



285 TechConnect Radio Club - NAØTC

Exploring the Nano VNA

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[Upgraded] AURSINC NanoVNA-H4 V4.2 Vector Network Analyzer 10KHz-1.5GHz HF VHF UHF Portable Antenna Analyzer Measuring S Parameters, Voltage Standing Wave Ratio, Phase, Delay, Smith Chart 4" Screen

[Visit the AURSINC Store](#)

★★★★★ 120 ratings

\$98⁹⁹

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VNA (Vector Network Analyzer) measures the frequency characteristics of reflected power and passing power of a high frequency network (RF Network).

NanoVNA measures the following elements:

- Input voltage I / Q signal
- Reflected voltage I / Q signal
- Pass voltage I / Q signal

From here we calculate:

- Reflection coefficients S11
- Transmission coefficient S21

Nano VNA then can calculate and display.

- Reflection loss
- Passing loss
- Complex impedance
 - resistance
 - reactance
- SWR

I/Q Signal – (In-phase and Quadrature)

- Two measurements, separated by 90 degrees at a constant frequency.
- Nano VNA performs 101 measurements with frequencies varied between the start and end frequencies specified by the user
- Calibration of the Nano-VNA is necessary to maintain accuracy of the I/Q Signal measurements.

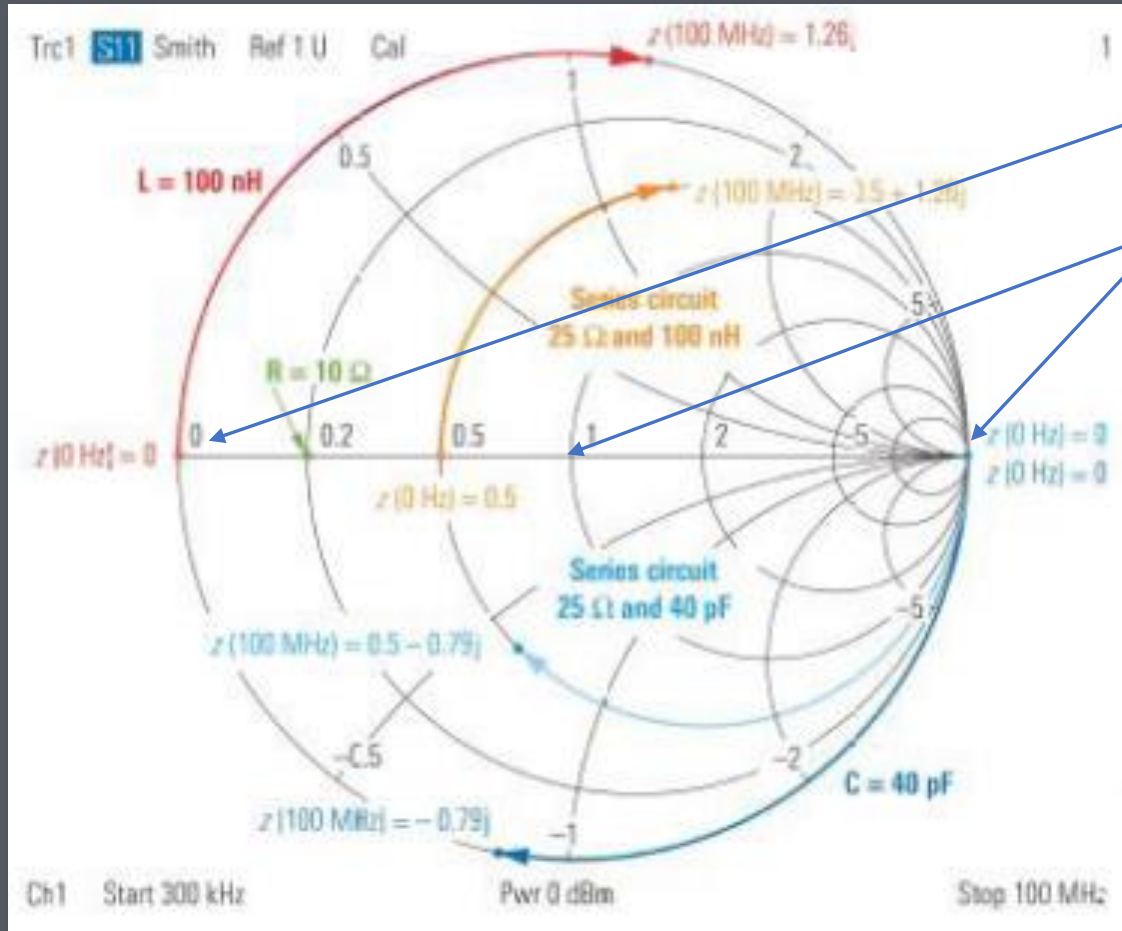
Smith Chart Background:

Nano VNA Calibration:

- Short
- Open
- Load (50 Ω)

Impedance Example (f from 0 to 100MHz, $R_1 = 50\Omega$)

