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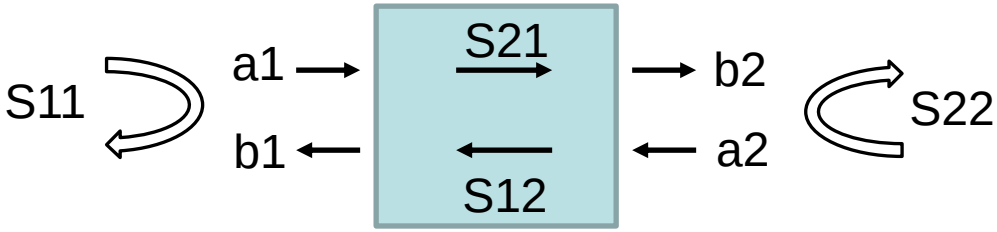
Nano VNA V2 Plus 4

W5LUA

May 1, 2021

S Parameters



S21 = b2/a1
S12 = b1/a2
S11 = b1/a1
S22 = b2/a2

- Scalar network analyzer
  amplitude only – measure gain (loss) & return loss (VSWR)
- Vector network analyzer
  amplitude and phase – allows additional data including insertion phase & Smith Chart representation of devices

Nano VNA V2 Plus 4 compared to Nano VNA V2

Differences in Red

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- Frequency range: **50kHz - 4GHz 50 kHz – 3 GHz**
- System dynamic range: **70dB** (up to 3GHz, calibrated, no averaging)
- System dynamic range: **80dB** (up to 3GHz, calibrated, 5x averaging)
- System dynamic range: **90dB** (up to 1GHz, calibrated, 20x averaging)
- S11 noise floor (calibrated): **-50dB (up to 1.5GHz), -40dB (up to 3GHz)**
- Sweep rate: **400 points/s 200 points/s (140MHz and above) 100 points/s (below 140 MHz)**
- Display: **4", 480 x 320 2.8”, 320 x 240**
- USB interface: **USB Type-B Micro USB**
- Power: **USB**
- Battery: 3000mAh 18650 lithium battery (included if DHL shipping is selected) lithium-ion battery 6 x 40 x 60 mm maximum
- Maximum sweep points (on device): **201**
- Maximum sweep points (USB): **1024**
- Port 2 return loss (1.5GHz): **20dB typ**
- Port 2 return loss (3GHz): **15dB min**, 17dB typ 13 dB min
- VNA-QT software supported platforms: **Linux, Windows (7+), Mac OS**

