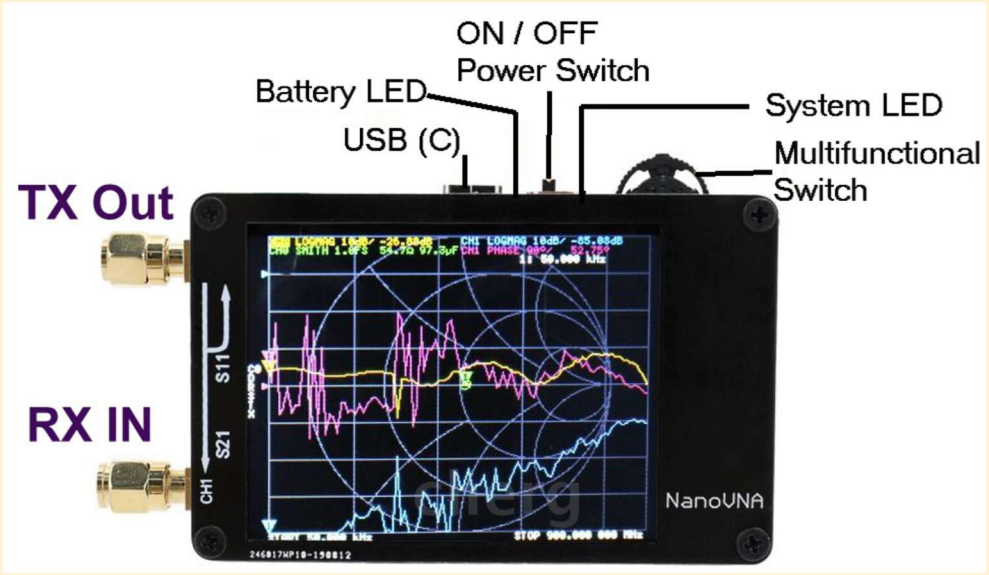
NanoVNAH-4

Vector Network Analyzer



West Chester Amateur Radio Association
Presentation by Bob Fay - WBØNPN

NanoVNAH-4

Donated By

Ron Leedy – WB8ONG

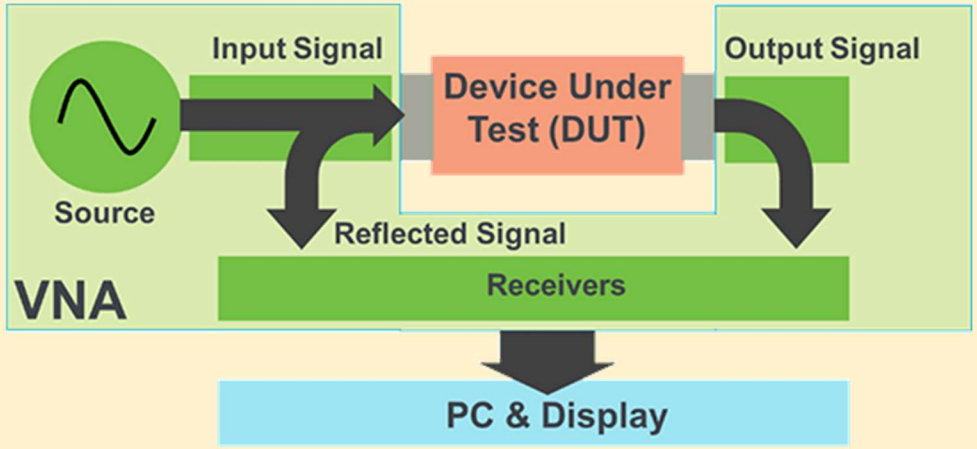
Contents

a) Two short coaxial cables (normally: RG174) with SMA connectors on both ends
b) A USB-C connection cable to a PC
c) **A SOLT calibration set (SOLT = Short / Open / Load / Through**). It consists of four parts:
Short = I**deal short circuit** in an SMA plug
Open = **Ideal open circuit** in the form of an SMA plug that just has a small open tube inside.
Load = **Ideal SMA Termination (male) of 50Ω**
Through = **SMA coupling with sockets at both ends (SMA, Female to Female adaptor.**

What Is A Vector Analyzer?

An instrument that measures both amplitude and phase of an electrical signal.

A Vector Network Analyzer 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 device-under-test or DUT.



Capabilities of a VNA

Measure the frequency parameters of most circuits

Resistance, capacitance, inductance

Characteristics of filters

Antenna resonance & SWR

Coax parameters – Time domain - velocity factor, length

Review Some Basic Electricity

Electrical Circuits Contain

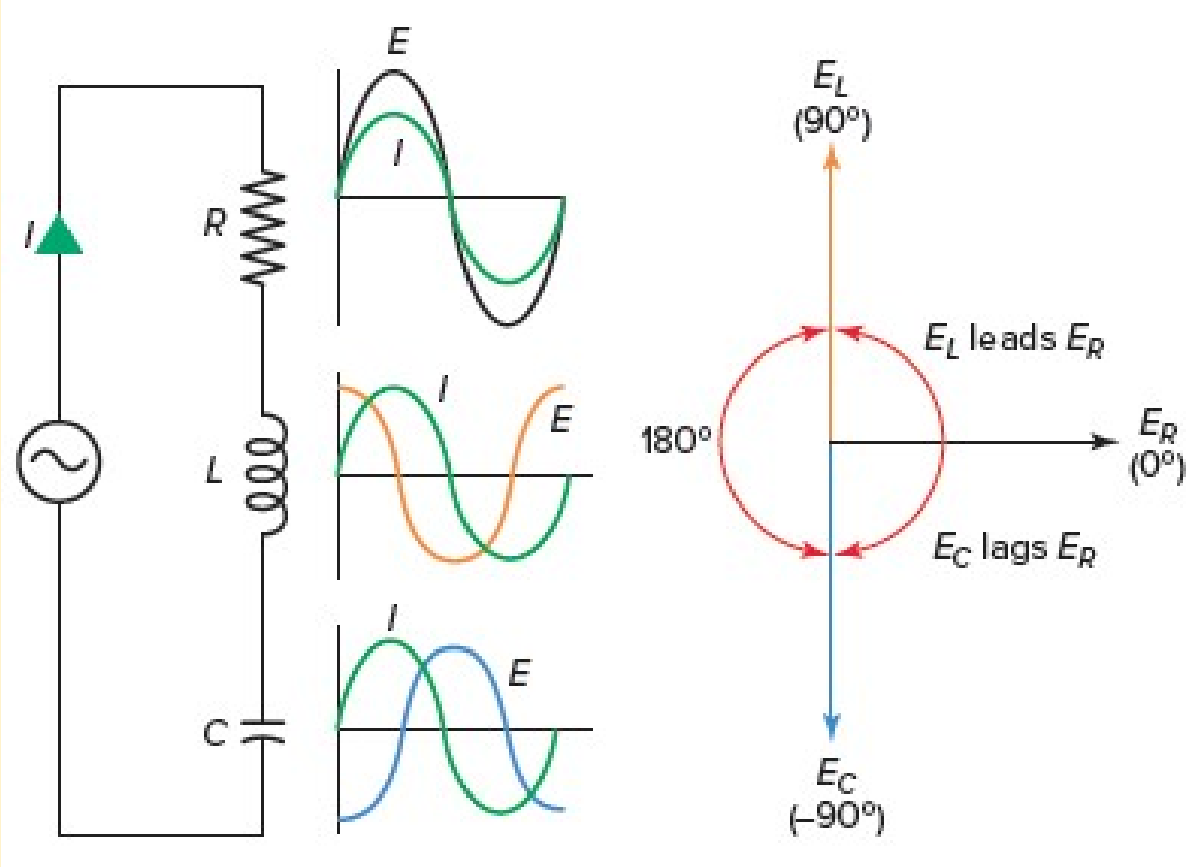
Resistance

Capacitance

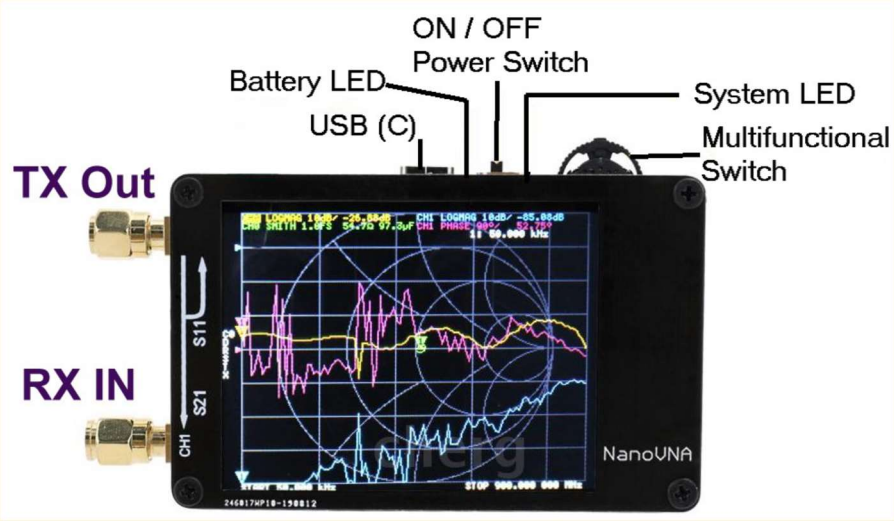
Inductance.

