NanoVNA

Getting Started

- What is a VNA?
- VNAs vs Other Test Equipment
- Using the NanoVNA
- NanoVNA Options
- Software Options

What is a VNA?

- A Vector Network Analyzer (VNA) measures both the amplitude and phase properties of the device-under-test (DUT).
- A VNA contains both a source, used to generate a known stimulus signal, and a set of receivers, used to determine changes to this stimulus caused by the DUT.
- The stimulus signal is injected into the DUT and the VNA can measure both the signal that's reflected from the input side, as well as the signal that passes through to the output side of the DUT. The VNA receivers measure the resulting signals and compare them to the known stimulus signal. The results are then processed and sent to a display.
- Reflected Signals are designated S11 (Transmit & Receive on Port 1)
- Transmitted Signals are designated S21 (Transmit from Port 1, Receive on Port 2)

VNAs vs Antenna Analyzers

- VNAs
  - More measurement options and configurability
  - Multi-port design allows for both reflected and transmitted signal tests (S11 & S21)
  - Not designed for field use
  - NanoVNA is better value (more features for the $)
- Antenna Analyzers
  - Intended for testing antennas and feedlines
  - Single port design with some models capable of displaying sweeps and performing S11 measurements like a VNA
  - More convenient for field use with more robust construction
  - Generally more expensive than NanoVNA

VNAs vs Spectrum Analyzers

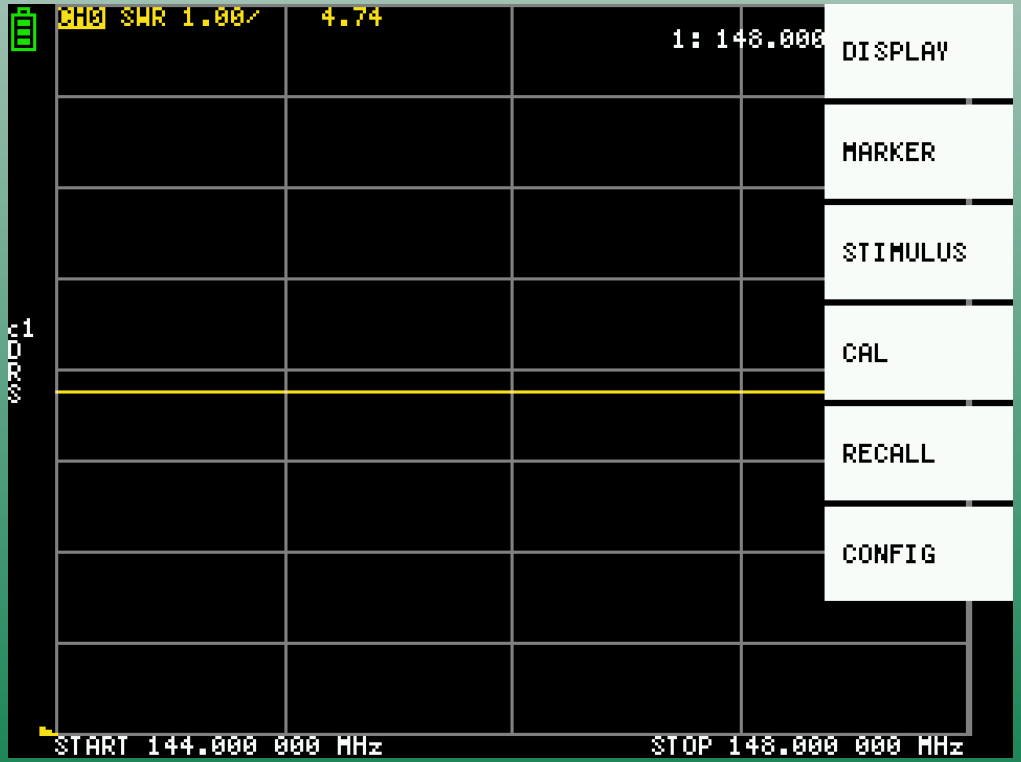
- VNAs
  - Contain both Source & Receiver
  - Measures response from known stimulus
  - Tend to be multi-channel
- Spectrum Analyzers
  - Contain only receivers
  - Typically used to measure unknown signals
  - Tend to be single channel

Update Your Firmware

- Check firmware version of your NanoVNA
  - Menu – Config – Version
- New units should have relatively new firmware
- Older units can be very out of date and missing useful features
- Follow procedure on https://nanovna.com/
- All required software is free