- **L = 100nH, C = 40pF, R = 25 Ω**
- **Series R,L**
- **Series R,C**



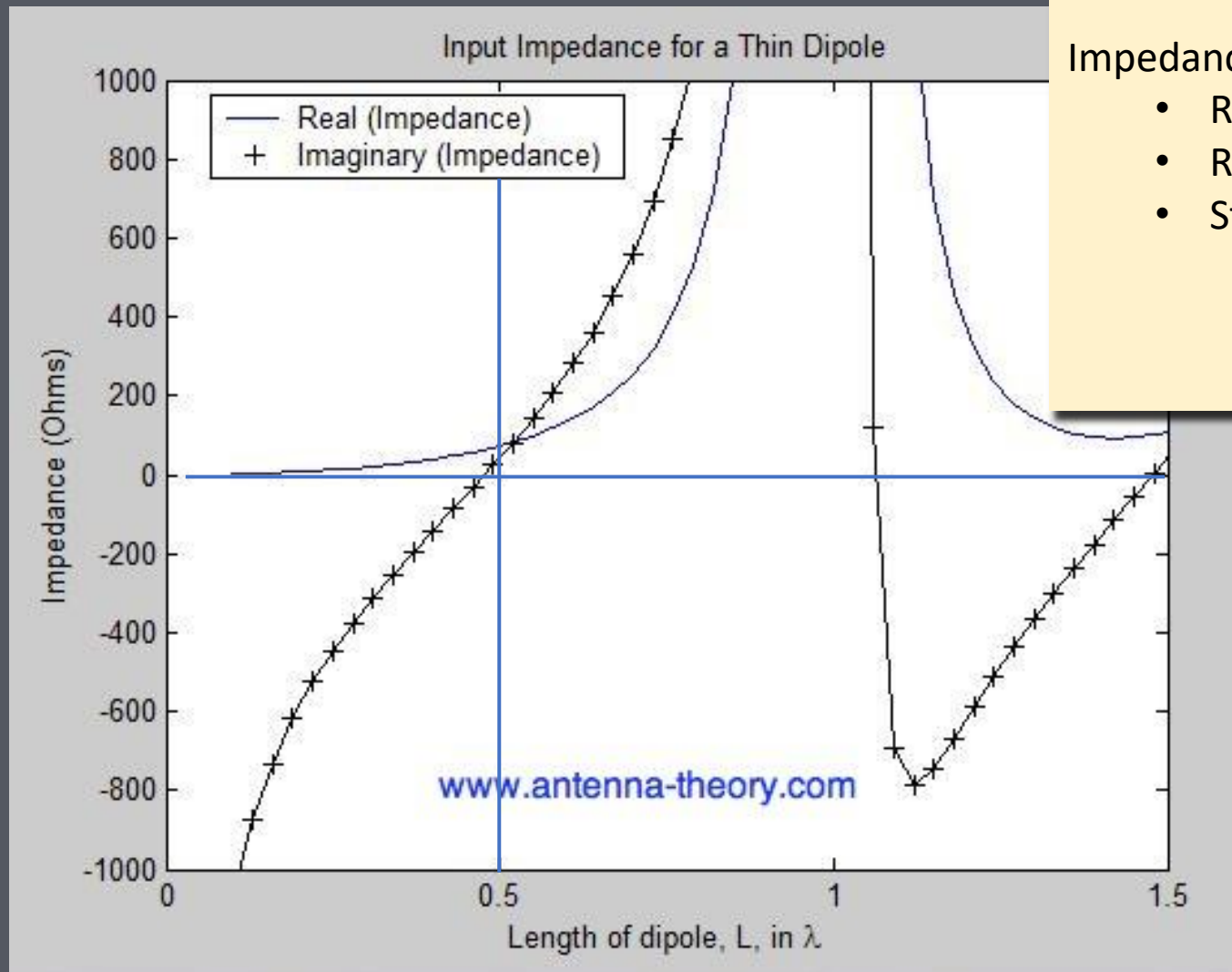


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Ideal Dipole Example:

Impedance as a function of wavelength

- Resonance impedance ($X_L = X_C = \text{zero}$)
- Resonance impedance $R + j0 = 73\Omega$
- Standing Wave Ratio for $R_{\text{load}} = 50\Omega$
 - $\text{SWR} = 1.5$





