The nanoVNA, an inexpensive Vector Network Analyzer

by
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Overview

- What is a Vector Network Analyzer (VNA)?
- A brief history of the “nanoVNA”
- nanoVNA calibration
- How can *you* setup the nanoVNA HW & SW
- nanoVNA measurements (demos)
- Questions, comments, & feedback

What is a Vector Network Analyzer (VNA)?

- A device used to characterize antennas, filters, crystals, transmission lines, and other networks.

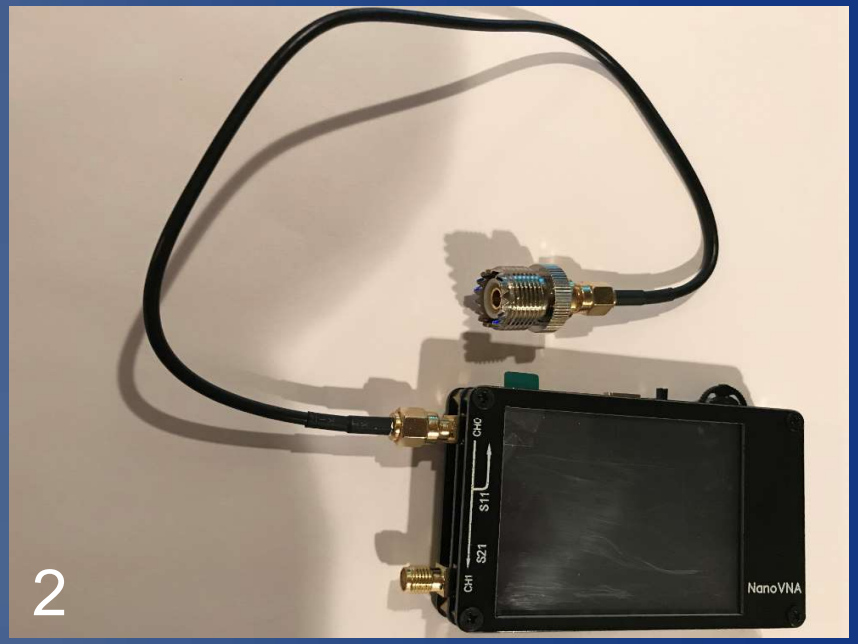
A brief history of the nanoVNA

- The original NanoVNA was designed by edy555 in Japan and he placed his source code & circuit design in Github.com*.
- Github is an online repository used by a global community of software developers that share code. Here they work on each others' code to implement bug fixes & enhancements.
- After edy555 lost interest and discontinued the project, a developer in China, hugen or hugen79, then picked up the mantle and improved the circuit. What improvements did hugen79 do?*
  - Improved the battery charging circuit
  - Boosted voltage on the RF mixers
  - Changed the microUSB to a type-C USB interface
  - Replaced the Voltage controlled oscillator (VCXO) with a Temperature Controlled oscillator (TCXO)

* source = QEX magazine, Jan-Feb 2020 issue, “An Ultra Low Cost Vector Network Analyzer” by George Steber

nanoVNA calibration (1/3)

1



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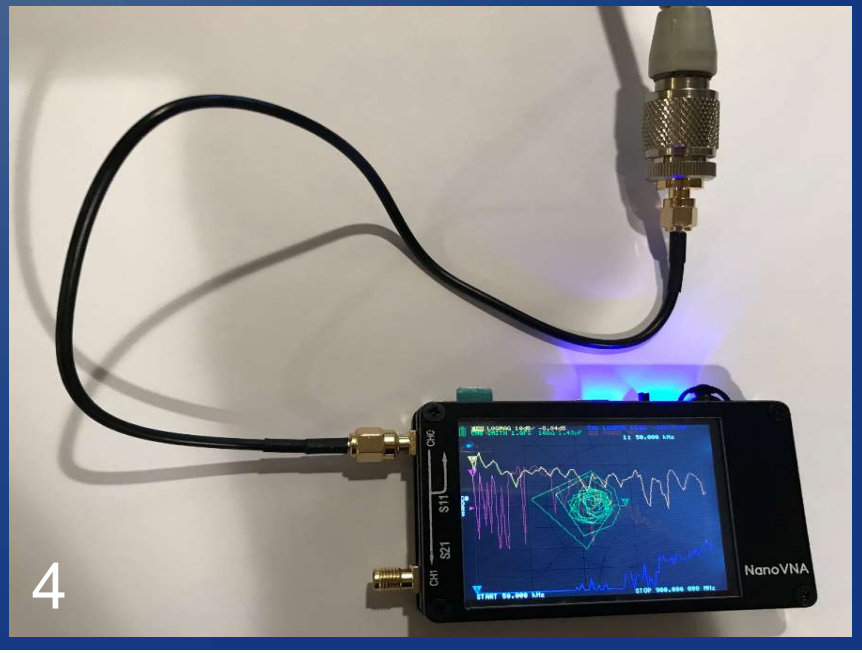
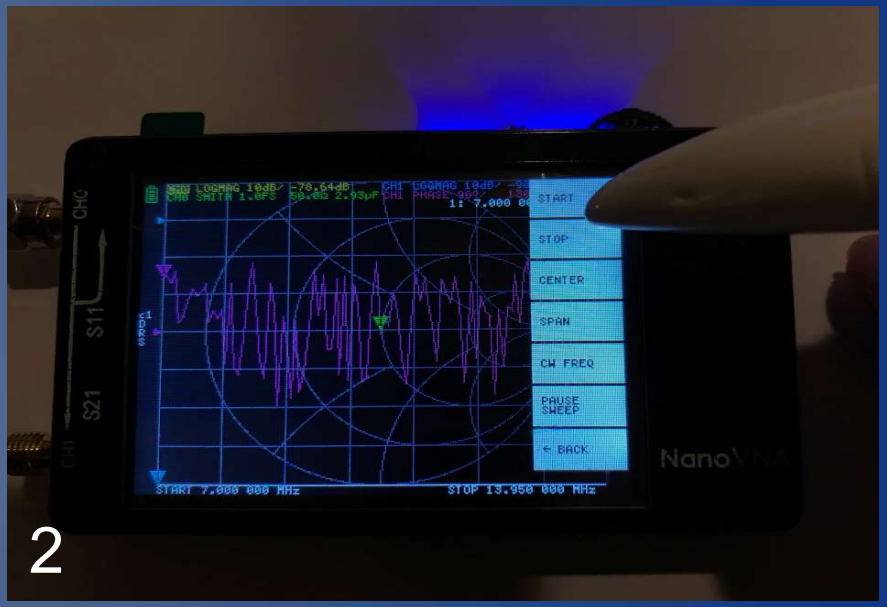


