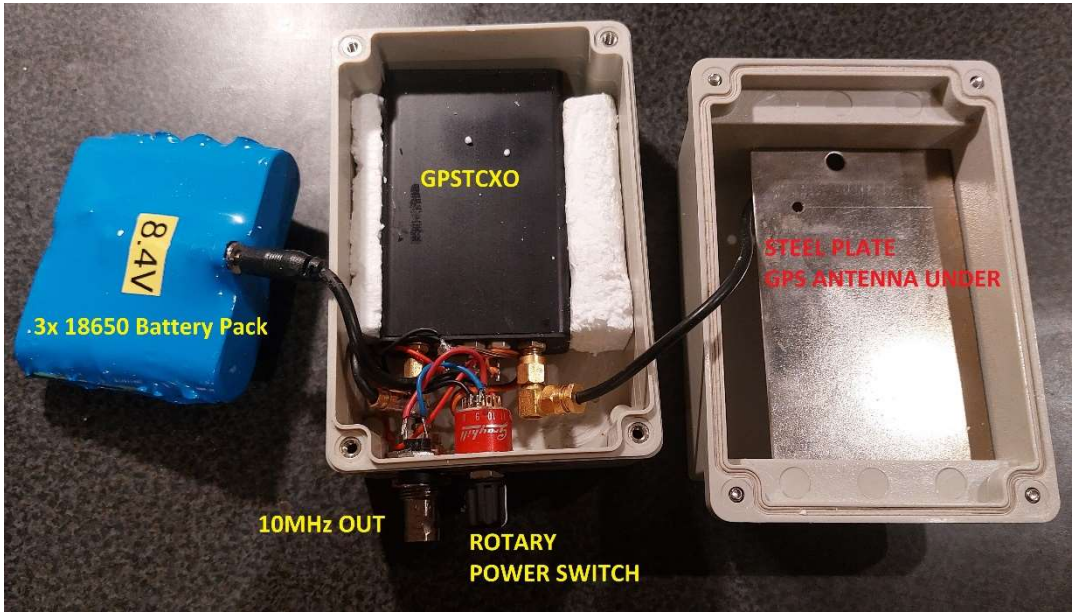
- Jackson Module + Puck antenna+ 8.4V Battery pack all inside PLASTIC BOX



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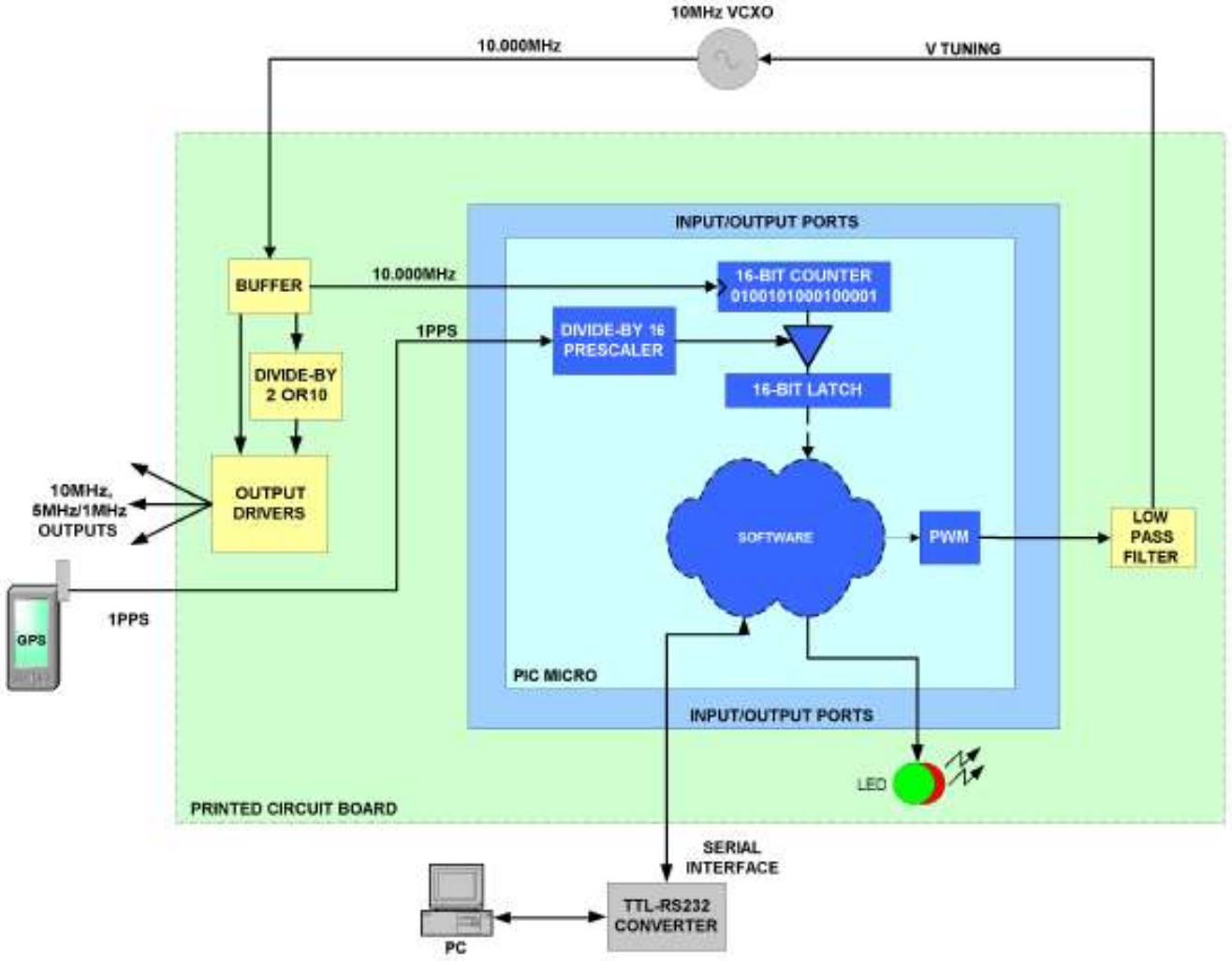
VE2ZAZ Mk1



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VE2ZAZ Mk1

PIC Controller using 1PPS from GPS

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True Position

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- 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

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Trueposition module

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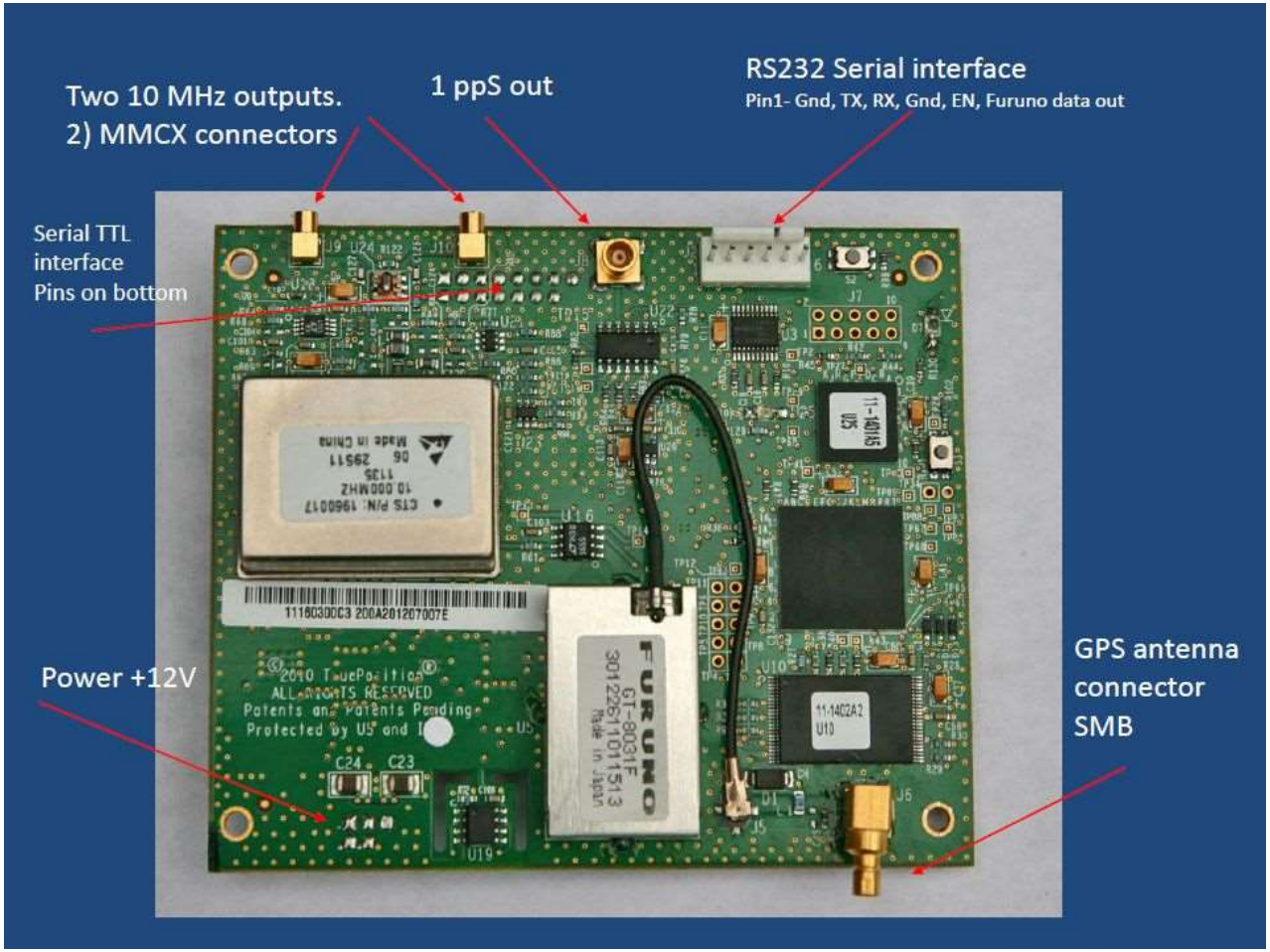