Update Your Firmware

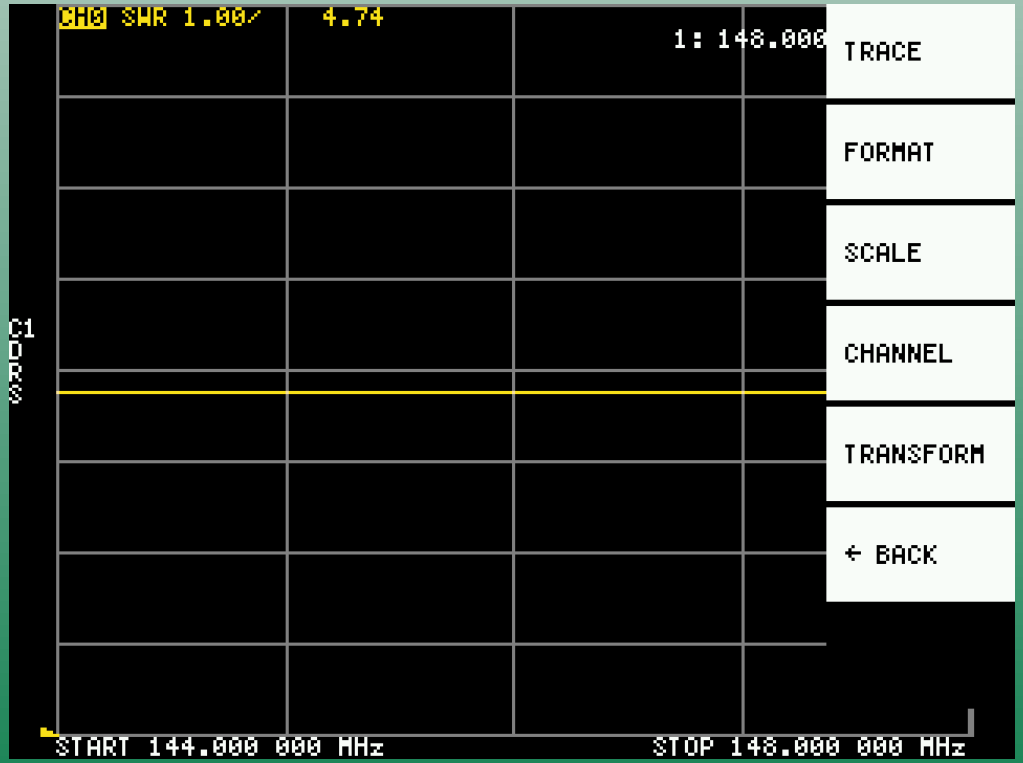
Old Firmware



New Firmware

Update Your Firmware

Old Firmware



New Firmware

Using the NanoVNA

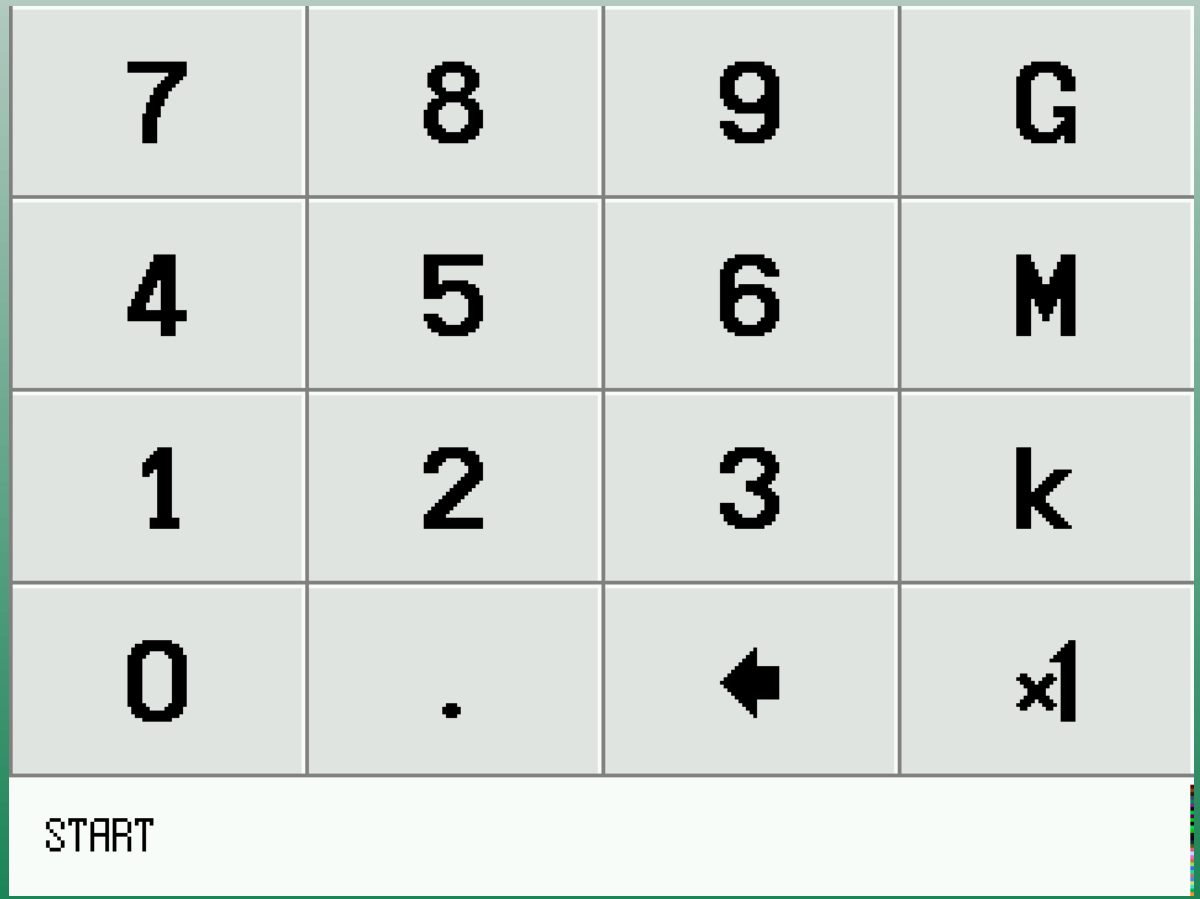
- Menu Options
  - Display
  - Marker
  - Stimulus
  - Calibrate
  - Recall

