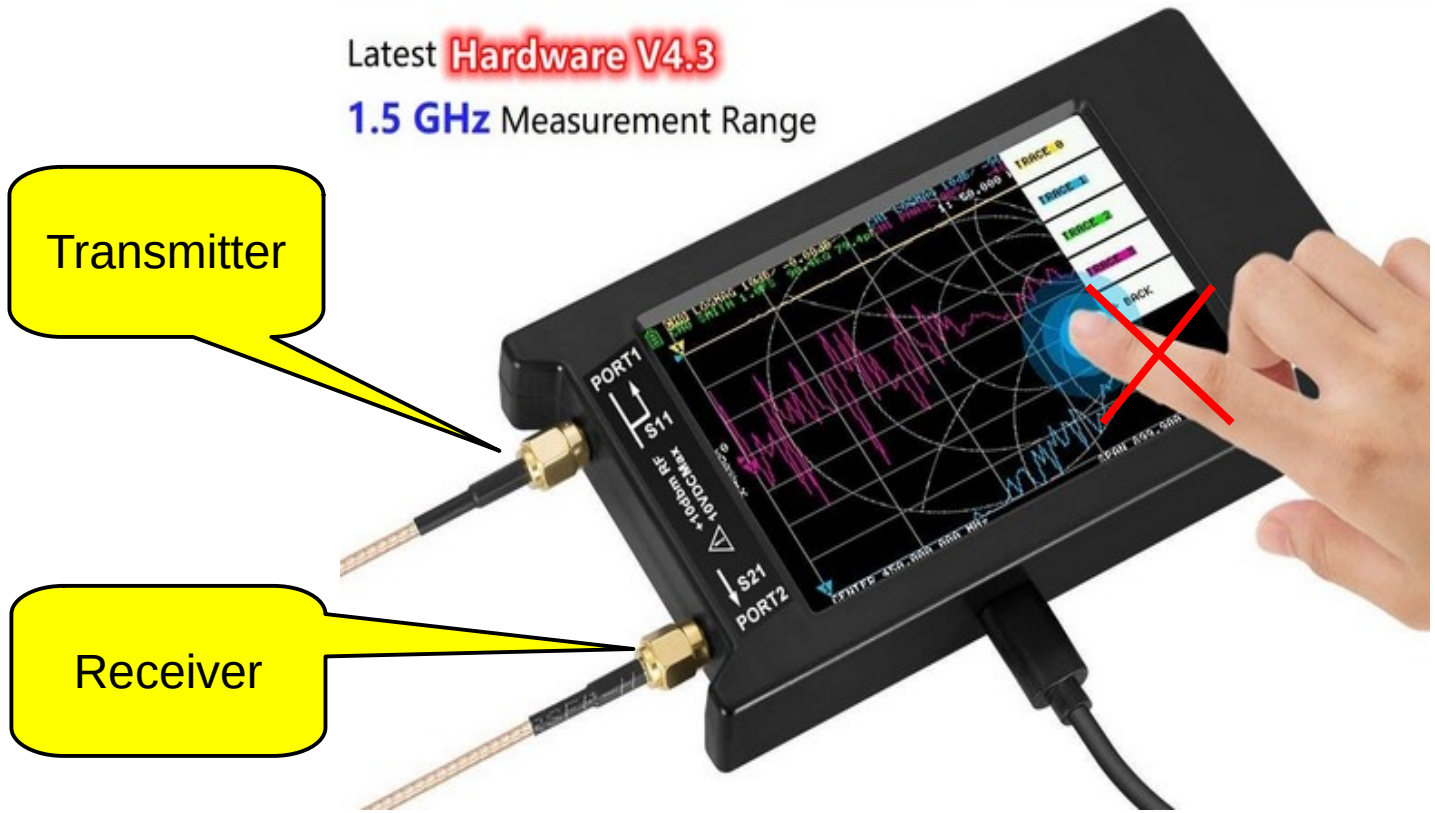
nanoVNA

What is it and how to use it?