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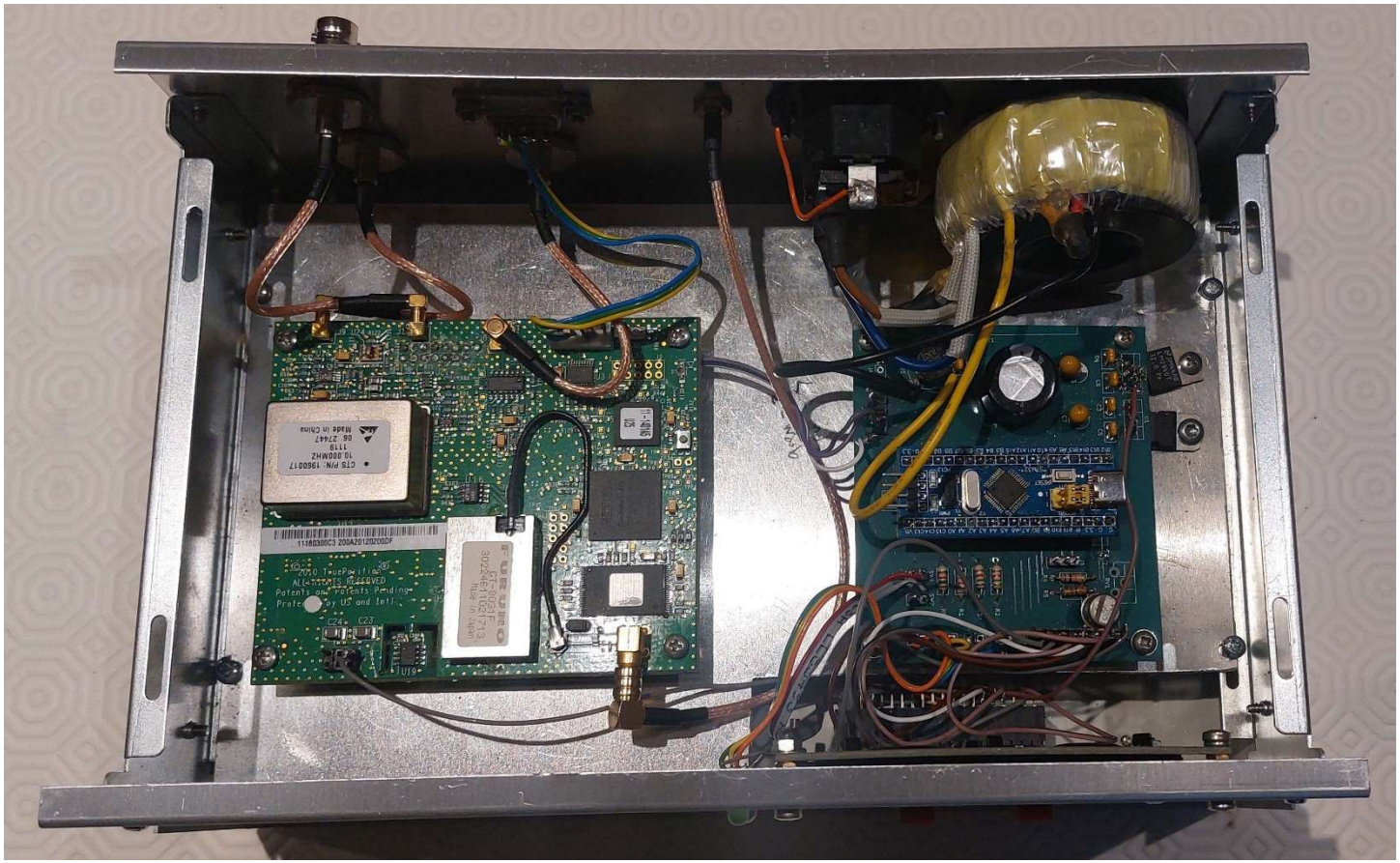
YAGPSDO



Note LINEAR PSU

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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

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M1DST Netduino

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Enough History!

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Enough History!

Lets look at what is around to build today!

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VE2ZAZ Mk 2

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

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VE2ZAZ Mk2

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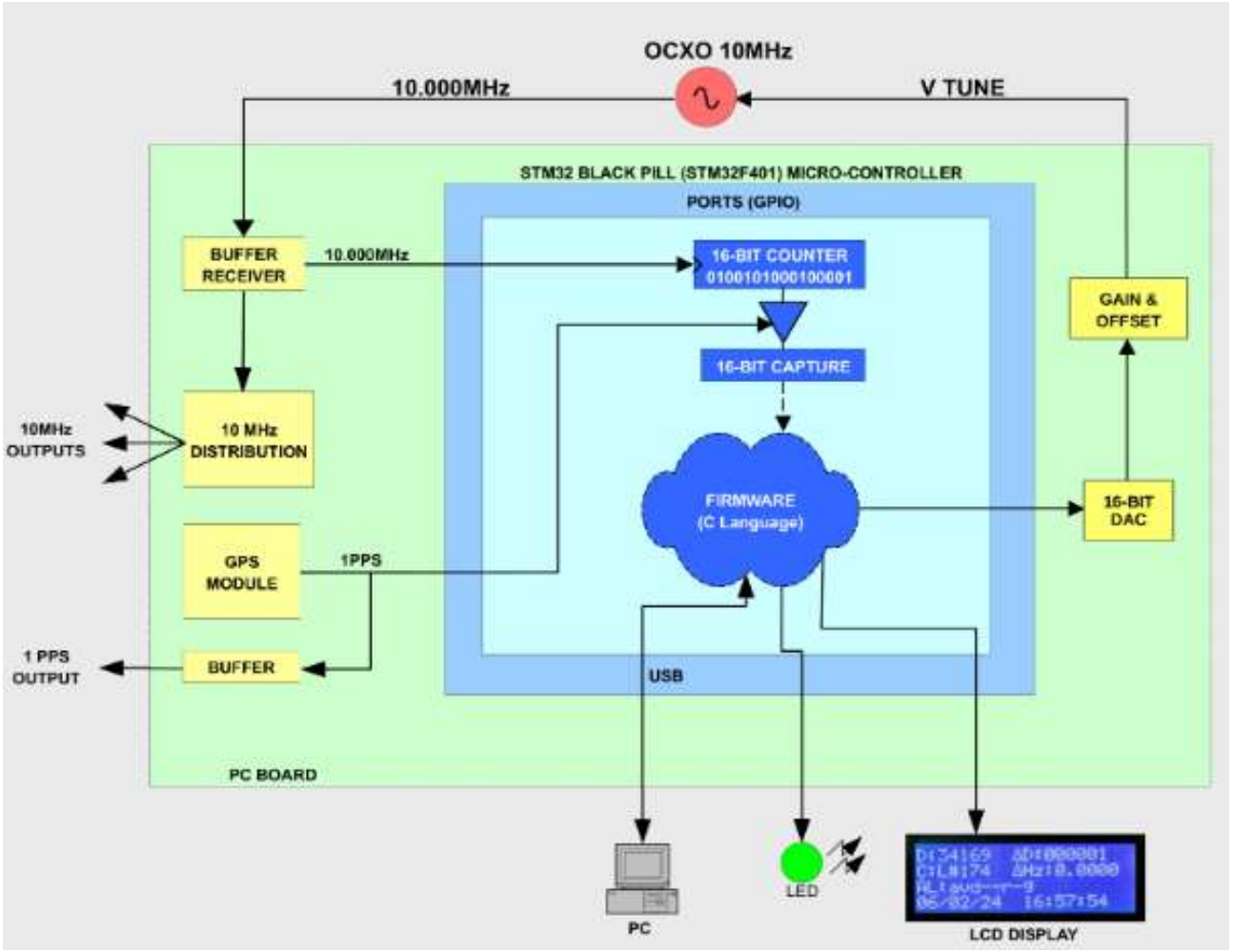

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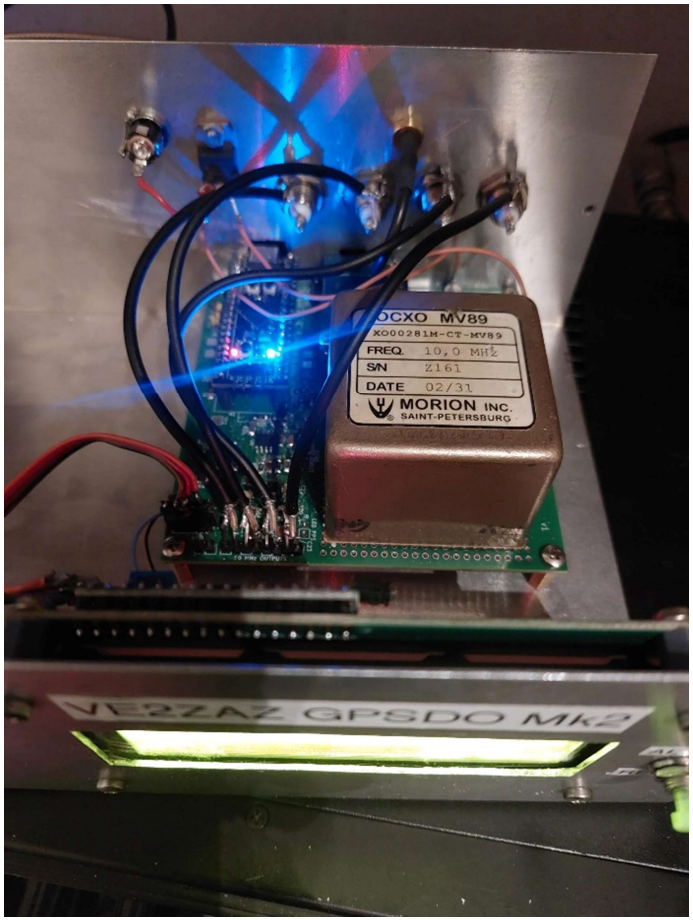
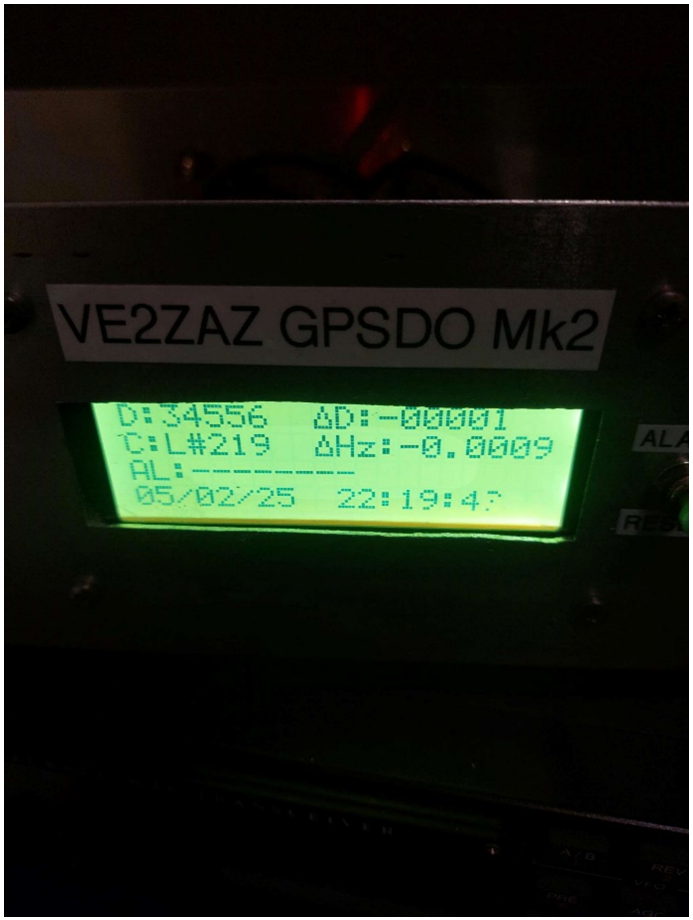
VE2ZAZ Mk2





