INTRODUCTION TO THE NANO VNA

Neil Goldstein

W2NDG

- ▸20 years as an IT professional
- ▸SWL since childhood
- ▸Licensed in 2008
- ▸Raised in Ulster County
- ▸Recently returned to the Hudson Valley
- ▸Ham Radio University forums on Linux, SDR, Digital Modes, and Raspberry Pi
- ▸Currently living in Poughkeepsie. Spouse (Jill) also a Ham
- ▸Working at Sloan Kettering Cancer Center as a Research Computing Specialist
- ▸HF, VHF/UHF, Kit Building, SDR, Digital Modes, Transmitter Hunting, More
- ▸Fun Fact: I used to lecture about edible wild plants

- ▸Shameless Plugs: radiokitguide.com, and the Long Island CW Club (W2LCW) longislandcwclub.org

WHO IS W2NDG?

NANO WHAT?

ORIGINAL OPEN SOURCE NANOVNA PROJECT BY @EDY555 AND TTRFTECH

V N A

Vector Network Analyzer

A VNA is a form of RF network analyzer widely used for RF design applications (Wikipedia)

Like an antenna analyzer, but with input and output connectors for testing loop antennas, filters, cables, and other pass-thru devices as well as single connector uses (like an AA)
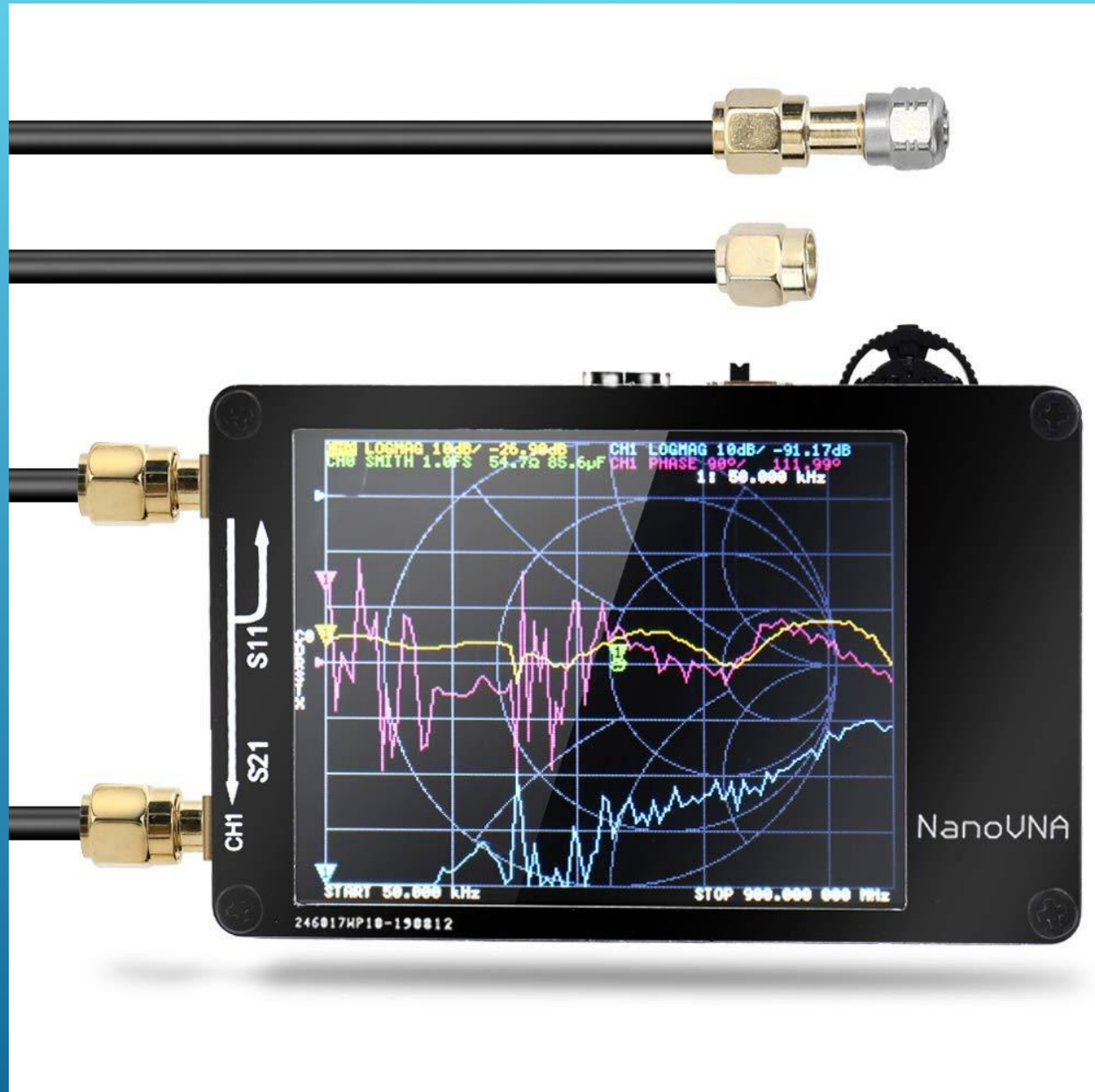
Keysight Field VNA

Forget the NANO for a moment. What does a VNA look like?

Where can you find one?

How much do (did) they cost?

How do they work?

VNA BASICS

Keysight Field VNA

WHERE CAN YOU FIND ONE?