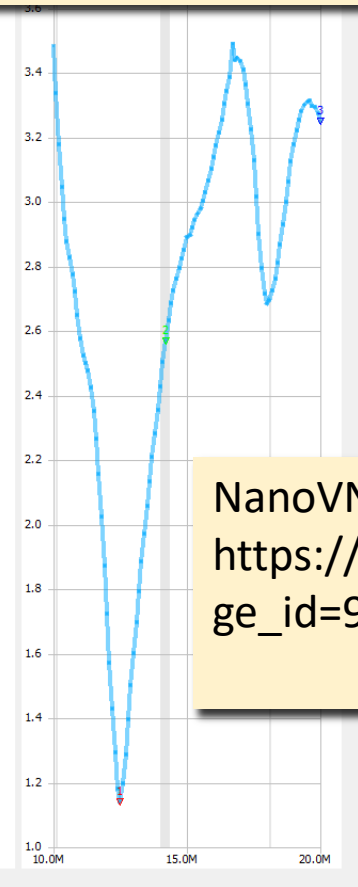
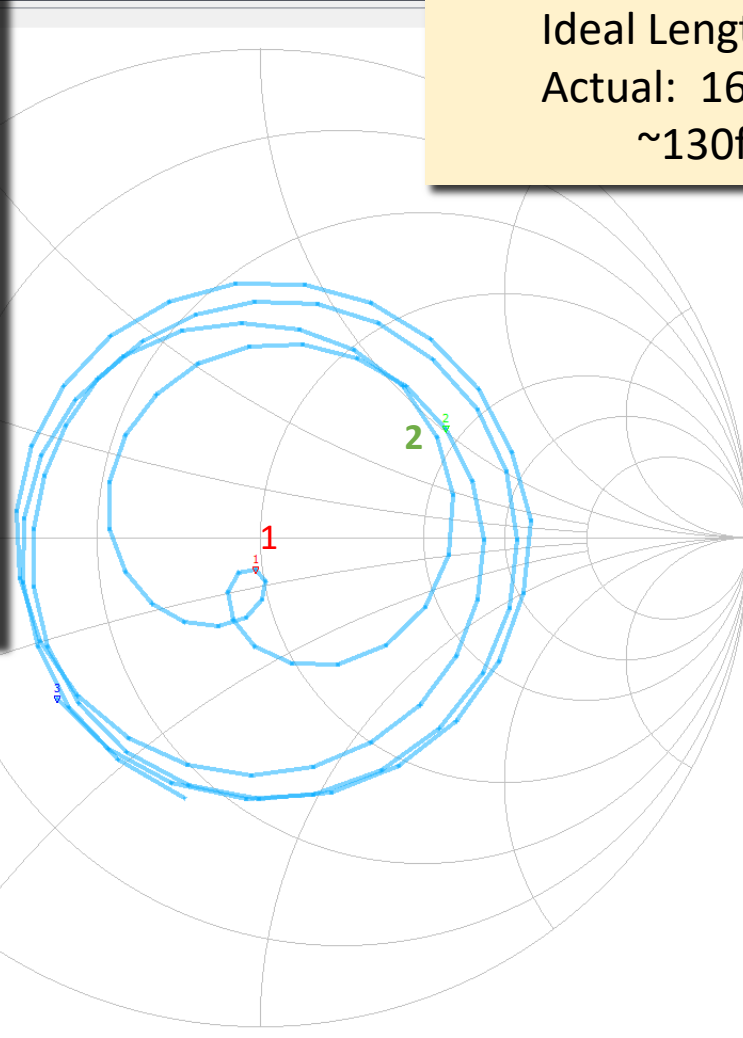
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Sweep control
Start: 10MHz, Center: 15MHz, Stop: 20MHz, Span: 10MHz, Segments: 1, 100.0kHz/step
Sweep settings ...
Sweep: 100%
Markers: Marker 1: 12.48MHz, Marker 2: 14.2MHz, Marker 3: 20MHz
TDR: Estimated cable length: 41.667 m

| Marker | Frequency | VSWR | Return loss | Quality factor | S11 Phase | S21 Gain | S21 Phase |
|----------|-------------|-------|-------------|----------------|-----------|------------|-----------|
| Marker 1 | 12.5000 MHz | 1.142 | -23.572 dB | 0.132 | -98.40° | -80.733 dB | 19.97° |
| Marker 2 | 14.2000 MHz | 2.573 | -7.127 dB | 0.552 | 30.38° | -81.326 dB | 39.38° |

Reference sweep
Serial port control: COM5 (NanoVNA)

20m Dipole Antenna (14.2MHz):
Ideal Length: 16.4ft per leg
Actual: 16.5ft at 30deg inverted dipole
~130ft RG8x feedline



NanoVNASaver Software
https://nanovna.com/?page_id=90

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Live Example:

Find characteristics for mystery antenna.

Use Nano-VNA and NanoVNASaver windows PC Software

1. Power up NanoVNA and NanoVNASaver
2. Set frequency range
3. Calibrate – Short, Open, Load
4. Find minimum SWR, and resonance