Using the NanoVNA

- **Stimulus** sets the frequency range
- Must be set before performing Calibration
- Use Start & Stop to set frequency range

Using the NanoVNA

- Frequency input screen
- Enter magnitude and then frequency unit
  - G = GHz
  - M = MHz
  - k = kHz
- Example:
  - 14M = 14MHz



Using the NanoVNA

- **Calibration** is required for accurate readings
- NanoVNA must be recalibrated when the frequency range changes
- Calibrations can be saved and recalled

Using the NanoVNA

- Calibrate using the test standards included with your NanoVNA
- For S11 measurements only Open, Short & Load are used
- For S21 measurements Isolation & Thru are also required

Using the NanoVNA

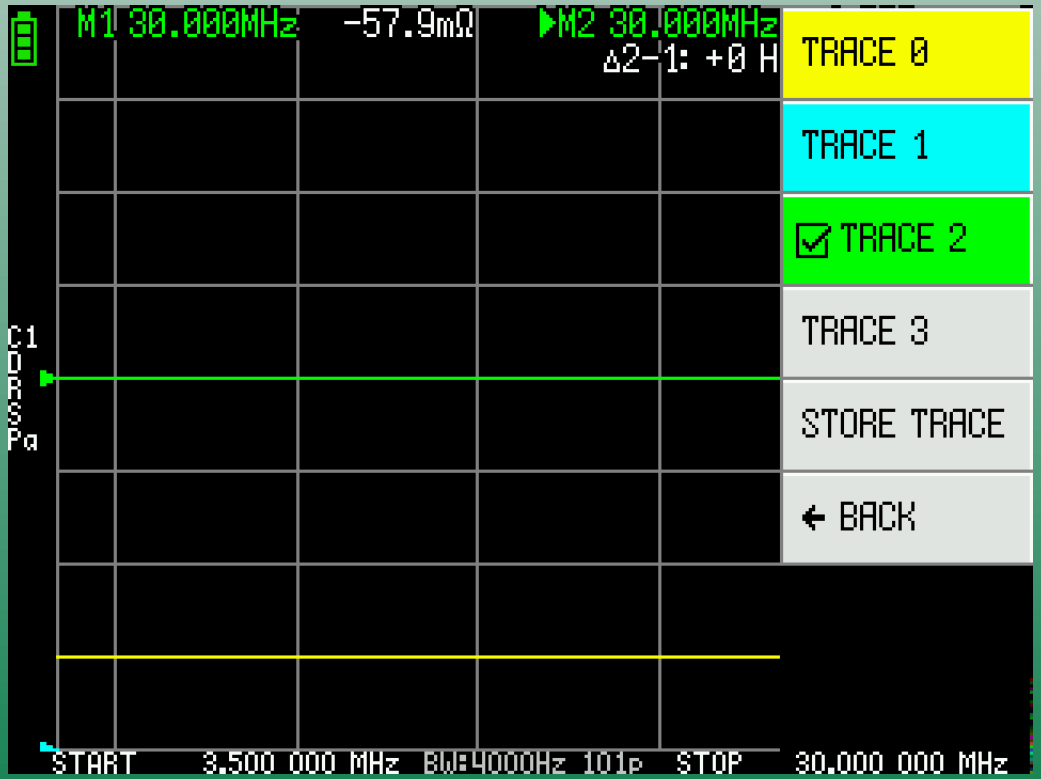
- **Save** and **Recall** your calibrations and settings to test different antennas and equipment
- Saving also retains your Trace & Display settings

Using the NanoVNA

- Many Display options to choose from:
  - Number of Traces
  - Scaling
  - Measurement Type