4

Calibration prelim - set scale

1



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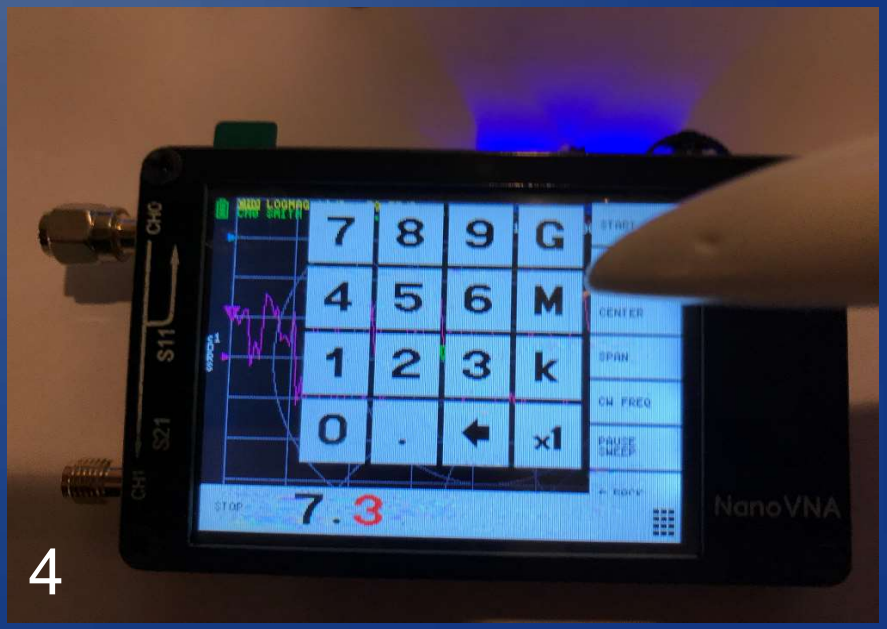
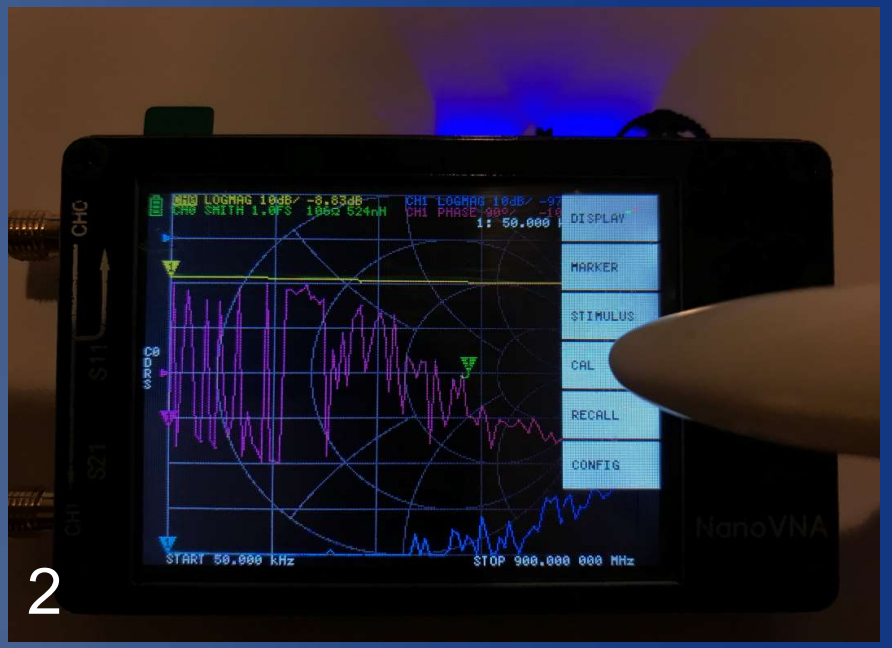
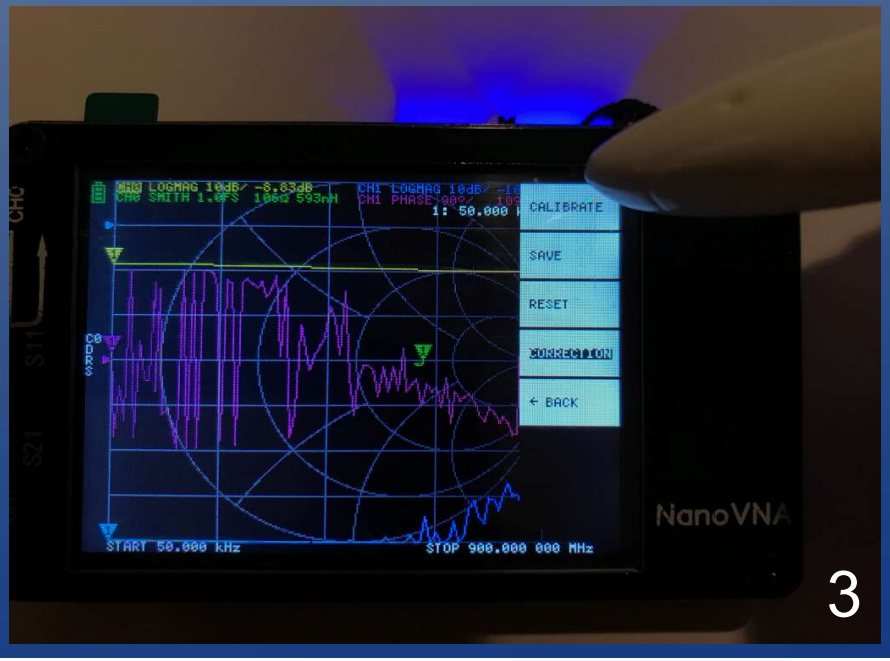