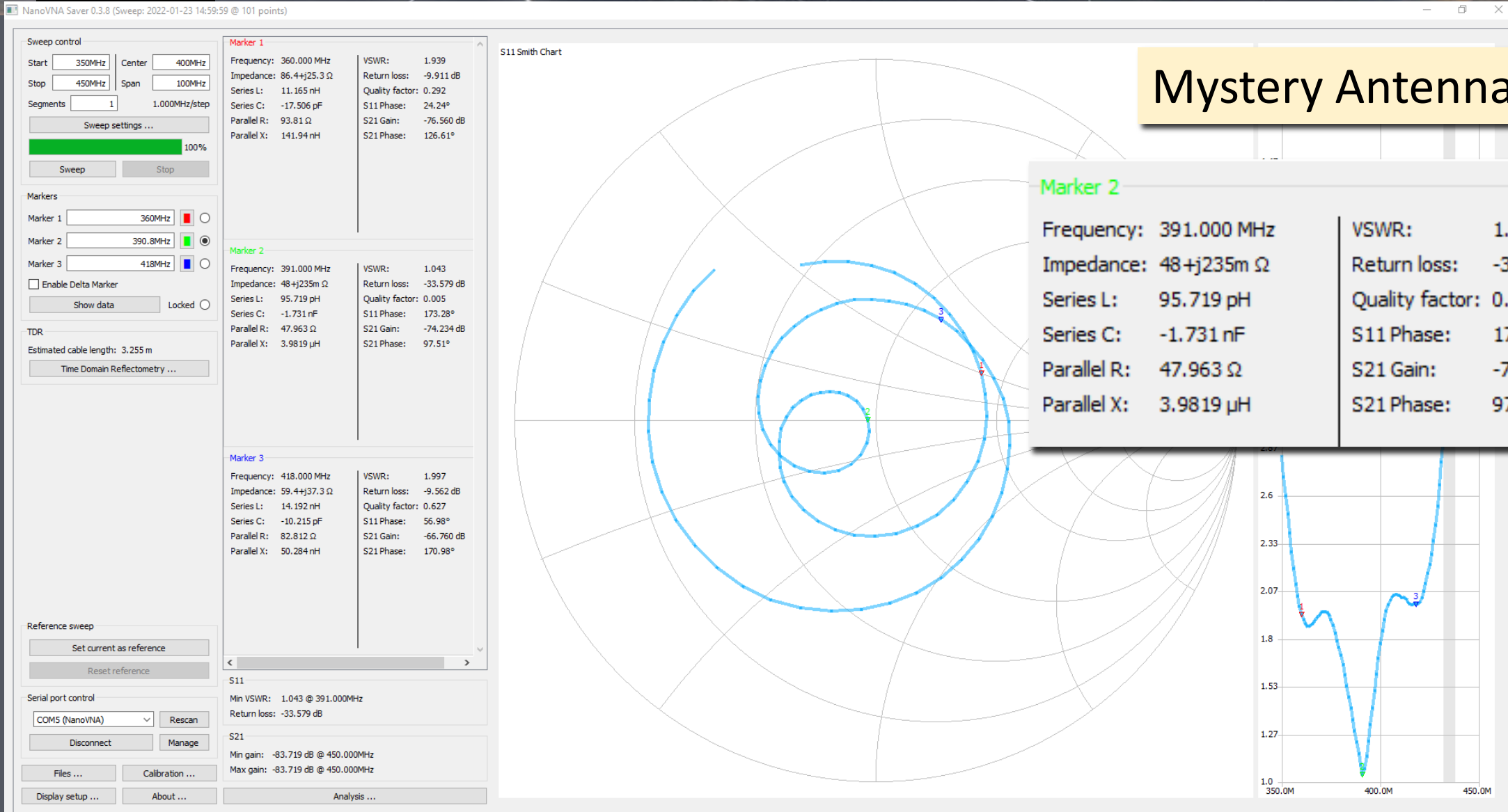


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Backup Slides



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Sweep control

Start: 300MHz Center: 400MHz
Stop: 500MHz Span: 200MHz
Segments: 1 2.000MHz/step
Sweep settings ...
100%
Sweep Stop

Markers

Marker 1: 438.4MHz
Marker 2: 364MHz
Marker 3: 453.6MHz
 Enable Delta Marker
Show data Locked

TDR

Estimated cable length: 49.324 m
Time Domain Reflectometry ...

Reference sweep

Set current as reference
Reset reference

Serial port control

COM5 (NanoVNA) Rescan
Disconnect Manage
Files ... Calibration ...
Display setup ... About ... Analysis ...

Marker 1

Frequency: 438.000 MHz VSWR: 1.161
Impedance: 55-j6.07 Ω Return loss: -22.533 dB
Series L: -2.2041 nH Quality factor: 0.11
Series C: 59.905 pF S11 Phase: -47.23°
Parallel R: 55.662 Ω S21 Gain: -68.113 dB
Parallel X: 720.04 fF S21 Phase: 67.21°

Marker 2

Frequency: 364.000 MHz VSWR: 1.199
Impedance: 50-j9.08 Ω Return loss: -20.877 dB
Series L: -3.9689 nH Quality factor: 0.182
Series C: 48.169 pF S11 Phase: -84.78°
Parallel R: 51.652 Ω S21 Gain: -75.748 dB
Parallel X: 1.5366 pF S21 Phase: 127.60°

Marker 3

Frequency: 454.000 MHz VSWR: 1.149
Impedance: 55.7-j4.61 Ω Return loss: -23.208 dB
Series L: -1.6175 nH Quality factor: 0.083
Series C: 75.978 pF S11 Phase: -36.63°
Parallel R: 56.054 Ω S21 Gain: -74.366 dB
Parallel X: 518.32 fF S21 Phase: 168.48°