These are the parameters that a VNA will analyze and display

Phase Relationships



Here Is The NanoVNAH-4

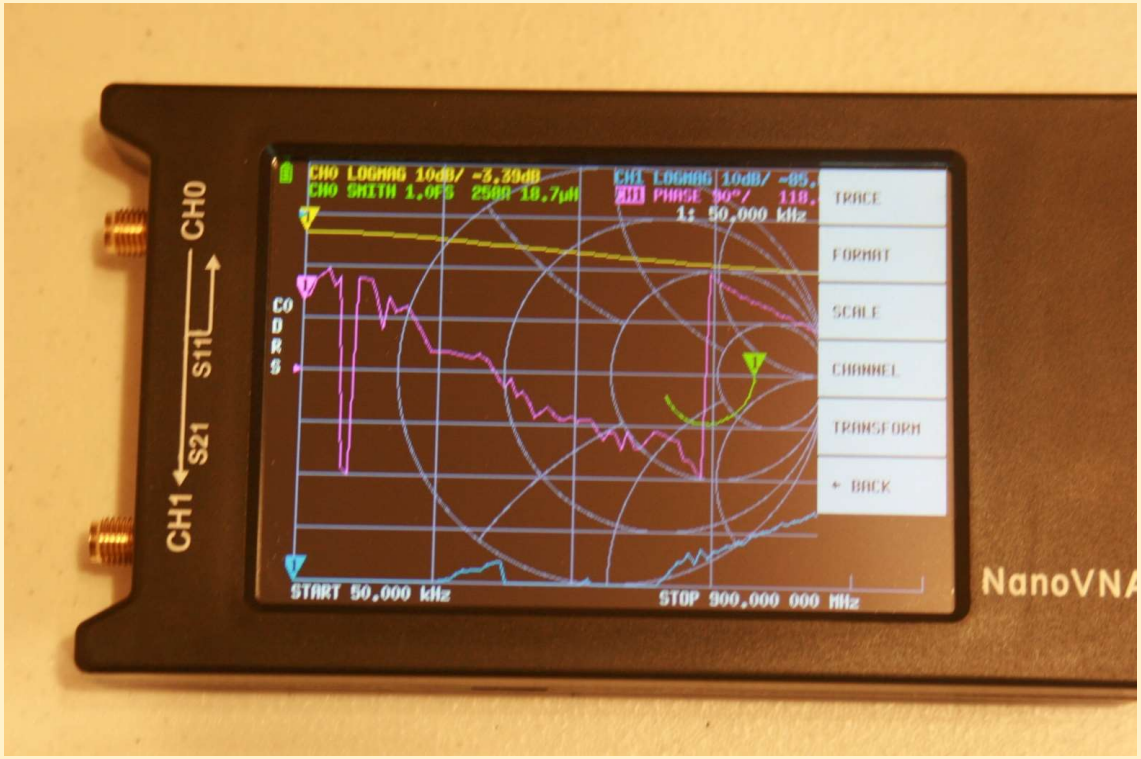


The upper socket is the transmit port (CH0) and is also the channel for S11 measurements (reflection).

The lower socket is the receive input (CH1) and used for transmission measurements (S21) conductive.

There are two types of S parameters of this two port device. The convention is letter "S" followed by two numeric digits first one is the port from where output is derived while second one is the port where input is to be fed.
For EXAMPLE: S12 -> Here Port-1 is the output port and Port-2 is the input port.

Let’s Power Up



This represents the stand alone mode. The device can also be connected to a computer using available software.

The menu tree is displayed either by touching the screen or depressing the rocker switch on the top of the unit.

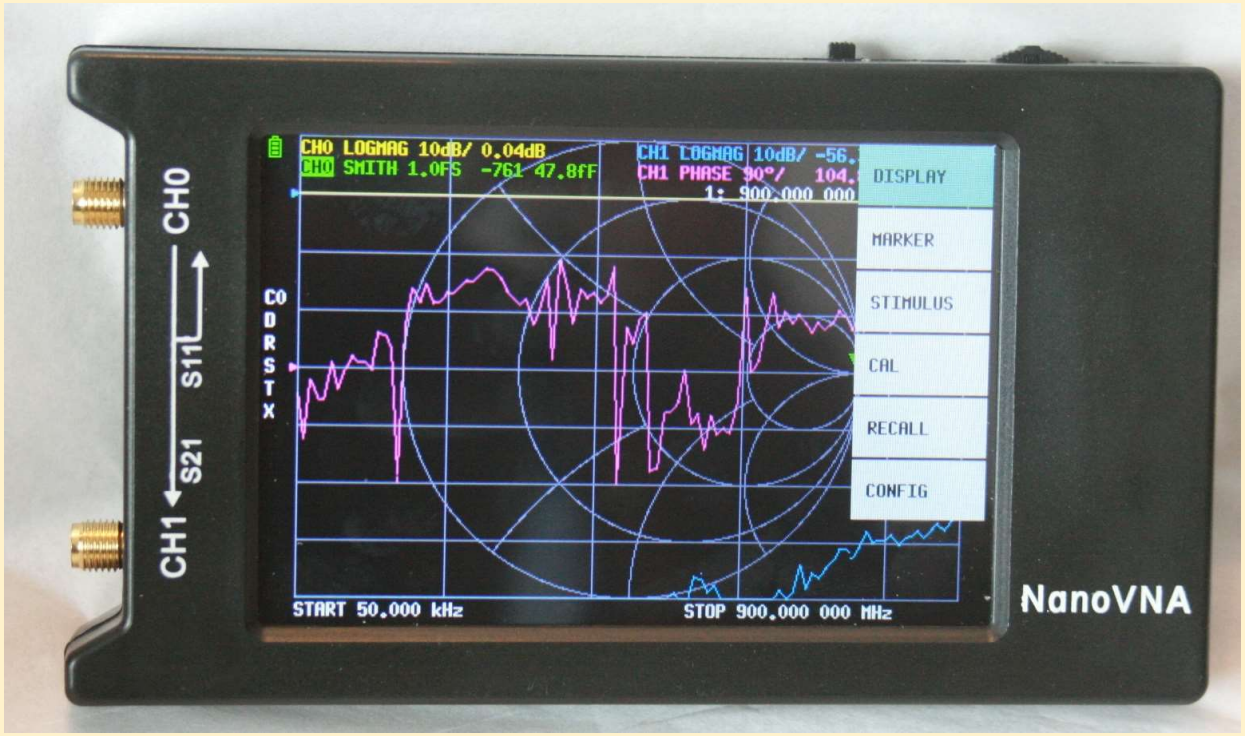
Connecting the VNR

This is a two port VNR

Reflected measurements connect to port 0 (S11)

Conductive measurements connect between port 0 and port 1 (S21)

Let's Power Up



The screen displays the traces that are available for circuit analyzation. The most recognizable is the Smith Chart. The other traces represent various programmable inputs from the two ports.

The upper part of the screen shows the parameters of each trace.

Trace Definitions

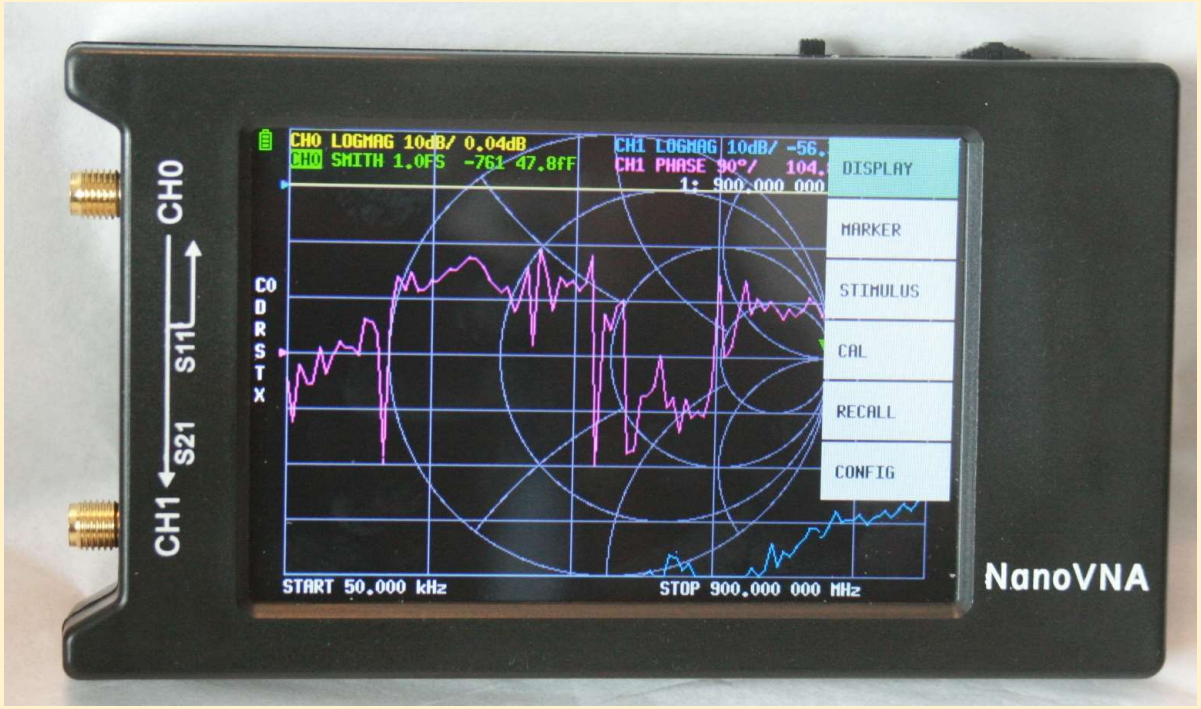
- LogMag – Logarithm of absolute value of measured value
- Phase – Phase angle in the range of -180 to +180 degrees
- Delay – Delay time in seconds
- Smith – Smith Chart
- SWR – Standing Wave Ratio
- Polar – Polar coordinate format
- Linear – Absolute value of the measured value.
- Real – Real number of measured value
- Imag – Imaginary number of measured value
- Resistance – Resistance component of the measured impedance
- Reactance – The reactance component of the measured impedance.