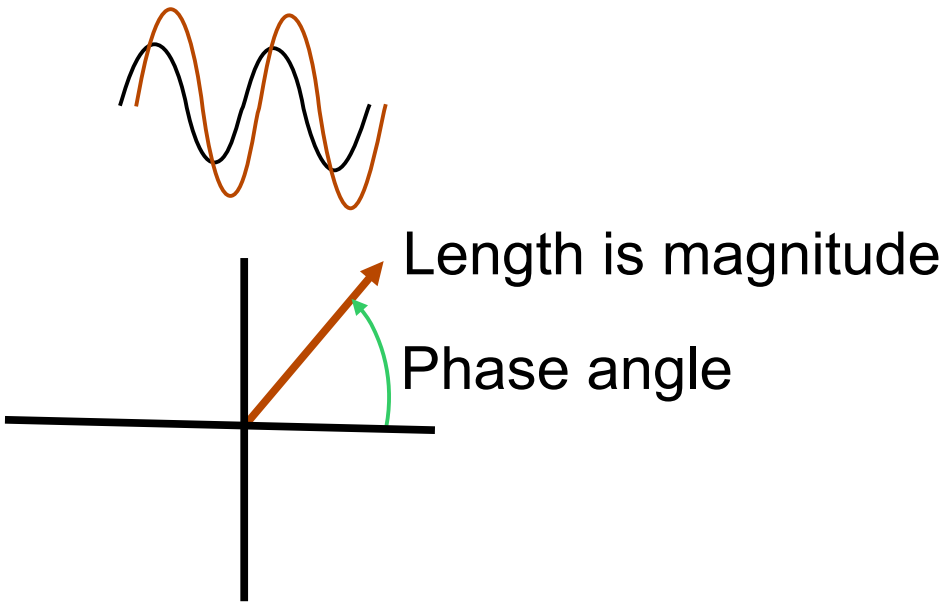


Must use guitar pick or stylus

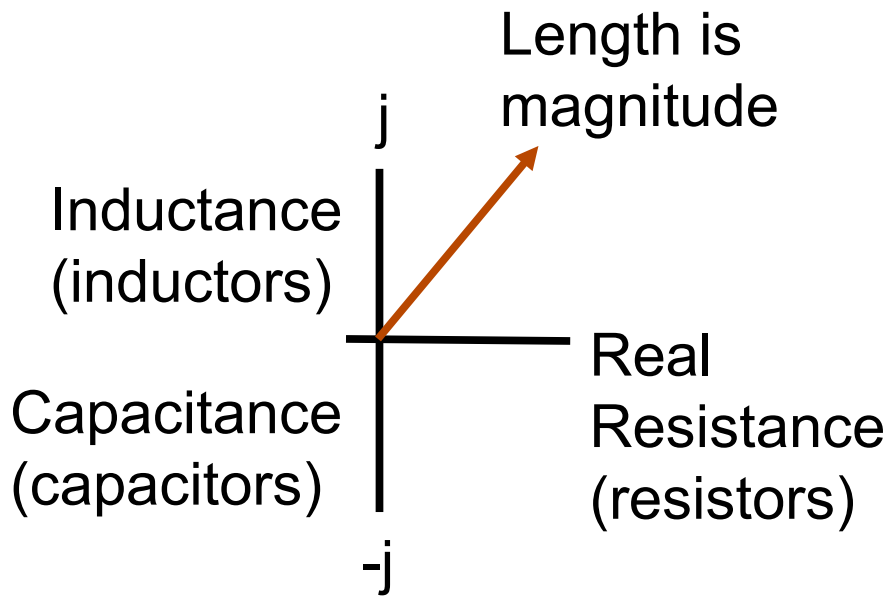
Vector Network Analyzer

- Generates a signal and measures a response (**vector**) of a DUT (Device Under Test) or **Network** and **Analyzes** the results.

Signal



Impedance



VNA Hardware

nanoVNA

Advantages
- ~$100
- Portable

Disadvantages
- Limited frequency range but fine for most ham frequencies
- Not as precise as the big boys

Professional

Advantages
- Higher frequencies
- Very accurate

Disadvantages
- >$100,000
- Not portable

Accessories

https://amazon.com/Pigtail-SMA-Coaxial-Antenna-Connector/dp/B072324FCK

SMA male

SO239

PL259

SMA male

SMA male and female

SO239 and PL259

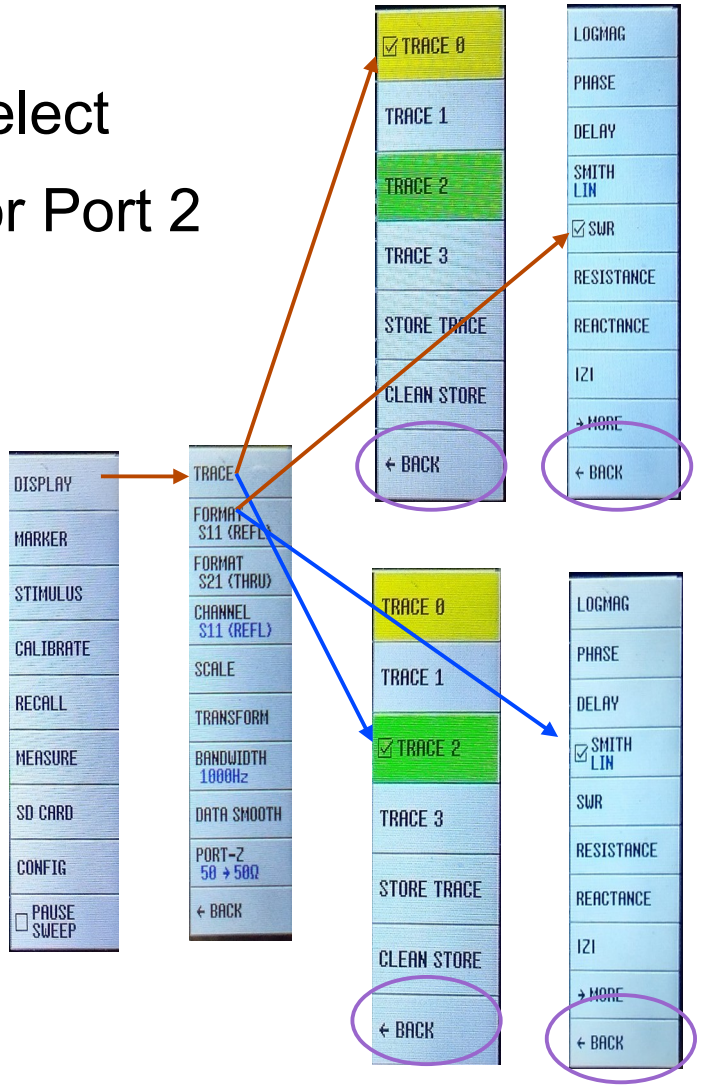
https://amazon.com/SMA-UHF-Connectors-Nickel-Plated-Converter/dp/B01MQNJVMT

nanoVNA Web Resources

- NanoVNA main page
  - https://nanovna.com/
- NanoVNA-Saver
  - Allows Windows/Linux/Mac to run the nanoVNA
    - https://nanovna.com/?page_id=90
- Firmware upgrades
  - DiSlord and Hugen are 2 versions of firmware
    - https://nanovna.com/?page_id=103
- This Presentation
  - http://af8rj.net/Delara/

Initial Setup

- CONFIG / EXPERT SETTINGS to SET DATE and SET TIME
- DISPLAY / TRACE
  - Click on TRACE 0, 1, 2 or 3 to select or deselect
  - TRACE 0 & 2 for Port 1 and TRACE 1 & 3 for Port 2
    - above are default assignments
- After selecting a trace set its format
  - DISPLAY / FORMAT
  - Typical SWR for TRACE 0,
    SMITH for TRACE 2
- Set frequency range with STIMULUS
  - START and STOP
  - CENTER and SPAN
  - CW FREQ (single freq)