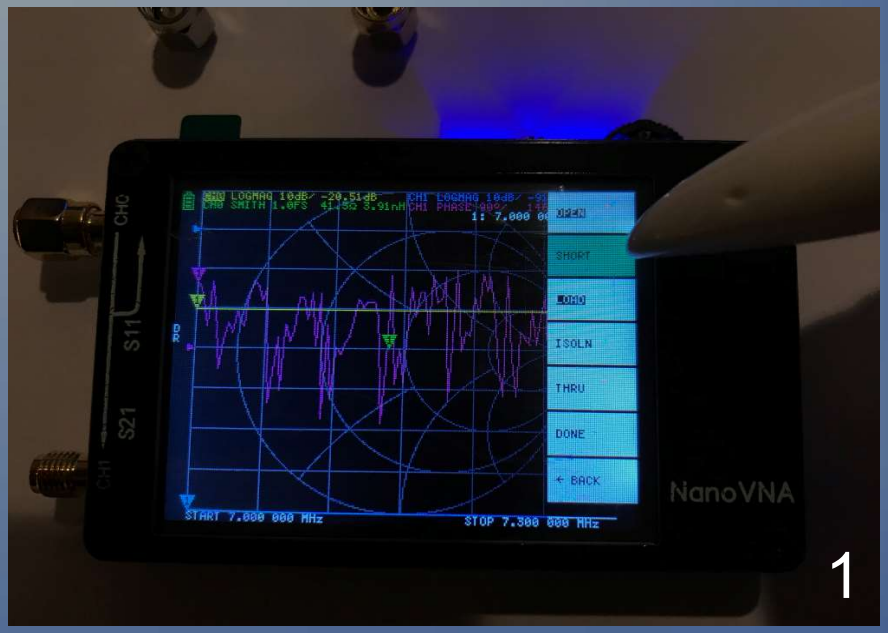
4

nanoVNA calibration (2/3)





nanoVNA calibration (3/3)



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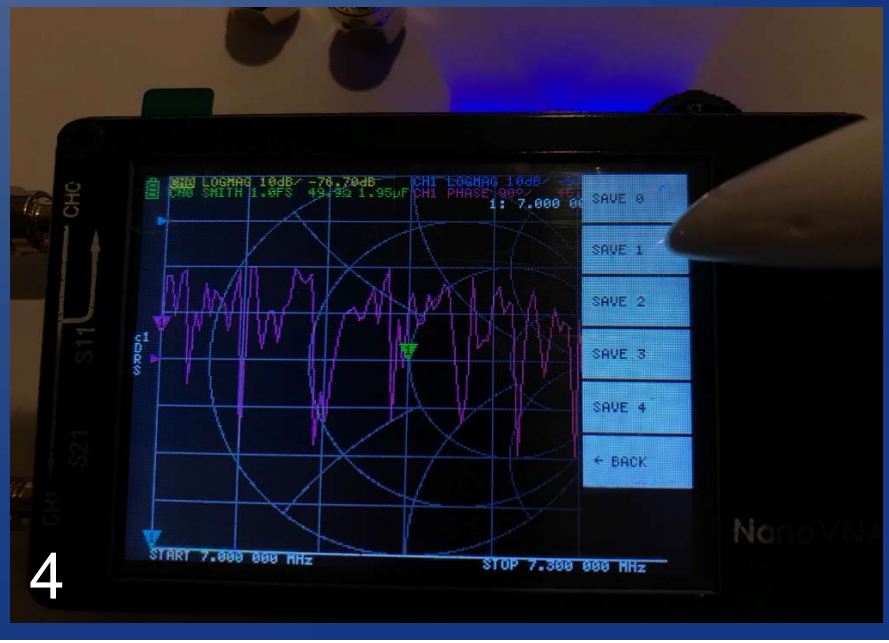
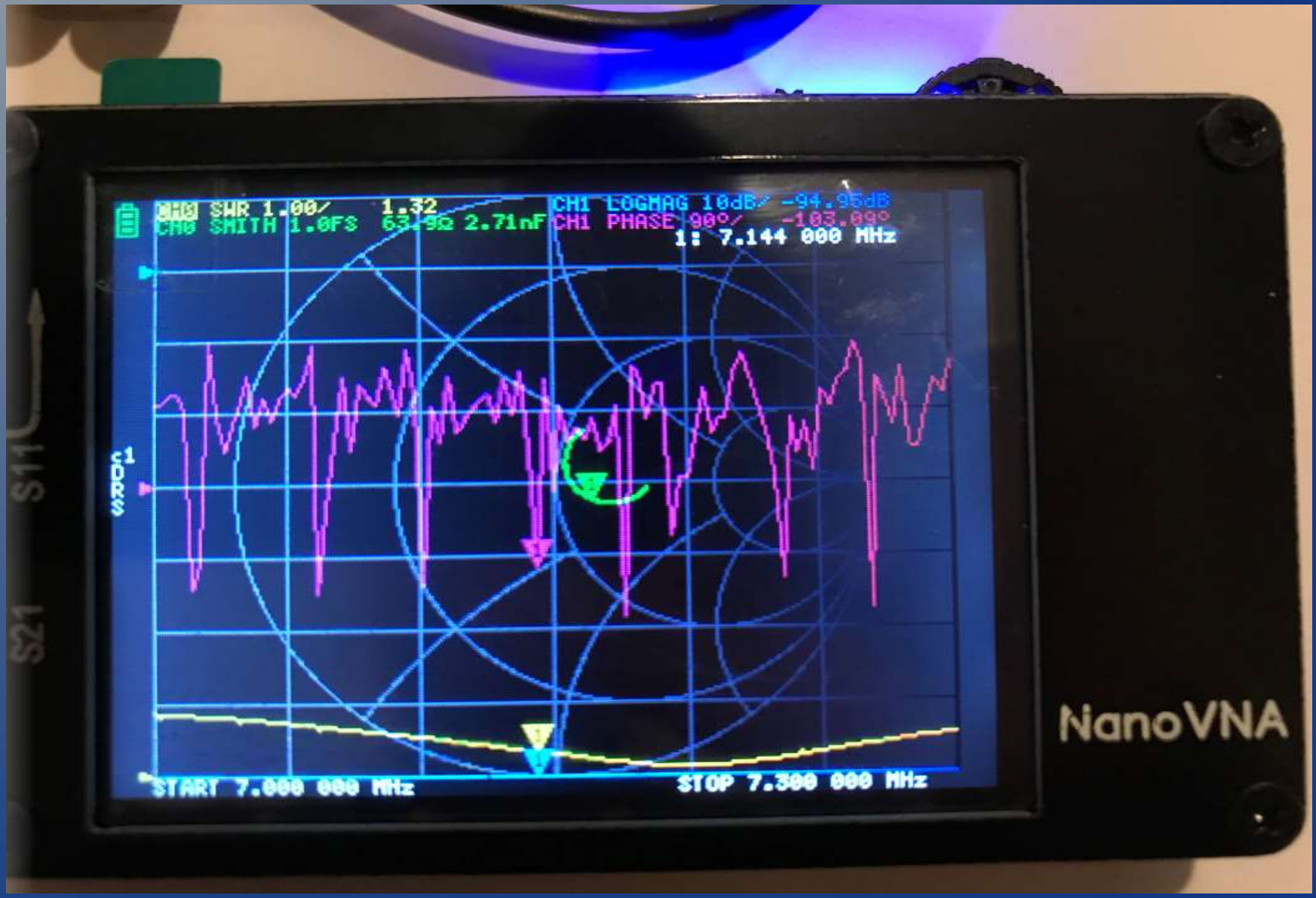