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VK6PH

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

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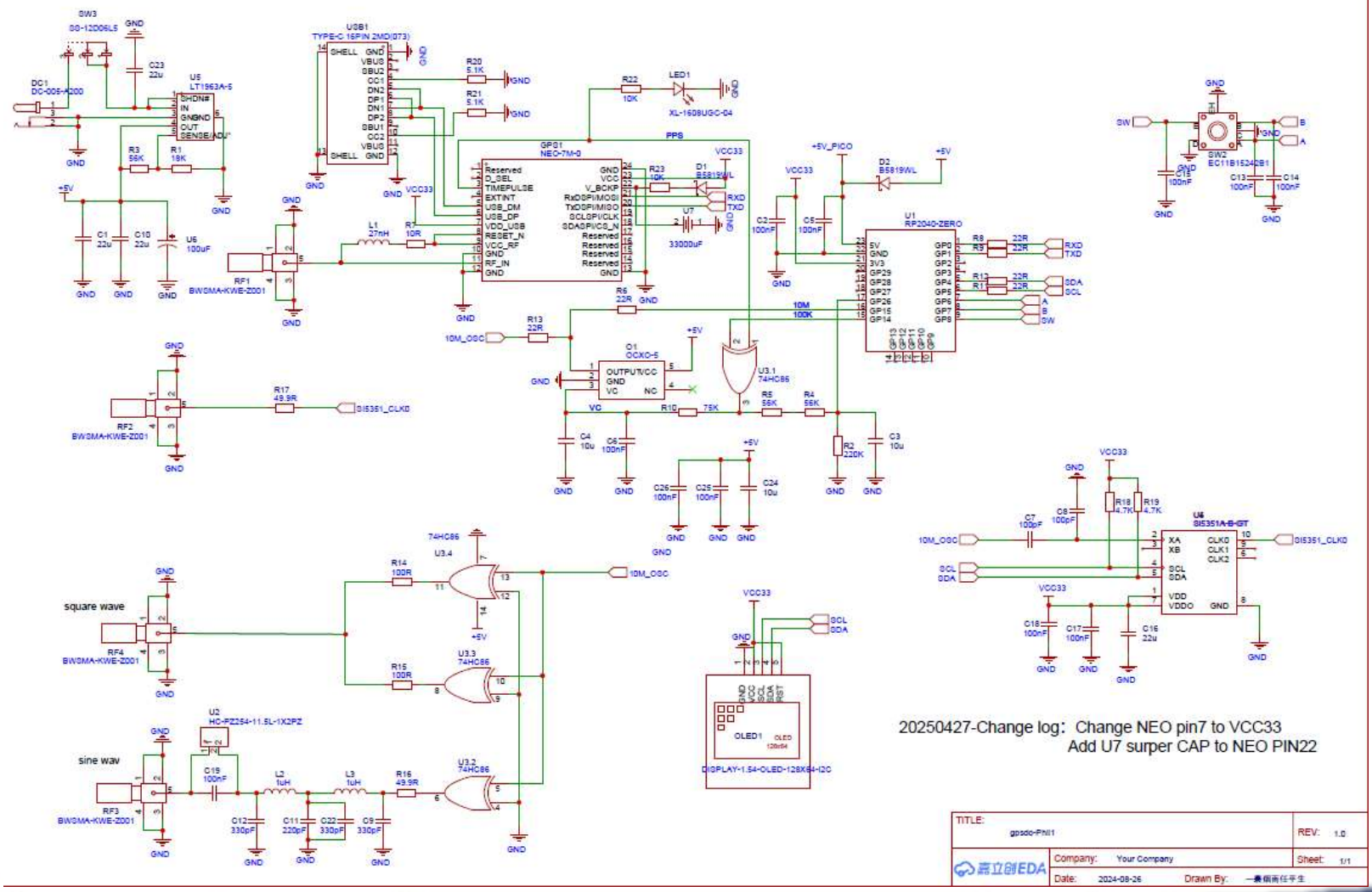
VK6PH



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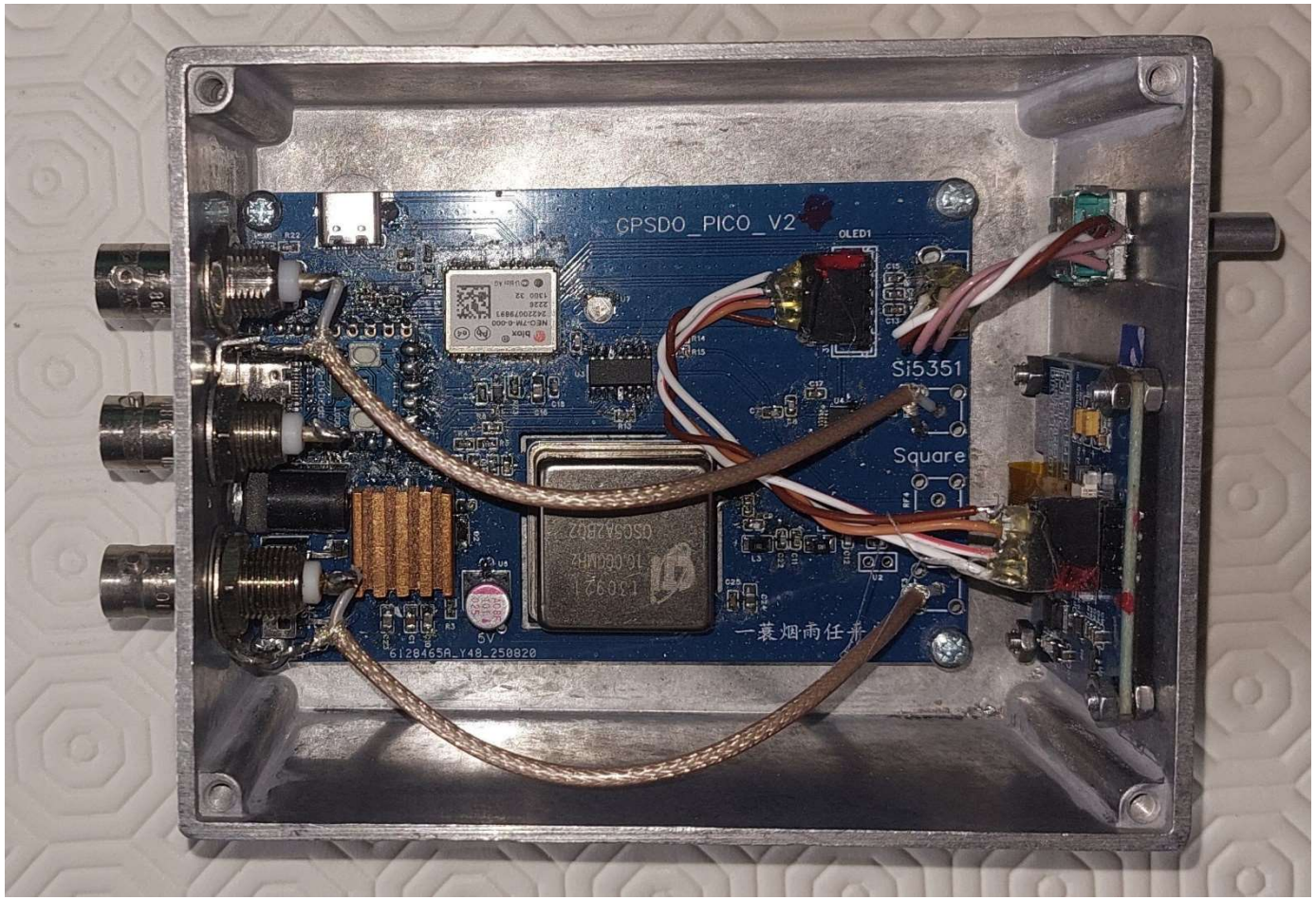

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How do they perform?

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NANOVNA

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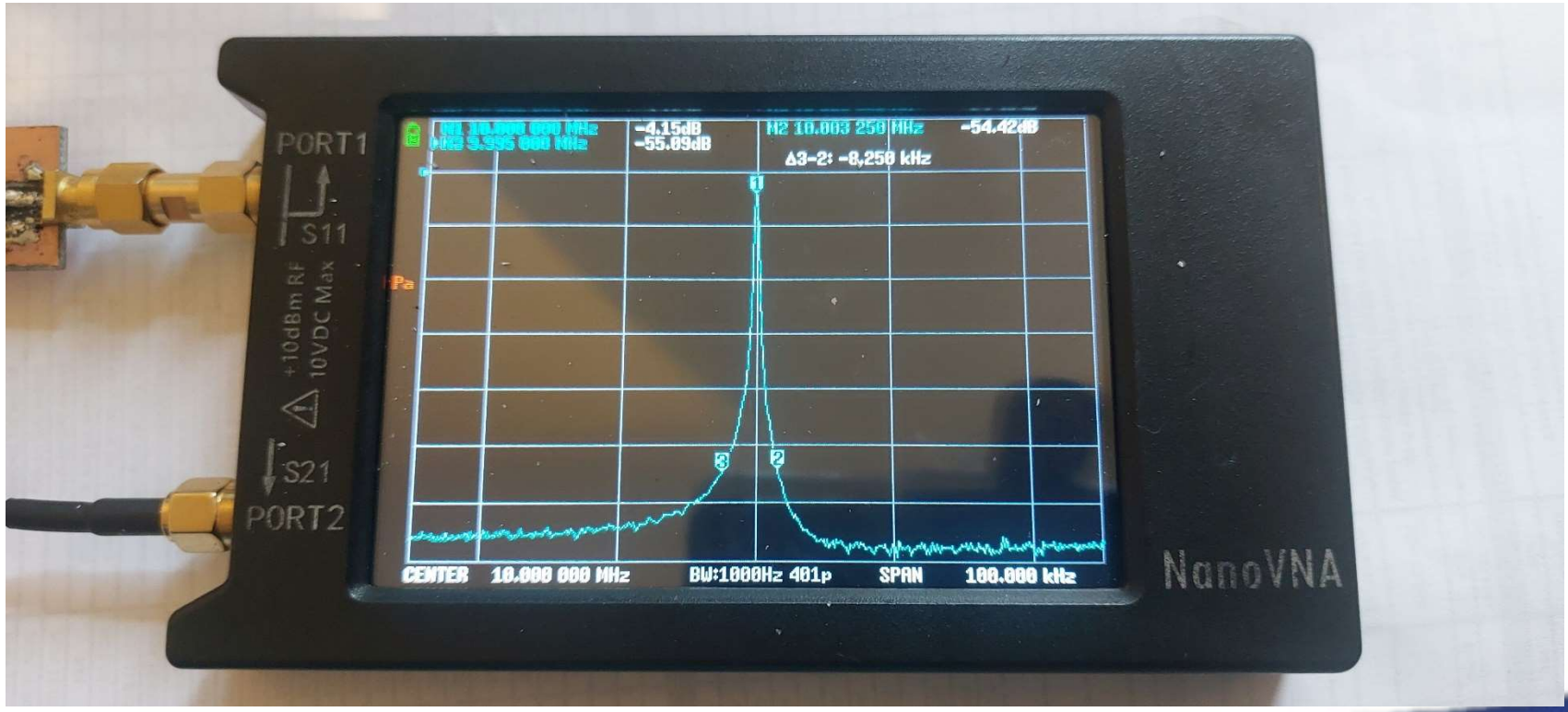
- Many will have one, but it can be re-tasked (and put back again)!