Let's Power Up

The unit contains a low level transmitter with a frequency range of 50 KHz to 300 MHz. Output is on CH0. Output frequency range is programmable and displayed at the bottom of the screen.

Receiver measurement range is 50 KHz to 1500 MHz.

Let's Power Up



The transmitter sweeps between the low and high ranges programmed. As it powers up, it is sweeping the entire 50 KHz to 300 MHz in 100 steps.

Let’s Power Up

To check a 2m antenna for SWR, the unit would be programmed for 144 MHz to 148 MHz.

**As you might have already guessed,
programming of the unit may be a challenge.**

**Tapping the screen or depressing the stepper switch
on the top displays the menu bar.**

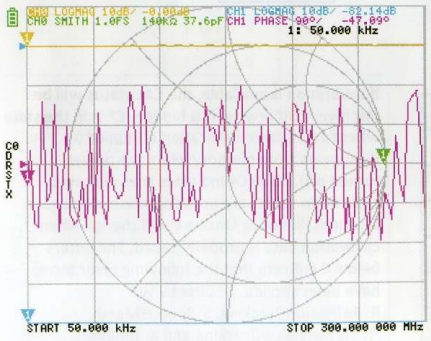
Here is the truth table for menu selection.

NanoVNA 菜单结构图

主菜单

- 显示
- 标记点
- 频率参数
- 校准
- 回调
  - 回调 0
  - 回调 1
  - 回调 2
  - 回调 3
  - *回调 4*
  - 返回
- 设置
  - 触摸校准
  - 触摸测试
  - 保存设置
  - 版本
  - 固件更新
    - 重启>更新模式
    - 返回
  - 返回

nanovna.com



- 迹线
  - 通道0 反射
  - 通道1 传输
  - 返回
- 格式
  - 对数幅度
  - 相位
  - 群延迟
  - 史密斯
  - 驻波比
  - >更多
    - 极坐标
    - 线性幅度
    - 实部幅度
    - 虚部幅度
    - 电阻
    - 电抗
    - 返回
  - 返回
- 比例
  - 比例/刻度
  - 参考电平
  - 电延迟
  - 返回
- 通道
  - 迹线 0
  - 迹线 1
  - 迹线 2
  - 迹线 3
  - 返回
- 时域变换
  - 打开变换
  - 低通脉冲
  - 低通阶跃
  - 带通滤波
  - 窗口
    - 最小
    - 正常
    - 最大
    - 返回
  - 速度因子
    - 软键盘
  - 返回
- 返回

- 选择标记
  - 标记 1
  - 标记 2
  - 标记 3
  - 标记 4
  - 全部关闭
  - 返回
- >起始
- >终止
- >中心
- >扫宽
- 返回

- 起始
- 终止
- 中心
- 扫宽
- 单点频率
- 暂停扫描
- 返回

软键盘

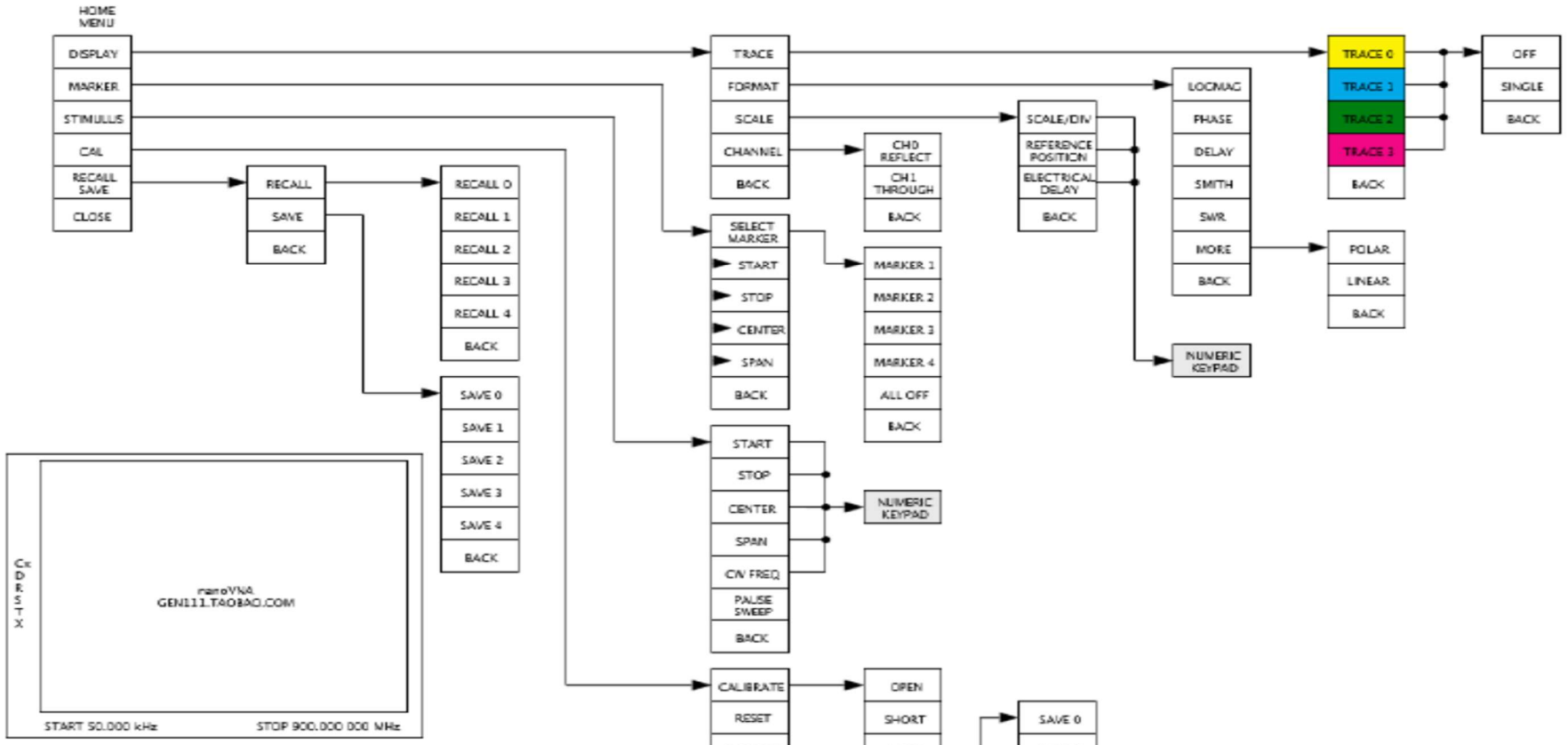
- 校准
  - 开路
  - 短路
  - 负载
  - 隔离
  - 直通
  - 完成
  - 返回
- 保存
  - 保存 0
  - 保存 1
  - 保存 2
  - 保存 3
  - *保存 4*
  - 返回
- 重置
- 应用
- 返回

