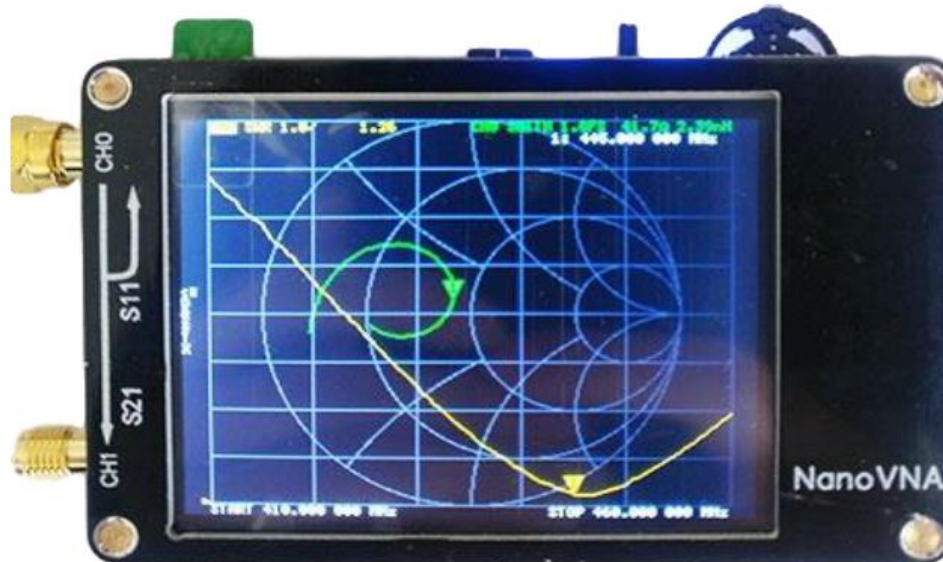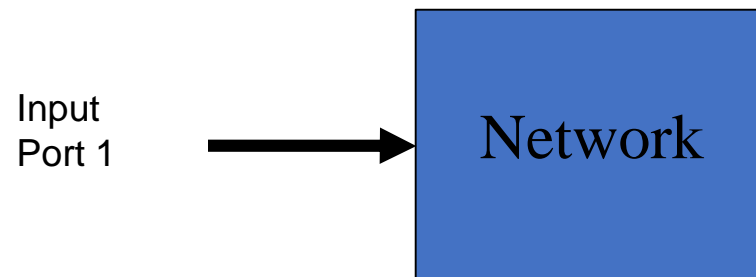# NanoVNA Measurements

Greg Algieri
WA1JXR

- NanoVNA Measurement Types

- There are 3 basic measurement types that can be performed using the NanoVNA

- 1. One Port Reflection Measurement

- 2. Two Port Transmission "Thru" Measurement
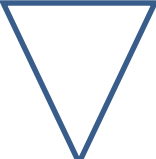
- 3. Time Domain Reflectometry (TDR) Measurement