Using the NanoVNA

Trace



Format - 1

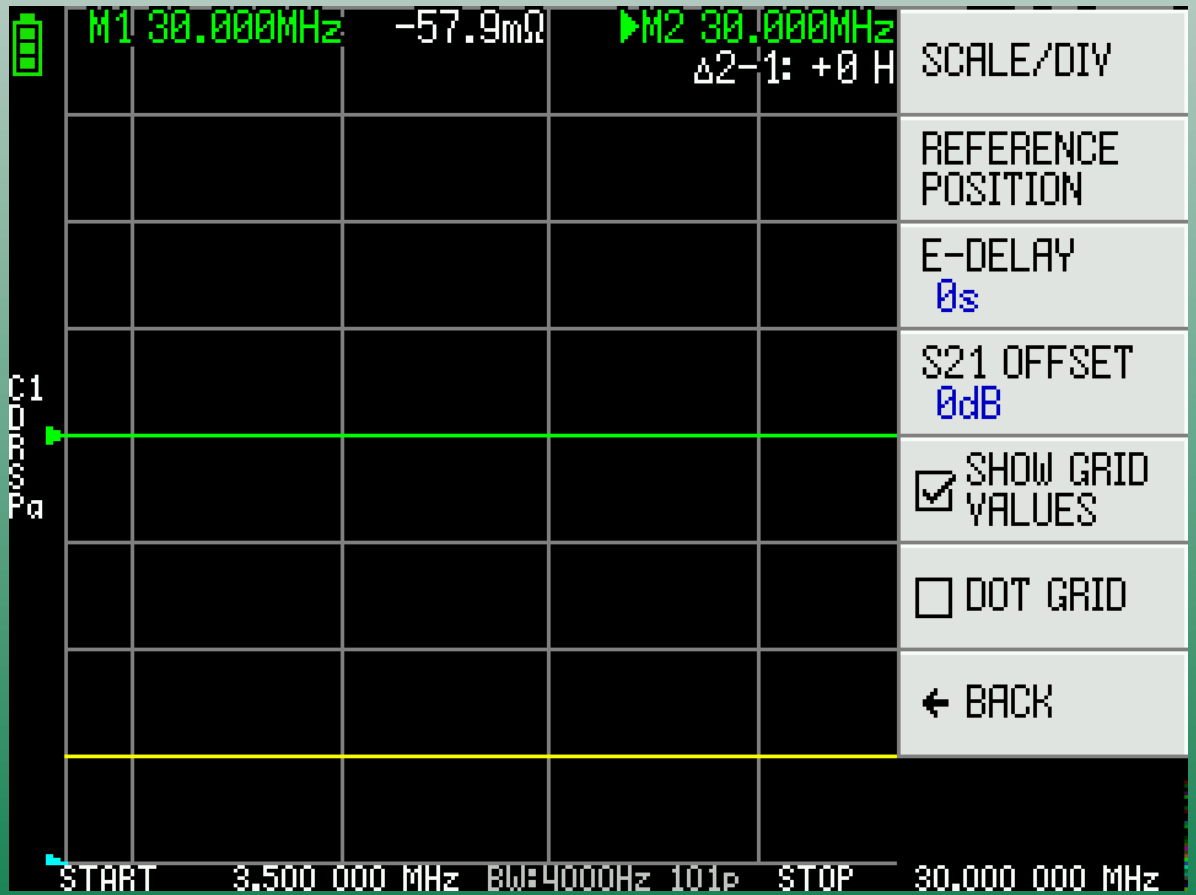
Using the NanoVNA

Format - 2

Format - 3

Using the NanoVNA

- Adjust the **Scale** and turn on the **Grid Values** to make it easier to read measurements

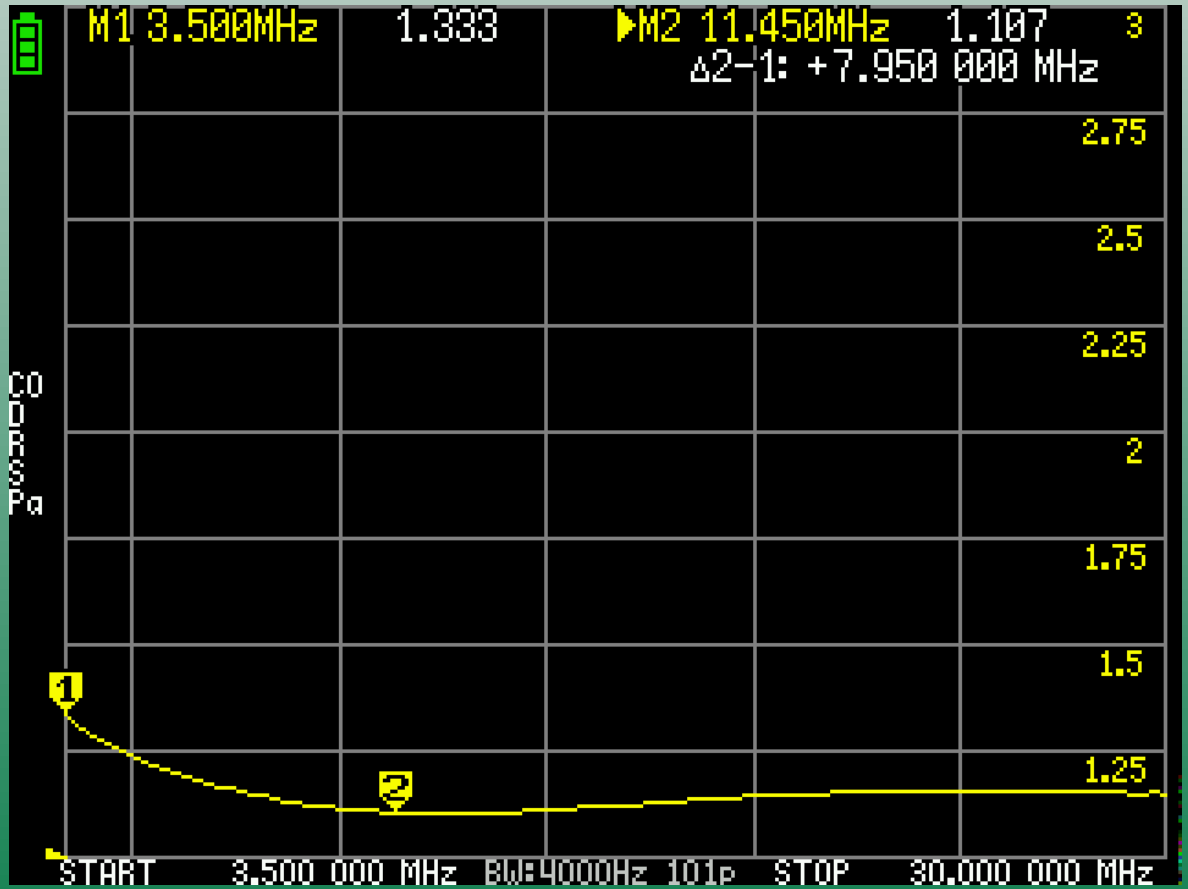


Using the NanoVNA

- Setting up **Markers** makes it easy to find the **Maximum** and **Minimum** points on the sweep