https://www.tindie.com/products/hcxqsgroup/4-nanovna-v2-plus4/ed

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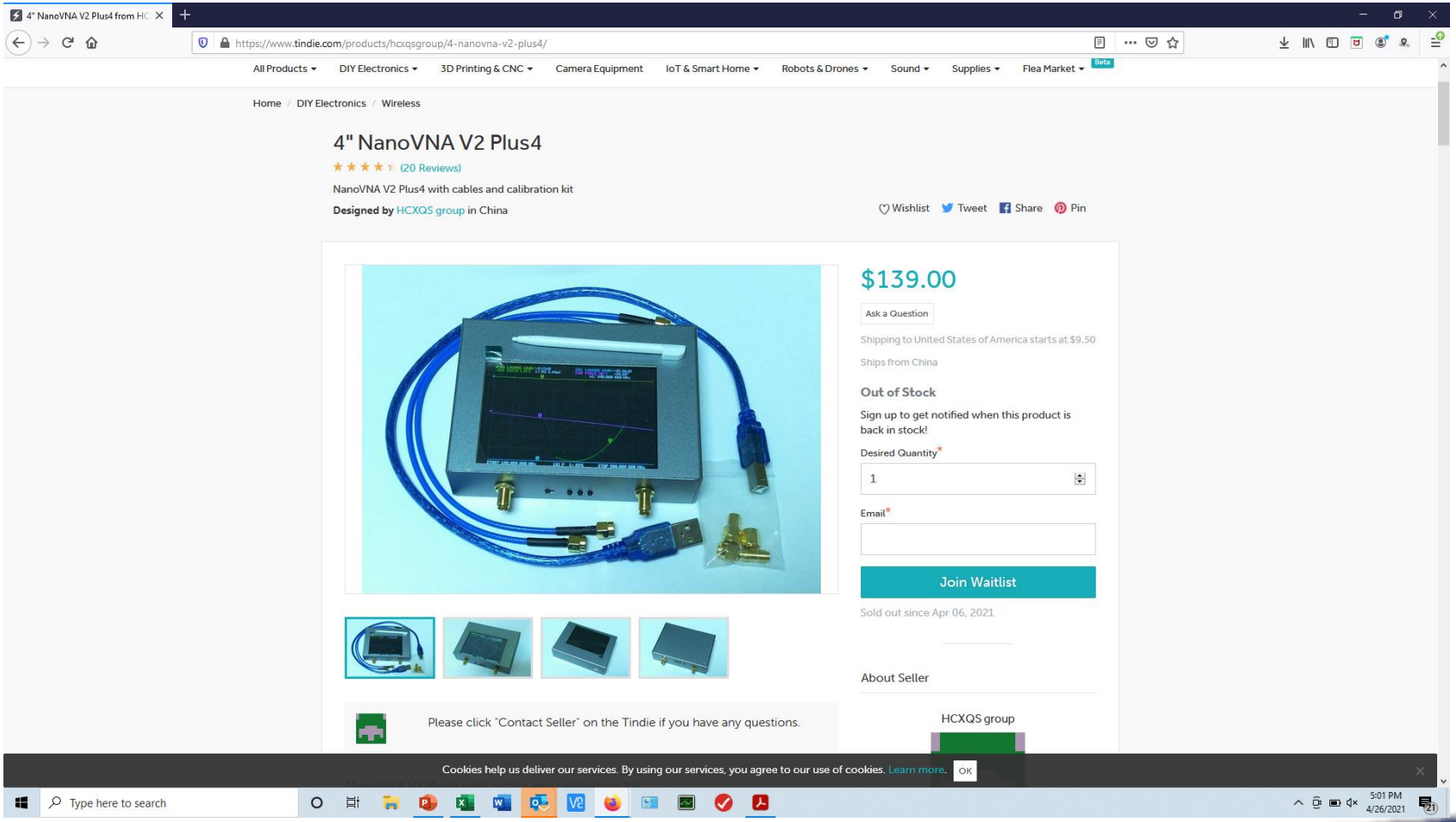
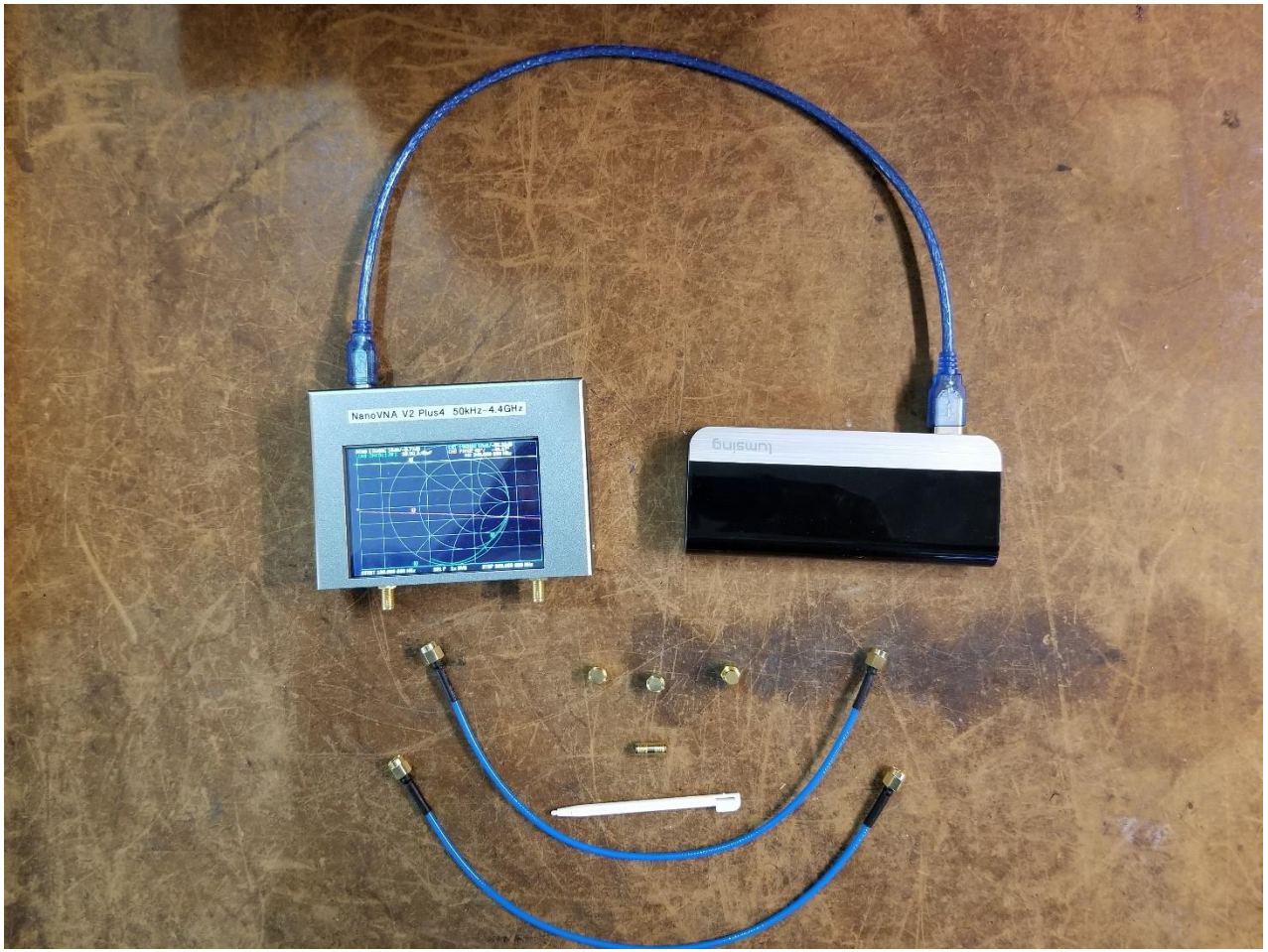