Keysight Field VNA

HOW MUCH DO (DID) THEY COST?
THIS ONE IS OVER $11K
OUR KEYSIGHT AGAIN
REMEMBER THAT

Keysight Field VNA

Incident power

Port 1 Port 2

Transmitted power

Device under test

Reflected power

Transmitted power

Port 1 Port 2

Incident power

Device under test

Reflected power
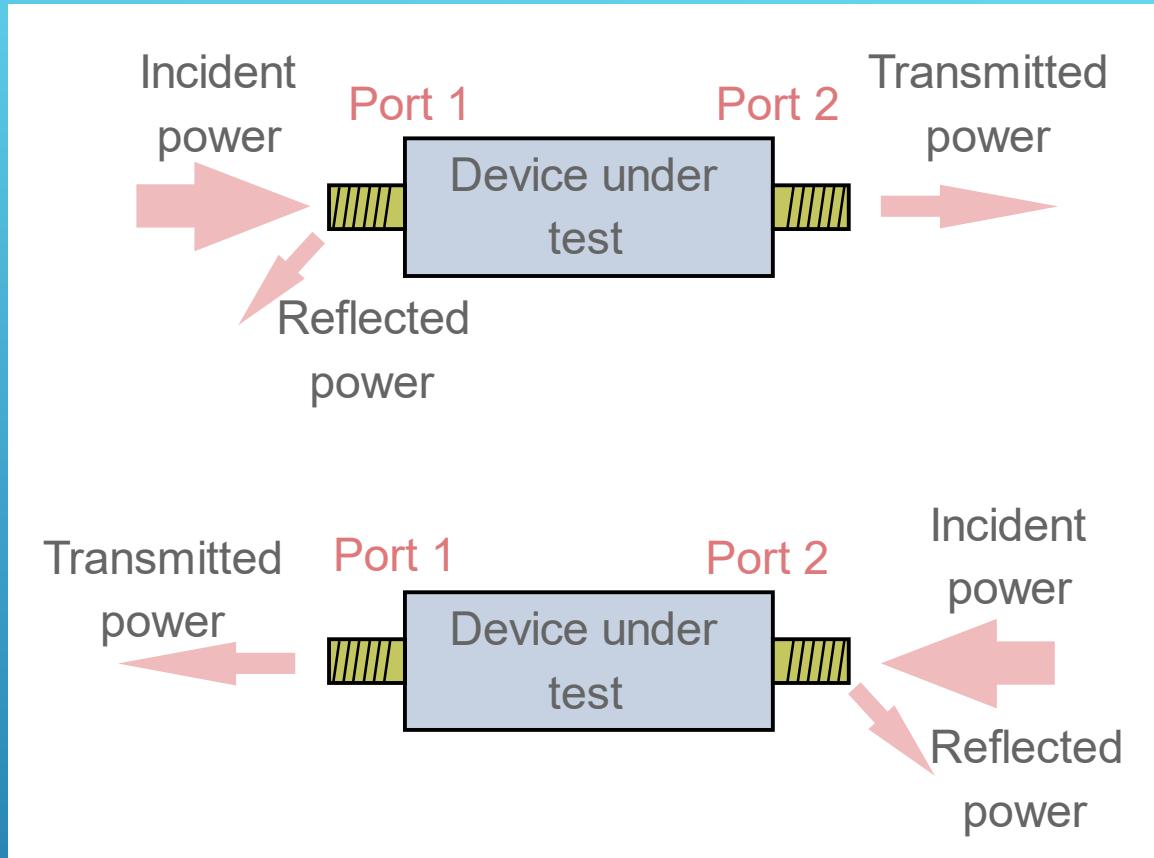
HOW DO THEY WORK?

The block diagram of a basic two port vector network analyzer is shown above. This shows the high level blocks needed for a typical VNA.

The VNA has precision connectors on the front panel of the unit itself and then precision cables are used to connect these to the device under test. Precision cables are required because the phase and loss of a standard cable would vary too much with even slight movement, etc.

To test the device, a variable frequency signal is generated within the vector network analyzer and the output is switched to test the DUT in either one direction or the other. In this case the left hand side on the diagram is selected. The signal passes to the splitter where one output is used as the reference signal for the receiver and the other side is passed to a direction coupler and then into the DUT via the external connection on the VNA and the precision cables.