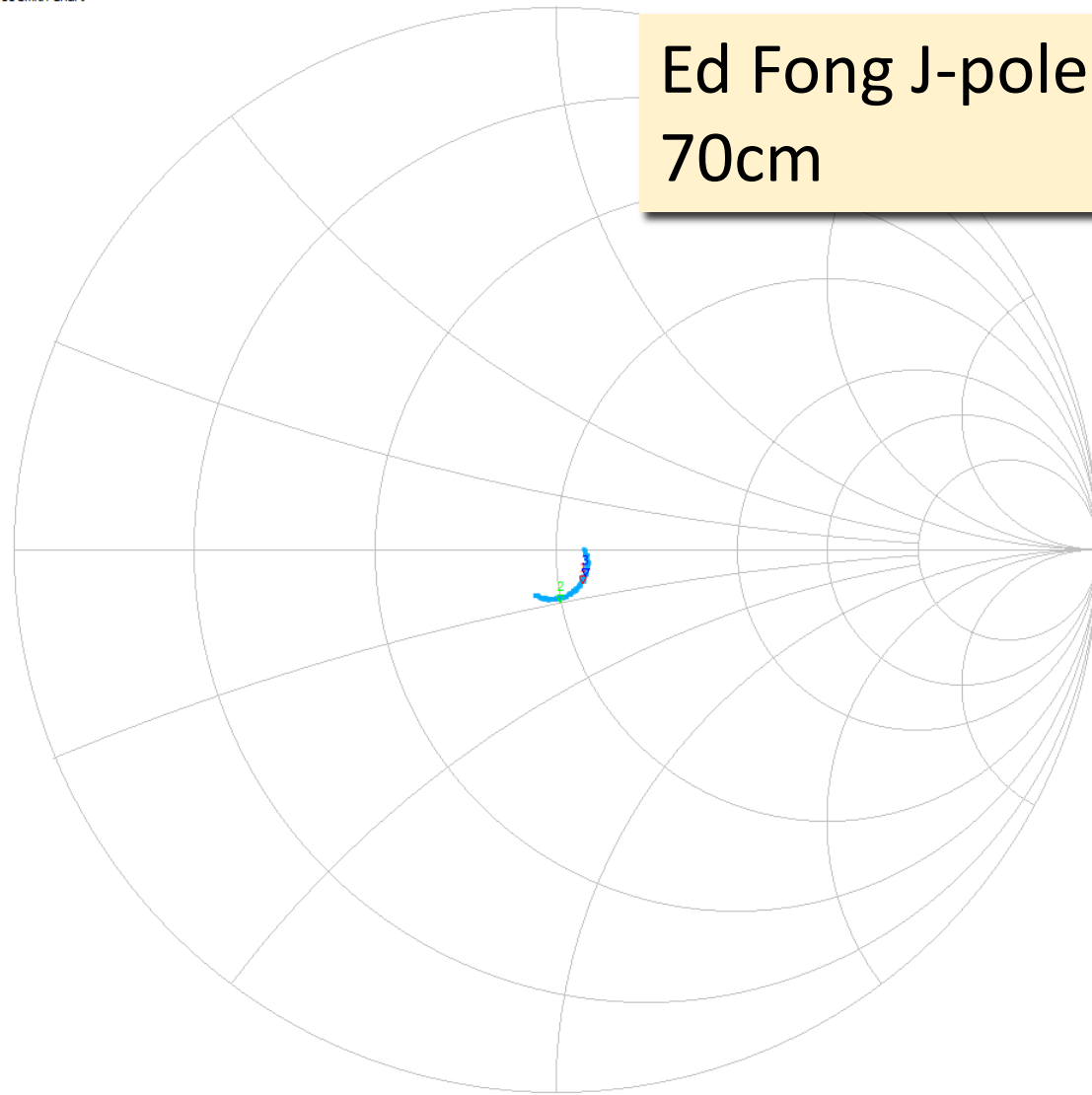
S11

Min VSWR: 1.111 @ 500.000MHz
Return loss: -25.572 dB

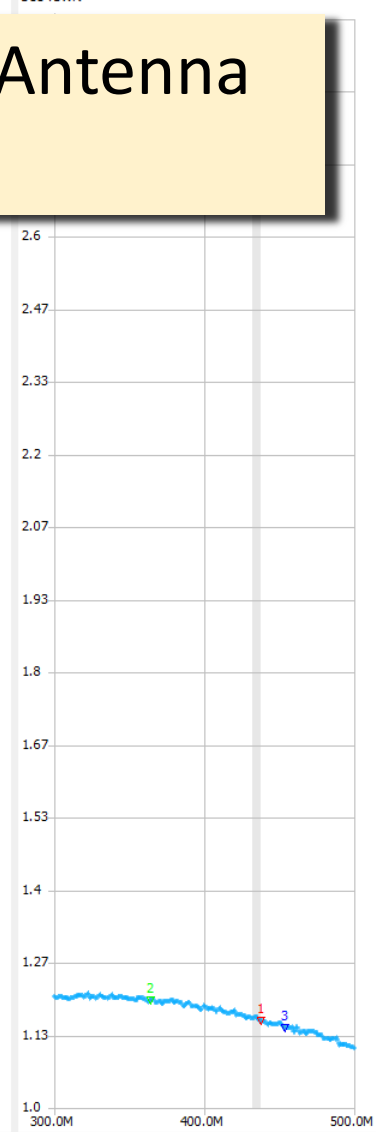
S21

Min gain: -95.355 dB @ 450.000MHz
Max gain: -95.355 dB @ 450.000MHz