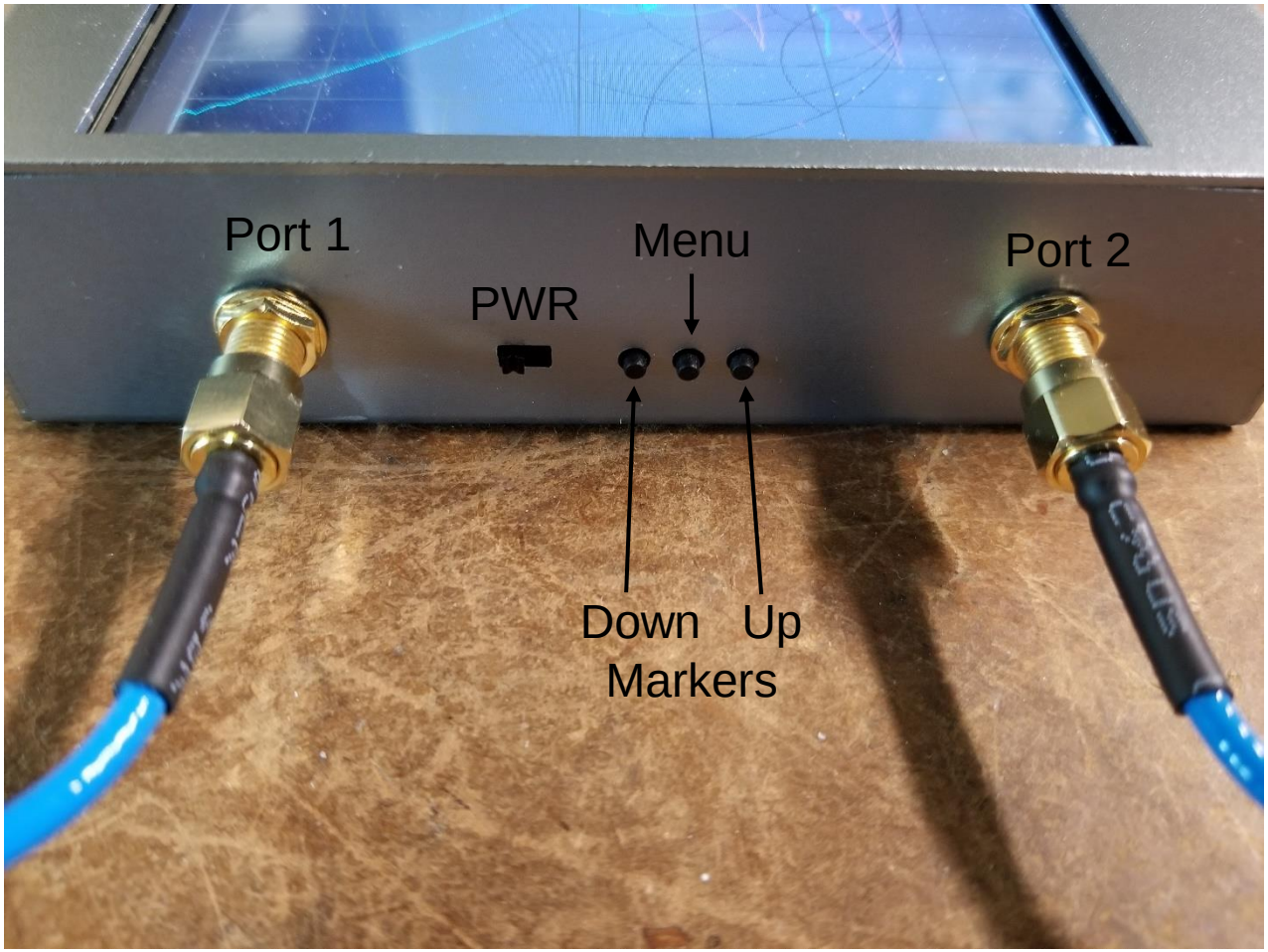
My setup



Mine did not come with the 18650 battery so I used an external charging pack

18650 3500mAh Lithium-Ion batteries cost $15 to $17

Side View



Making a Thru Measurement

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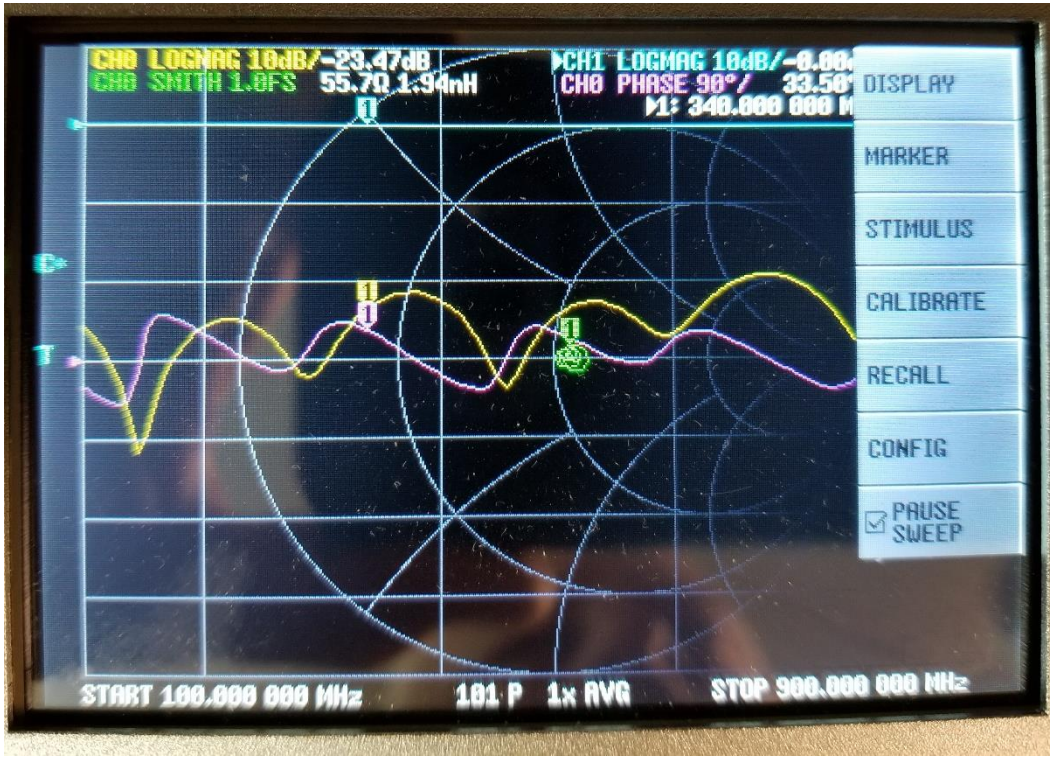
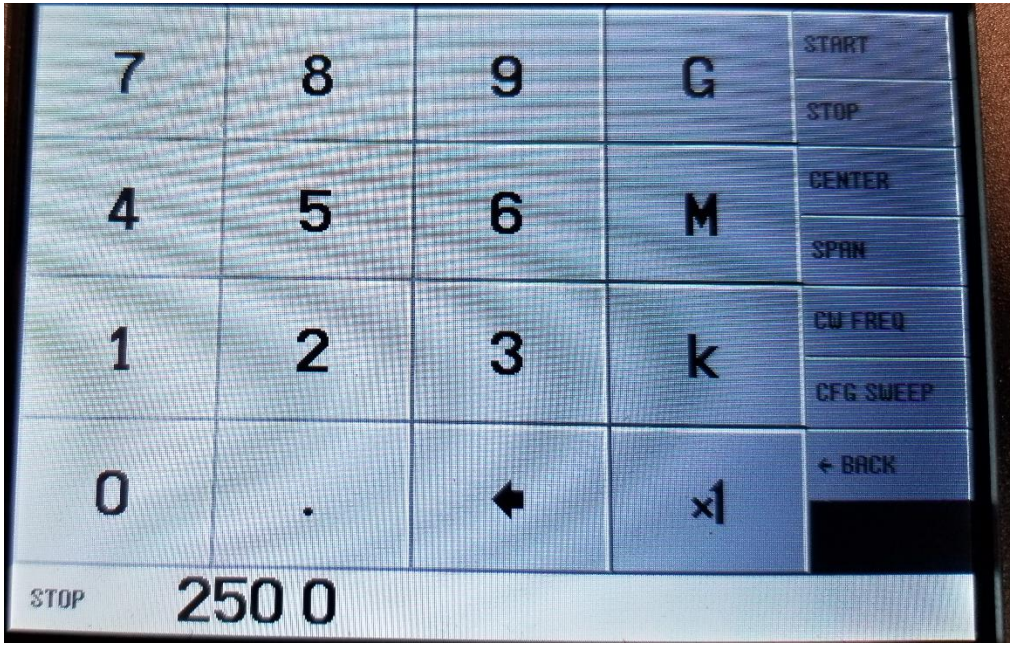