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TINYPFA

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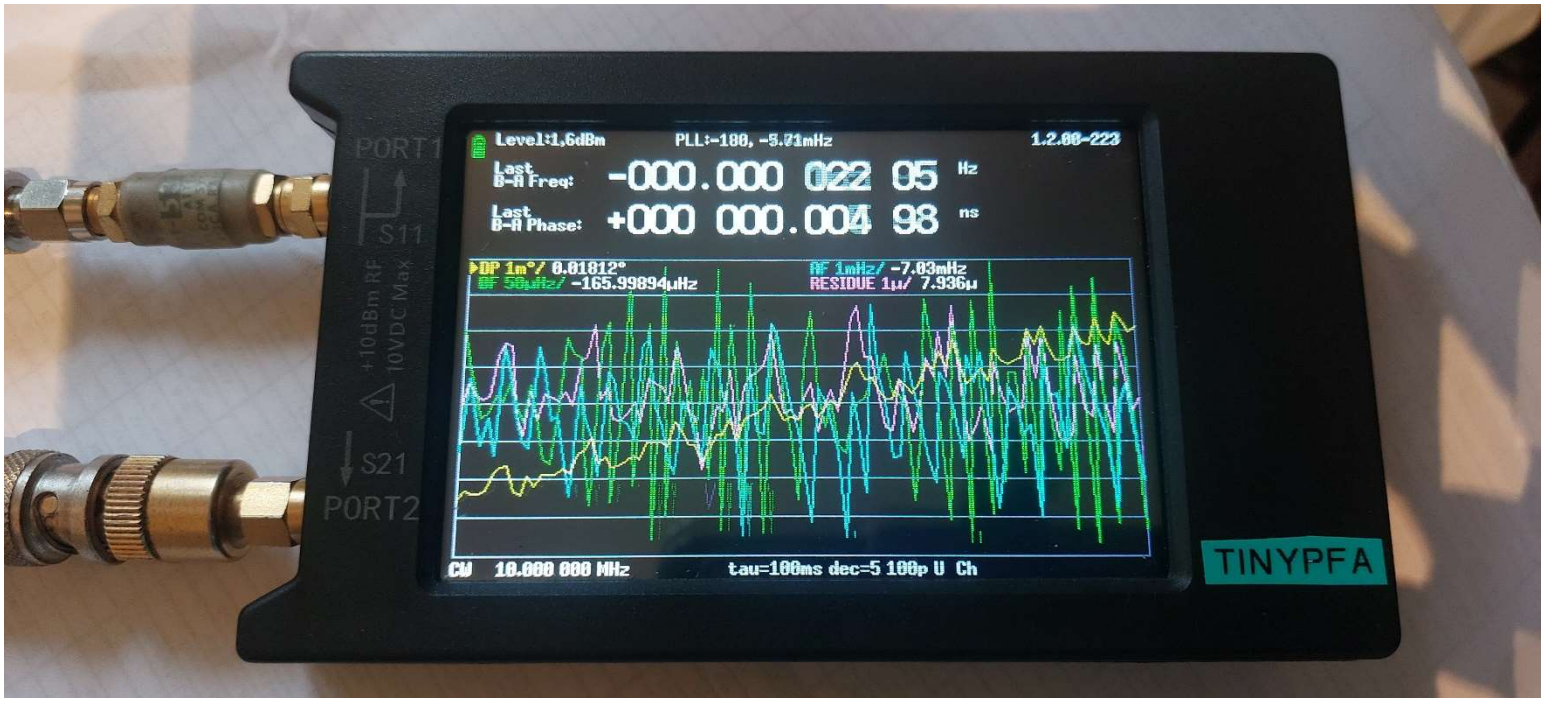
- Can measure/output Frequency and phase difference between two similar frequency sources



- What can we measure?

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ADEV: A measure of oscillator Stability

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- 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

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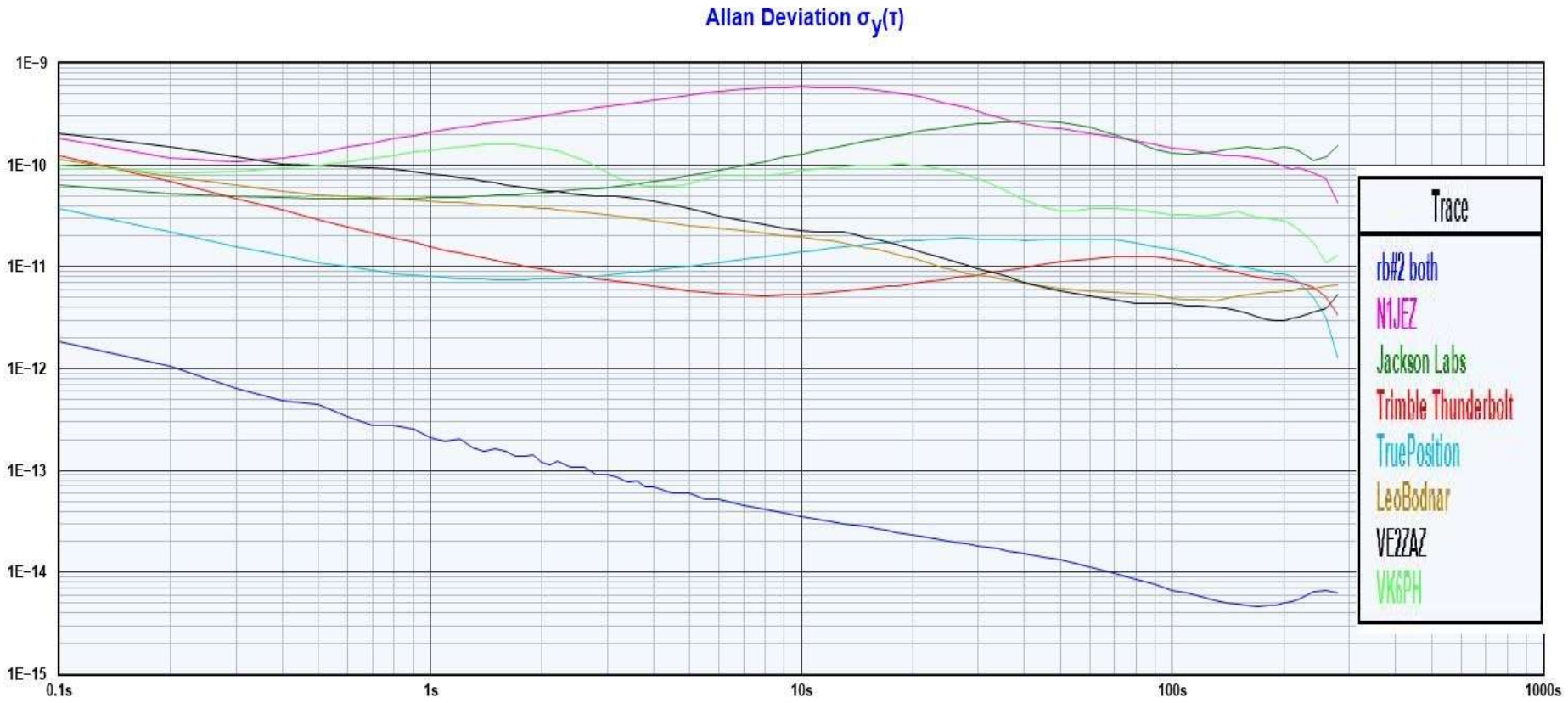
My GPSDO Comparisons



VE2ZAZ performance close to Bodnar

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But how do they do on the air?

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- ZLPLL as source on 10368.2MHz
- DB6NT 10GHz Transverter 144 MHz IF
- MV89 Oscillator
- NRSP-ST SDR