One Port Networks measured with Reflection Measurements

- One Port Network

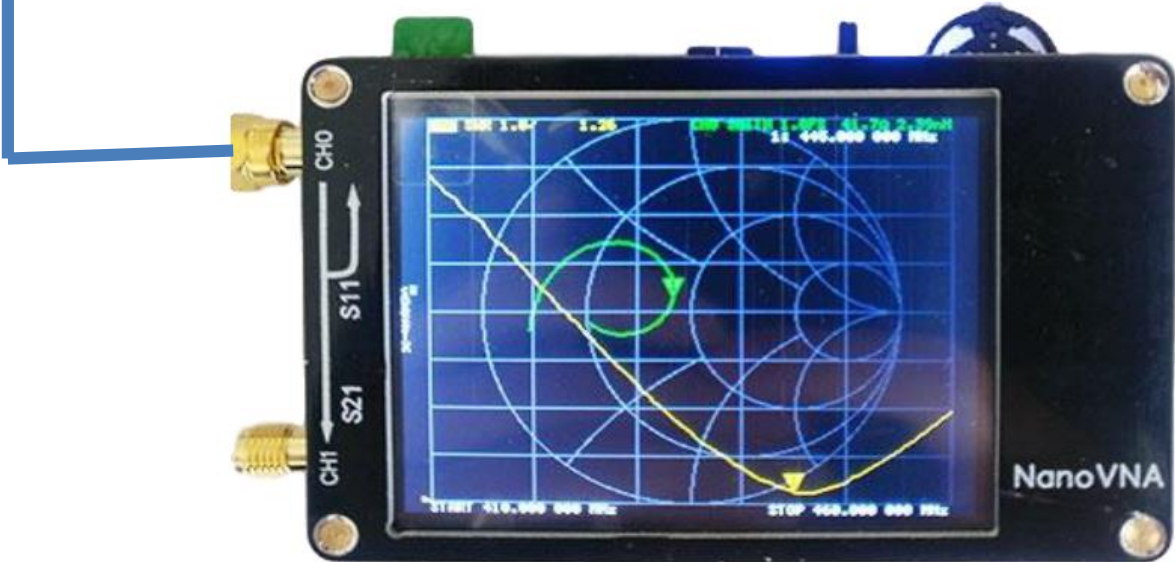- Apply signal to Port1 and measure the Reflected Signal

  - Typical One Port Network Devices

    - Amateur Antenna

    - RF Load

    - RF Transmission Line Open or Shorted Stub

Input
Port 1 → Network

nanoVNA Set Up for Measurement

2M / 70cm HT Antenna

nanoVNA setup for Reflection Measurement

Our first measurement example will be measurement of a 2M/70cm HT duo band antenna.
We will use the nanoVNA Saver software for this demonstration.
We will set the nanoVNA to S11 Reflect mode.
Set Stimulus for Start freq. = 100 MHz, Stop freq. = 500 MHz.
Set Display for 1 Trace Set Format to SWR Set for 1 Marker.
 We will perform SOLT Calibration on CH0 and Save the Cal.
We will connect the 2M/70cm HT duo band antenna to CH0
We will analyze the SWR trace and place the marker in the 2M and 70cm bands and read the antenna SWR and/or Impedance.

- NanoVNA Measurement Types

- There are 3 basic measurement types that can be performed using the NanoVNA

- 1. One Port Reflection Measurement

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Two Port Networks are measured using Thru Measurement

- **Two Port Network**

- **Apply signal to Port1 then measure the signal that has gone "Thru" the DUT on Port2**