Out of the box, it is set up for 100 to 900 MHz
Still needs to be calibrated

Frequency Entry Screen



Frequency options available under STIMULUS options in menu

Open, Short, Load & Thru Calibration

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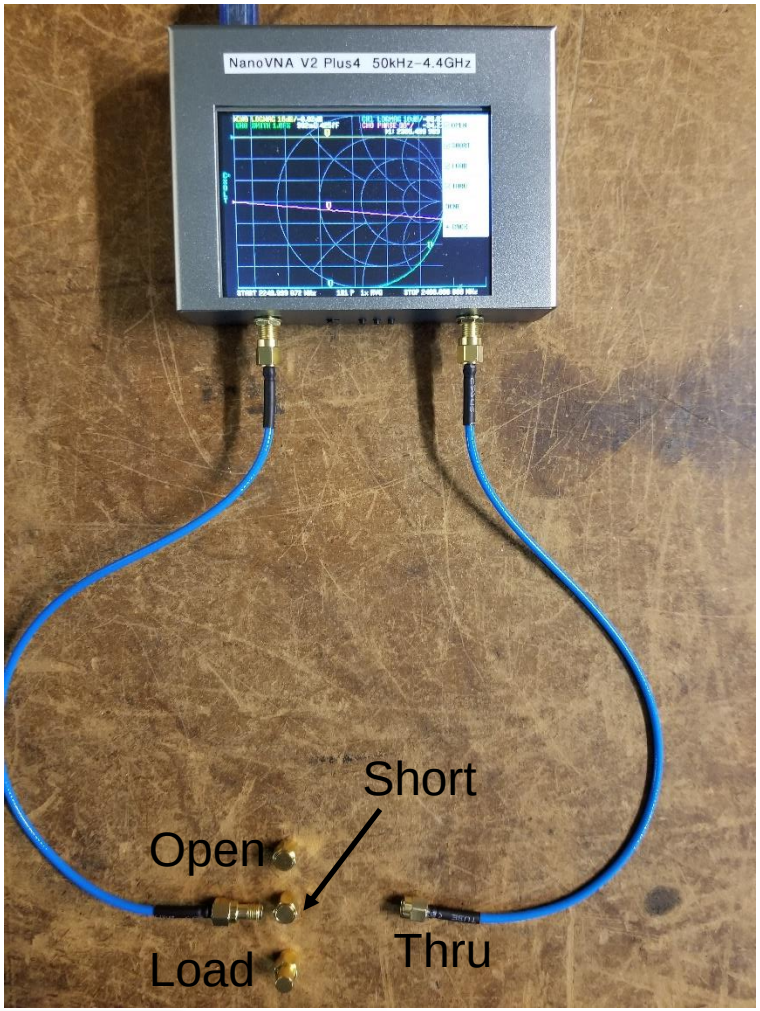