Using the NanoVNA

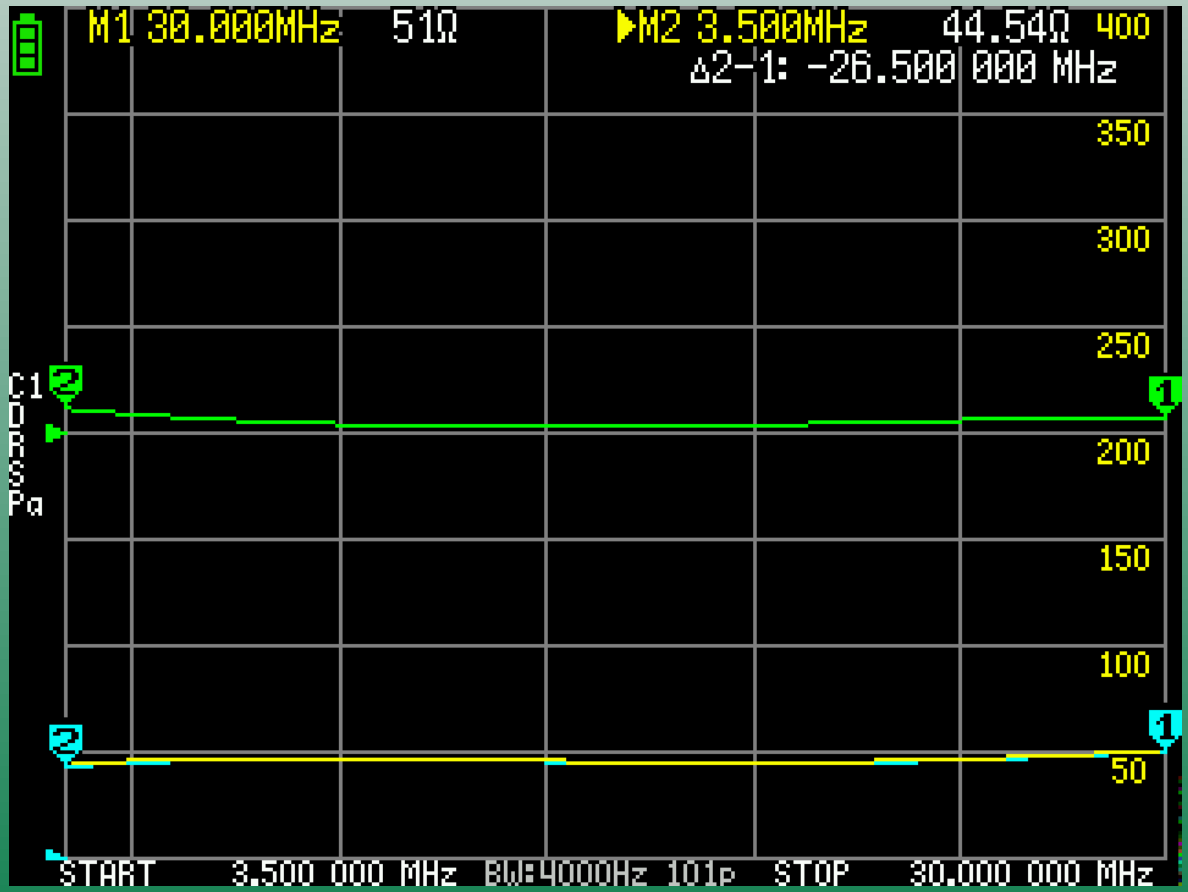
- Example SWR sweep of a 36:1 End-Fed Half-Wave matchbox connected to an 1800 Ohm resistor
- Marker #1 shows the maximum SWR & the frequency where it occurs
- Marker #2 shows the minimum SWR & frequency



Using the NanoVNA

- Example multi-trace sweep of a 36:1 EFHW matchbox connected to an 1800 Ohm resistor