FROM ELECTRONICS-NOTES.COM
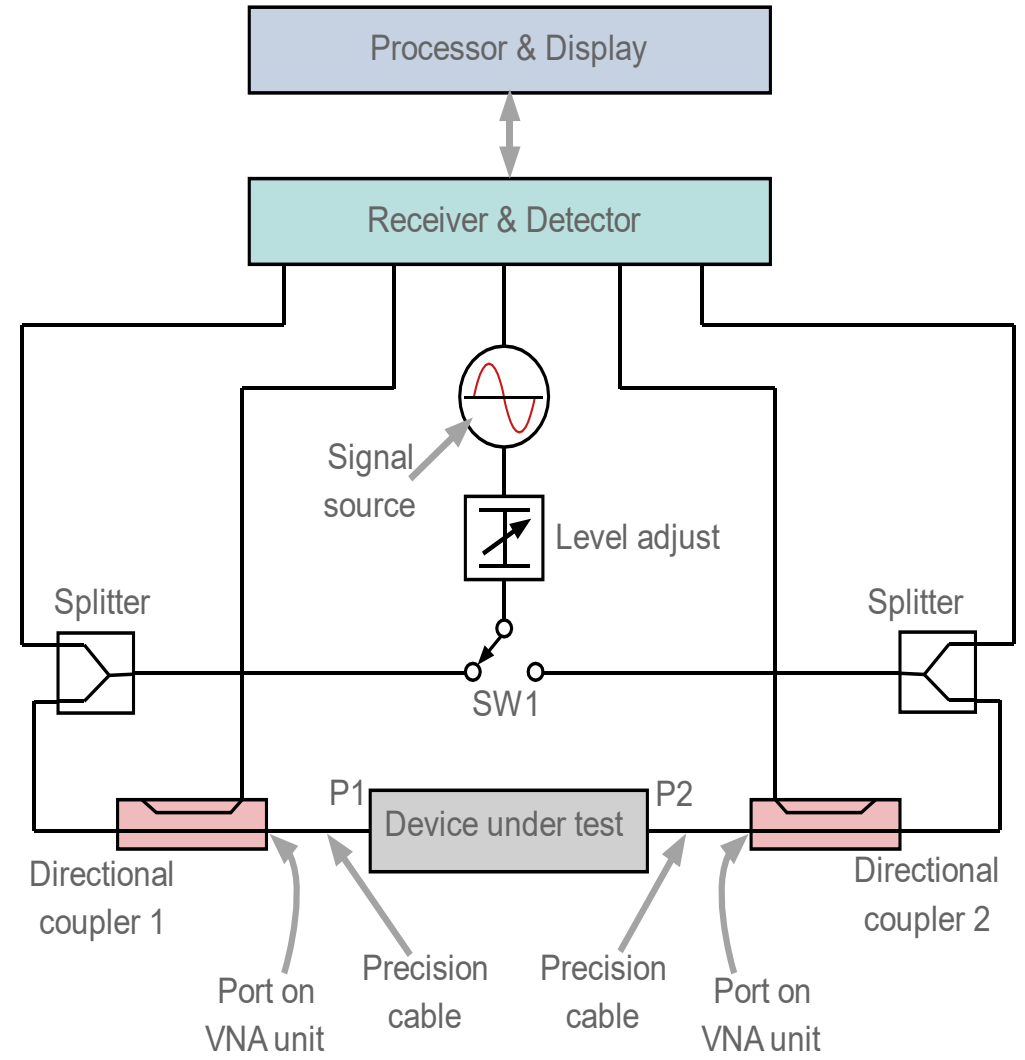
Power passes through the directional coupler (directional coupler 1) to the DUT, but the third port detects the reflected power and this is connected to the receiver again.

Power that passes through the device under test is sampled by directional coupler 2 and this signal is connected to the receiver.

The signals are processed by the receiver are then fed to the processor and display. This section will again make heavy use of microprocessor technology to provide the control, functionality and user-friendly displays that are needed for modern test instrumentation.