如果下一菜单项为空或点击屏幕空白处关闭菜单

**虚线斜体项目表示该项在大字体版本不可用*

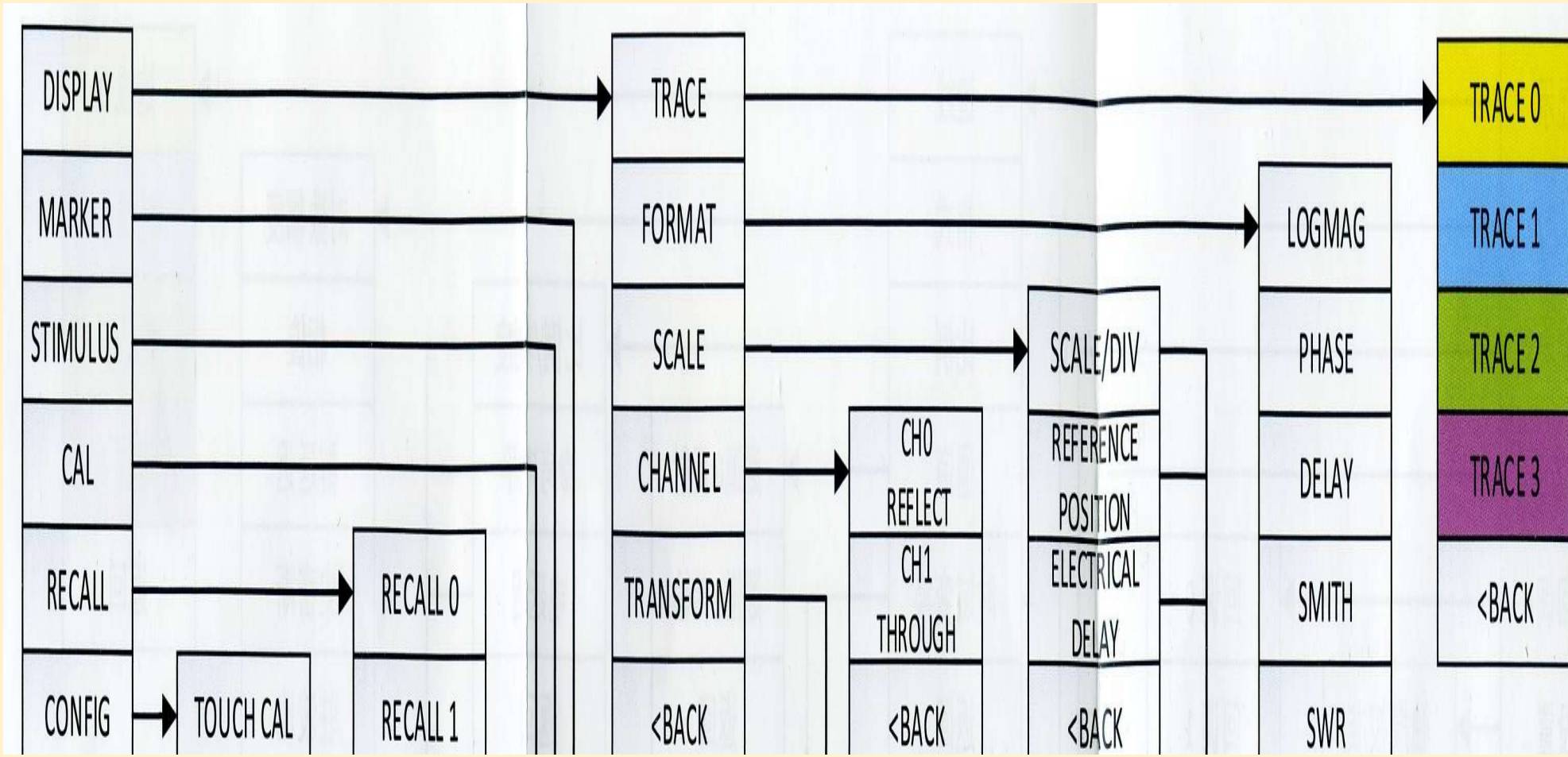
如果校准数据可用，左侧显示CAL状态。 否则，它是隐藏的。
C*表示有未保存的数据（关闭电源后从内存中消失）。
C0至C4表示校准值已保存在这个位置。
C下方的字母表示已应用的校准参数：
D：方向性； R：反射跟踪；
S：源匹配； T：传输跟踪； X：隔离。

NanoVNA Menu Structure Map

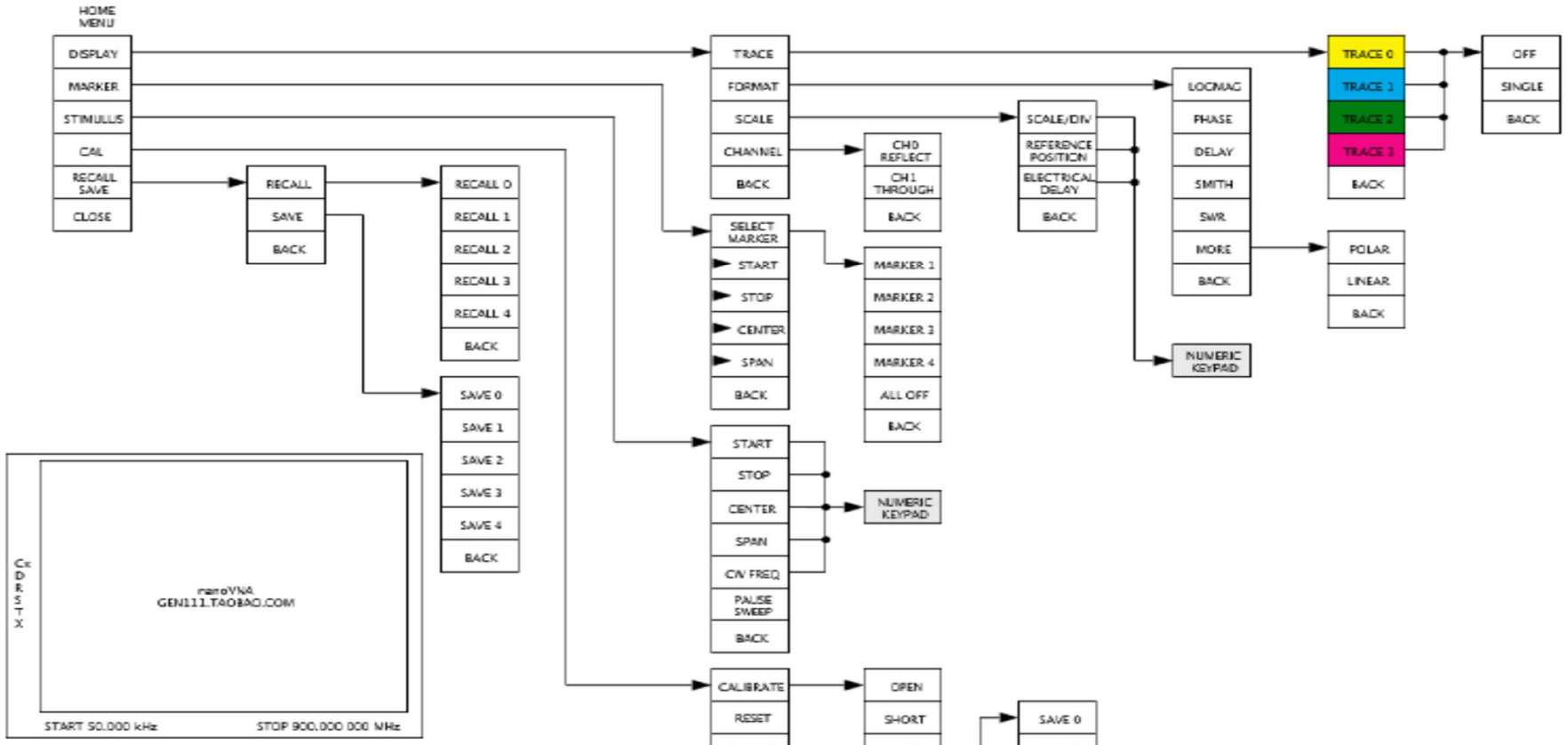


If calibration is available, the CAL status will be displayed. Otherwise, it is hidden. **C *** is in the state where an unsaved calibration is applied (it disappears from memory when the power is turned off).
C0 to **C4** Indicates that the saved calibration values are applied to one of the save locations. Saved or Unsaved will change when calibration data is properly saved. The letters below **C** indicate that the following error terms have been applied. **D: Directivity, R:** Reflection Tracking, **S:** Source Match, **T:** Transmission Tracking and **X:** Isolation

By: AE5CZ
Date: 26 July 2019
Release: 1.1


DISPLAY
MARKER
STIMULUS
CAL
RECALL
CONFIG
TOUCH CAL
RECALL 0
RECALL 1
TRACE
FORMAT
SCALE
CHANNEL
TRANSFORM
<BACK
CH0 REFLECT
CH1 THROUGH
<BACK
SCALE/DIV
REFERENCE POSITION
ELECTRICAL DELAY
<BACK
LOGMAG
PHASE
DELAY
SMITH
SWR
TRACE 0
TRACE 1
TRACE 2
TRACE 3
<BACK