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ZLPLL OFF

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ZLPLL CTI 10MHz Ref

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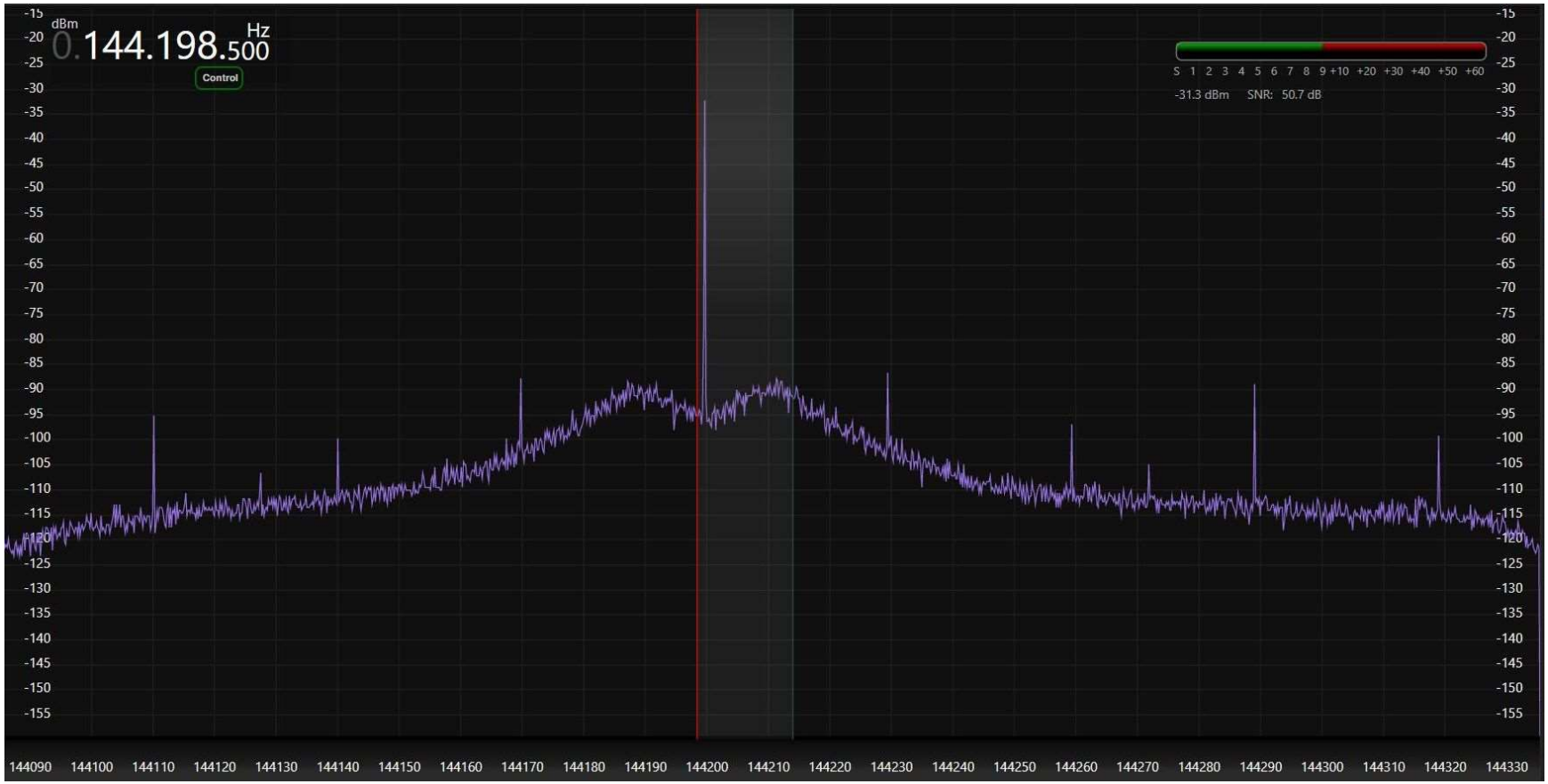

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VK6PH as 10MHz reference

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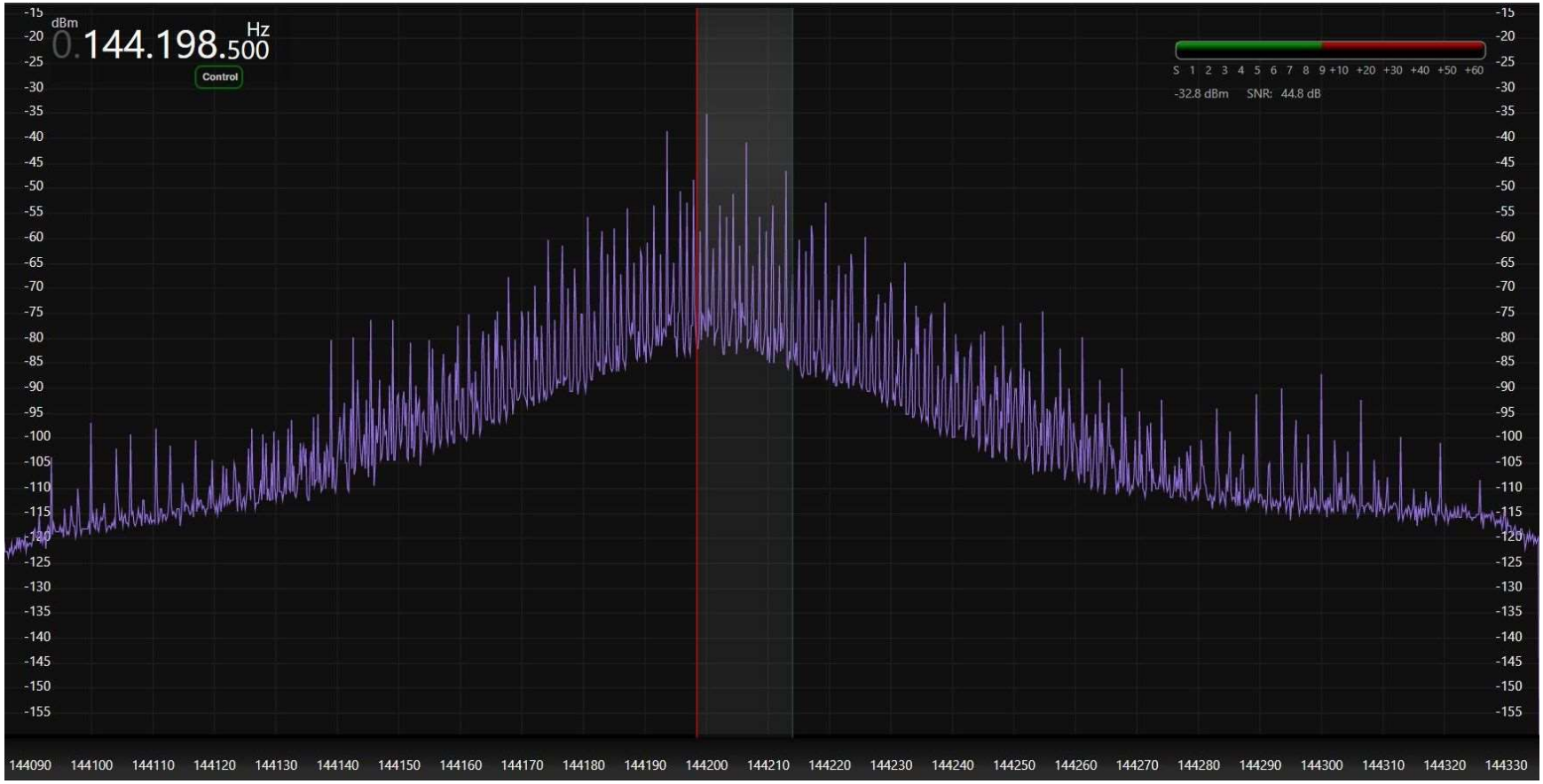

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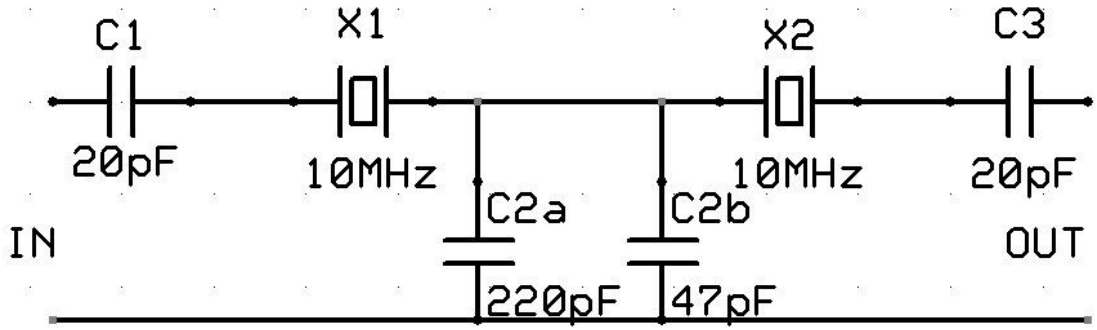
Oh Dear!

- Built 10MHz 2 crystal filter



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

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VK6PH Ref with XTAL Filter

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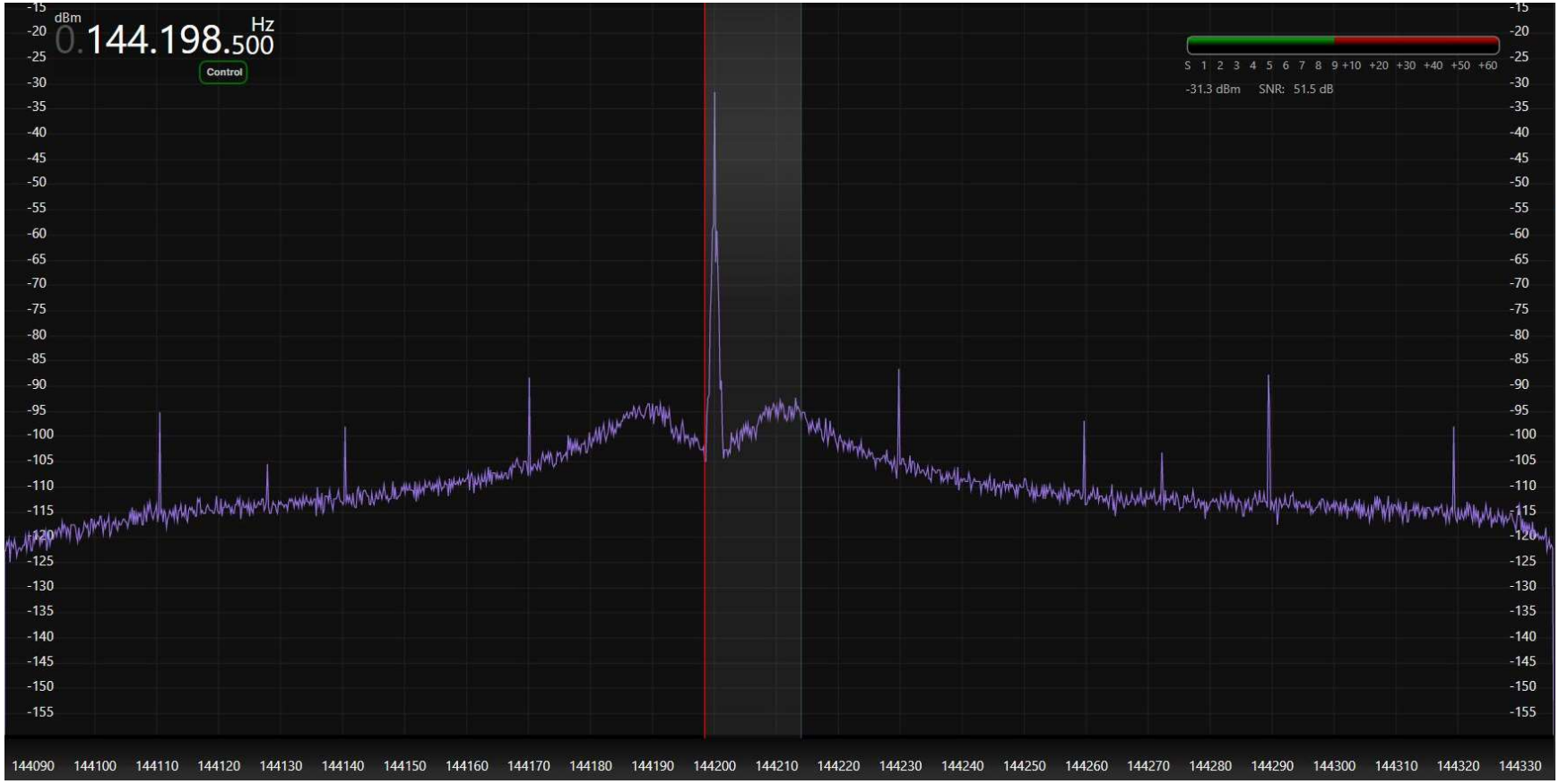

All my GPSDO (and Rubidiums) will have crystal filters!