S11 Smith Chart



S11 VSWR

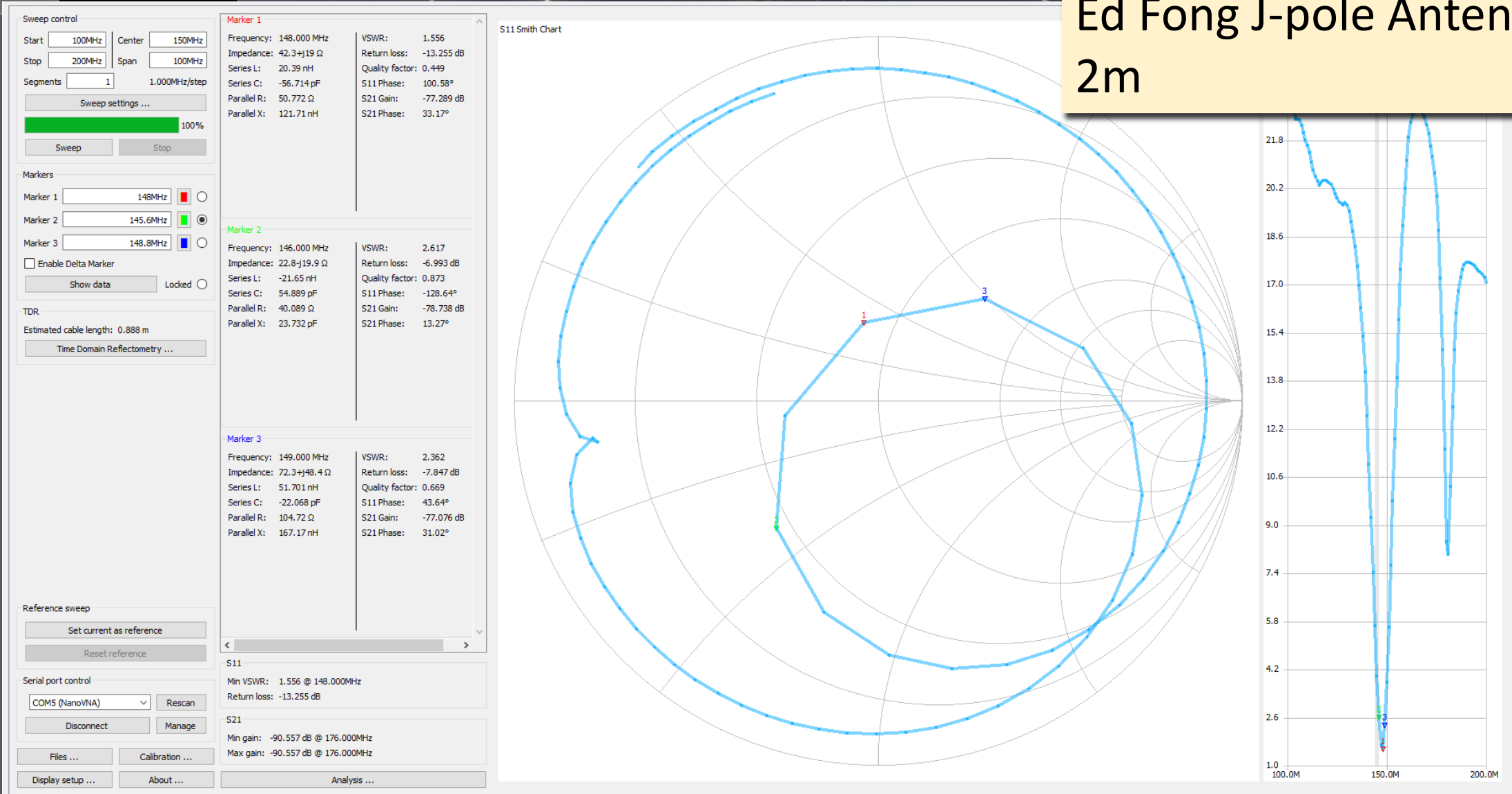


Ed Fong J-pole Antenna
70cm



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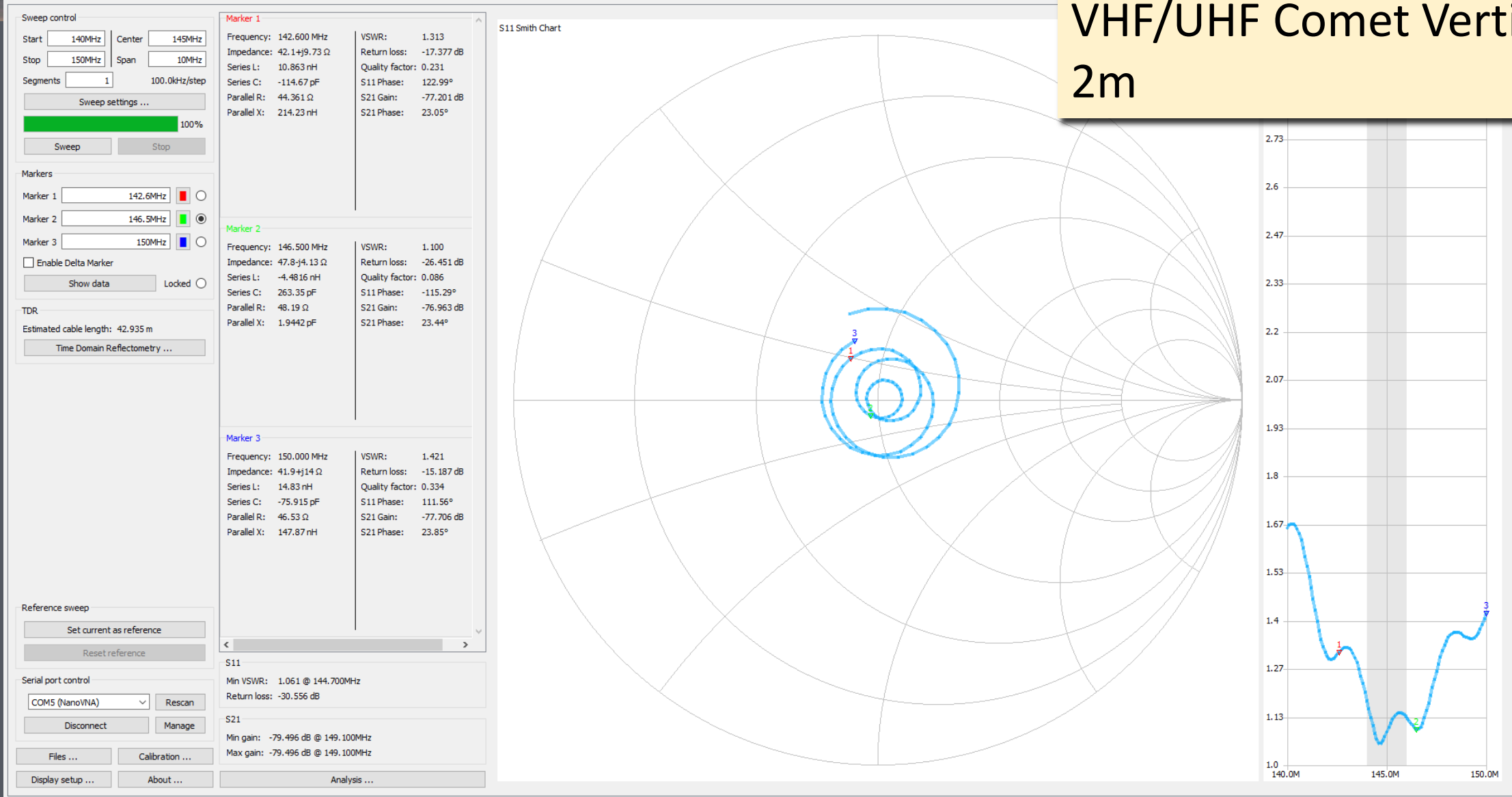
Ed Fong J-pole Antenna
2m