Although this very simplified example of an RF network analyzer shows two ports, some vector network analyzers may use more ports for systems where many different signal paths exist.
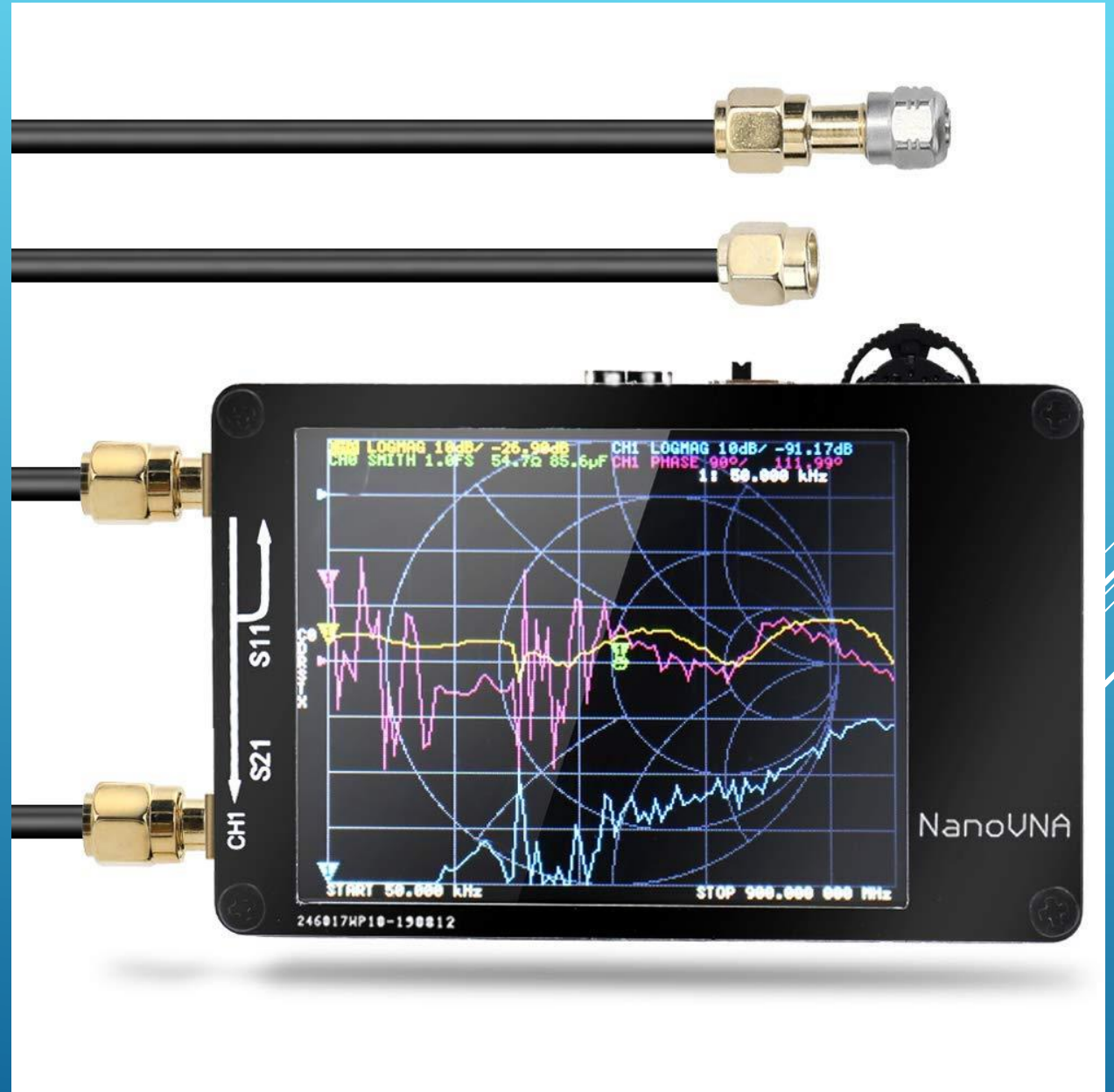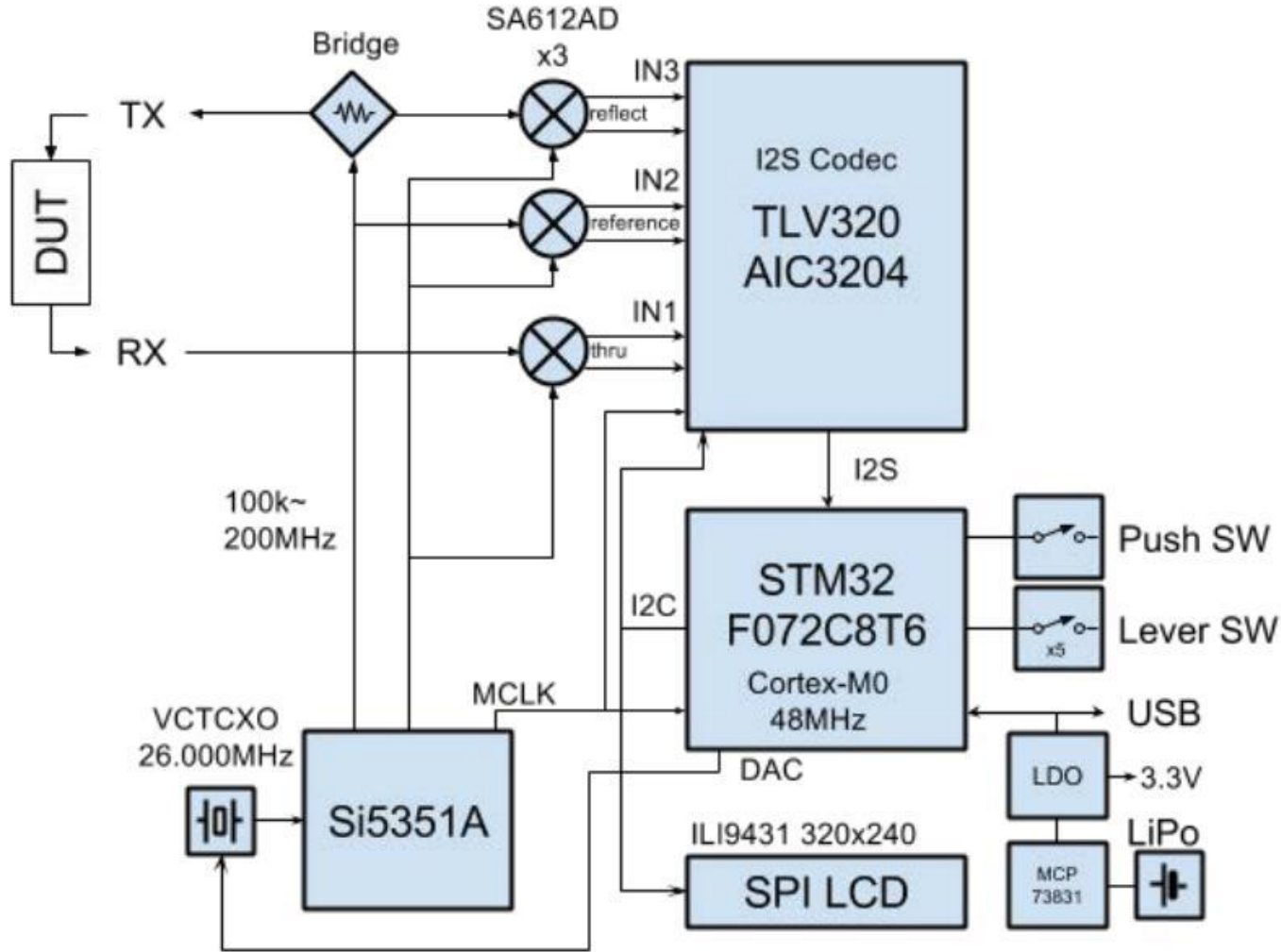
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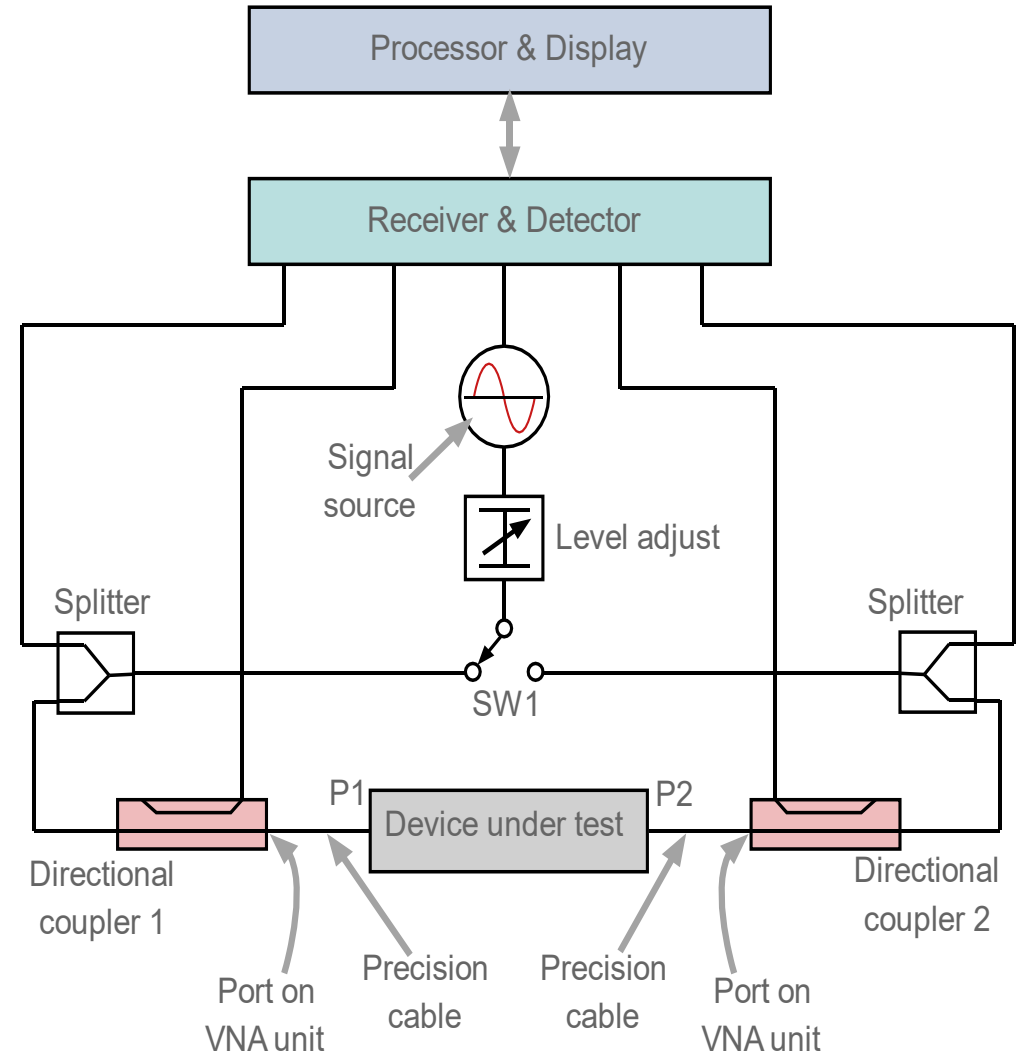
ENTER THE NANO VNA