4

Voilá! A calibrated nanoVNA!



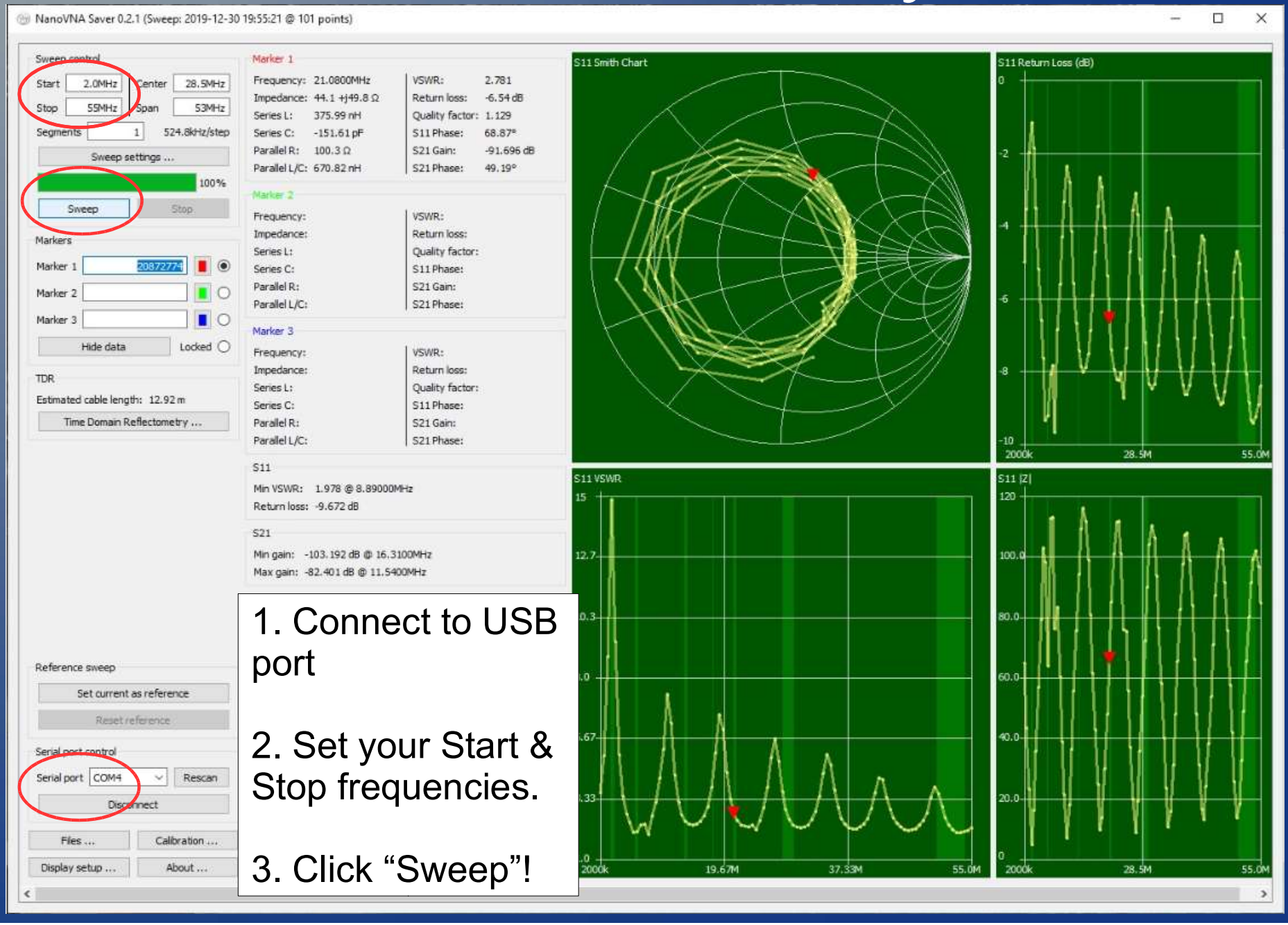
How can ***you*** setup the nanoVNA? (Hardware)

USB
(provided)

How can ***you*** setup the nanoVNA? (Software)

- I used “NanoVNAsaver” version 0.2.1
- NanoVNAsaver is free to use and is written in Python on Windows, using Pycharm, and the modules PyQT5, numpy, scipy and pyserial.
- You can download the .exe file at this Github URL: https://github.com/mihtjel/nanovna-saver/releases
- Note that the QEX article mentions another software called “NanoSharp” which needs MS Framework 4.0 (heads up!)

NanoVNA Saver – easy to use



1. Connect to USB port

2. Set your Start & Stop frequencies.

3. Click “Sweep”!

Final impressions & thoughts

- I've ***learned*** about Vector Network Analyzers.
- You can't go wrong with the price of the nanoVNA, $54 at Amazon (and their return policy is good).
- It's a nice addition to the PC oscilloscope in my HAM shack (Mantra = measure, measure, measure).
- The device is portable, so I could take it to the field (with care). The E&M environment *will* be different there.
- I've delved into S11, S21, S12, and S22 “scattering” parameters (S-matrix). This applies to Physics *and* EE.
- Do 2 radials work better than 1? If so, how *much* better??
- I've had ***fun*** characterizing all antennas at home!