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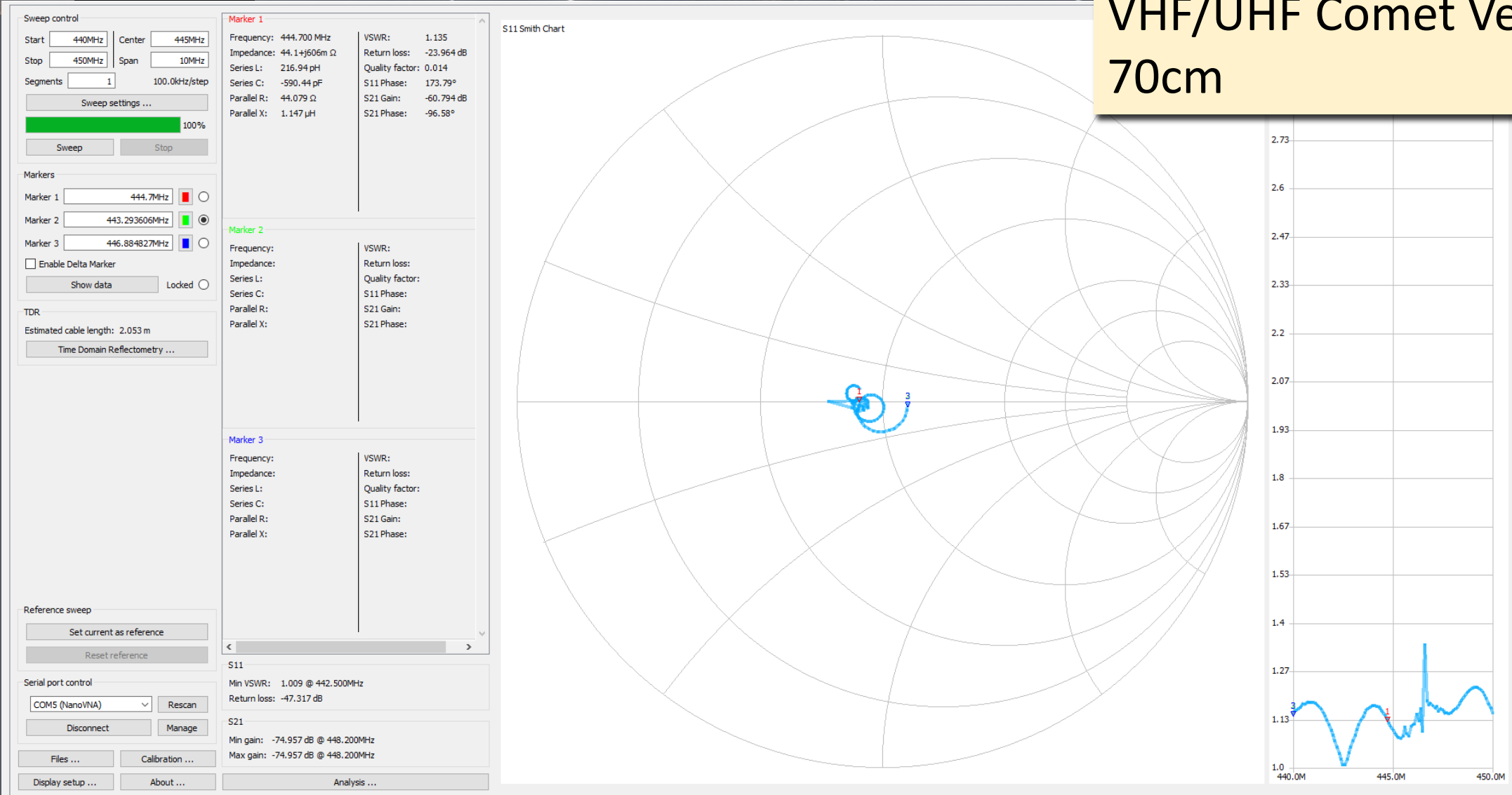
VHF/UHF Comet Vertical
2m





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VHF/UHF Comet Vertical
70cm





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Diamond SRH77CA
100 – 500MHz

Sweep control

Start: 100MHz | Center: 300MHz
Stop: 500MHz | Span: 400MHz
Segments: 1 | 4.000MHz/step
Sweep settings ...
100%
Sweep | Stop

Markers

Marker 1: 450.4MHz
Marker 2: 170.4MHz
Marker 3: 376MHz
Enable Delta Marker
Show data | Locked

TDR

Estimated cable length: 0.083 m
Time Domain Reflectometry ...