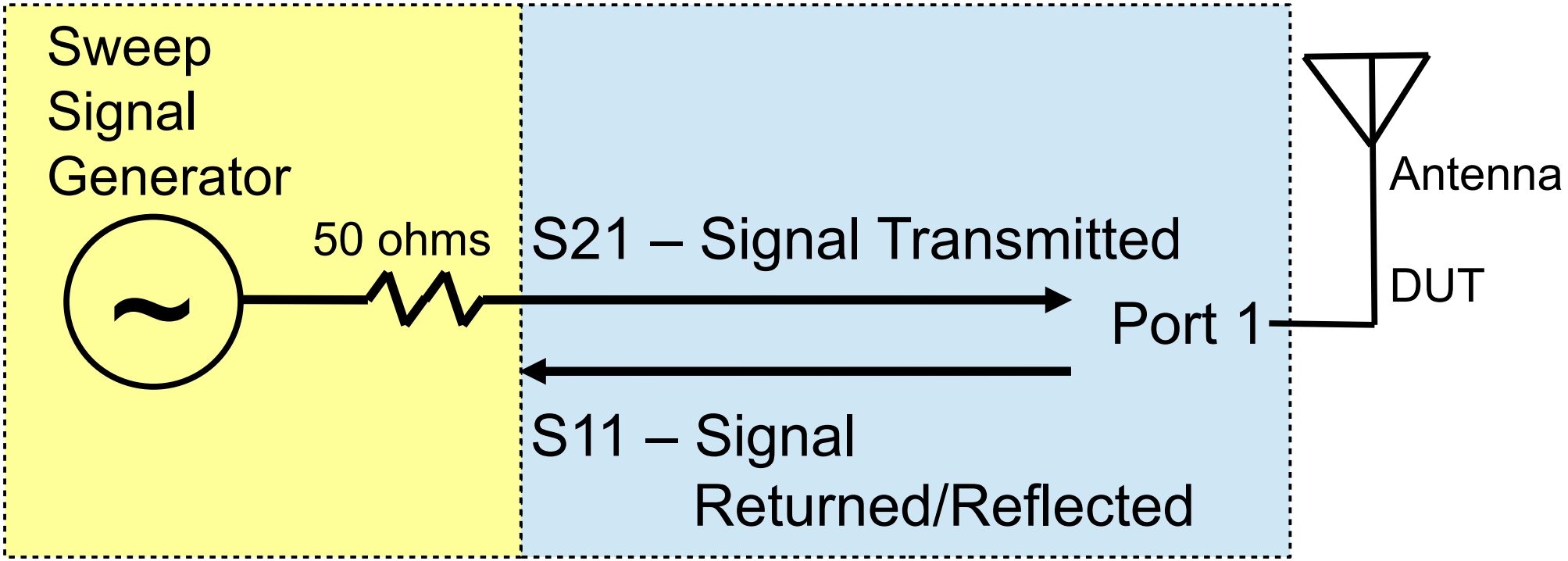


Calibration

OPEN LOAD (50 ohm) SHORT

- Click on RECALL and either select an option or see which one you want save your calibration to.
- Set your stimulus and display options
- Click on CALIBRATE
- Connect OPEN standard to Port 1 (click OPEN, wait to go to next)
- Connect SHORT standard to Port 1 (click SHORT, wait to go to next)
- Connect the LOAD standard (50 ohm) to the Port 1 (click LOAD, wait to go to next)
- If not using Port 2 you can go to DONE
- Connect the LOAD standard to Port 2 (click ISOLN, wait to go to next)
  - *Connect a second LOAD to Port 1 if you have it. (doesn't come with device)*
- Connect Port 1 to Port 2 with test rig cable (click THRU, wait to go to next)
- Click DONE
- Save to one of the calibration slots (0-5). They can be RECALL'd later.

Port 1 Measurements - VSWR

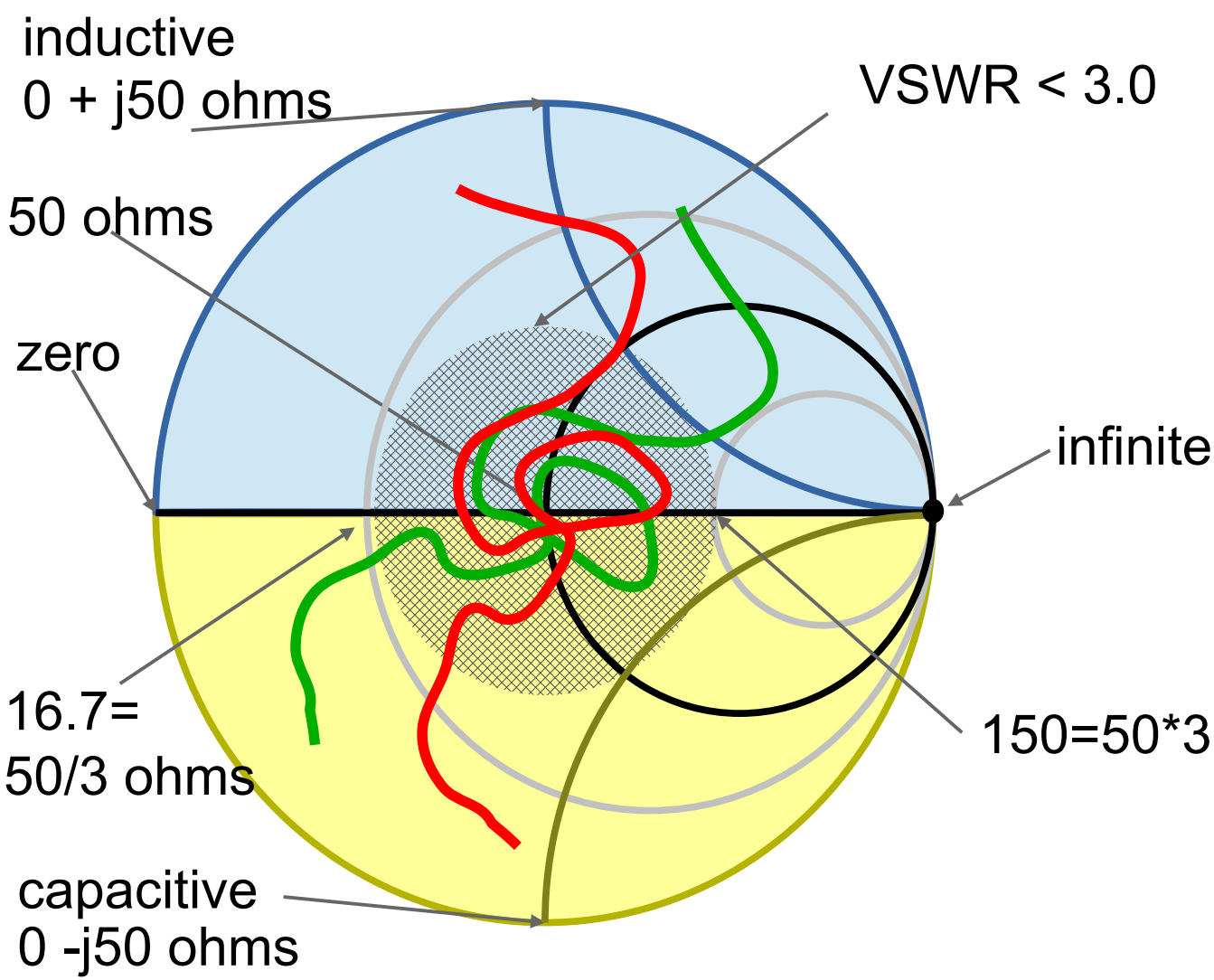


VSWR = (1 + |S11|) / (1 – |S11|)