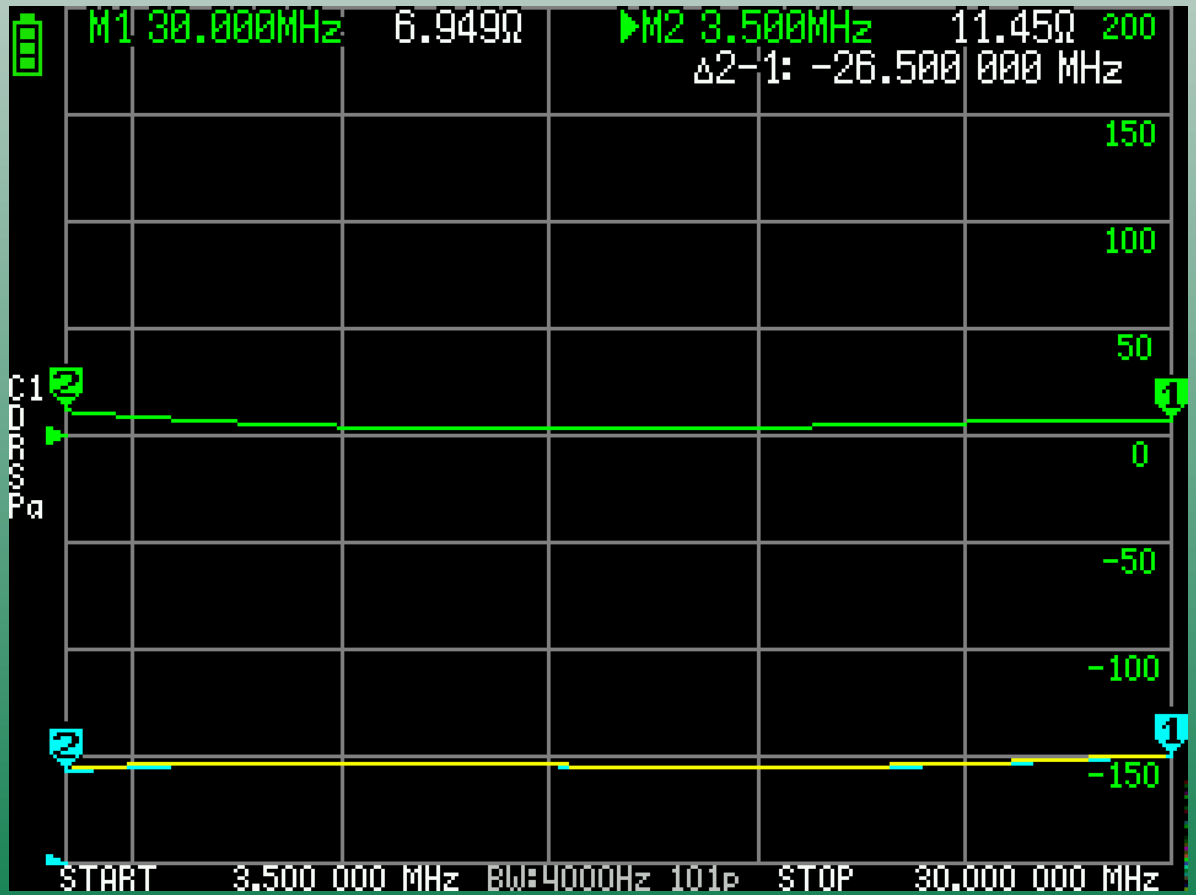
- Yellow = Impedance
- Cyan = Resistance
- Green = Reactance



Using the NanoVNA

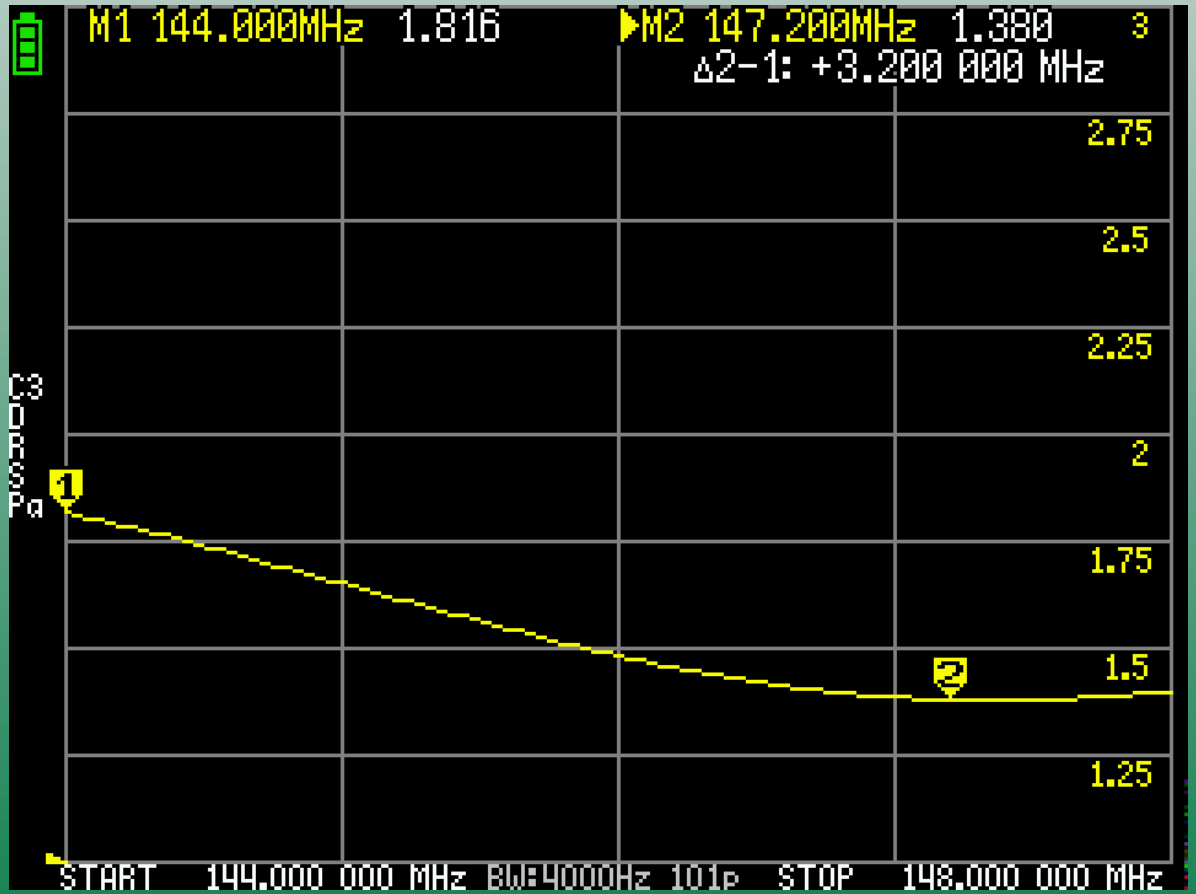
- Same example as previous slide, but notice that the Scale and Measurement colors changed when the Green Trace is active