Reference sweep

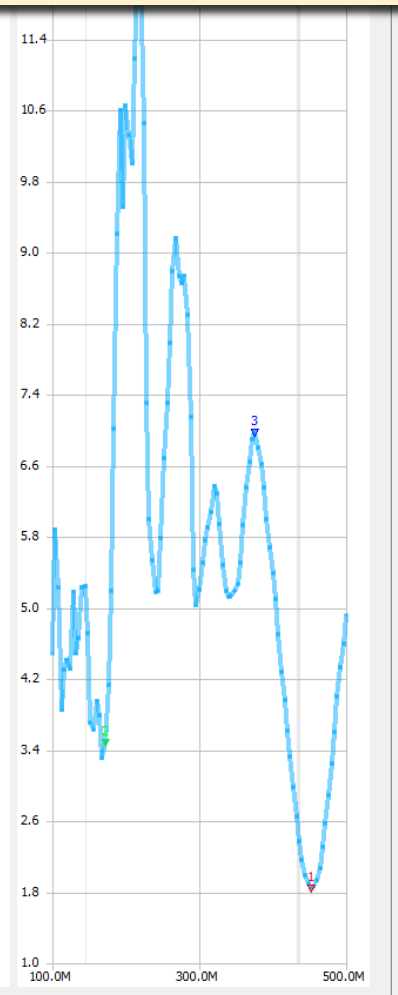
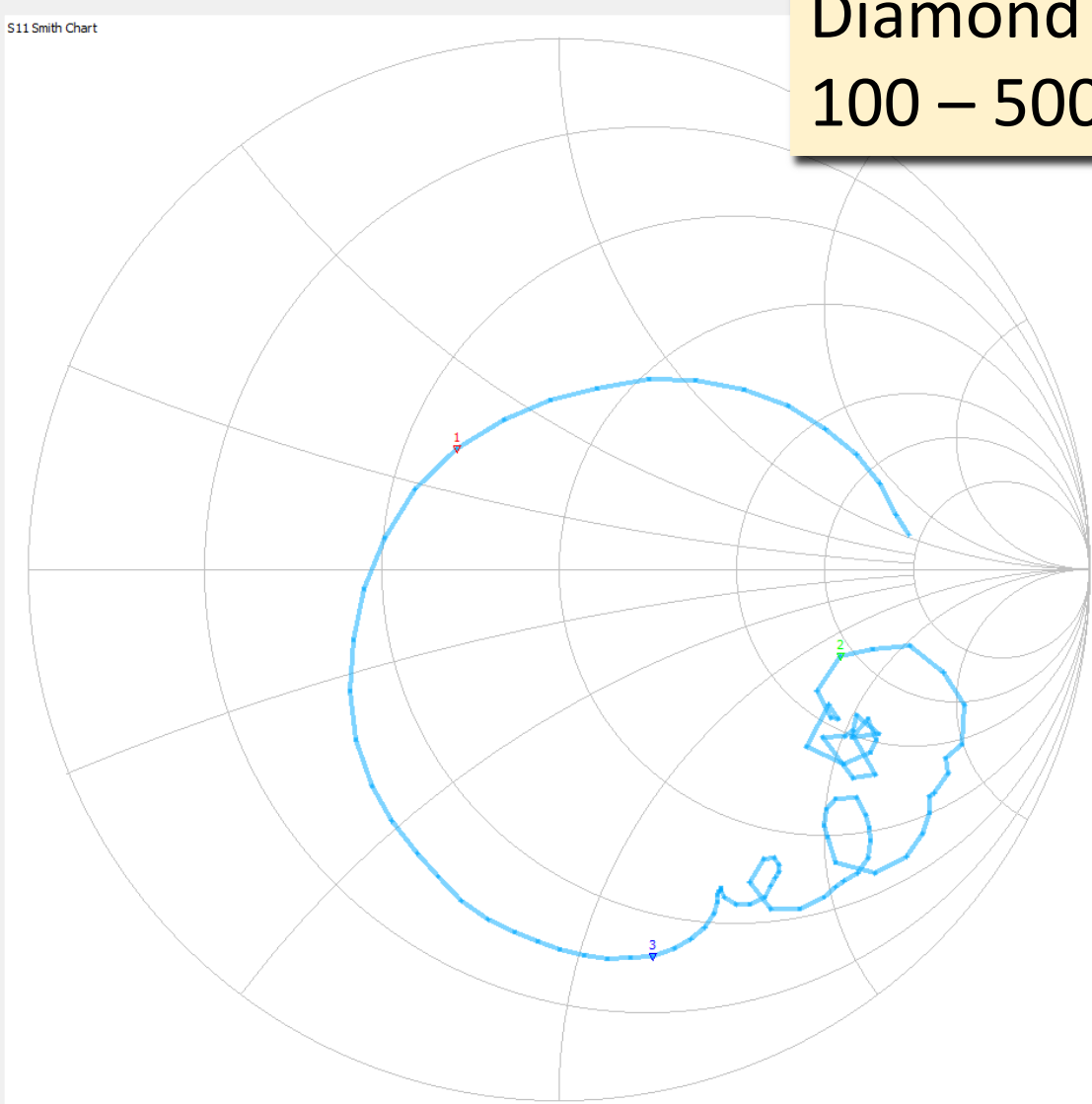
Set current as reference
Reset reference

Serial port control

COM5 (NanoVNA) | Rescan
Disconnect | Manage
Files ... | Calibration ...
Display setup ... | About ...

Analysis ...

| Marker | Frequency | VSWR | Return loss | Quality factor | S11 Phase | S21 Gain | S21 Phase |
|----------|-------------|-------|-------------|----------------|-----------|------------|-----------|
| Marker 1 | 452.000 MHz | 1.844 | -10.550 dB | 0.498 | 130.13° | -80.287 dB | 73.48° |
| Marker 2 | 172.000 MHz | 3.488 | -5.124 dB | 0.471 | -17.10° | -76.764 dB | 12.45° |
| Marker 3 | 376.000 MHz | 6.975 | -2.508 dB | 3.319 | -76.30° | -71.624 dB | 107.54° |





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FT3d Rubber Duck
100 – 500MHz