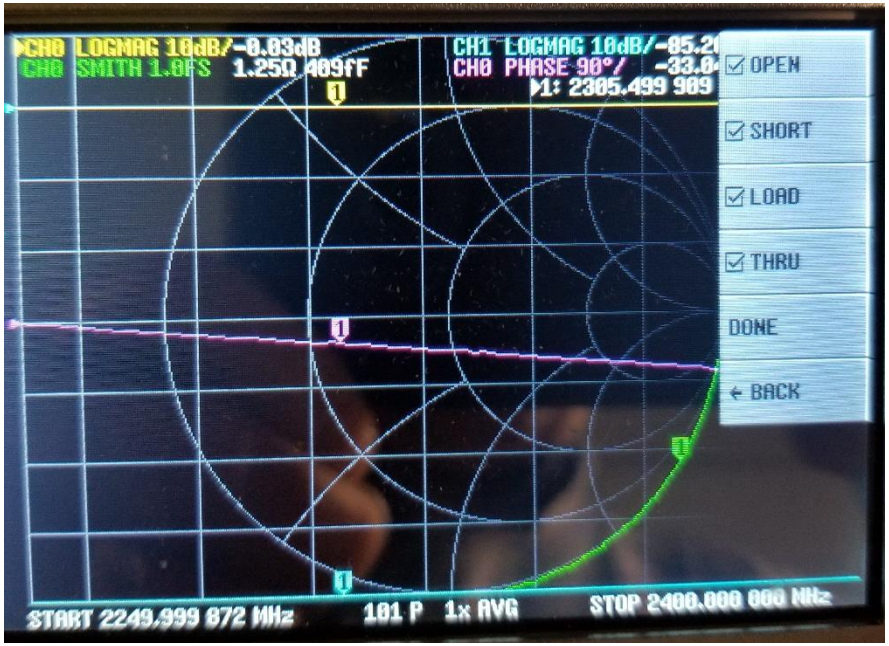

2304 MHz Filter Test

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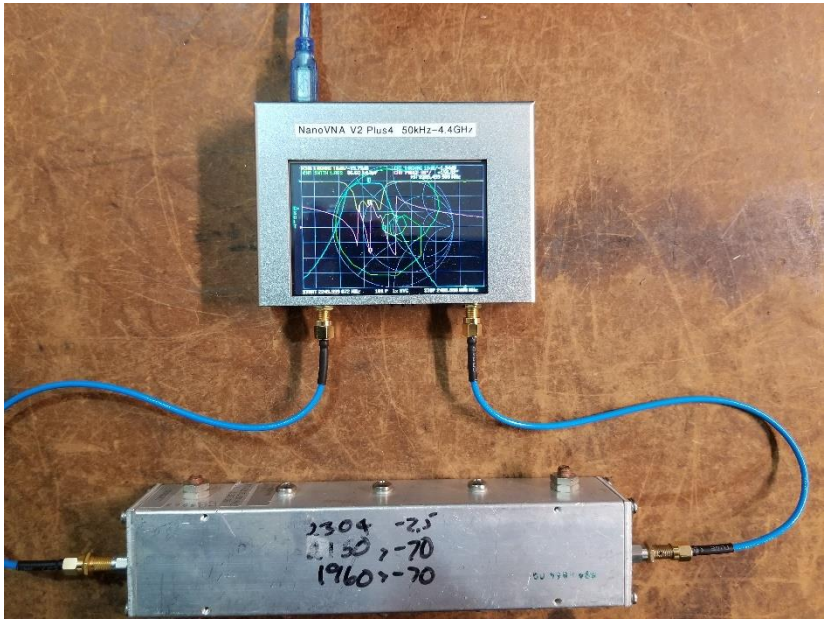