NanoVNA Menu Structure Map



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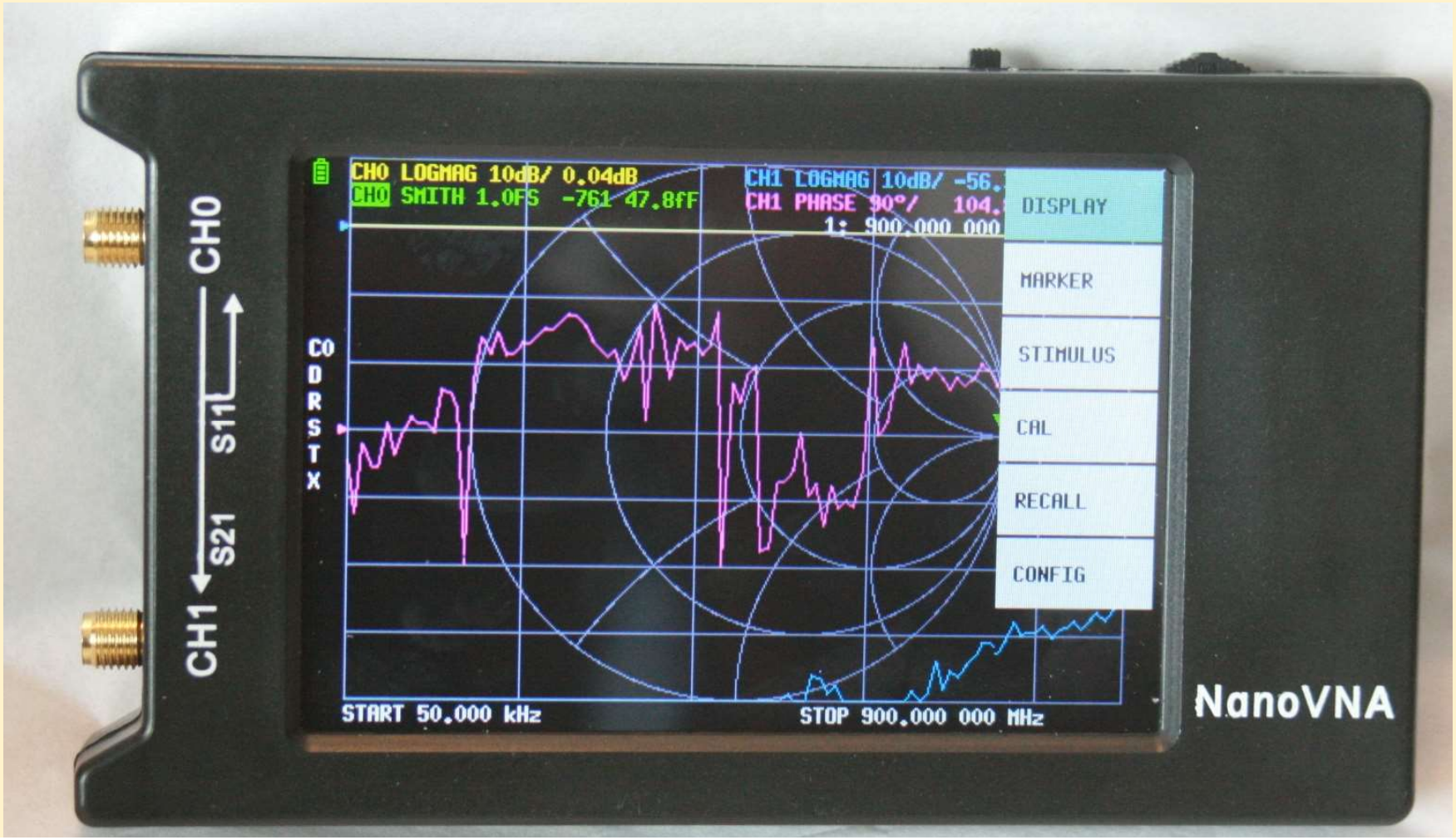
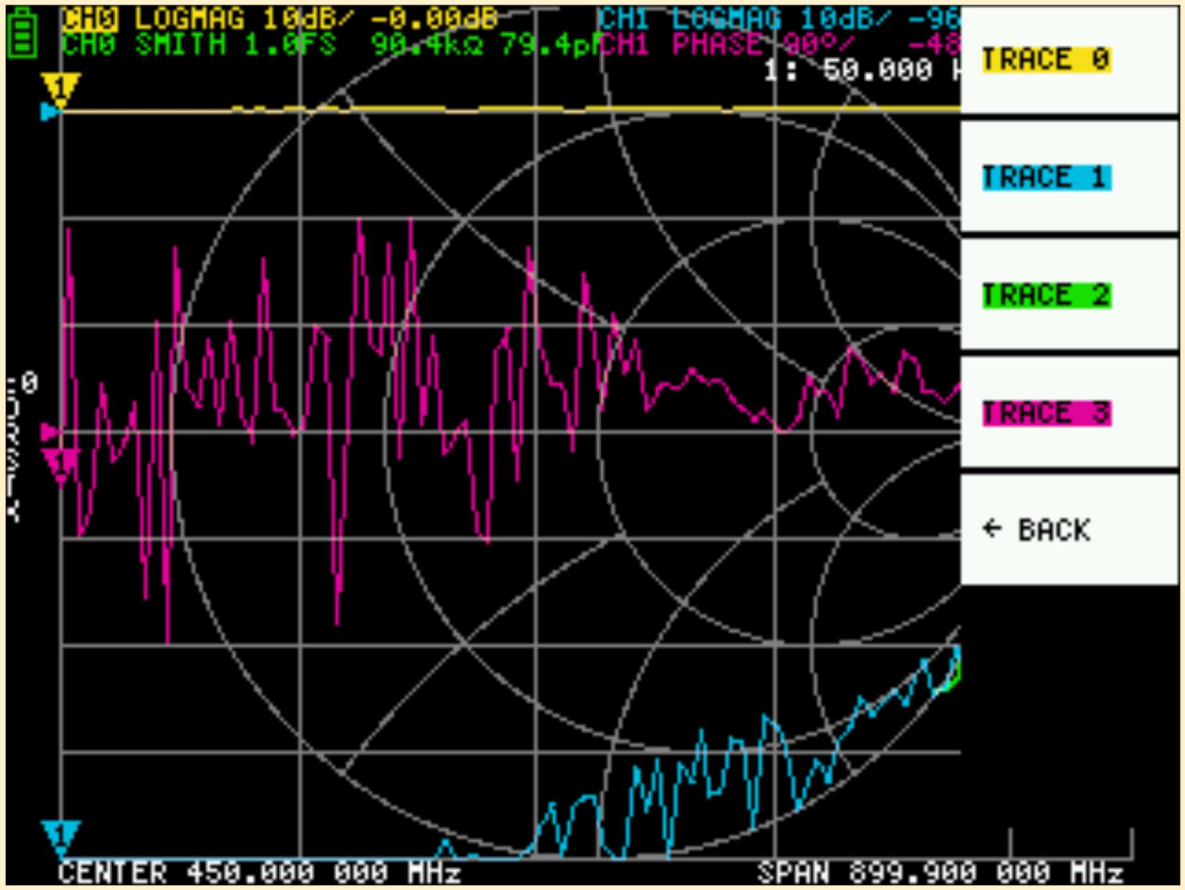
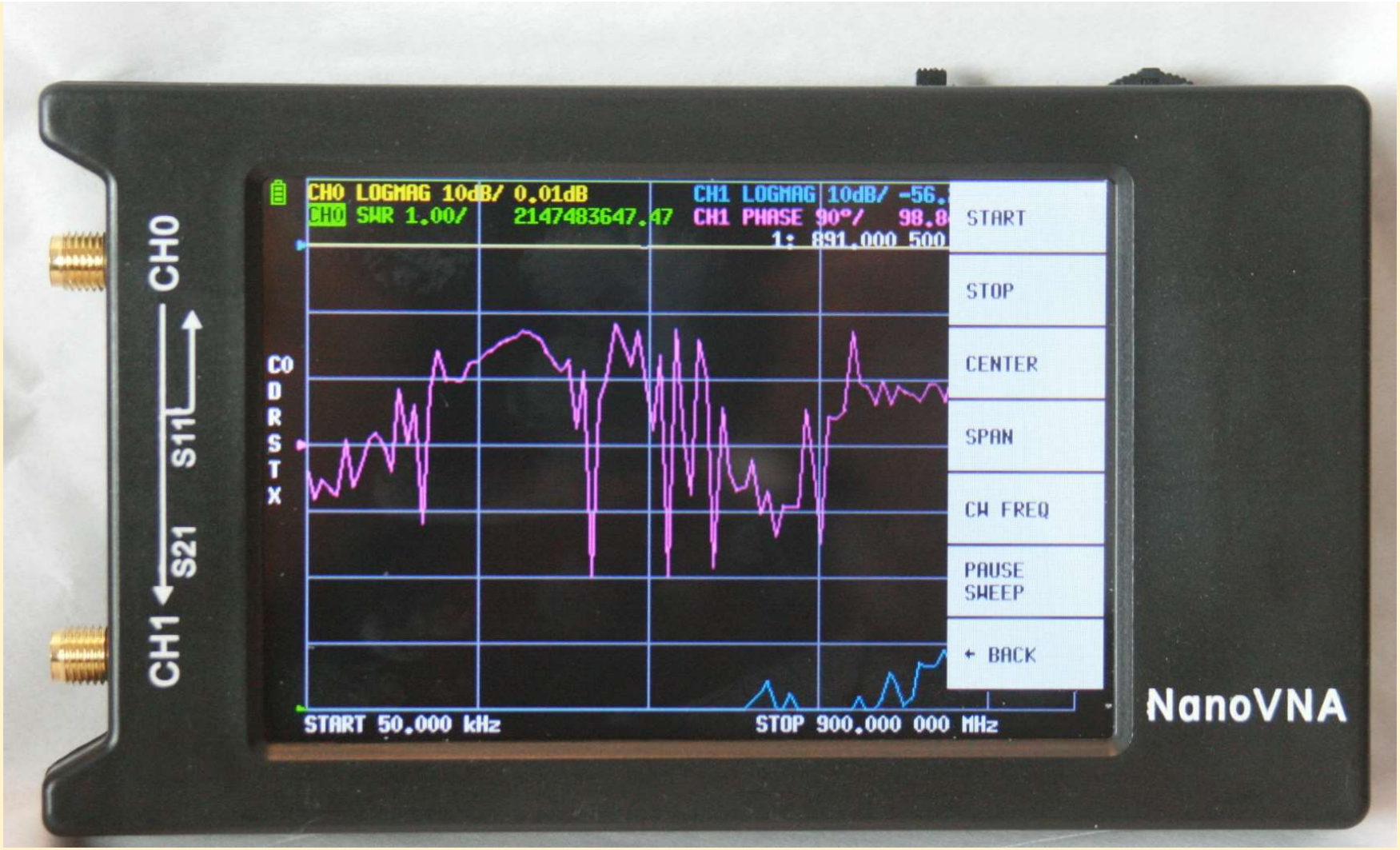
Set Up Steps – SWR Measurement