- Yellow = Impedance
- Cyan = Resistance
- Green = Reactance



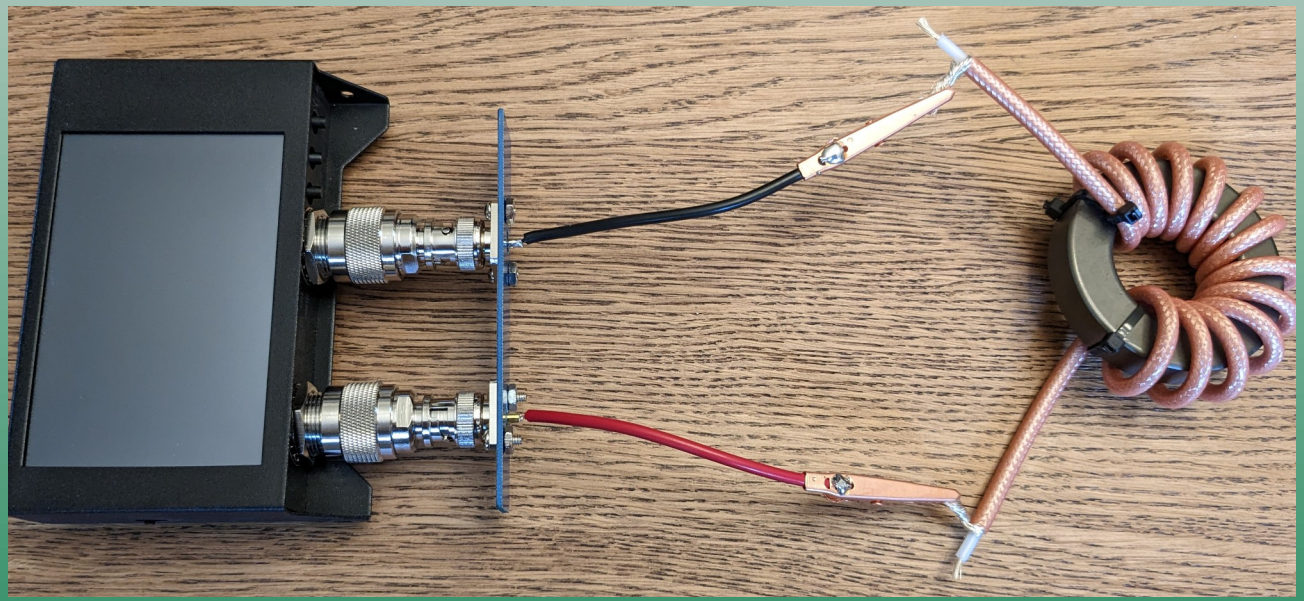
Using the NanoVNA

- **S11 Measurements**
  - Useful for testing antennas, baluns, and impedance transformers
  - Connect to Channel 0 (Port 1)
  - Set S11 Format to test SWR, Impedance, etc.



Using the NanoVNA

- **S21 Measurements**
  - Useful for testing chokes and filters
  - Connect to Channel 0 (Port 1) & Channel 1 (Port 2)
  - Set S21 Format to test LogMag, Phase, etc.
  - May require custom testing hardware



NanoVNA Options

- Official NanoVNA Models
  - NanoVNA-H
  - NanoVNA-H4
  - SAA2N
  - LiteVNA
  - LiteVNA64
- Available from official dealers listed on NanoVNA website (R&L Electronics, GigaParts)
- Newer models offer more frequency range in the GHz and higher dynamic range measurements. These improvements don’t matter much for the average ham.
- Many other clone models available from other sellers (Amazon, eBay) of varying quality. Do your research before buying.

NanoVNA Options

- NanoVNA-H
  - SMA Connections
  - 50KHz – 1.5GHz Range
  - 2.8” Screen
  - $60

NanoVNA Options

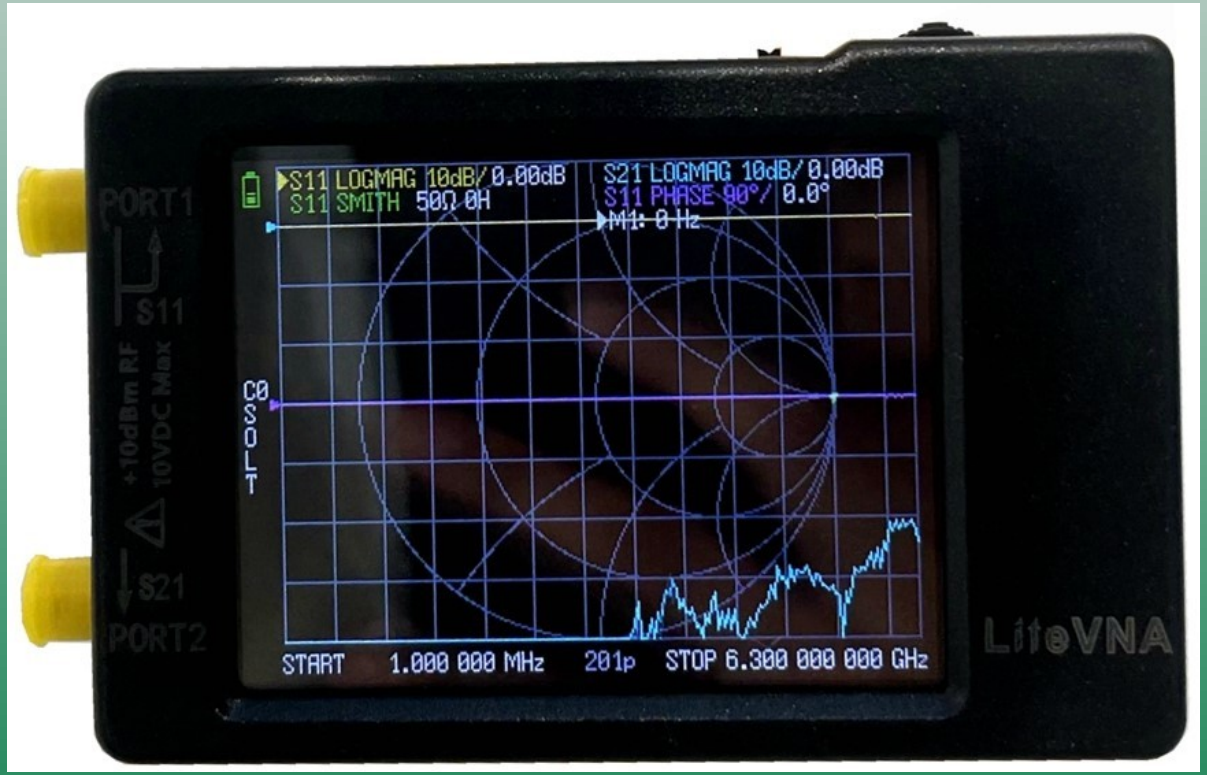
- NanoVNA-H4
  - SMA Connections
  - 50KHz – 1.5GHz Range
  - 4” Screen
  - $90