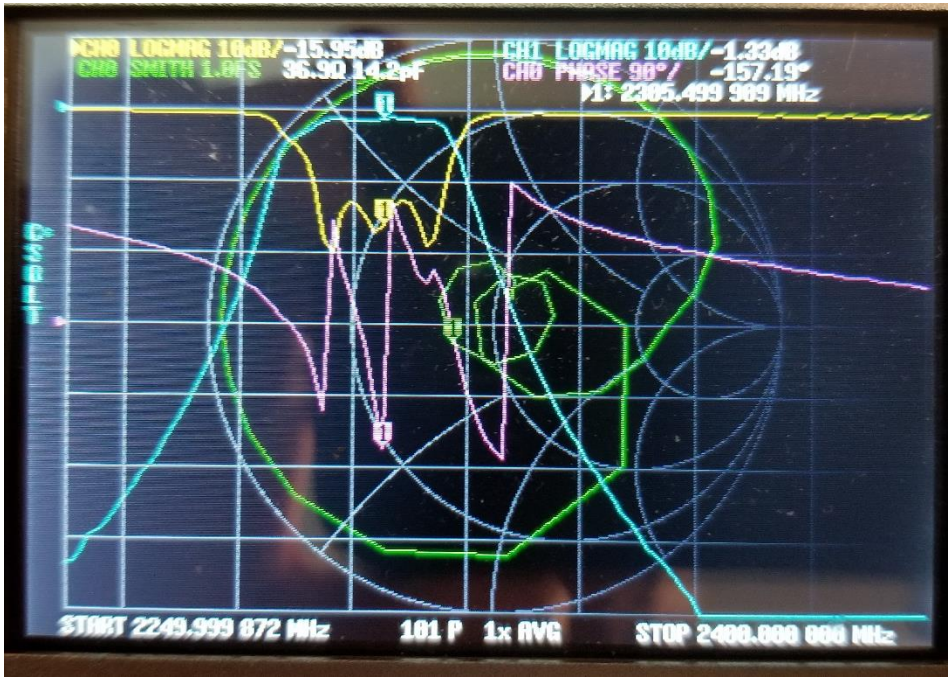

Performed Open, Short, Load and Thru calibration

Blue S21 Loss
Yellow S11 Return Loss
Green Smith Chart
Purple Insertion Phase

CW Frequency Mode

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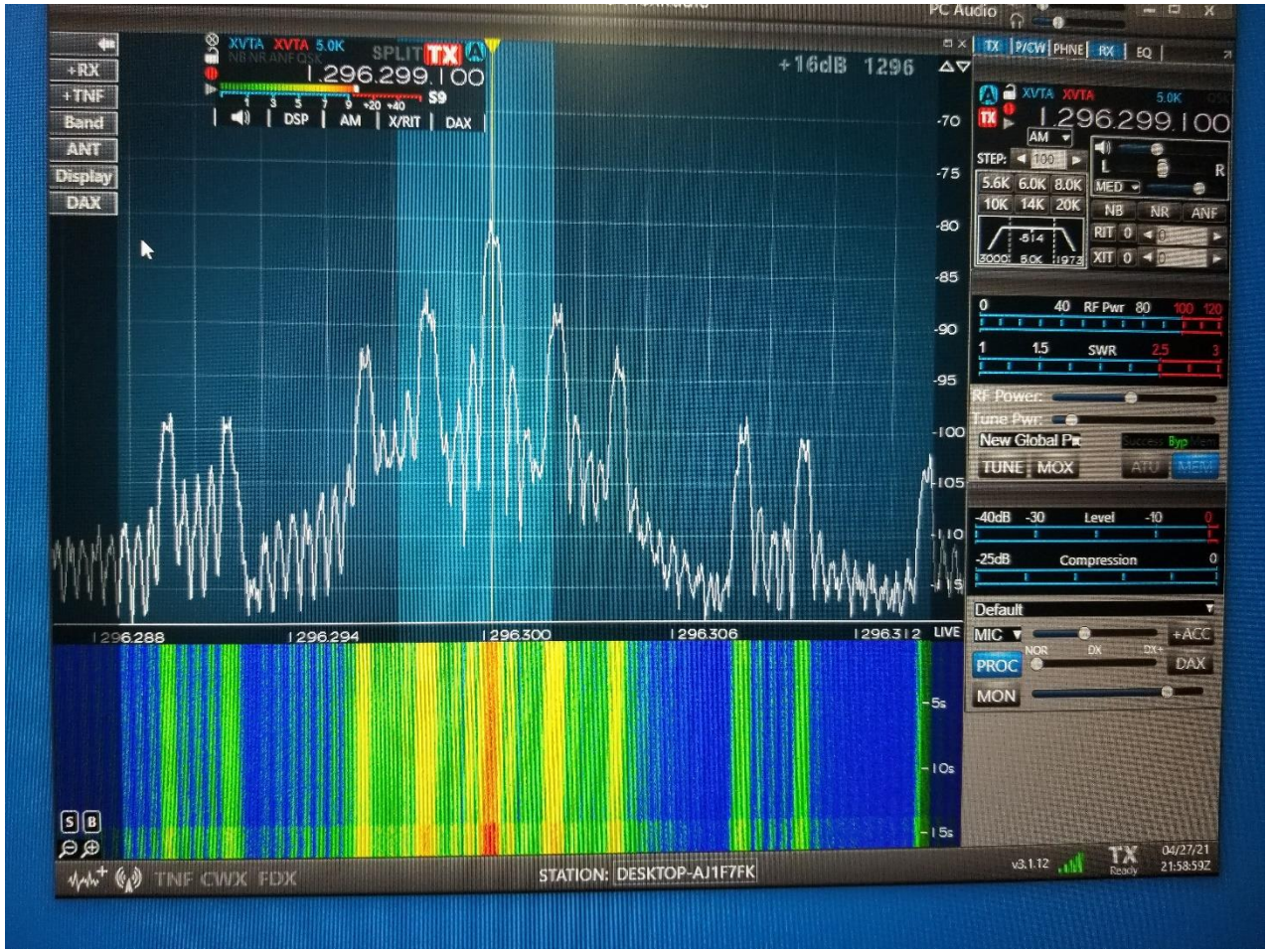

Signal available at Port 1

2 kHz amplitude modulation

~ 900 Hz frequency error

Power @1296 MHz = -11.6 dBm

Measuring Low Level Amplifiers, 10 mW or less

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Freq	Power @ port 1
50 kHz	-25.3 dBm
100 kHz	-22.6 dBm
1 MHz	-12 dBm
10 MHz	-9.3 dBm
100 MHz	-10 dBm
1 GHz	-10.8 dBm
2 GHz	-13.7 dBm
3 GHz	-15.4 dBm
4 GHz	-16.8 dBm
4.4 GHz	-17.3 dBm

This could be dangerous! The Nano VNA at port 2 has a AD8342 mixer preceded by a pi attenuator of unknown attenuation.

According to the AD8342 data sheet, the input P1dB is +8 dBm at 460 MHz and Pmax is +12 dBm

I suggest putting in a 20 dB attenuator at port 1 to limit Amp DUT input level to -30 dBm or less. Then use a 10 dB attenuator on Port 2 and perform a thru calibration. Then apply offset to reference.

To verify power incident to the NanoVNA from the amplifier, first use a well calibrated microwave power meter!

We don't want to drive the AMP DUT to compression and we do not want to blow up our VNA