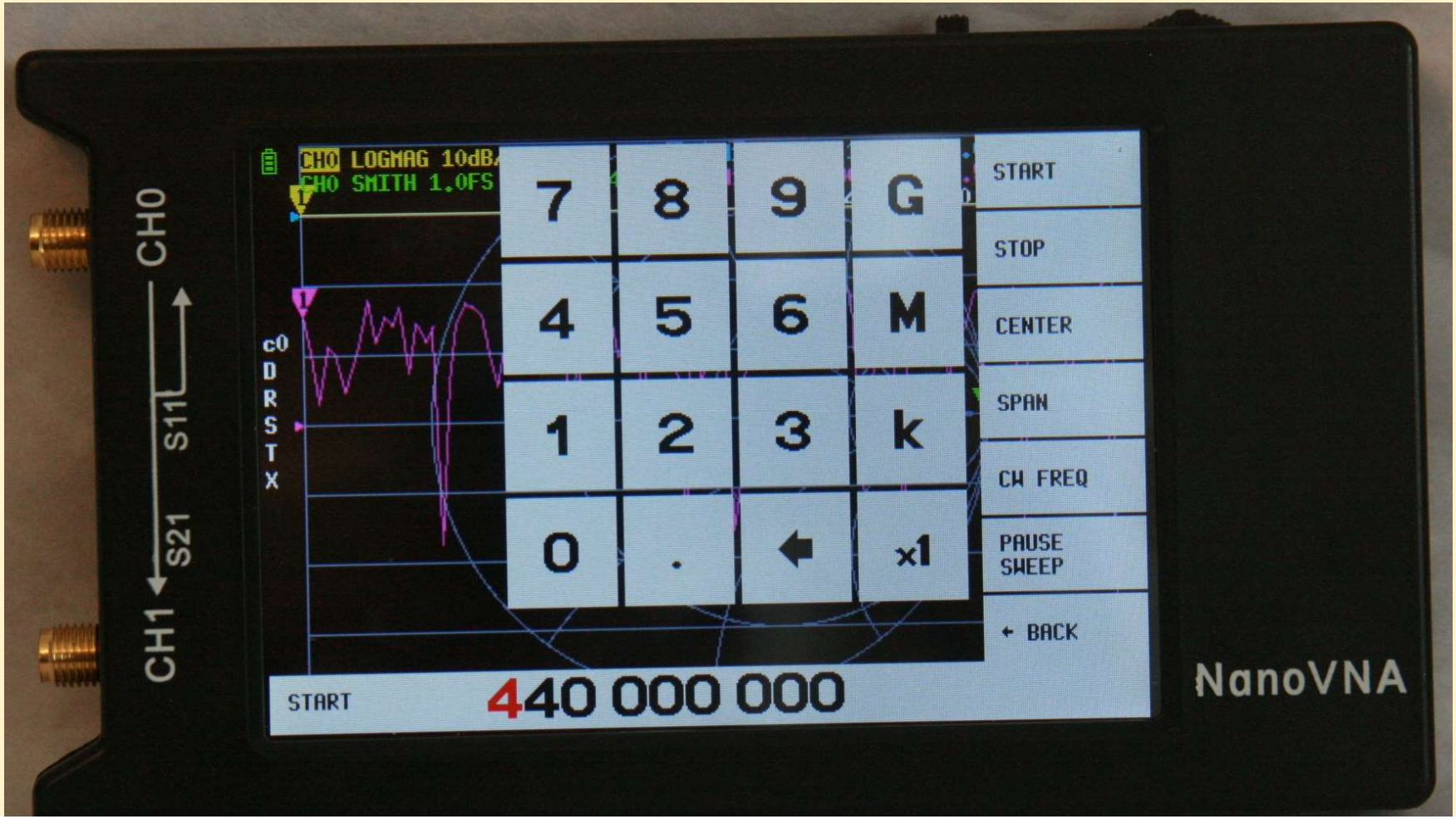
- Determine what you want to measure
- Select the trace you want to display
- Set the format you want to use (SWR)
- Set the frequency spread you want to measure
- Perform calibration
- Use the NVA menu to perform the operations.

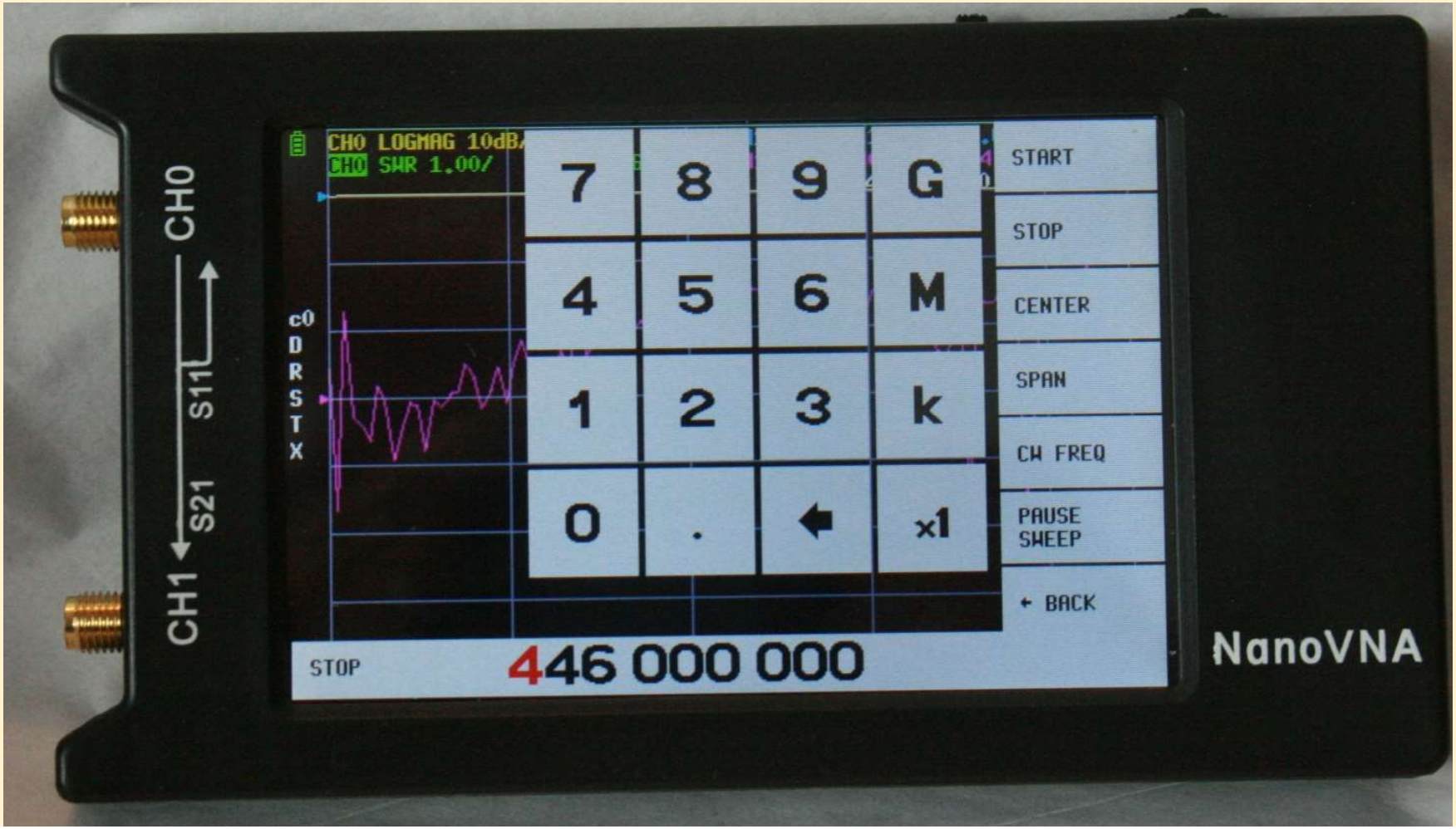

CH0 LOGMAG 10dB/ 0.04dB
CH0 SMITH 1.0FS -761 47.8fF
CH1 LOGMAG 10dB/ -56.
CH1 PHASE 90°/ 104.
1: 900.000 000
DISPLAY
MARKER
STIMULUS
CAL
RECALL
CONFIG
START 50.000 kHz
STOP 900.000 000 MHz
CH0
S11
S21
CH1
CO
D
R
S
T
X
NanoVNA