  - **Typical Two Port Network Devices**

    - **RF Amplifier**

    - **RF Transmission Line (Coax)**

    - **RF Filter**

    - **RF Phasing Lines**

Input
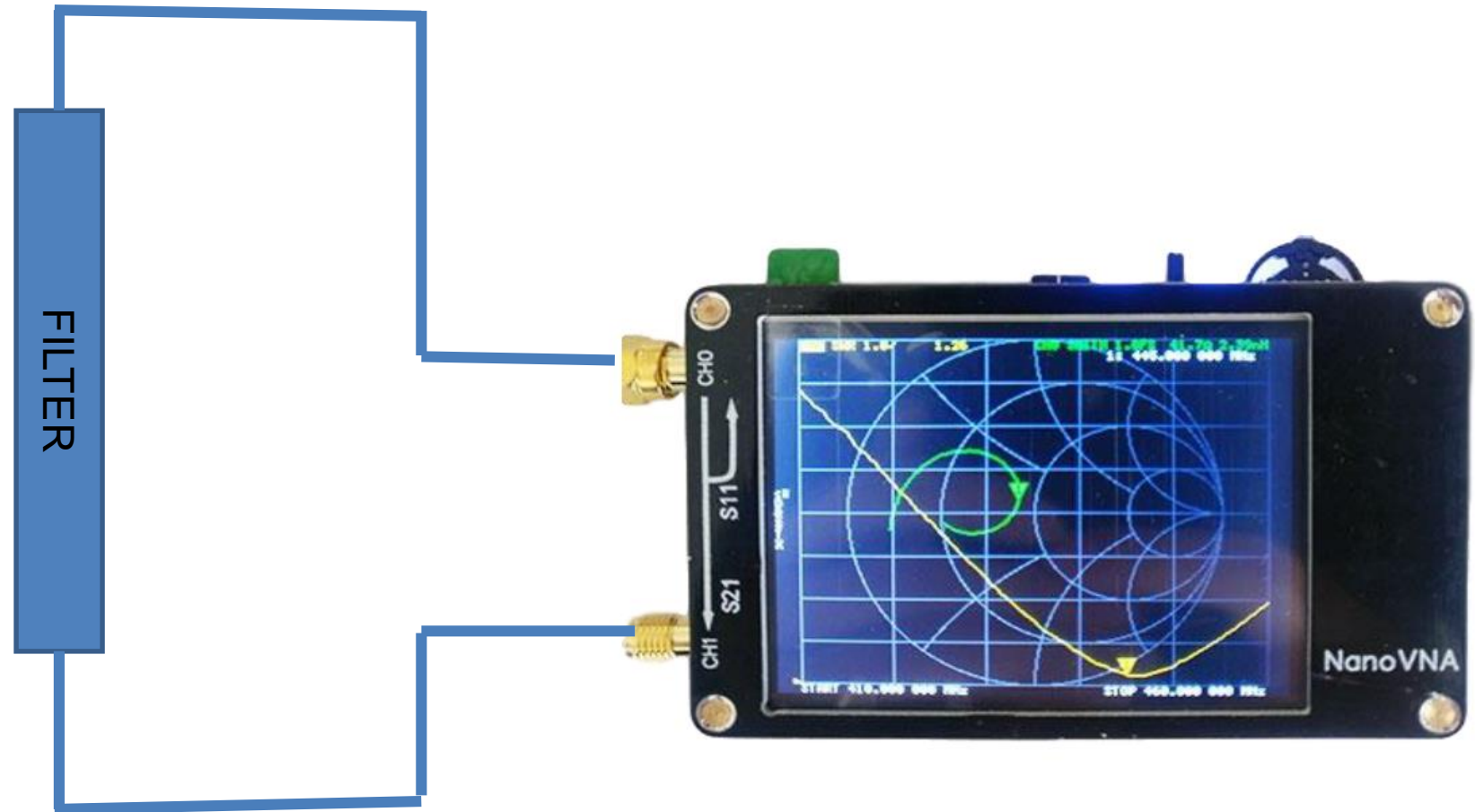Port 1   →   Network   →   Output
Port 2
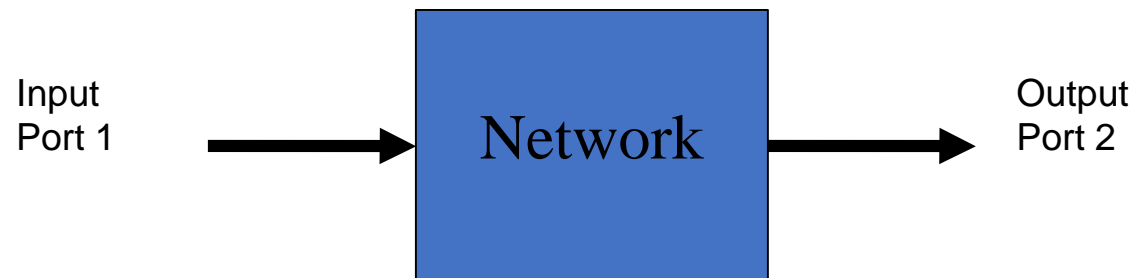
nanoVNA Set Up for Measurement

Signal is sent thru the Bandpass Filter and the result vs frequency is displayed.

Altoids Tin Filters

Band Pass Filters for 432 MHz, 902 MHz, and 1296 MHz.

nanoVNA setup for Transmission (Thru) Measurement

Our second measurement example will be measurement of a Altoids Tin 440 MHz Bandpass Filter.

We will use the nanoVNA Saver software for this demonstration.

We will set the nanoVNA to S21 Thru mode.

Set Stimulus for Start freq. = 400 MHz, Stop freq. = 500 MHz.