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Links

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- N1JEZ https://g4fre.com/n1jez_construction.pdf
- VE2ZAZ V1https://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

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Wavelab Investigation

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- ZLPLL as source on 24048.2MHz
- DB6NT 24GHz XV 432 MHz IF
- WAVELAB 24 GHz XV 144 MHz IF with ENE3311 onboard Oscillator
- NRSP-ST SDR

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DB6NT XV Internal reference

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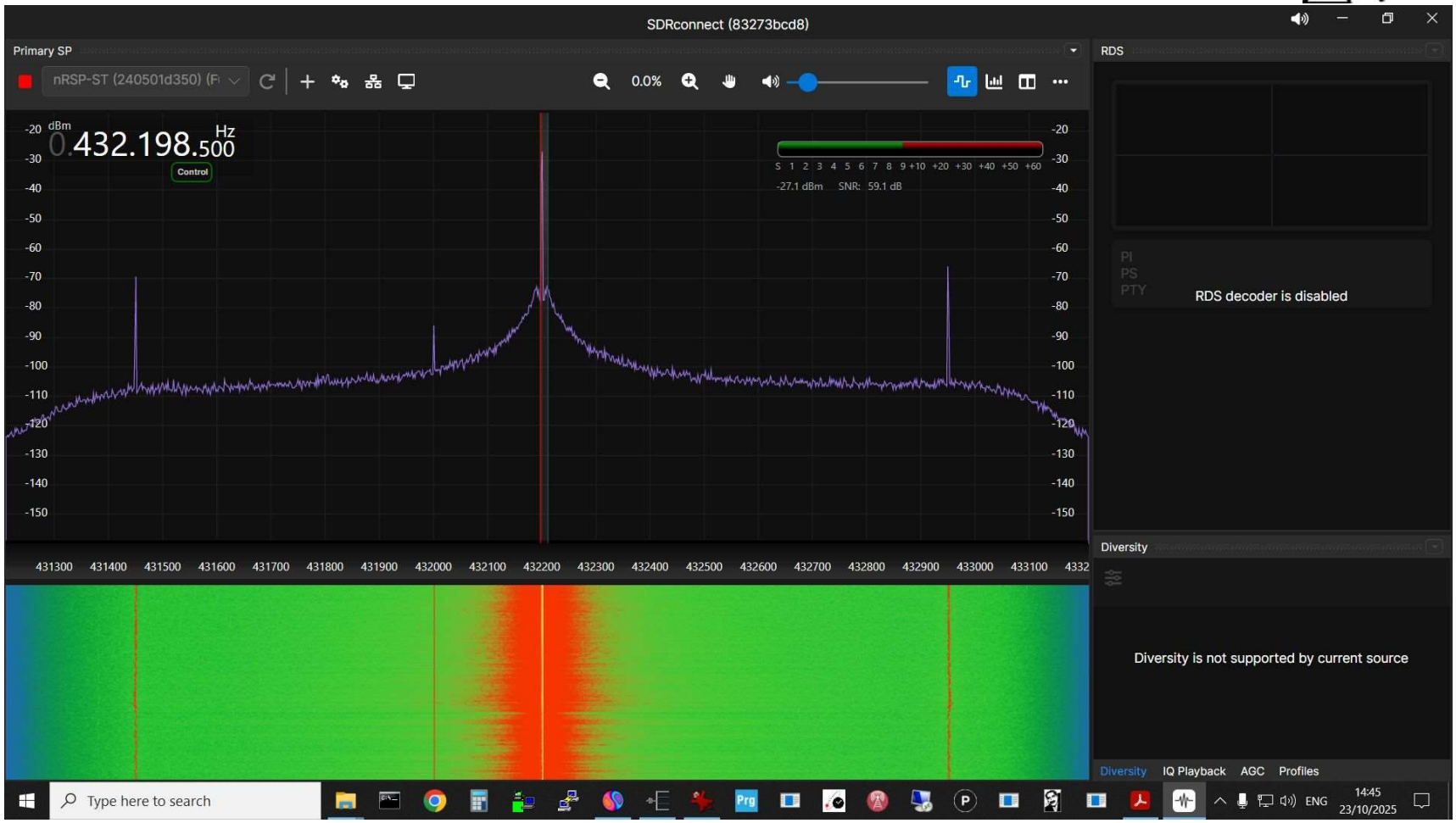

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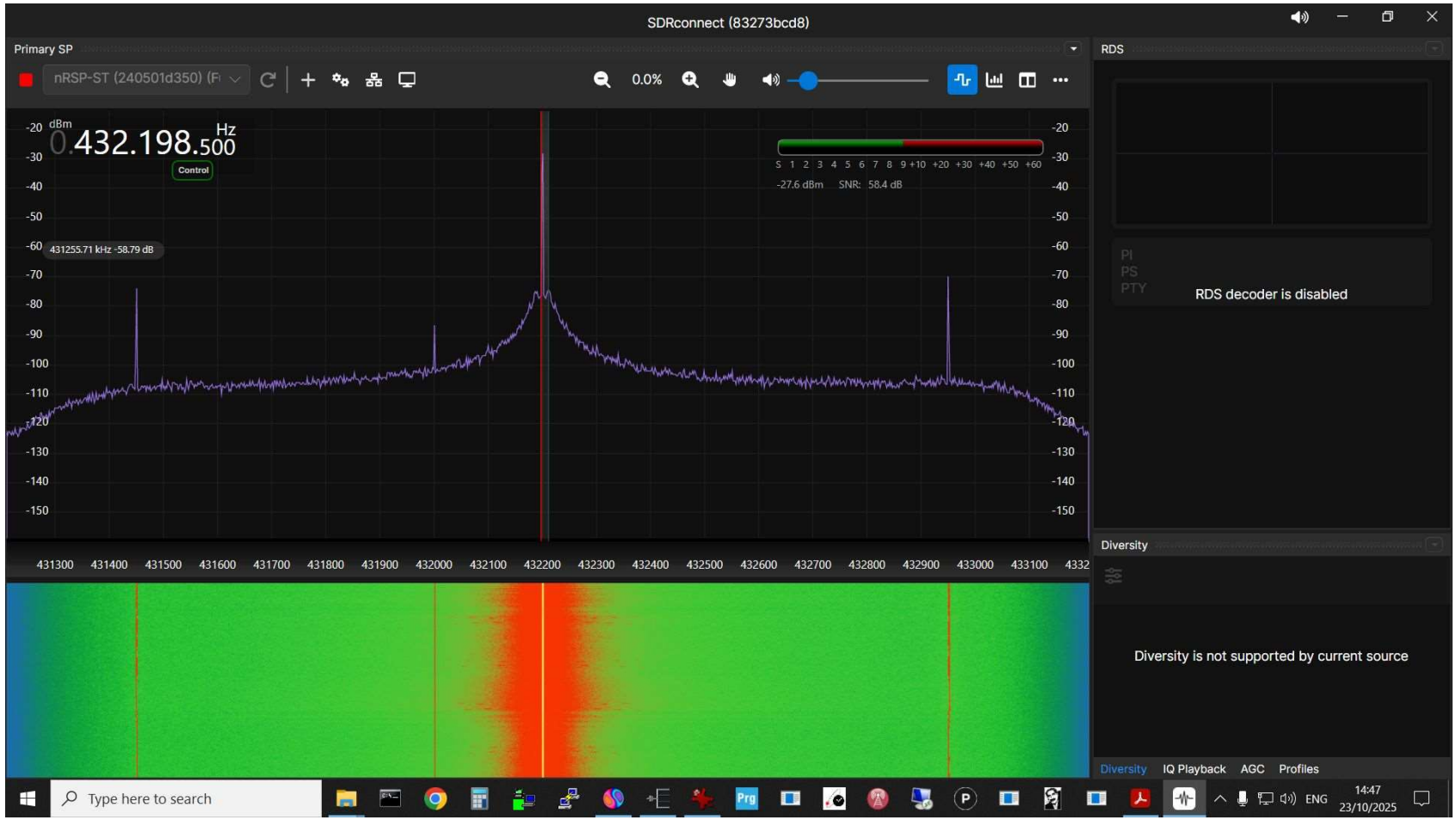
DB6NT XV Bodnar Reference



Little difference

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Wavelab Bodnar no filter

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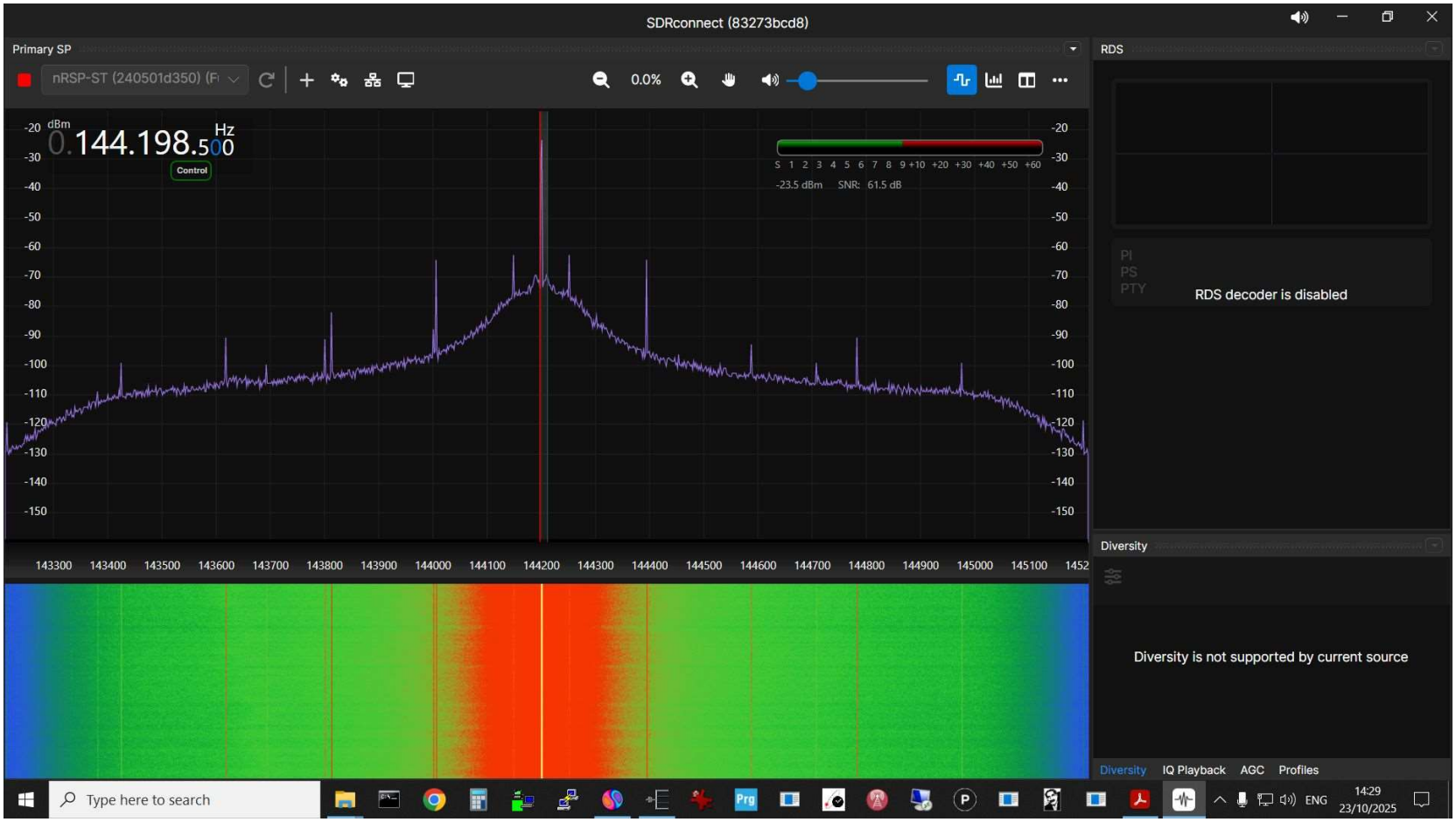