Calibrating System

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Thru Calibration

To Port 1

To Port 2

20 dB Attenuator

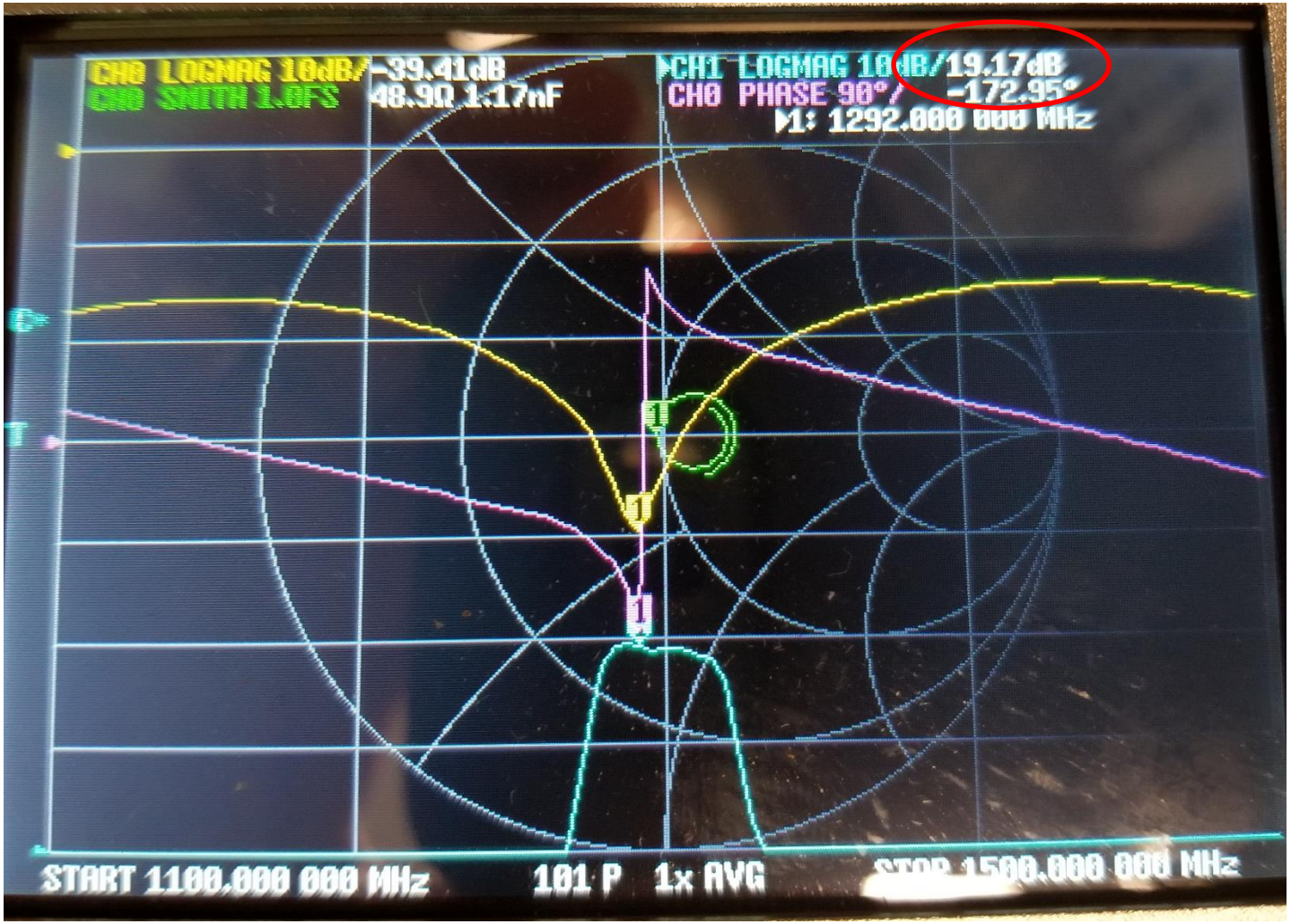
10 dB Attenuator

Amp DUT

To Port 1

To Port 2

DEMI L 1296 LNA



I had some difficulty in getting the “Reference Position” correct so the response would be on the screen.

More practice required here.

With some care it is possible to safely measure low level amplifiers with the NanoVNA

Operation from a PC

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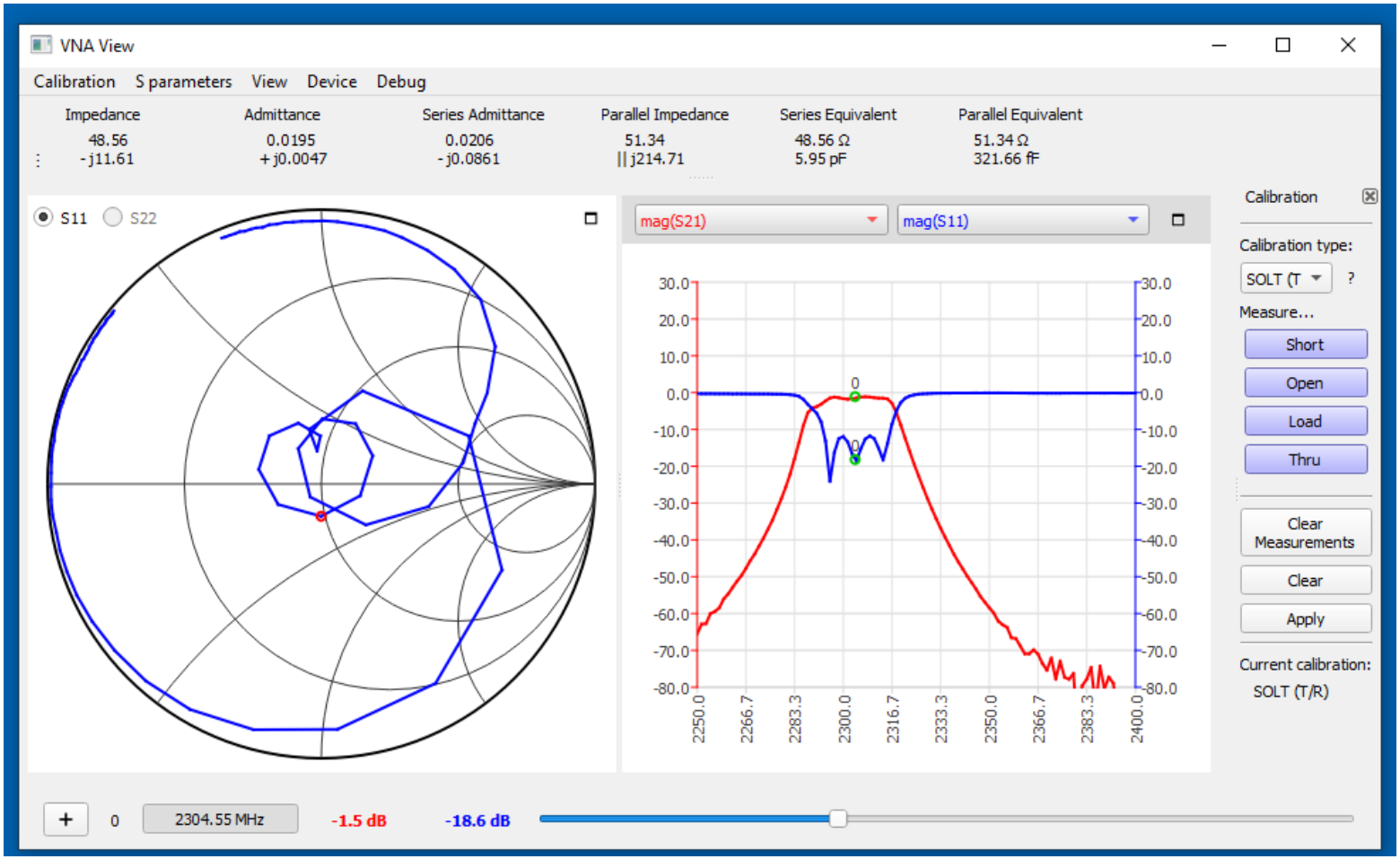