Set Display for 1 Trace Set Format to Log Mag Set for 1 Marker.
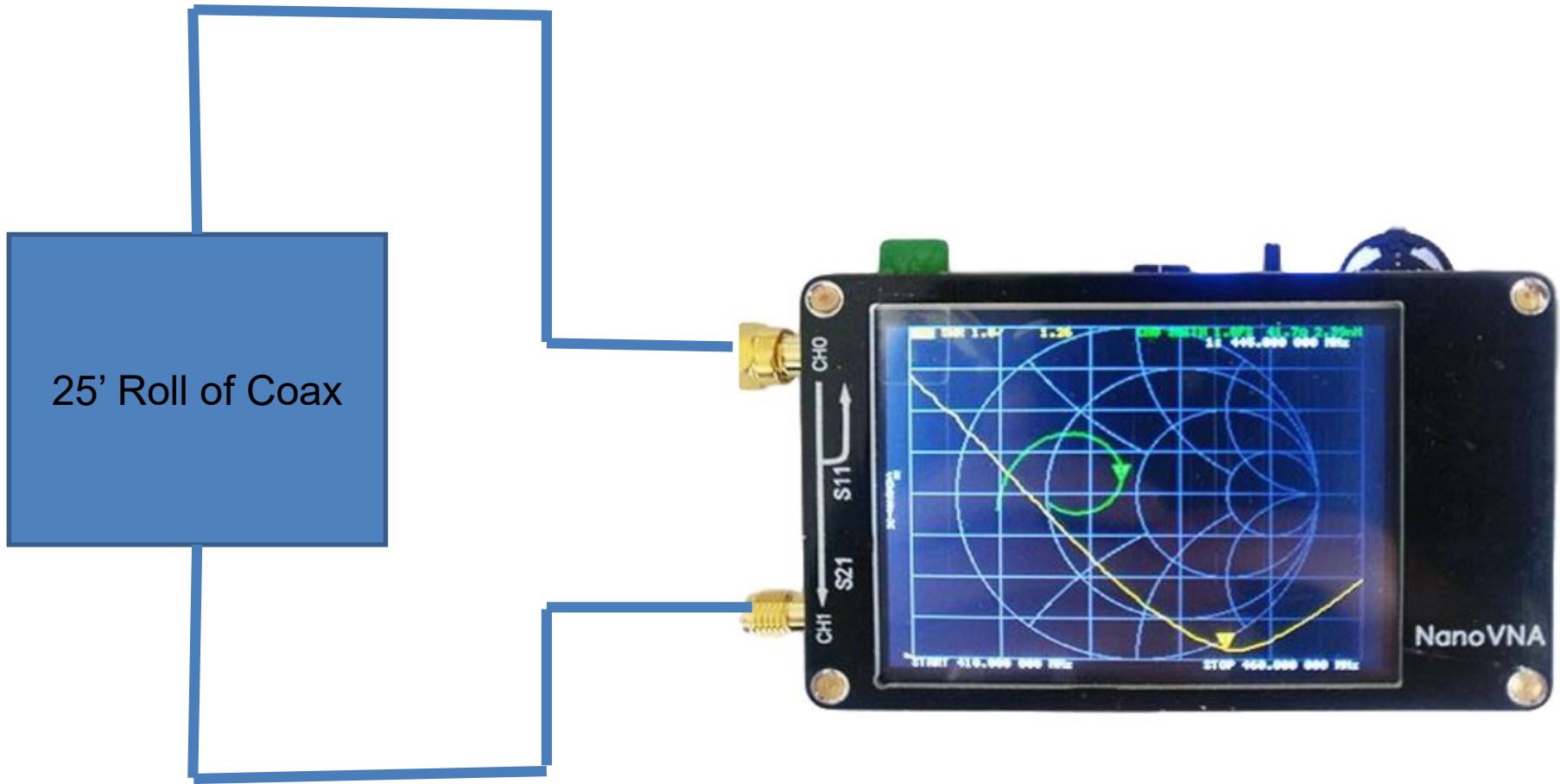
 We will perform SOLT Calibration on CH0/CH1 and Save the Cal.