Your Questions & Comments

Appendix 1 – Amazon order info

Delivered Dec 30, 2019

Your package was picked up from Amazon Locker

NanoVNA 50KHz-900MHz Vector Network Analyzer Kit MF HF VHF UHF Antenna Analyzer

Sold by: Qianfengyueying

Return eligible through Jan 31, 2020

$54.99

Buy it again | View your item

Delivered Dec 28, 2019

Your package was picked up from Amazon Locker

SMA-UHF RF Connectors Kit SMA to UHF PL259 SO239 4 Type Set SMA Jack/Plug to UHF Nickel Gold Plated Test Converter Pack of 4 ...

Sold by: OneLinkMore Tech

Return eligible through Jan 31, 2020

$7.68

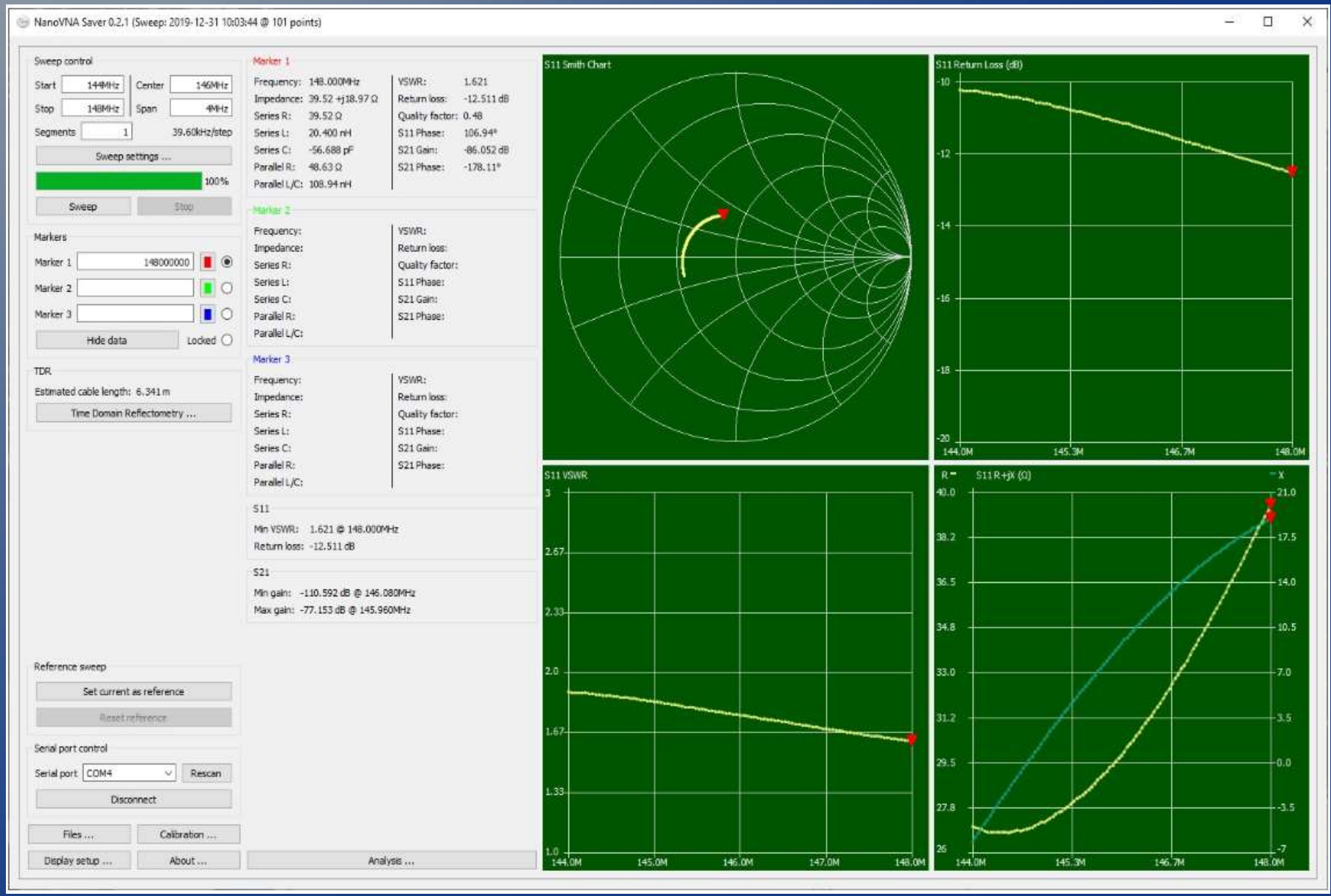
Buy it again | View your item

Appendix 2

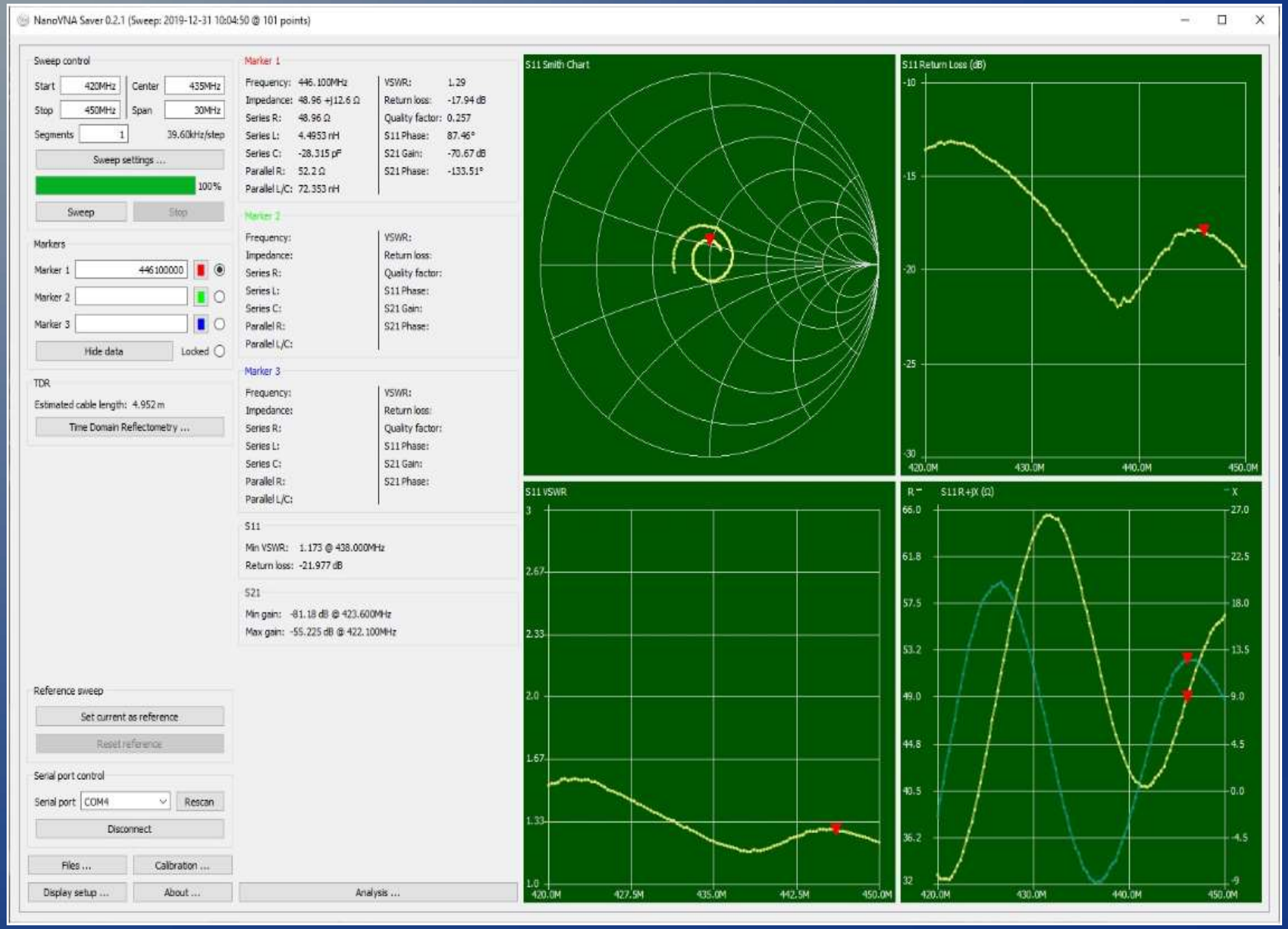
Antenna characterizations

- Wolf River Coils TIA 1000 “bug catcher”
- Nagoya UT 72 mag mount – stays on Prius roof at 80mph in West Texas!

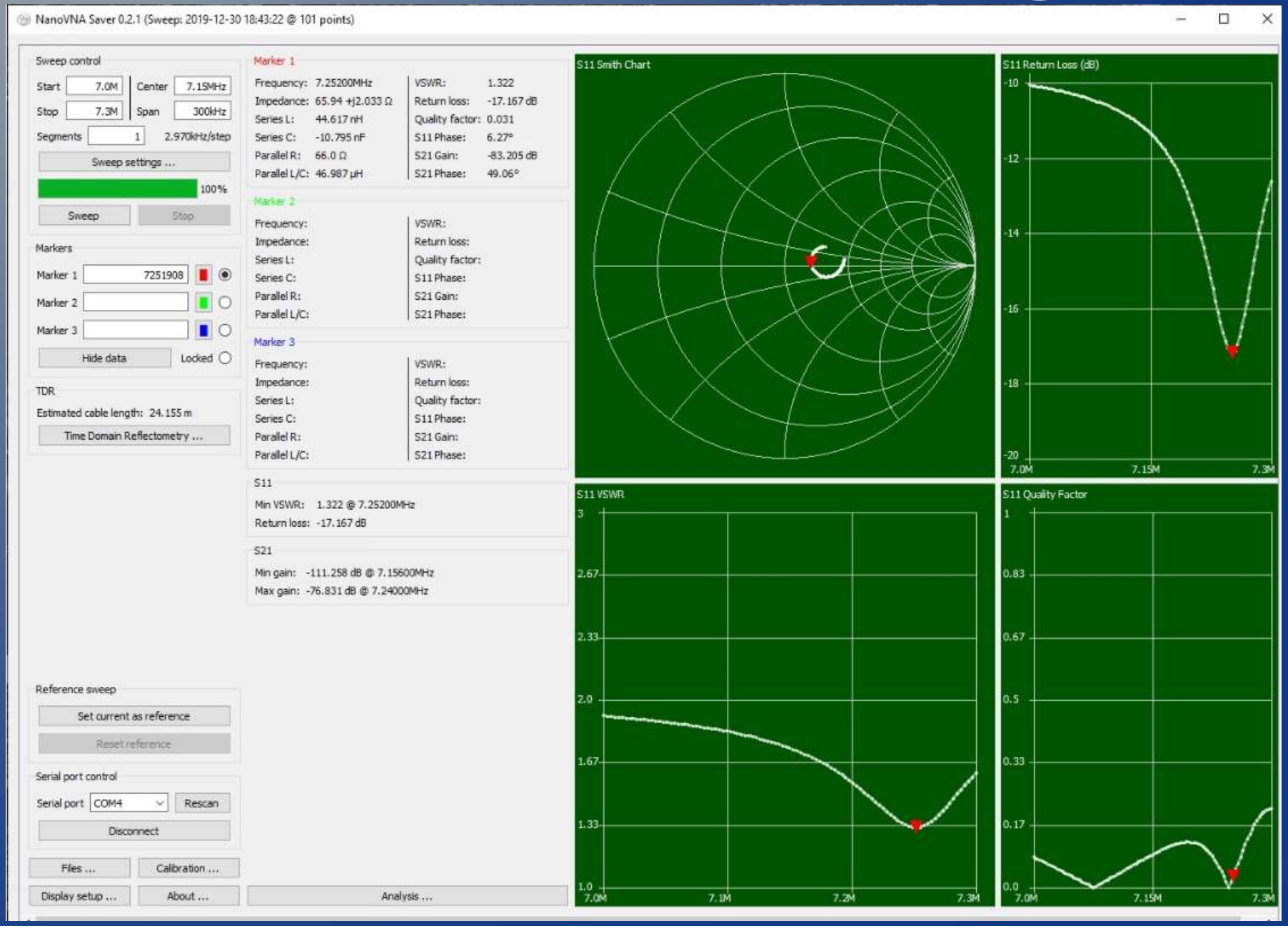
Nagoya UT-72 @ 2m (notice customized scale in lower right)