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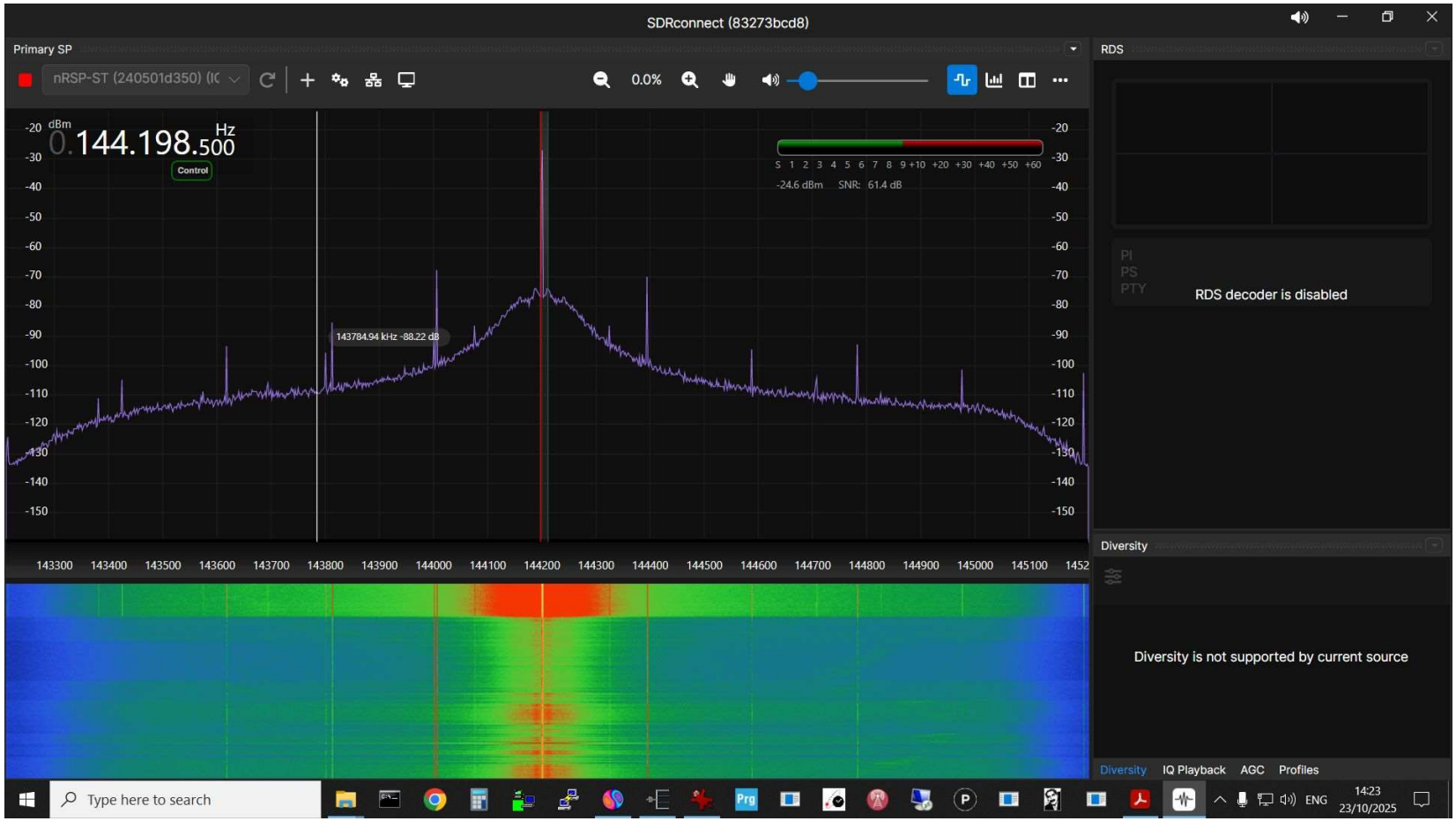
Wavelab Bodnar XTAL filter



Closein spurious reduced

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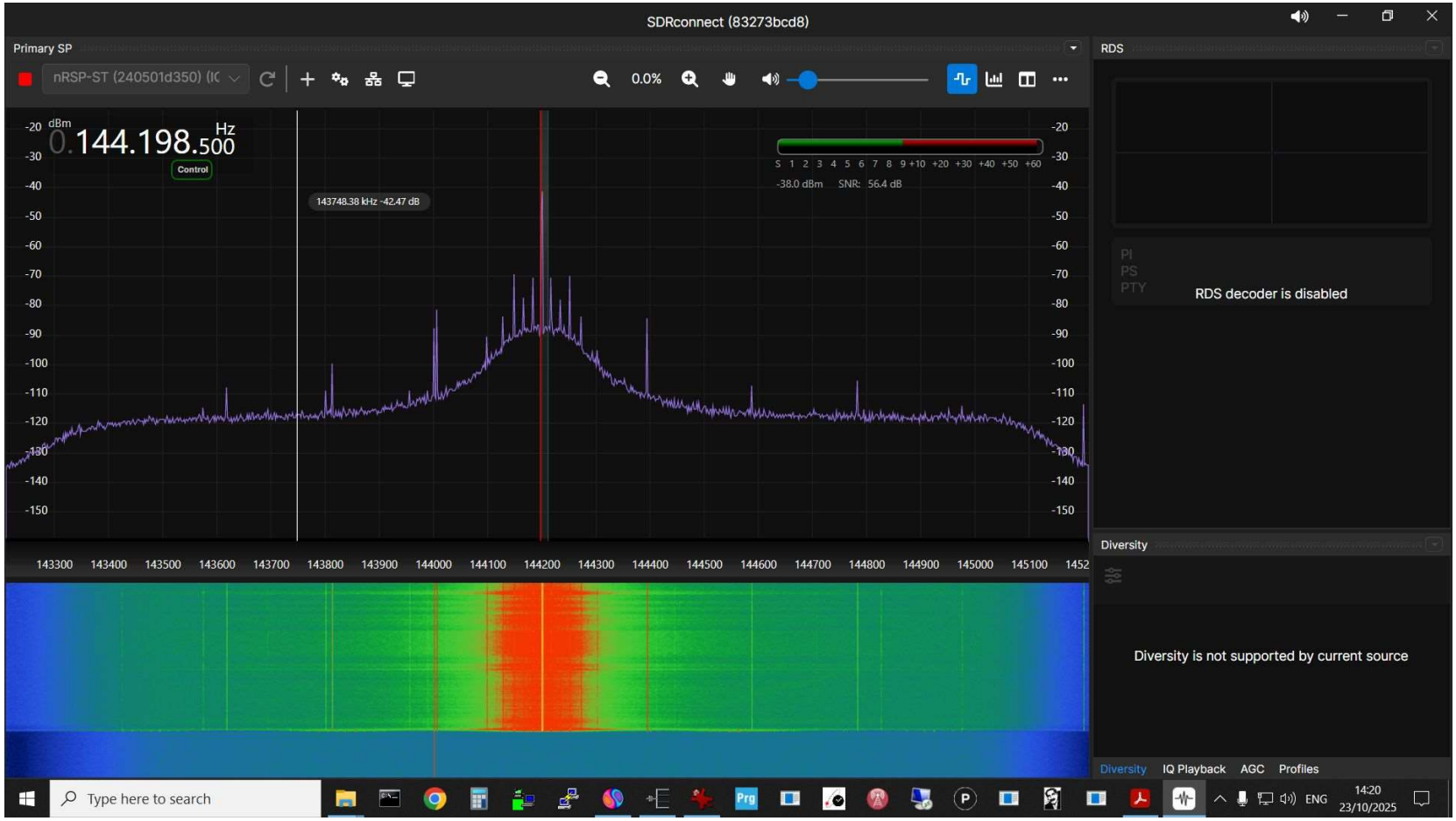
Wavelab CTI Ref



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Wavelab CTI Ref + XTAL Filter