NanoVNA Options

- SAA2N
  - N Connections
  - 50KHz – 3GHz Range
  - 4” Screen
  - Metal Case
  - $110

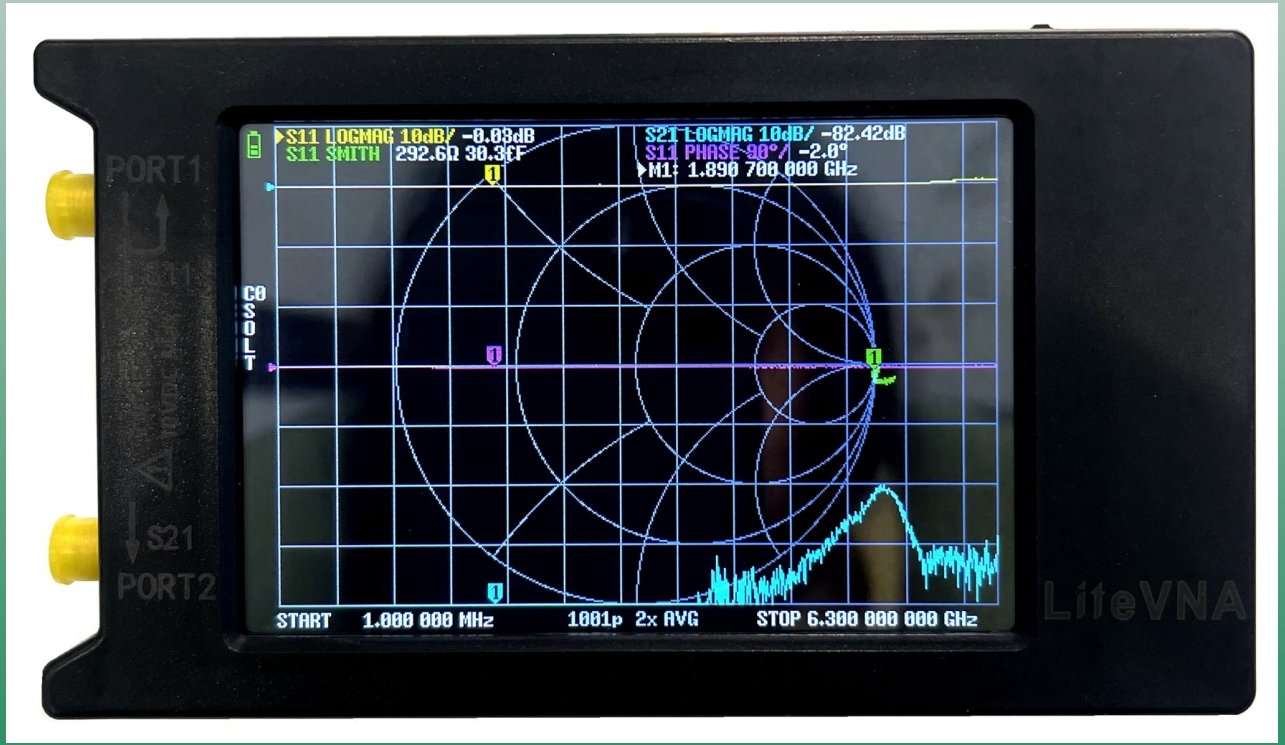
NanoVNA Options

- LiteVNA
  - SMA Connections
  - 50KHz – 6.3GHz Range
  - 2.8” Screen
  - $110



NanoVNA Options

- LiteVNA64
  - SMA Connections
  - 50KHz – 6.3GHz Range
  - 4” Screen
  - $130



Software Options

- **NanoVNA Saver**
  - Available for Windows & Linux
  - Integrates directly with the NanoVNA
  - Can capture screenshots from some NanoVNA models
- **NanoVNA App**
  - Available for Windows
  - Easier to use and more versatile
  - Uses NanoVNA hardware but performs all measurements and calculations in software
  - Can save and transfer calibrations