S parameters are relative to input signal

Port 1 Measurement - Impedance

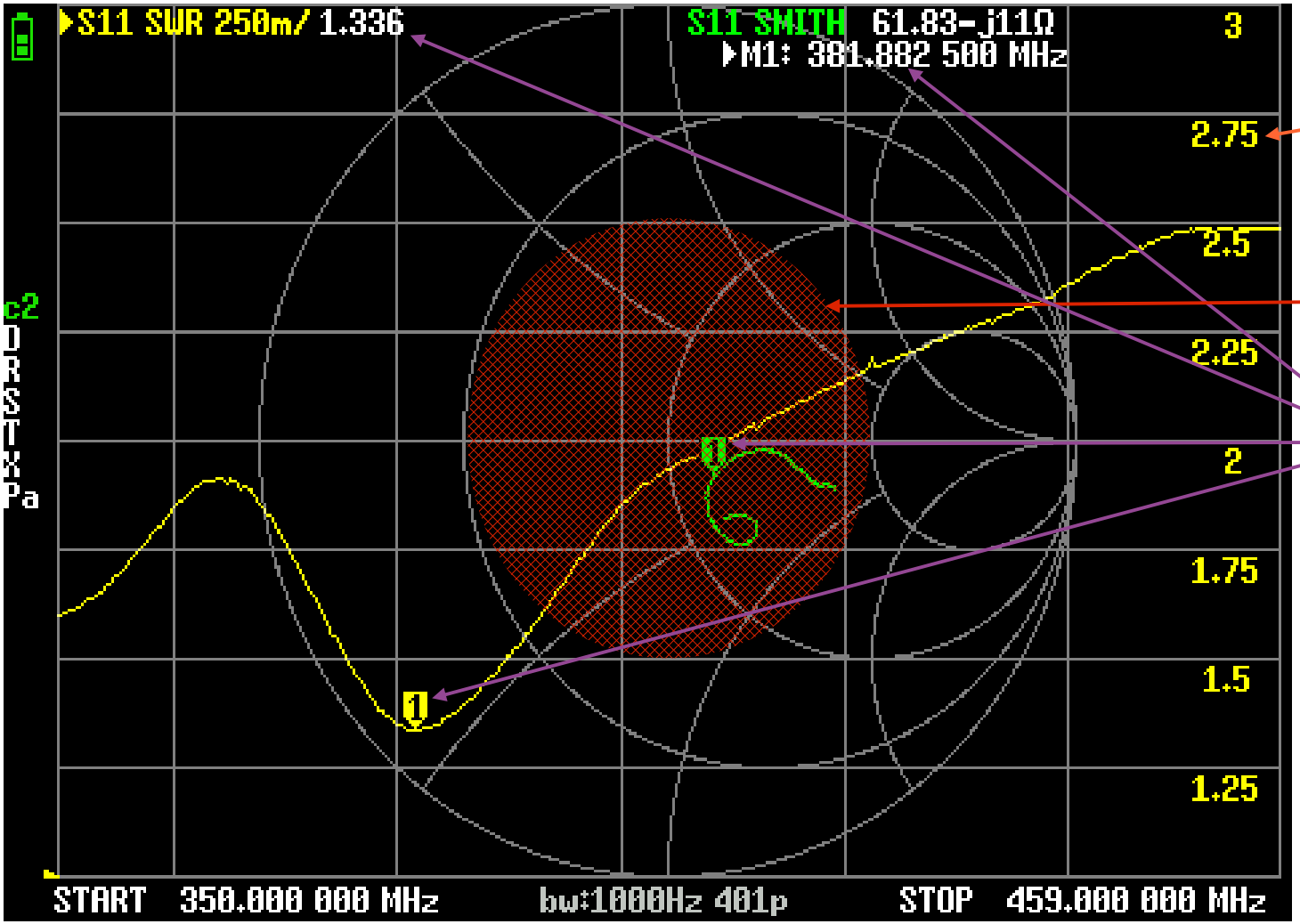
Shown with Smith Chart which uses S21 to calculate



Good News!

Top of the display shows the impedance at marker!