We will connect the Filter between CH0 and CH1

We will analyze the Log Mag trace and see the Bandpass Filter Frequency Response

nanoVNA Set Up for Measurement

S21 Thru measurement RF signal is sent "Thru" the coax and measured.

nanoVNA setup for Transmission (Thru) Measurement

Our second measurement example will be measurement of 25 ft of RG-174 Coax.

We will use the nanoVNA Saver software for this demonstration.
We will set the nanoVNA to S21 Thru mode.

Set Stimulus for Start freq. = 3 MHz, Stop freq. = 30 MHz.
Set Display for 1 Trace Set Format to Log Mag Set for 1 Marker.

 We will perform SOLT Calibration on CH0/CH1 and Save the Cal.
We will connect the Trap or Coax between CH0 and CH1

We will analyze the Log Mag trace and place marker at the 10 MHz point and measure the insertion loss of the 25 ft of coax.
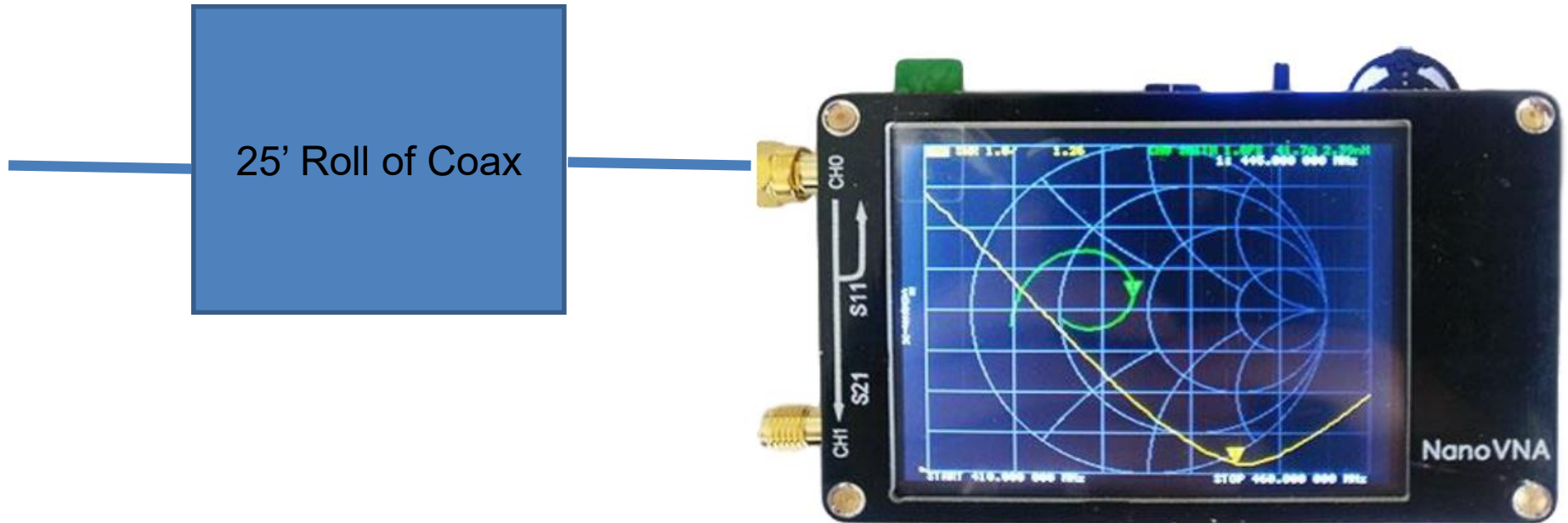
The specification dats sheet for the RG-174 coax says it has a loss of 3.3dB/100ft at 10 MHz. So 25 ft should be 0.825 dB at 10 MHz.

nanoVNA Set Up for Measurement

Measure the Loss of coax using reflection mode when only one end of the coax is easily accessible. Coax out to your tower or antenna.

Coax loss is ½ of the loss measured on the nanoVNA.