An inexpensive basic VNA for experimenters. Typical cost between $40 and $60

Comes with most of what you need to start testing
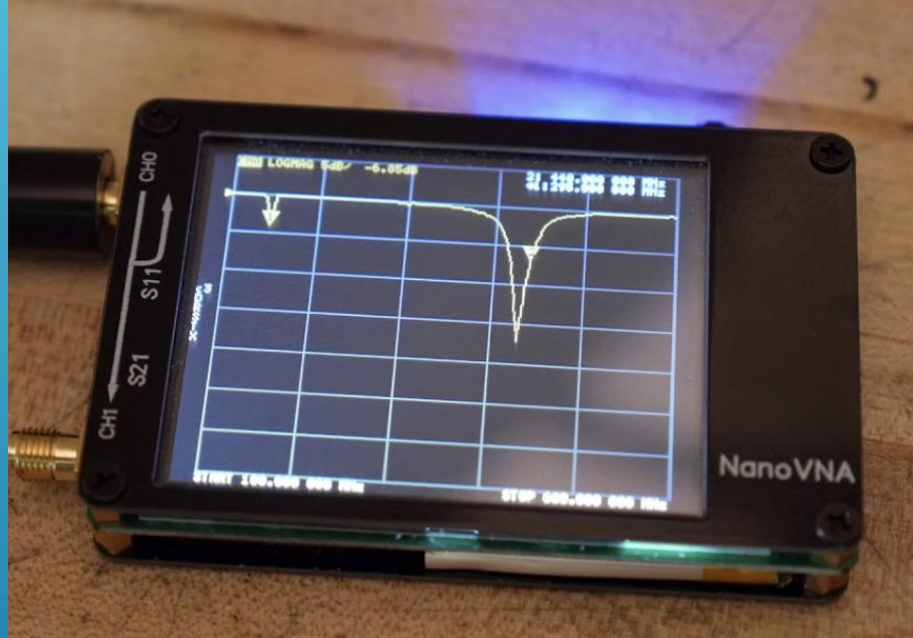
Some come with Li-ion battery
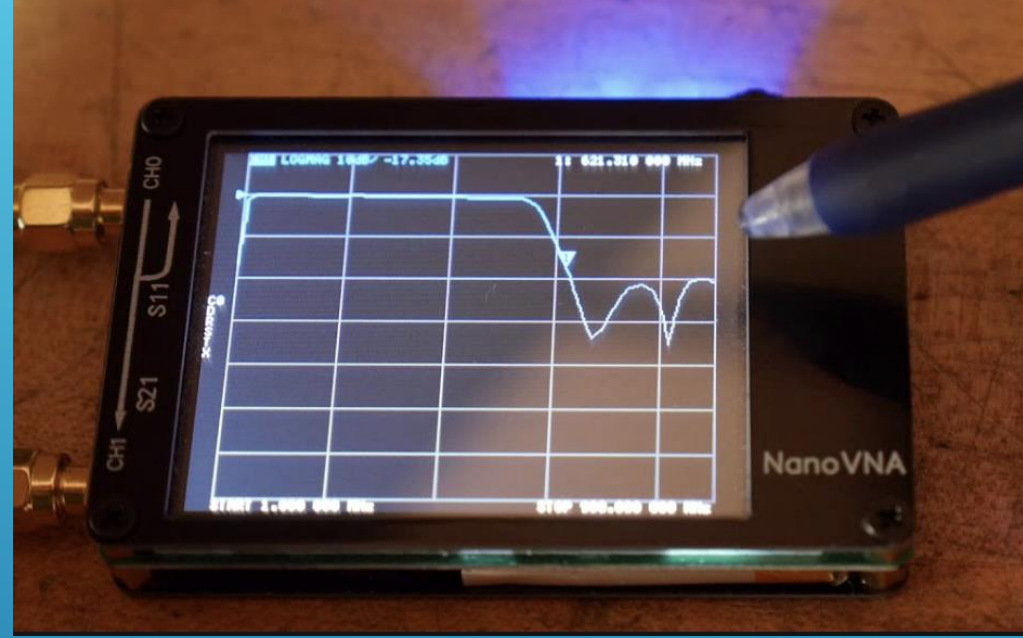
System Block Diagram:

WHAT'S INSIDE?

- Si5351A Clock Generator
- TLV320 AIC3204 I2S/PCM interface audio codec
- STM32 Microcontroller
- LCD
- SA612AD Mixer-Oscillator

Antenna Analyzer

Filter Analyzer

USES FOR THE NANO VNA

Multiple Ways to Display

Both SWR and Return Loss

- SWR ratios are something that are common to Amateur Radio and some other radio hobbyists. Usually in commercial radio, antenna performance is measured as return loss in Db. The NanoVNA defaults to this mode out of the box, but can be set to display either or both, as well as Smith charts, and others
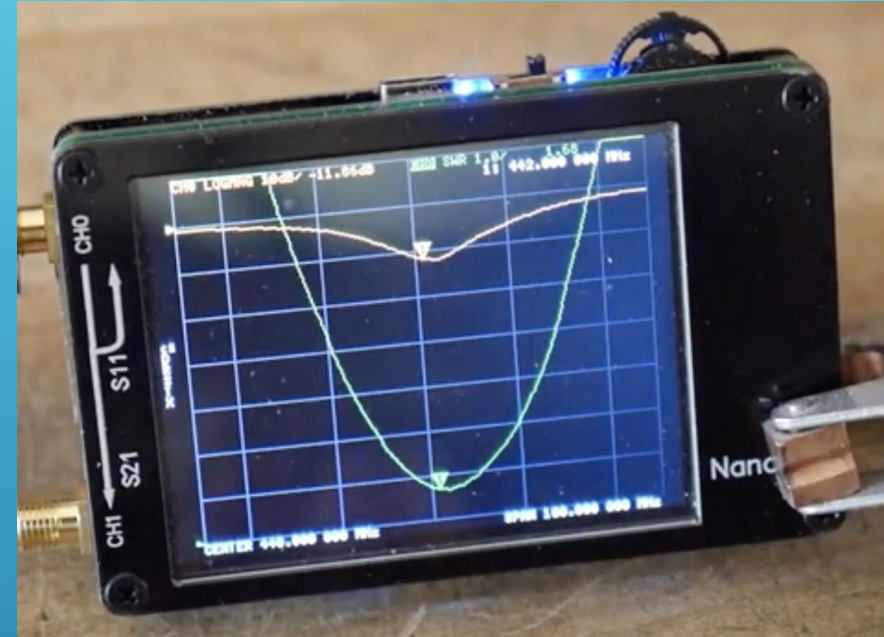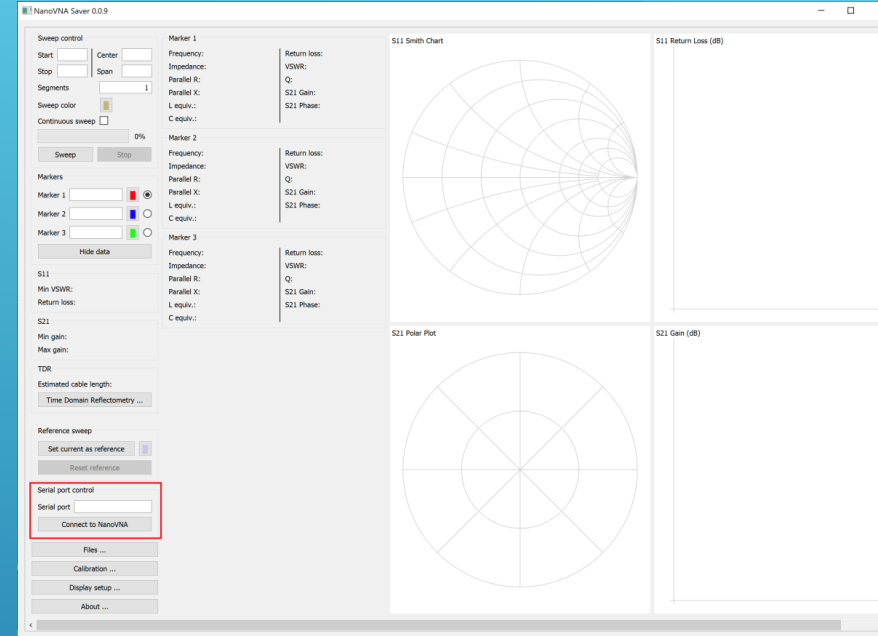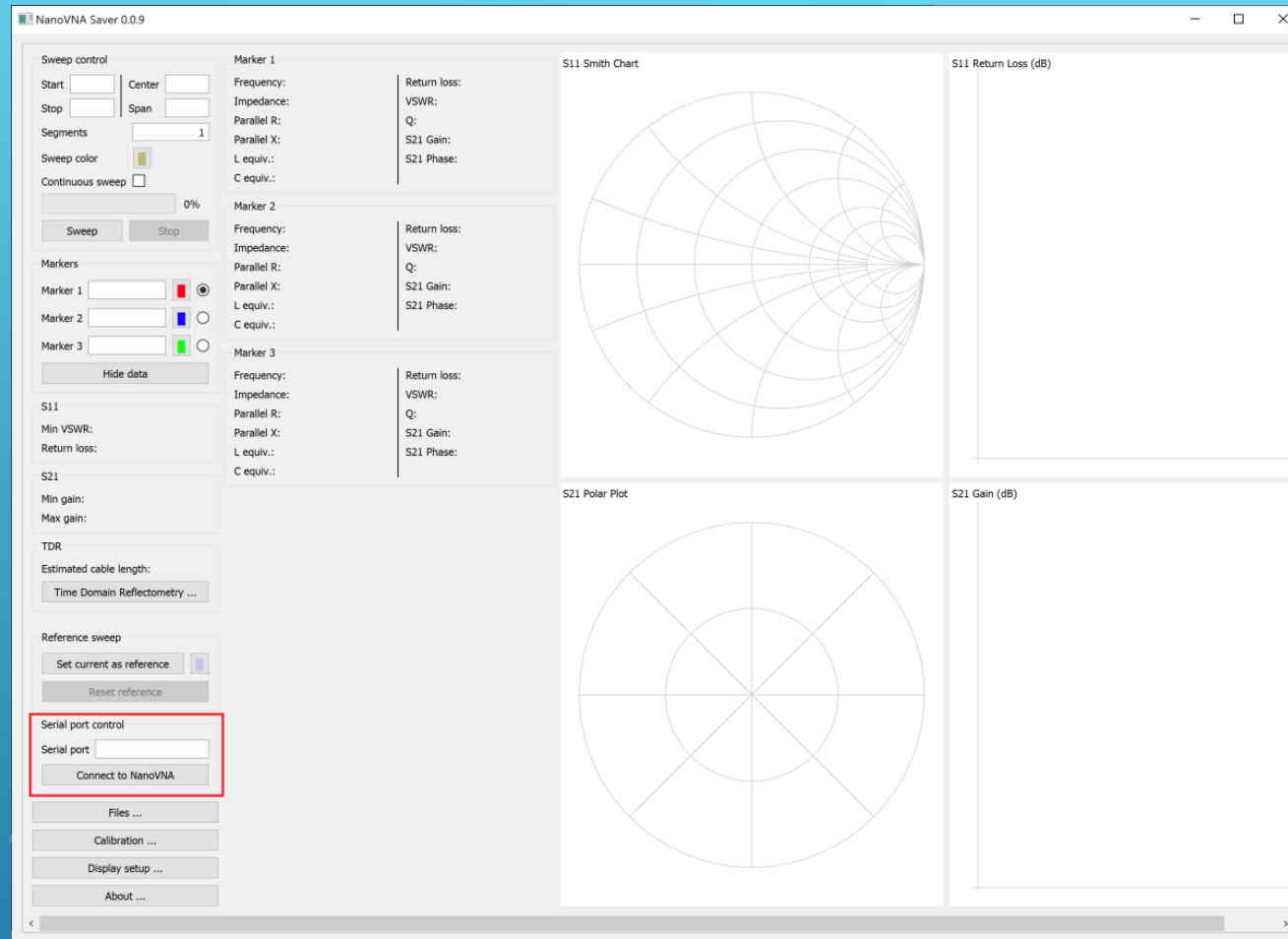