Port 1 Measurements - Screen



DISPLAY / SCALE to show values

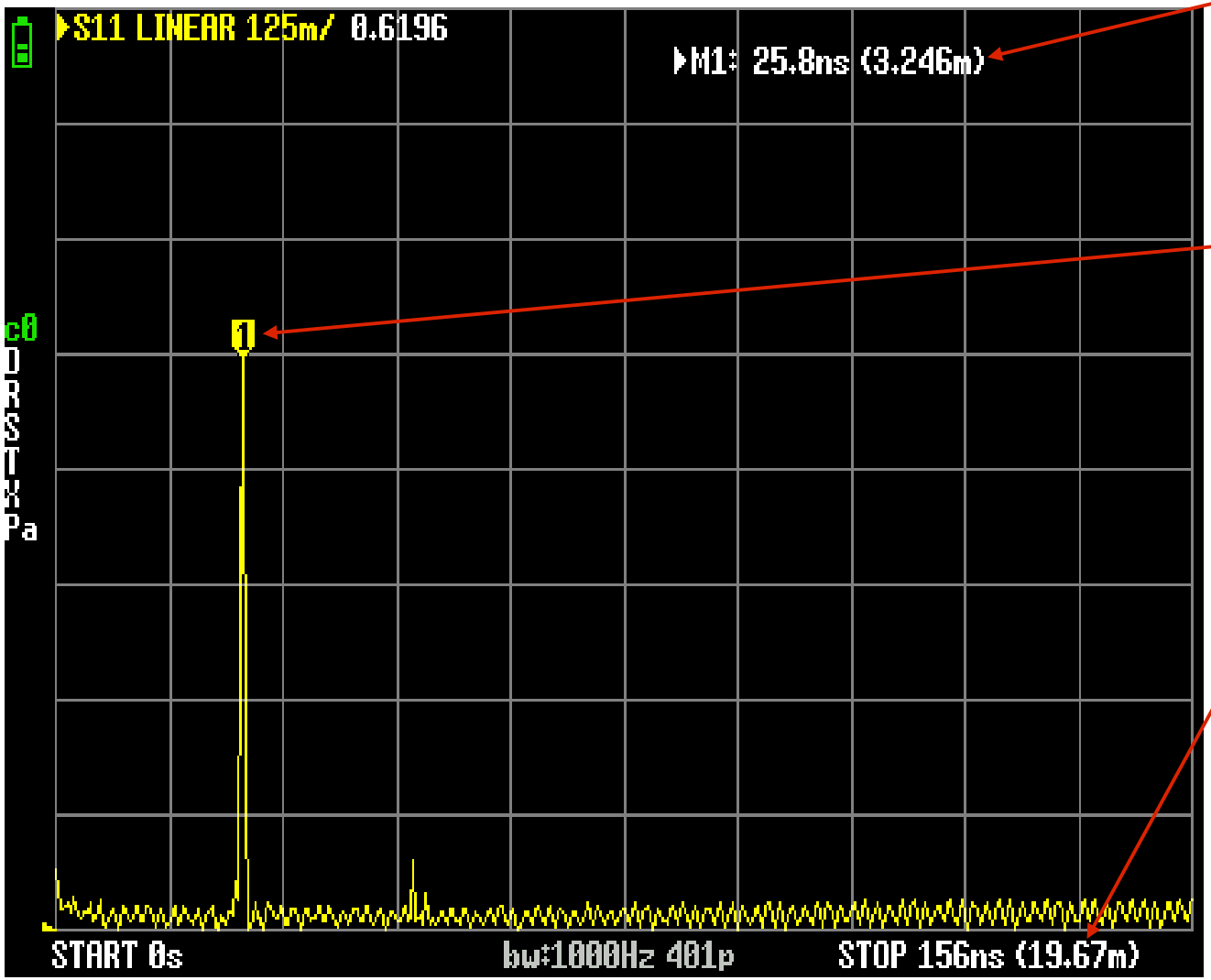
VSWR < 3.0

Marker

Port 1 Cable Length

- Display/Trace: Trace 0 only, set to Linear or Real
- Display/Transform: On, low pass impulse
  - Set Stimulus/Start to 50kHz
  - Set Stimulus/Stop to for maximum **electrical length** of (approximately):
    - 1GHz for 75ft, 500MHz for 150ft, 250MHz of 300ft, etc.
  - Velocity factor of cable you are using.
    - Approximate values of common cables:
    - RG-8 = 75%, RG-58 = 66%, RG-8X = 84%, LMR-400 = 85%
    - Actual length is “electrical length” x “velocity factor”
- Peak is the cable length *(or imperfection/break in cable)*
  - Actual length is shown at top of display in meters, velocity factor is correct

Port 1 Cable Length Screen



Length in meters
3.246m = 10' 8”
cable was:
10' with 7” adapter

Set Marker at peak

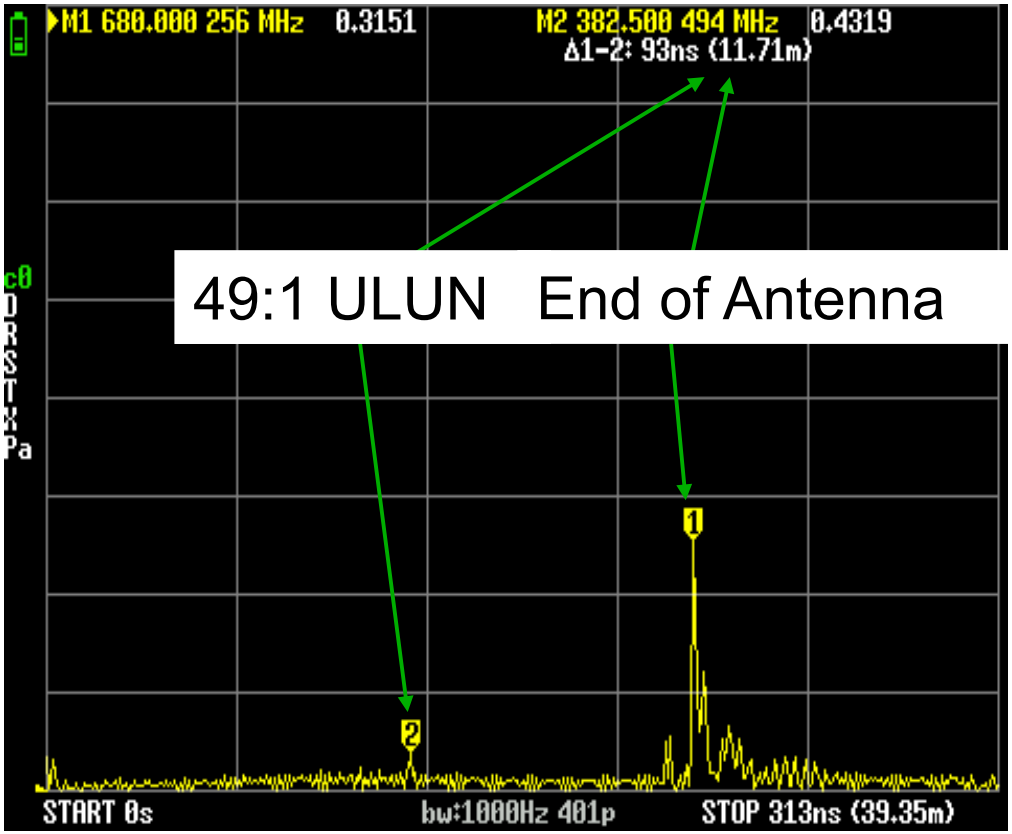
Maximum length in meters that it can measure