End of Coax left open or shorted

25' Roll of Coax

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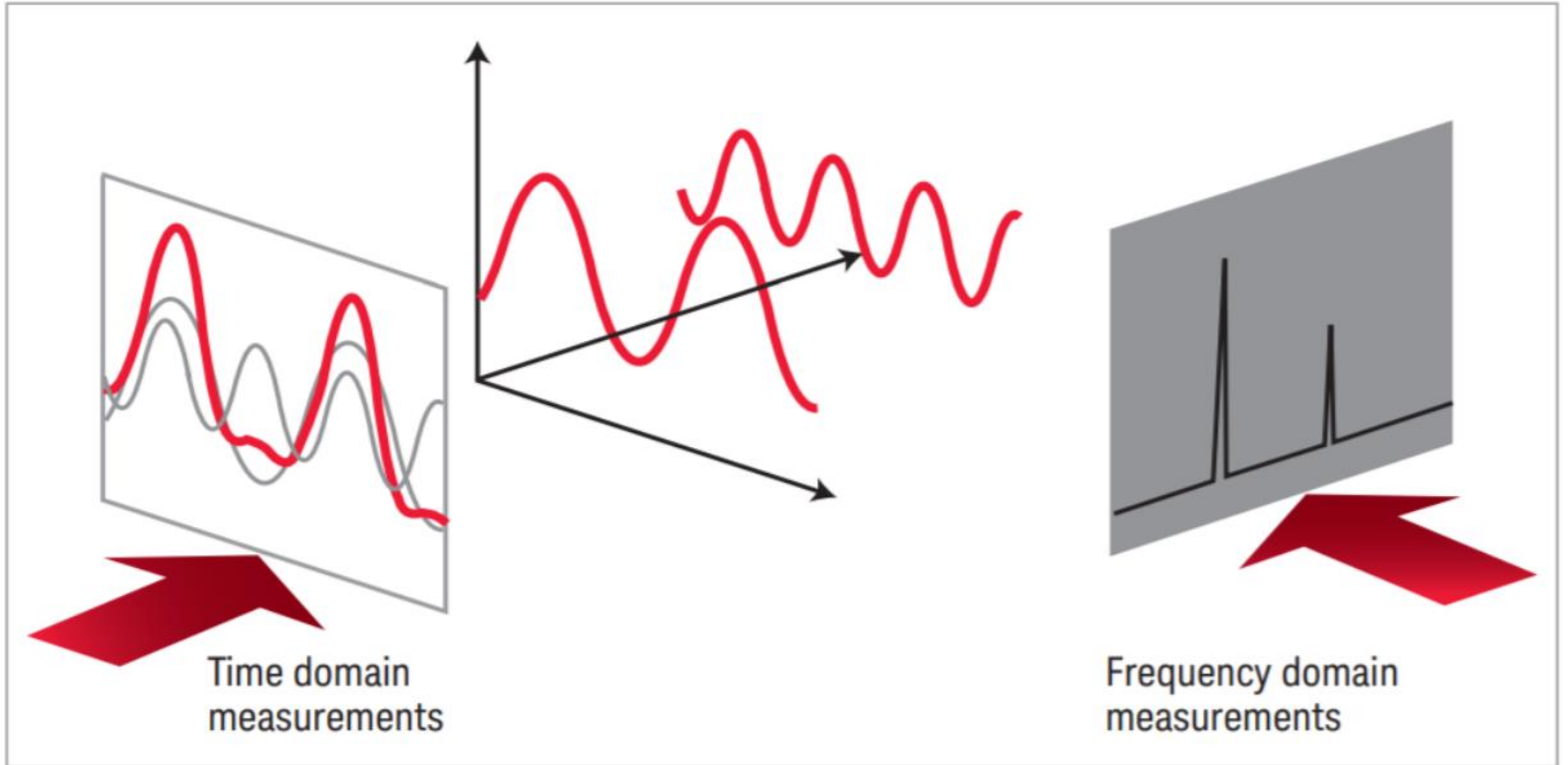
nanoVNA Set Up for Measurement

Measure the length of the coax using Time Domain Reflectometery (TDR) mode.

Can also find faults (discontinuities) or breaks in the feedline.