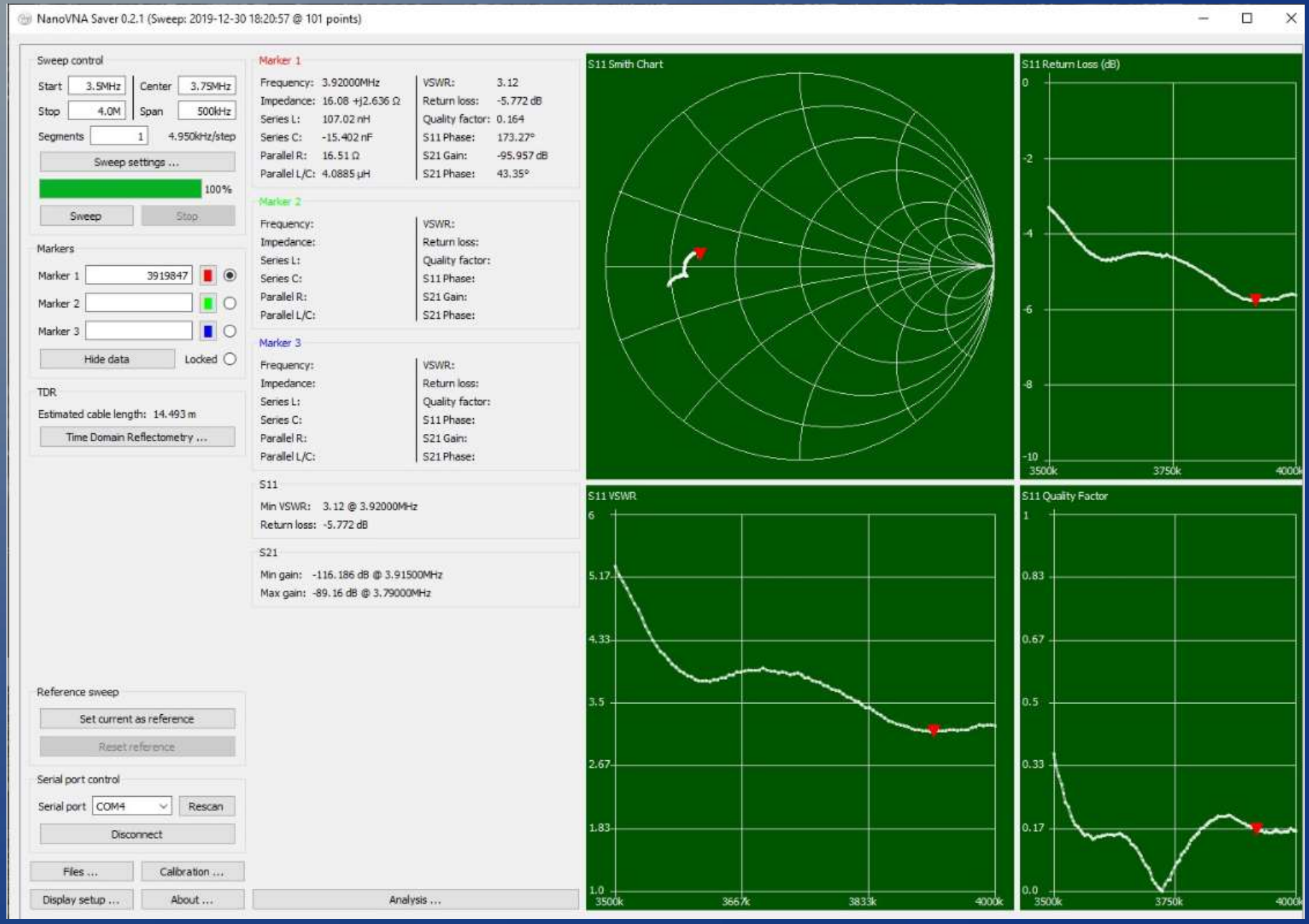
Nagoya UT-72 @ 70 cm



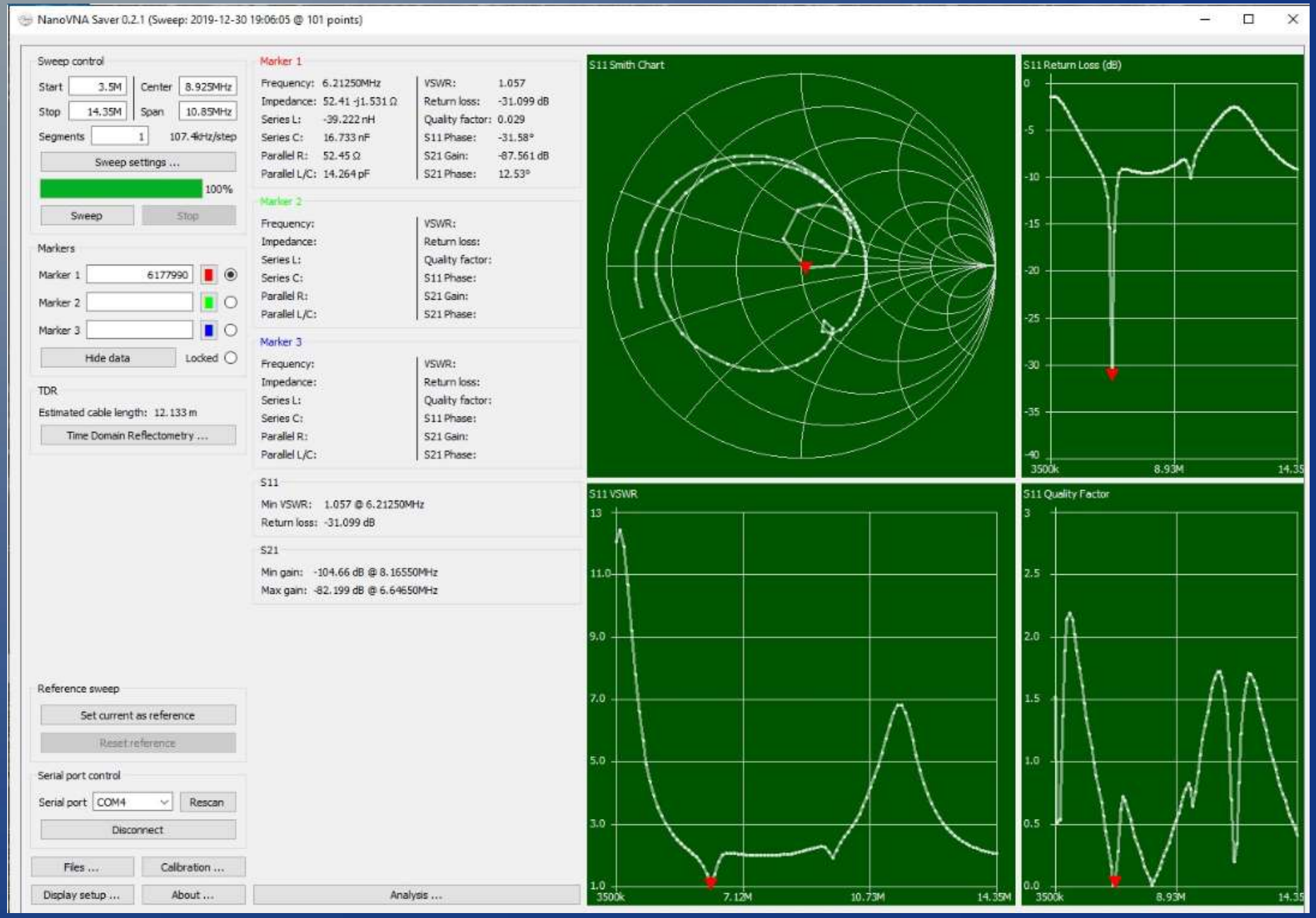
Wolf River Coils TIA 1000 @ 40 m



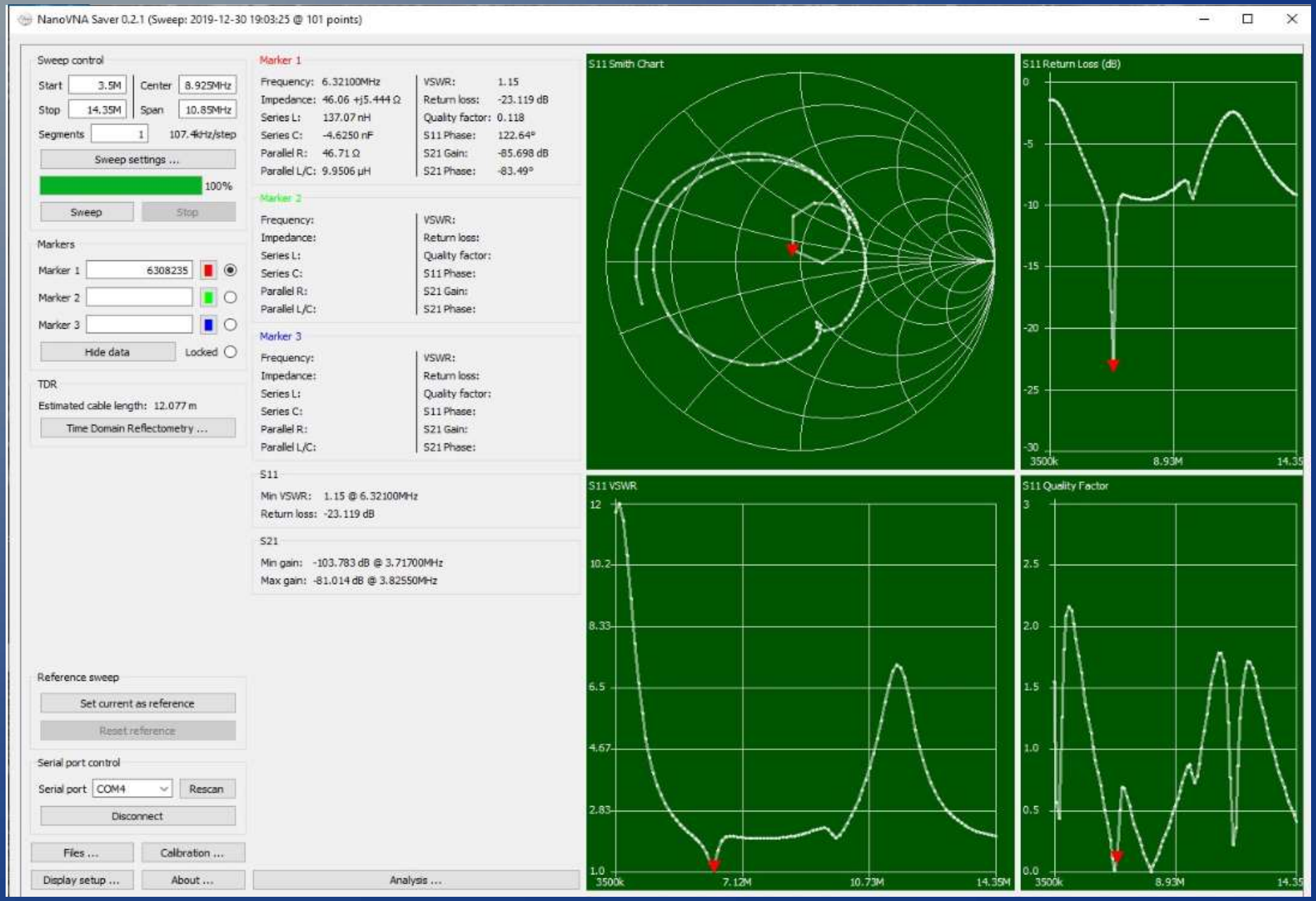
Wolf River Coils TIA 1000 @ 80 m



WRC TIA 1000 w/2 radials deployed



WRC TIA 1000 w/1 radial deployed



Appendix 3 - Useful Links

Ham Radio Crash Course episode on nanoVNA

https://youtu.be/tLMAStiaAxU

What's the accuracy of the nanoVNA?

https://youtu.be/ggcQ7GsGc8s

Using an Oscilloscope to find the location of an open or short in a coax, i.e. a “poor man's TDR”

https://youtu.be/II_eju4D_TM