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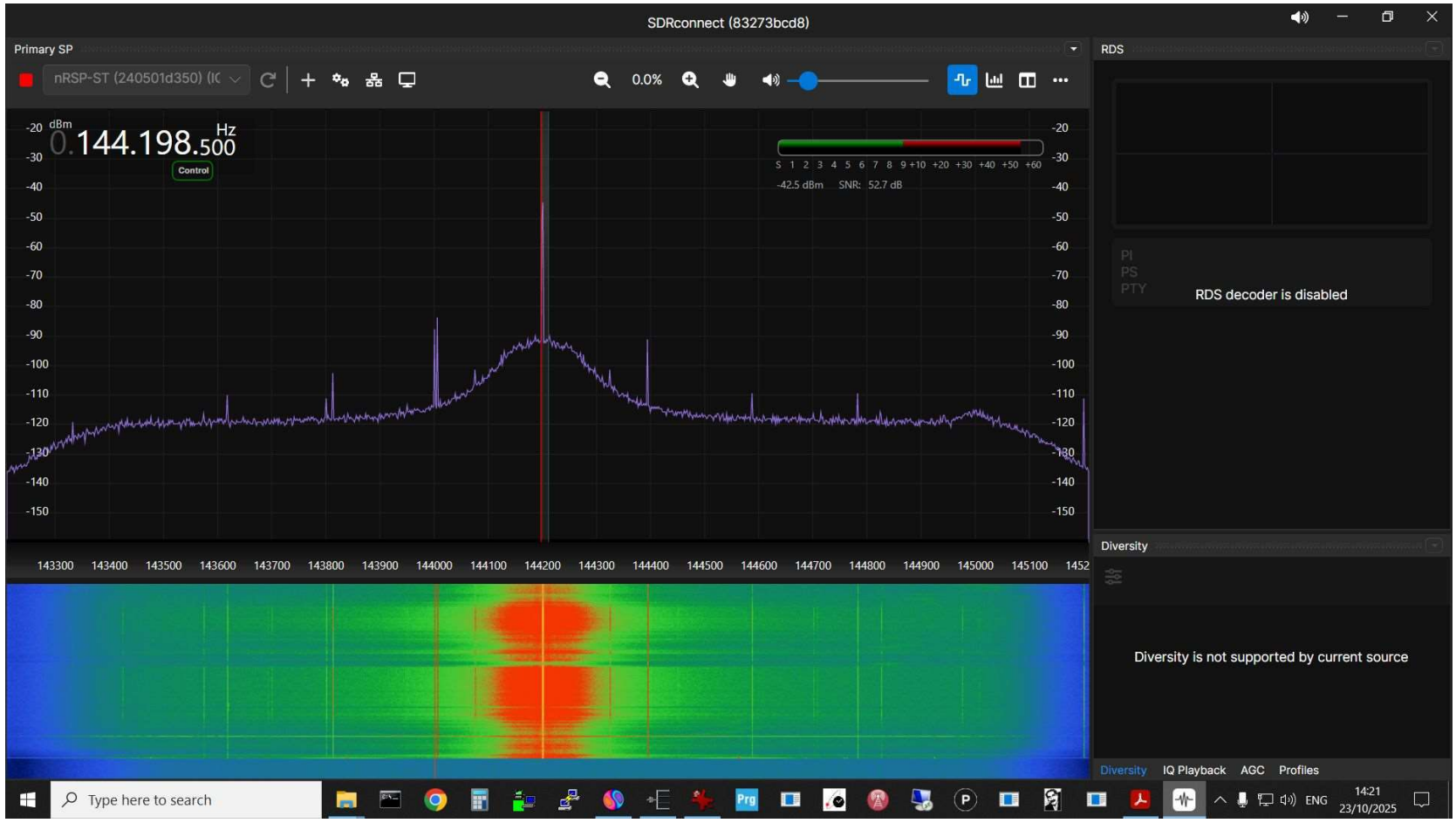

Closein spurious reduced

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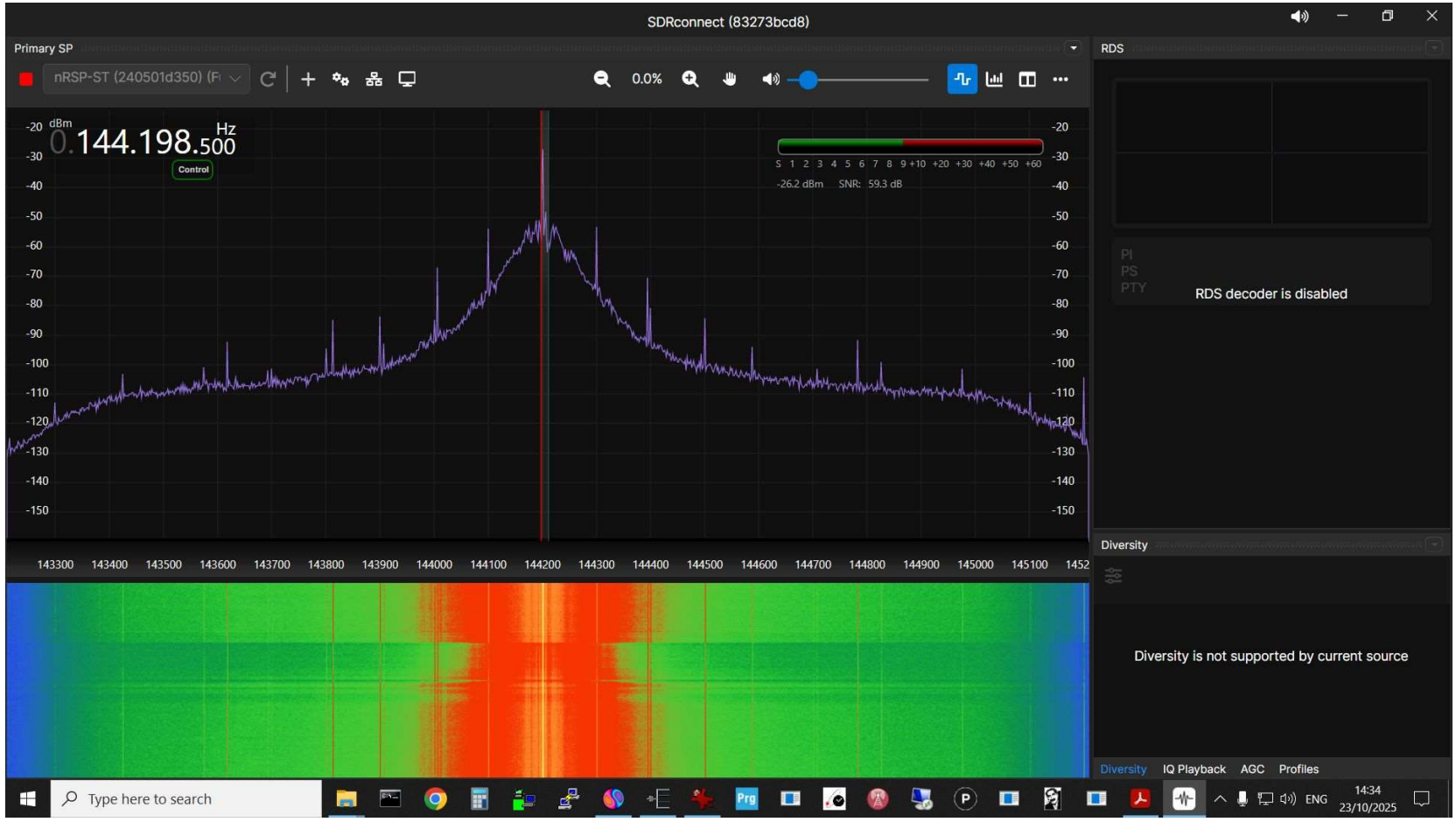
VK6PH Ref No filter



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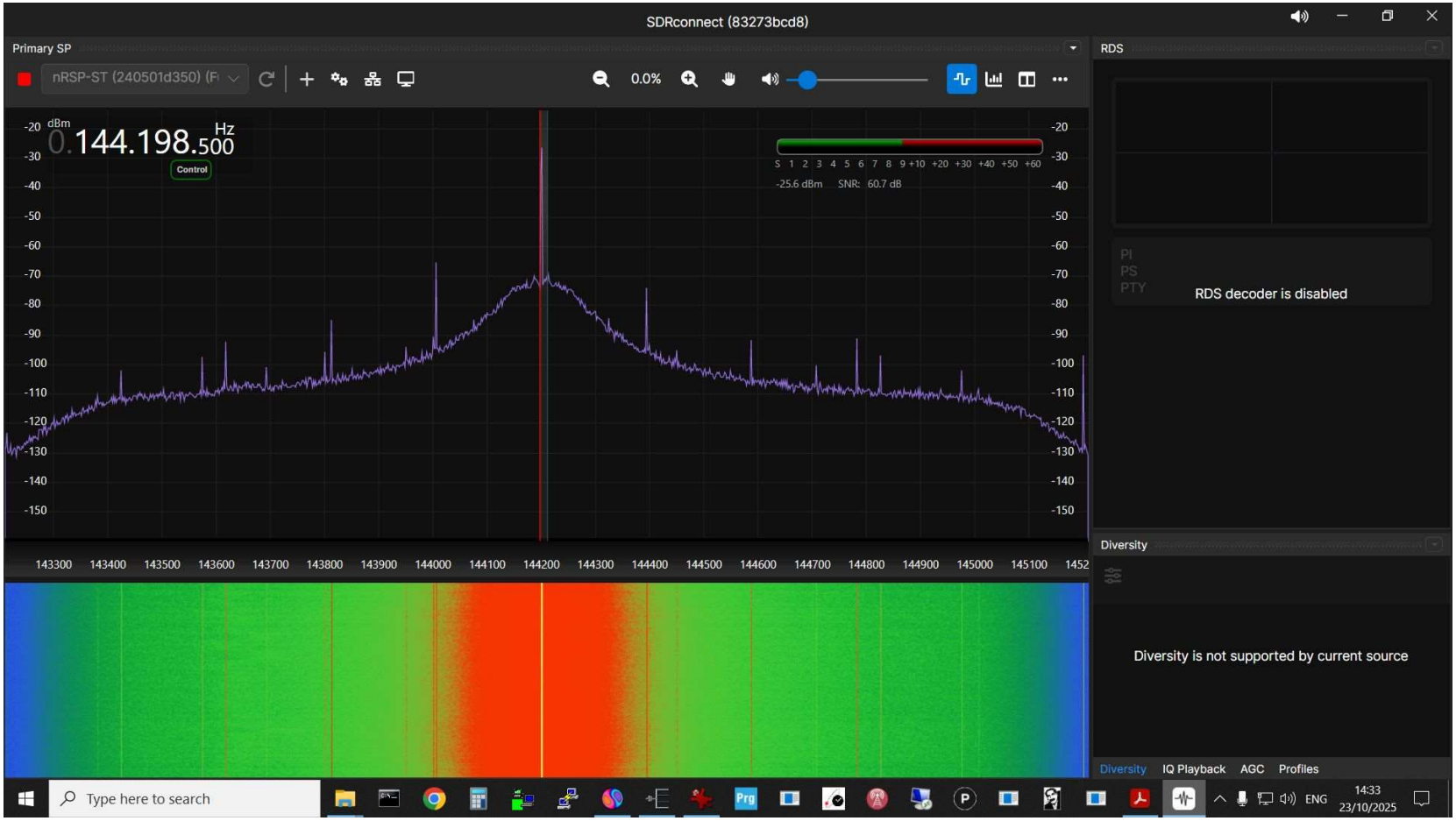
VK6PH Ref XTAL Filter



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