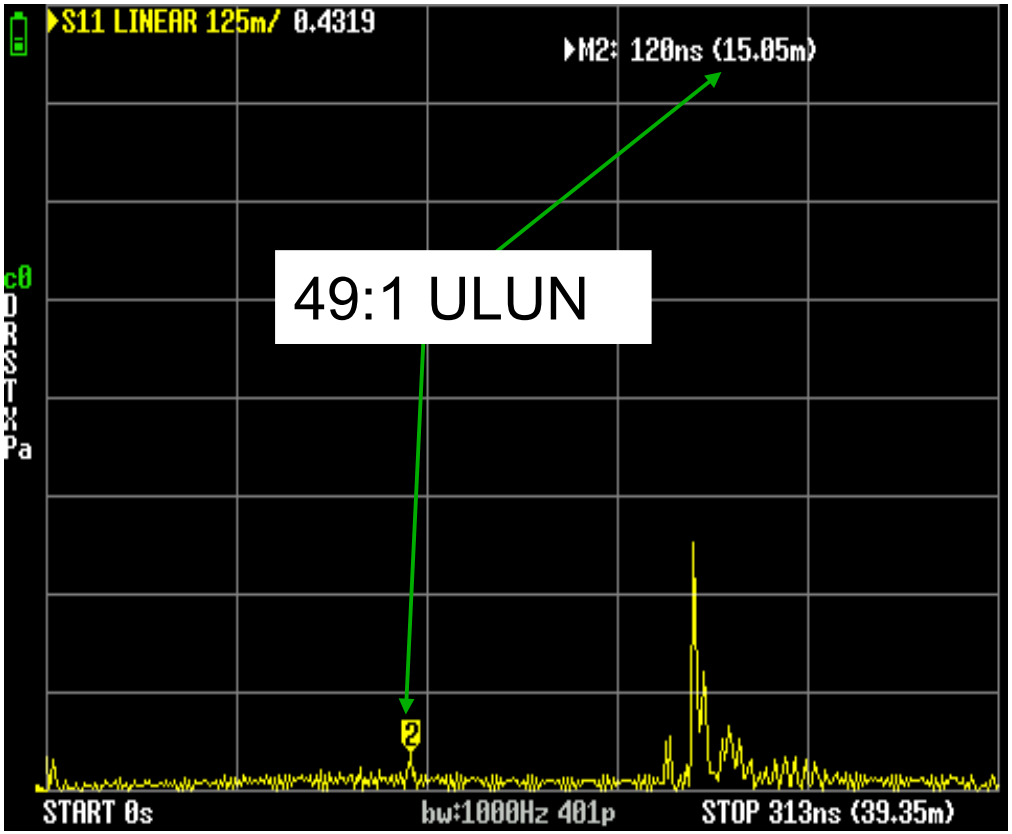
STOP = 1 GHz
Velocity Factor = 84%

Port 1 Cable Length Screen

Use of multiple markers to calculate differences.

Cable issues can be found.



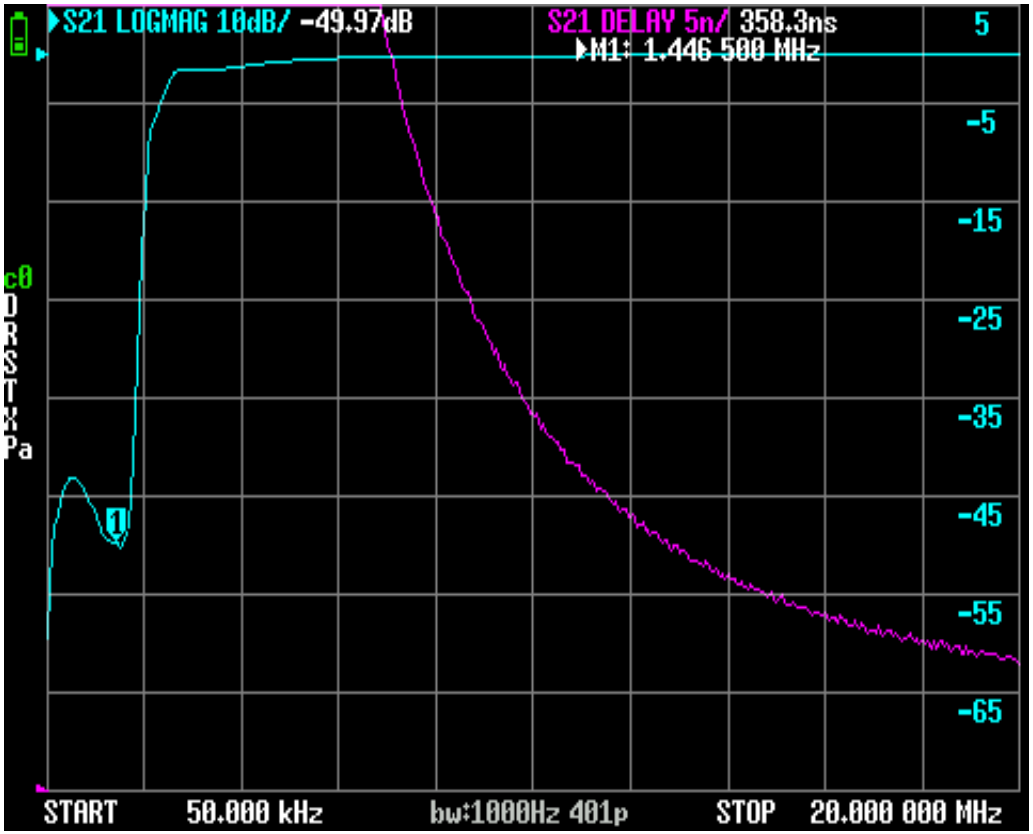


Port 1 and 2 Measurements - Filters

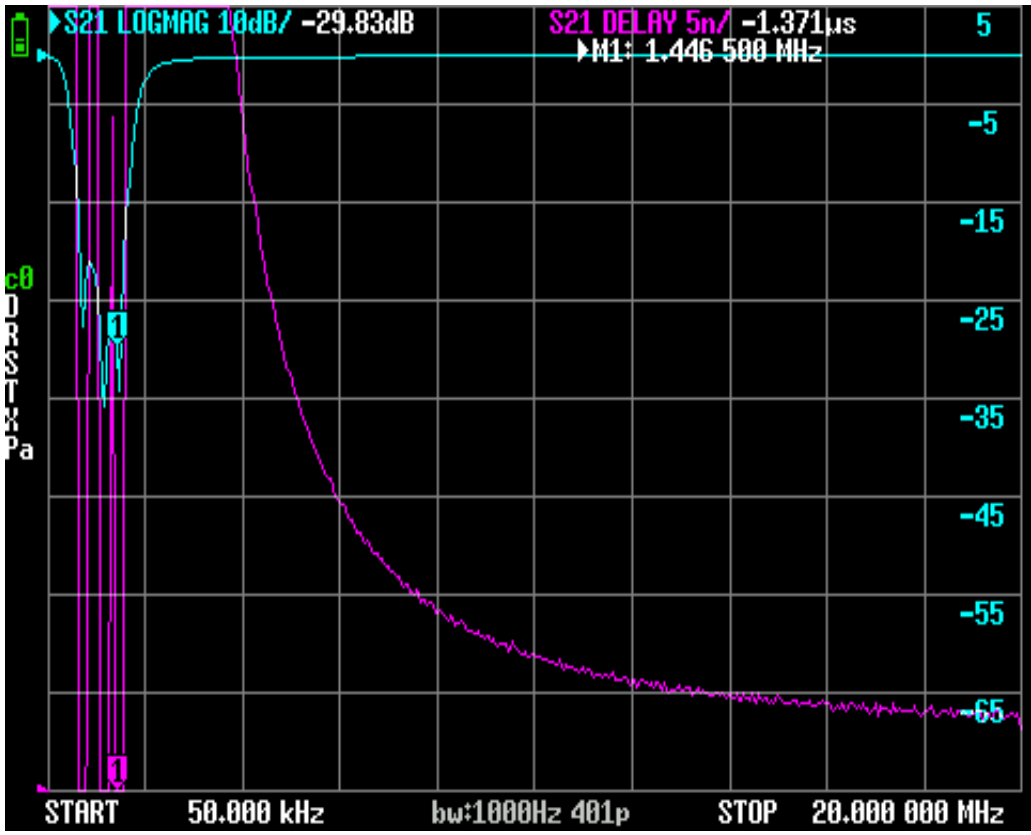
- Optionally turn off Trace 0 and 2
- Turn on Trace 1
  - S21 (Thru) Logmag
- Turn on Trace 3
  - S21 (Thru) Delay of Phase
- Set Stimulus to desired range