MULTIPLE DISPLAY MODES
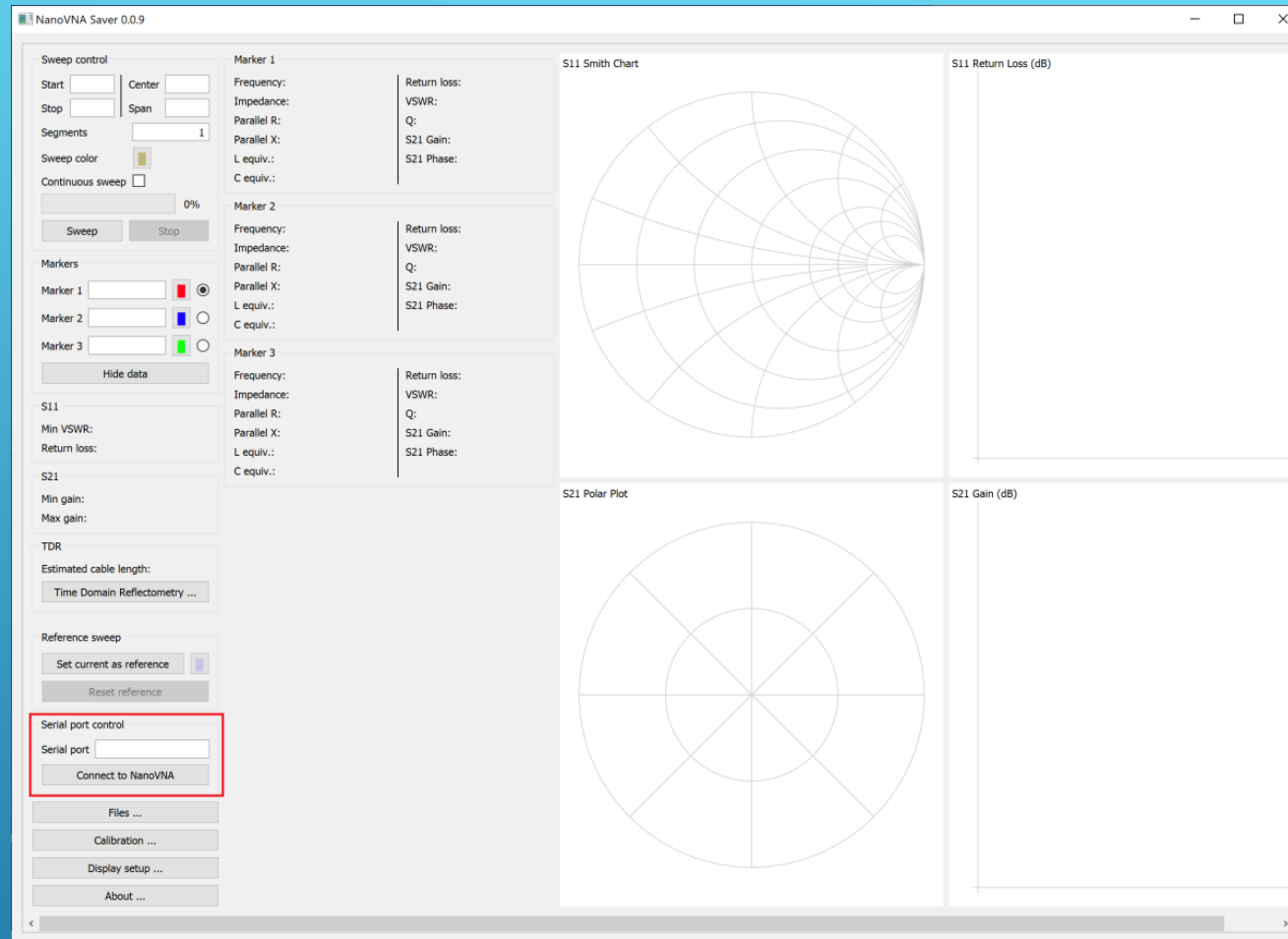
Cable Analysis
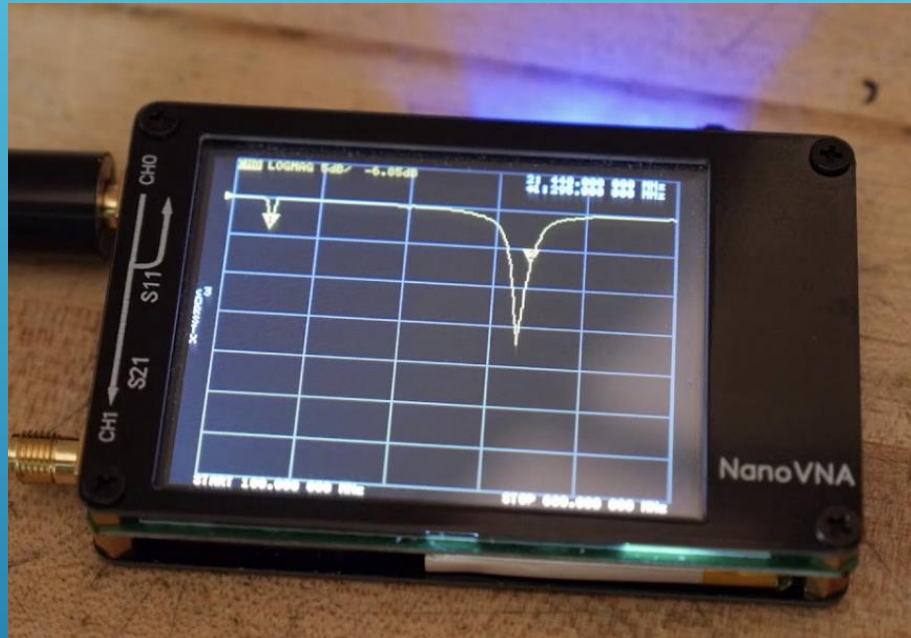
More Uses With Software

MORE USES FOR THE NANO VNA

NANOVNA SAVER

Python software. Easy install on Windows. A little more complicated on a Mac

All functions of the VNA directly plus some more analysis, like Time Domain Reflectometry (TDR)

- Small and portable

- Includes two SMA male jumpers

- Female barrel coupler and male coupler

- 50 Ohm load, shorted load, and open load

- Some come with Li ion battery

- USB C connector for data and charging

- Some models range 100kHz to 300 MHz

- Most now to 900 MHz

- Recent firmware updates to 1.5 GHz

- Amazon seller KKMOON is where I got mine

- ALL OVER eBay, but roll the dice

WHAT, WHERE, HOW MUCH?

Information will be posted on my blog: FOFIO!

Go to neilgoldstein.com and click on the link to FOFIO!

SOME OF THE LINKS AT THE BLOG:

- Comparison with "real" VNA
  - Read how well it does in the real world
- RTL-SDR.com reviews and articles
- Original open source project
- Electronics-notes.com primer on VNA's
- Hex and Flex guides 1, 2, and 3
- NanoVNA-saver download and source