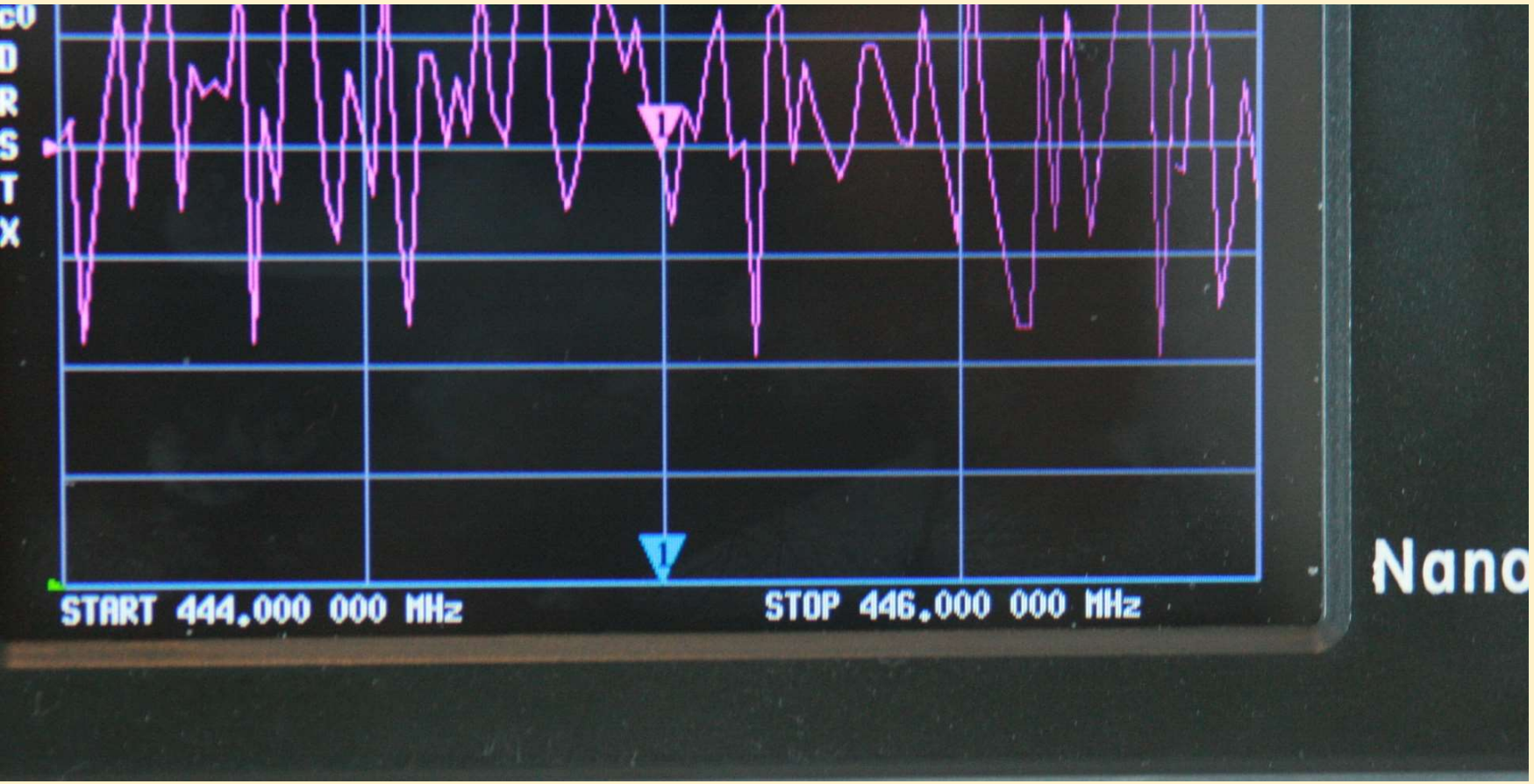

CH0 LOGMAG 10dB/ -0.00dB
CH0 SMITH 1.0FS 90.4kΩ 79.4pF
CH1 LOGMAG 10dB/ -96
CH1 PHASE 90°/ -48
1: 50.000
TRACE 0
TRACE 1
TRACE 2
TRACE 3
← BACK
CENTER 450.000 000 MHz
SPAN 899.900 000 MHz


CH0 LOGMAG 10dB/ 0.03dB
CH0 SMITH 1.0FS -548 48.1fF
CH1 LOGMAG 10dB/ -55.
CH1 PHASE 90°/ 102.
1: 900.000 000
LOGMAG
PHASE
DELAY
SMITH
SWR
→ MORE
← BACK
START 50.000 kHz
STOP 900.000 000 MHz
CH0
S11
S21
CH1
NanoVNA

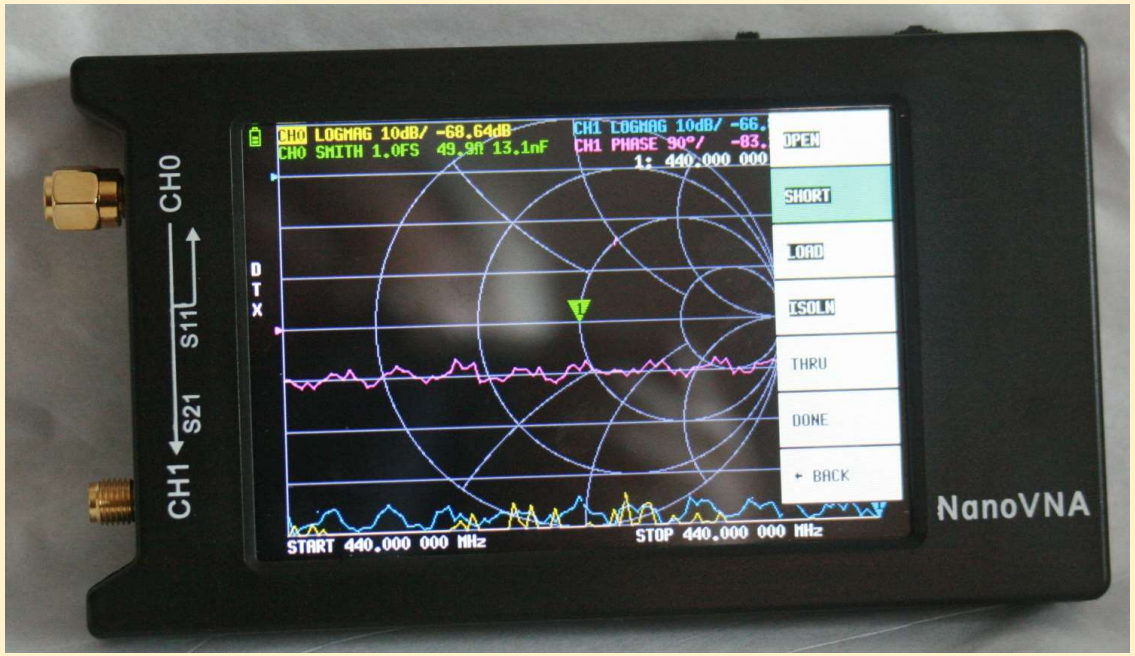

CH0 LOGMAG 10dB/ 0.01dB
CH0 SWR 1.00/ 2147483647.47
CH1 LOGMAG 10dB/ -56.
CH1 PHASE 90°/ 98.8
1: 891.000 500
START
STOP
CENTER
SPAN
CW FREQ
PAUSE SWEEP
← BACK
START 50.000 kHz
STOP 900.000 000 MHz
CH0
S11
S21
CH1
NanoVNA


CH0 LOGMAG 10dB/
CH0 SMITH 1.0FS
7
8
9
G
4
5
6
M
1
2
3
k
0
.
x1
START
STOP
CENTER
SPAN
CW FREQ
PAUSE SWEEP
← BACK
START
440 000 000
CH0
S11
S21
CH1
NanoVNA


CH0 LOGMAG 10dB/
CH0 SWR 1.00/
7
8
9
G
4
5
6
M
1
2
3
k
0
.
x1
START
STOP
CENTER
SPAN
CW FREQ
PAUSE SWEEP
← BACK
STOP
446 000 000
CH0
S11
S21
CH1
NanoVNA


START 444.000 000 MHz
STOP 446.000 000 MHz

Calibration



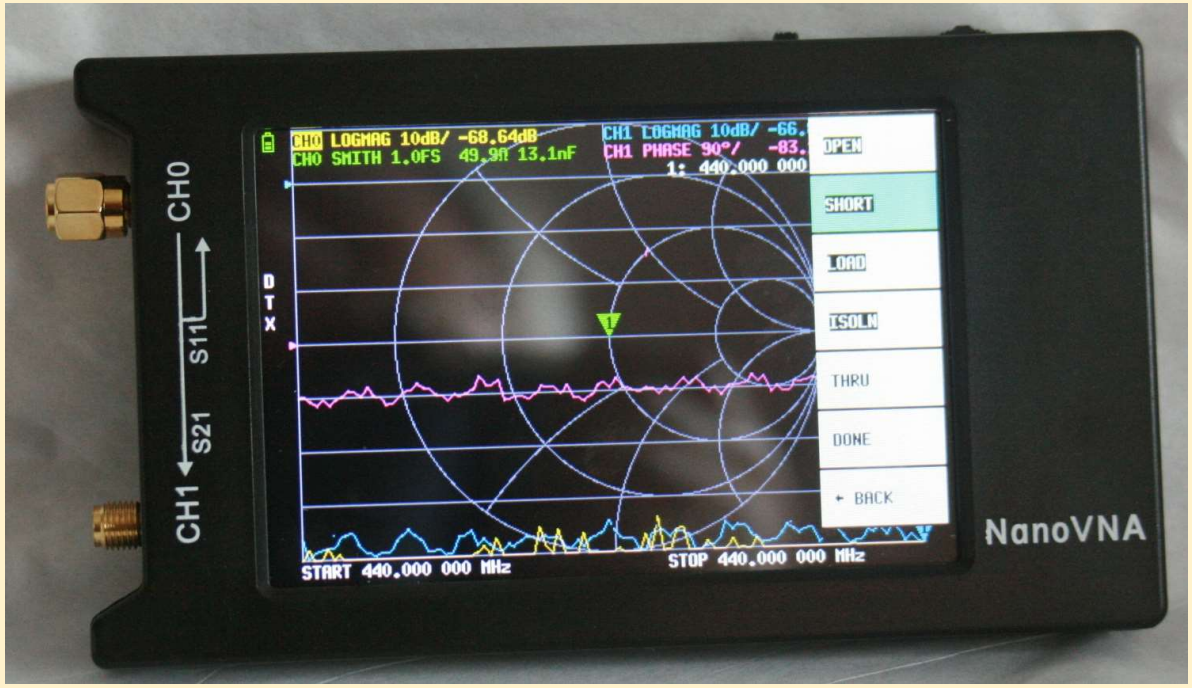
Three calibration plugs are provided.

Open
Short
Load

Identify by looking into them. You can see the obvious difference.

Calibration must be done for each frequency range, and can be saved in a memory.
Calibrate in the Open, Short, Load order. Next area to calibrate highlights.
The yellow marker may be moved around the chart to view values at each location.