Comparing Filters

RTL-SDR
2.6MHz High Pass

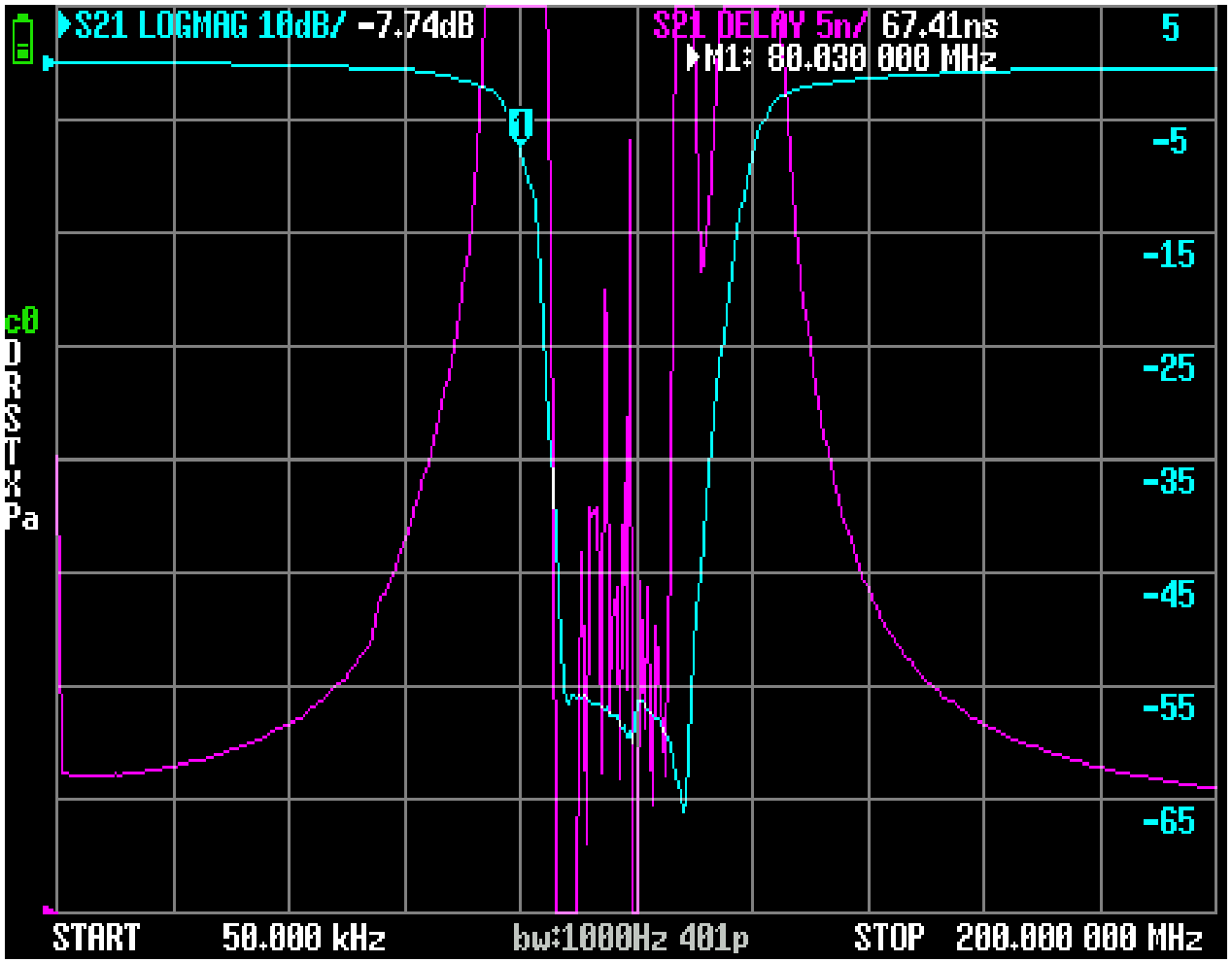


NooElec.com
for AM rejection

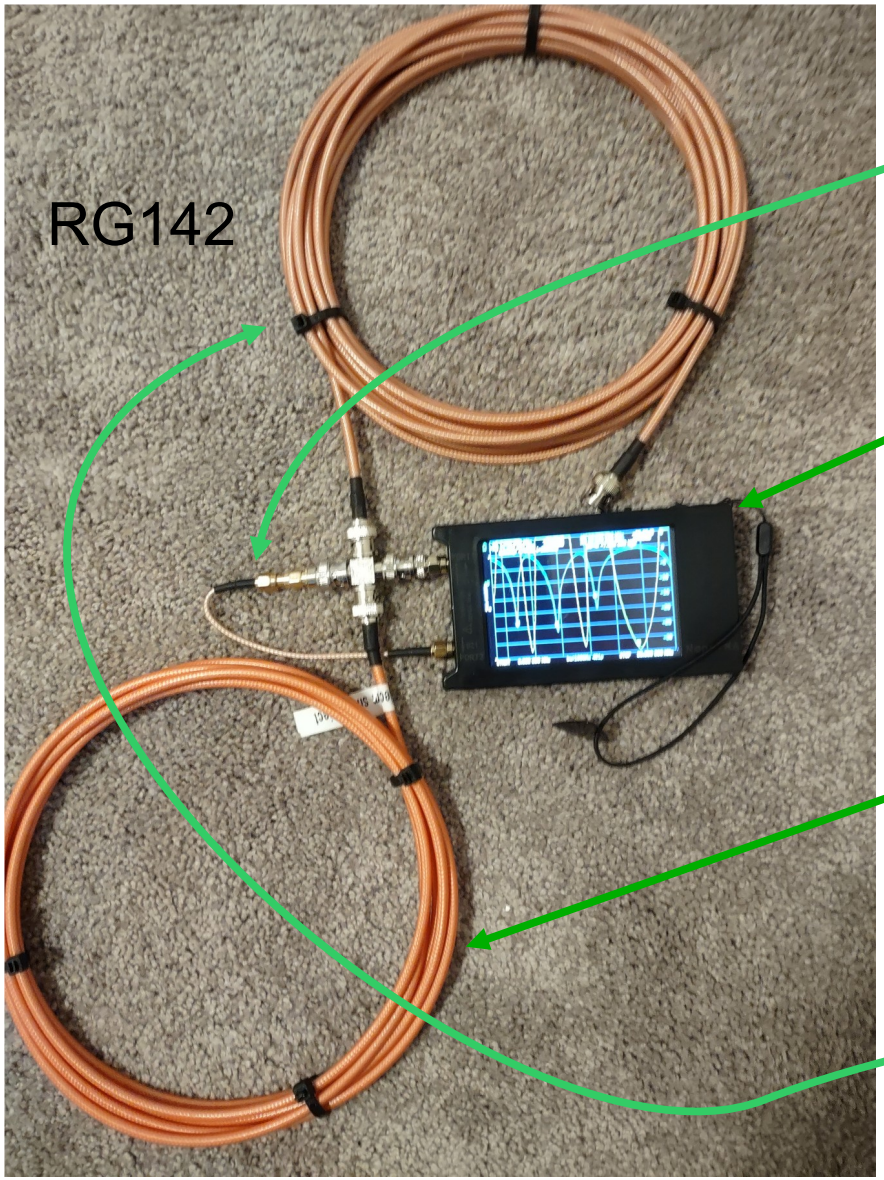


Notch Filter for FM

RTL-SDR
88-108 MHz Bandstop



Coax Trap using 1/4 Wave Stubs