What is a Time Domain Reflectometer

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- A TDR sends out an incident pulse and analyses the reflected wave. If the impedance of the cable is properly terminated, the return will be zero and provide a flat line.
- A higher amplitude return indicates a high impedance and a lower amplitude return indicates a lower impedance
- This is an excellent tool for analyzing where faults are located in a transmission line

Using the VNA as a TDR

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- The NanoVNA simulates time domain reflectometry by transforming frequency domain data.
- There are tradeoffs to consider
- Increasing the maximum frequency increases the time resolution
- The shorter the measurement frequency interval the longer the maximum time length

Time Domain Reflectometer Responses

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50 ohm load on end of 12 inch cable

Open circuit on end of 50 ohm cable
A short circuit will bring response low

Measuring a length of cable with a Time Domain Reflectometer

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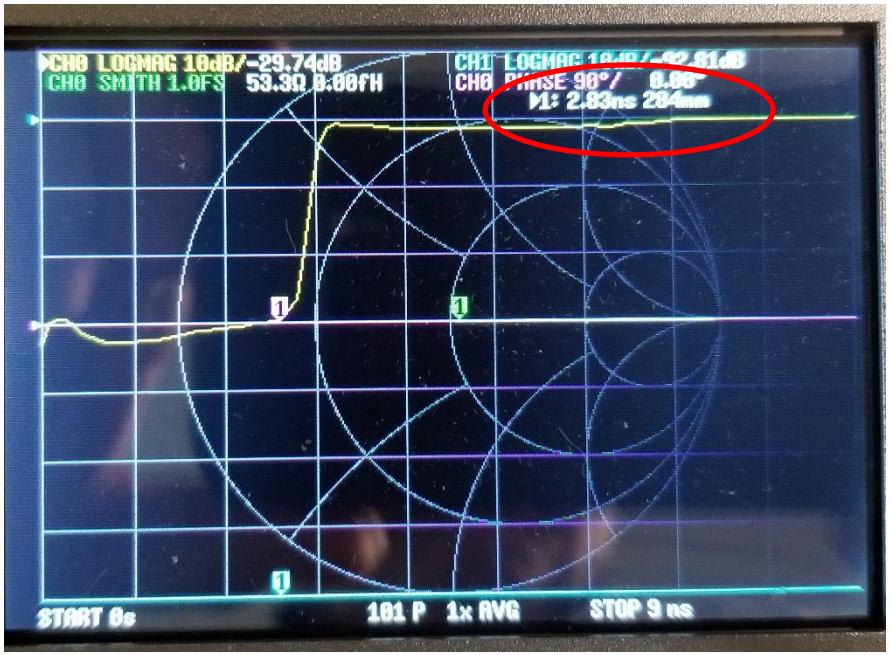

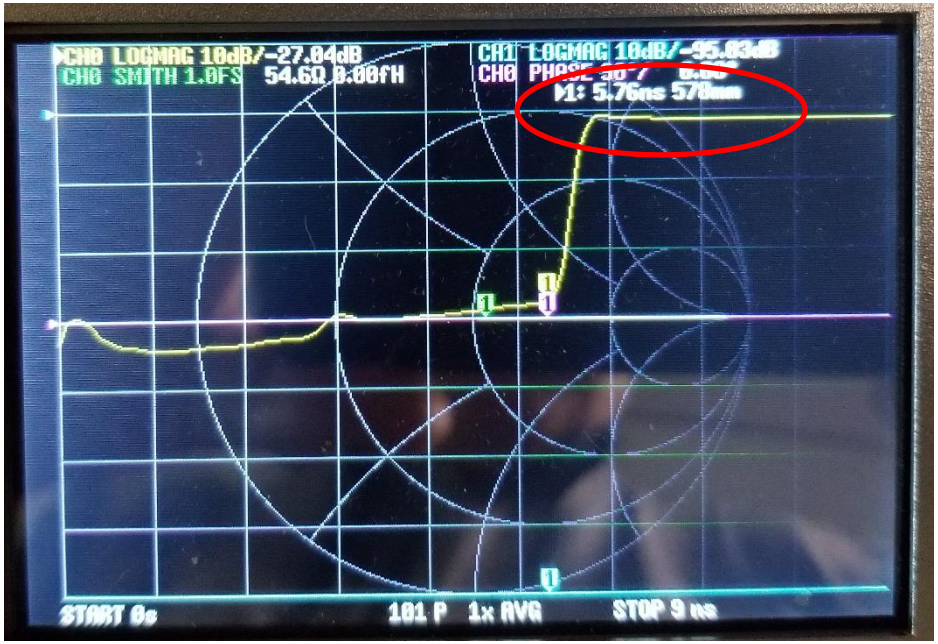

Position #1 is our reference of 2.83 nsec or a distance of 284 mm

Adding in an additional 12 inch cable increases the time delay to 5.76 nsec or a distance of 578 mm. Therefore the cable is 578mm – 284mm = 294mm or 11.6 inches long

More info

- User Manual https://nanorfe.com/nanovna-v2-user-manual.html
- Groups.io https://groups.io/g/NanoVNAV2

- Quite a nice piece of equipment for the money
- Thanks for listening
- Questions?