End of Coax left open or shorted

25' Roll of Coax
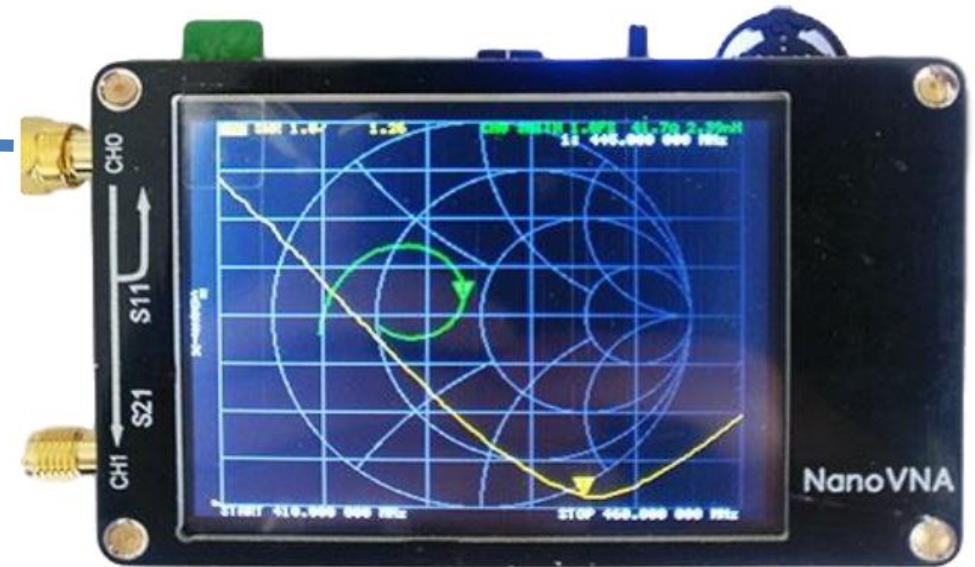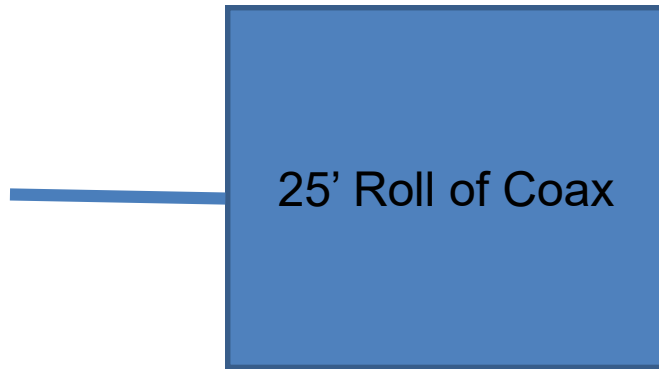
Time Domain versus Frequency Domain

Time domain measurements

Frequency domain measurements

NanoVNA setup for Reflection Measurement

Our third measurement example will be measurement of a 25ft (7.62m) of RG-174 Coax to measure the length of the coax using TDR function.

We will use the nanoVNA Saver software for this demonstration.

We will set the nanoVNA to TDR mode.

Set Stimulus for Start freq. = 50 KHz, Stop freq. = 300 MHz.

Set Display for 1 Trace Set Format to TDR Set for 1 Marker.

We will perform SOLT Calibration to CH0 and Save the Cal.

We will connect the Coax to CH0, leave the other end open.

We will use the TDR function to calculate the length of the cable.

NanoVNA setup for Reflection Measurement

The analyzer measures the reflected wave in the cable in the frequency domain.

It then performs in math a Inverse Fourier Transform.

Converts data to Time domain, voltage versus time.

Measures time for signal to go down the cable and reflect back.

Divide that time by 2 and knowing the velocity factor of the coax calculate the length.

Can also be used to find break or fault in the cable.

Summary

- Hope this presentation provided you with demo of the 3 modes of the Nano VNA.

- How the Nano VNA can be used for Amateur Radio measurements.

- Where to get support for the Nano VNA.

- If you have questions after you can reach me via e-mail at wa1jxr@comcast.net or wa1jxr@arrl.net

- Questions??

- 73's Greg WA1JXR

Questions and Answers

Beginning now