Antenna

10m Example

Transceiver

~11' 6"
traps 20m

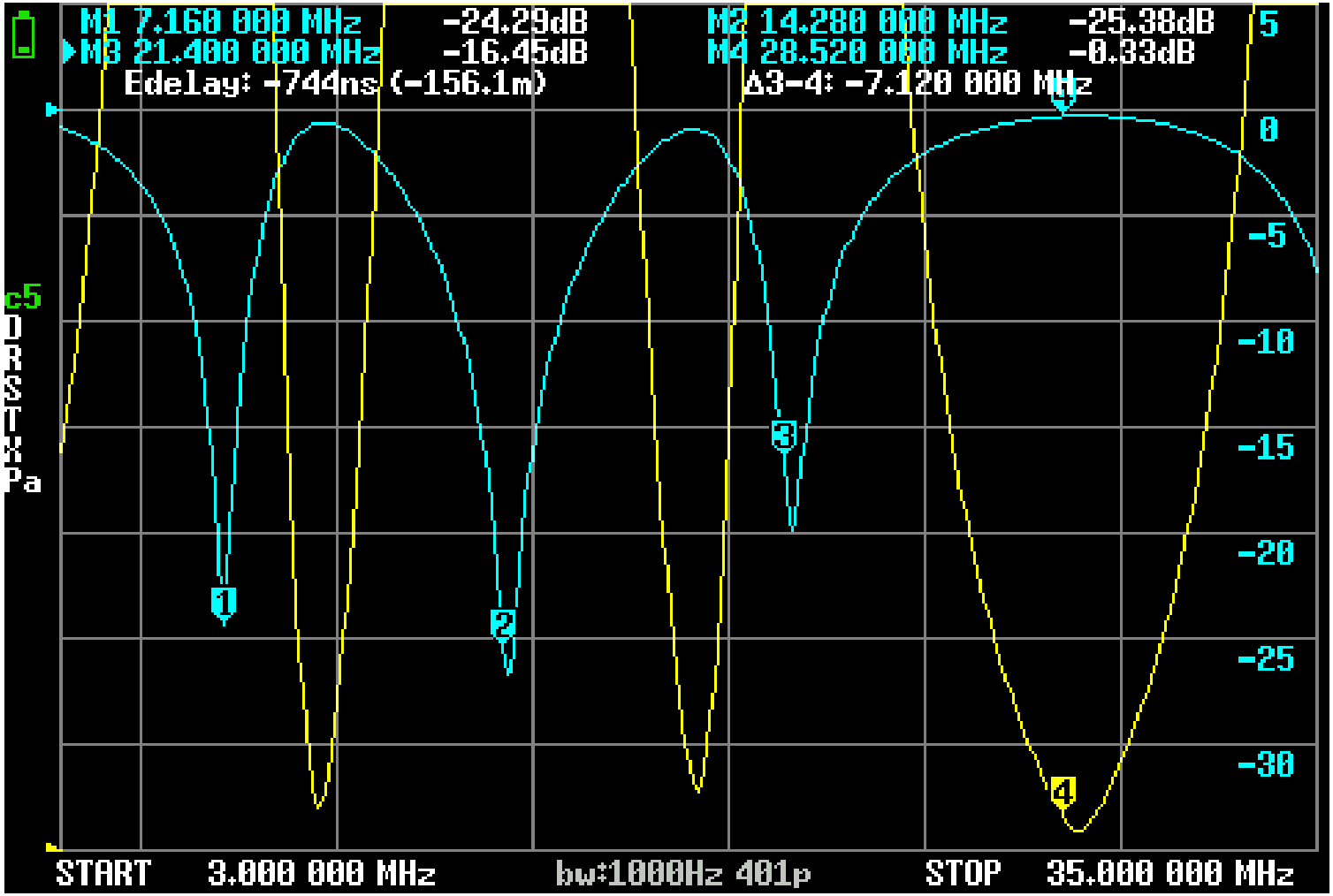
open

~23'
traps 40m & 15m

open

http://www.k1ttt.net/technote/k2trstub.html

Results of coax trap



Explore and Enjoy

More Trap Designs