Calibration



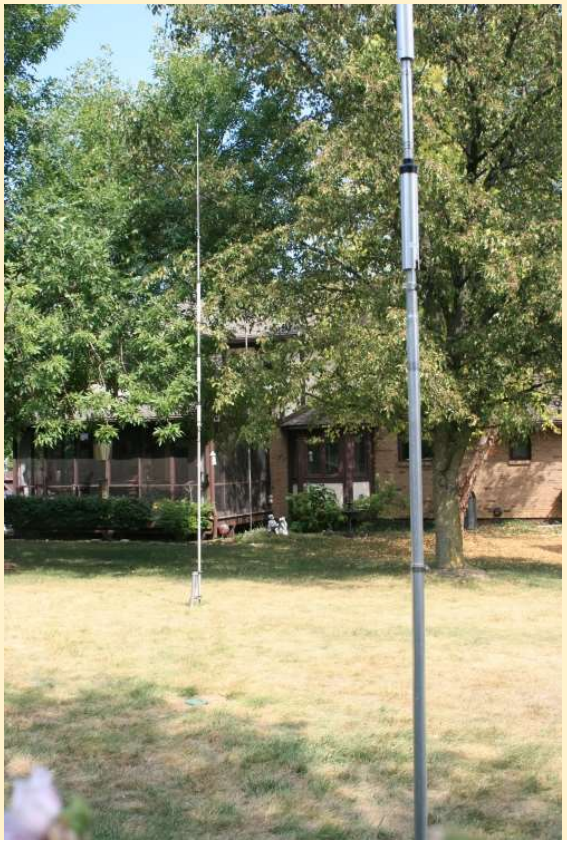
Calibration must be redone if the cable extensions or the feed through are used. The reason is that these change the timing delays by a few pico seconds which affect the testing results.

SHORT: Delay = 51.16ps
OPEN: C0 = 50fF Delay = 48.63ps
LOAD: R = 49.86Ω Delay = 61.59ps
THROUGH: Delay = 50.7ps

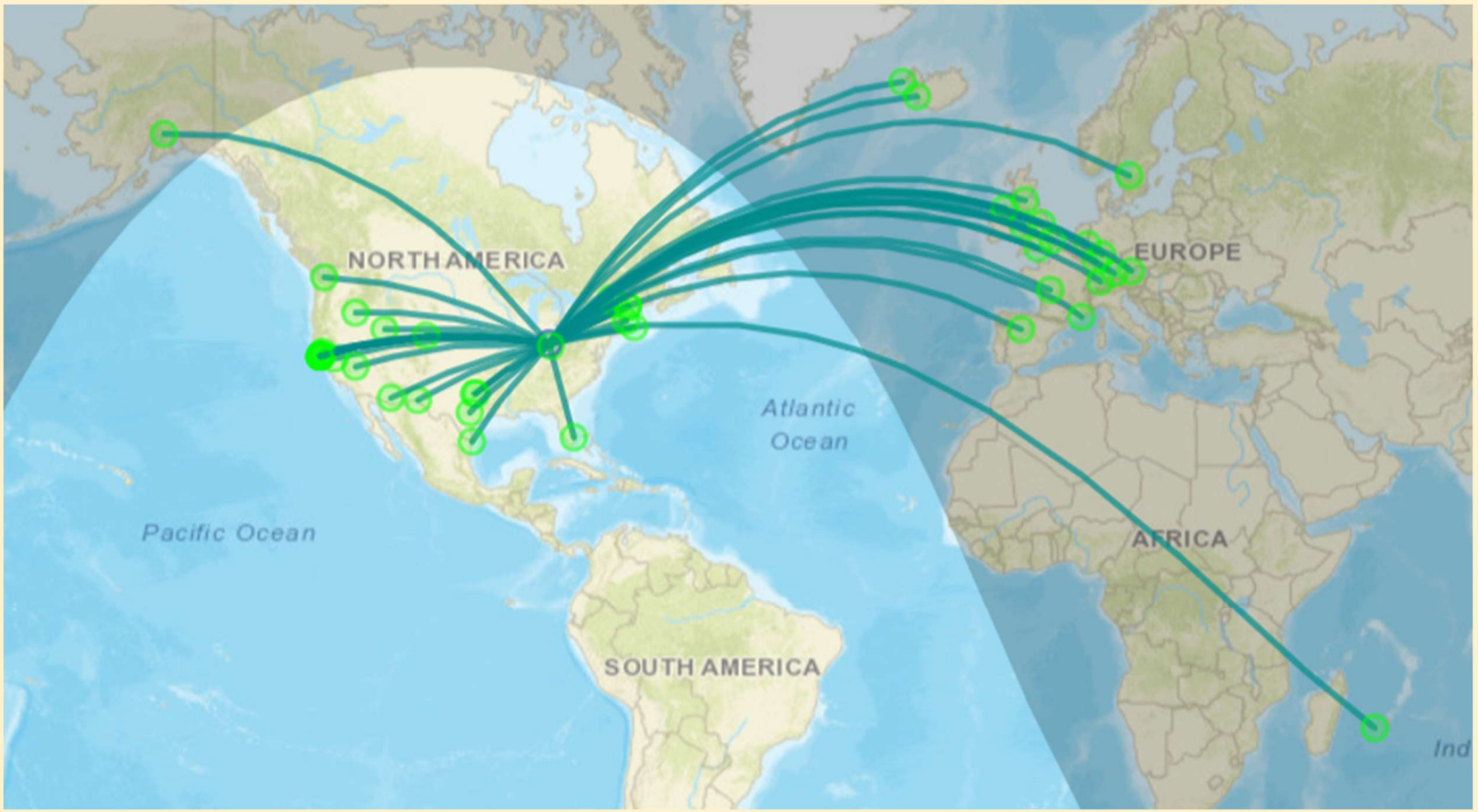
WBØNPN

2 Hy-Gain 14AVQ Phased For 20m & Oriented NE – SW

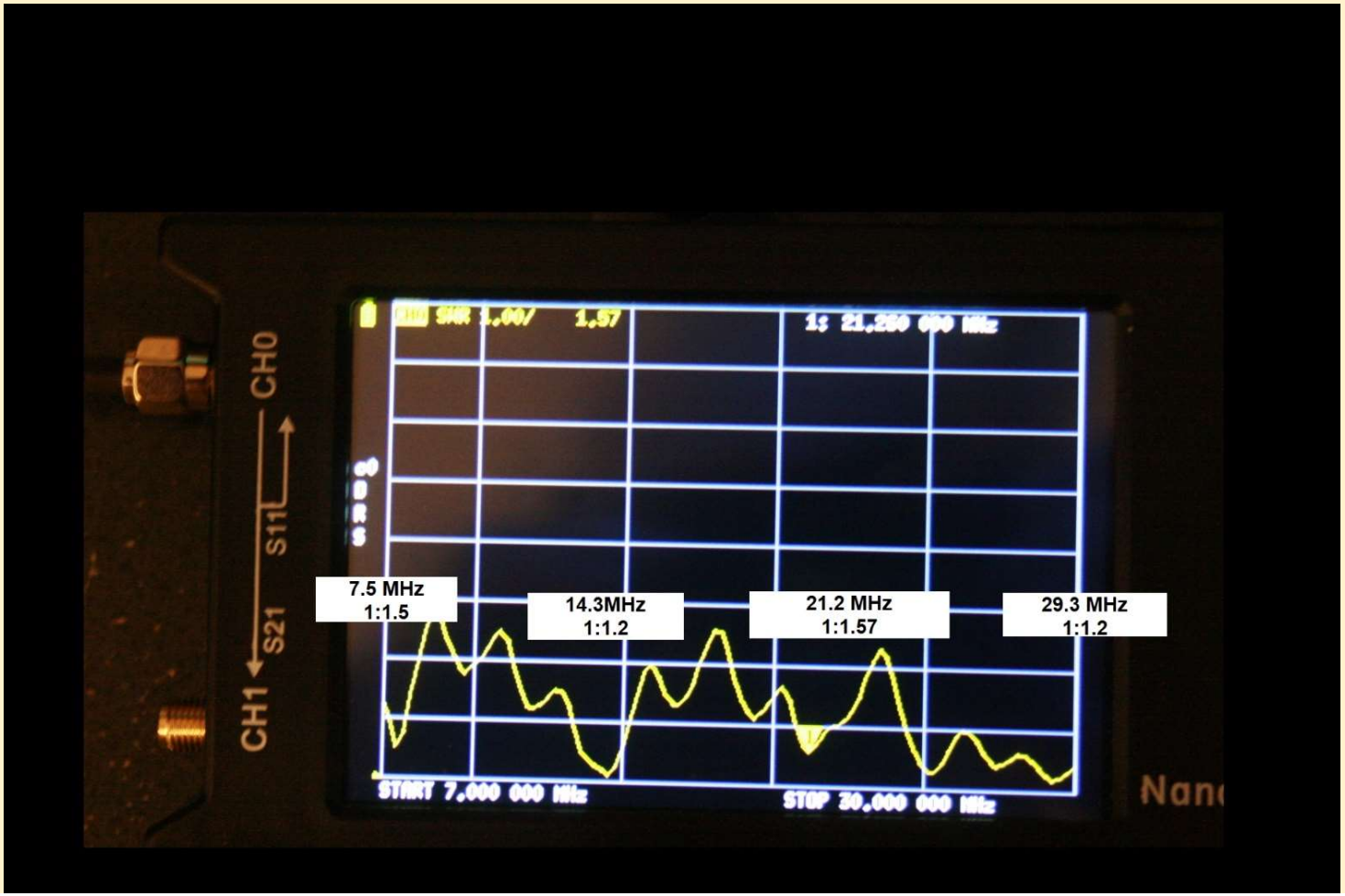
40 m – 20 m – 15 m – 10 m



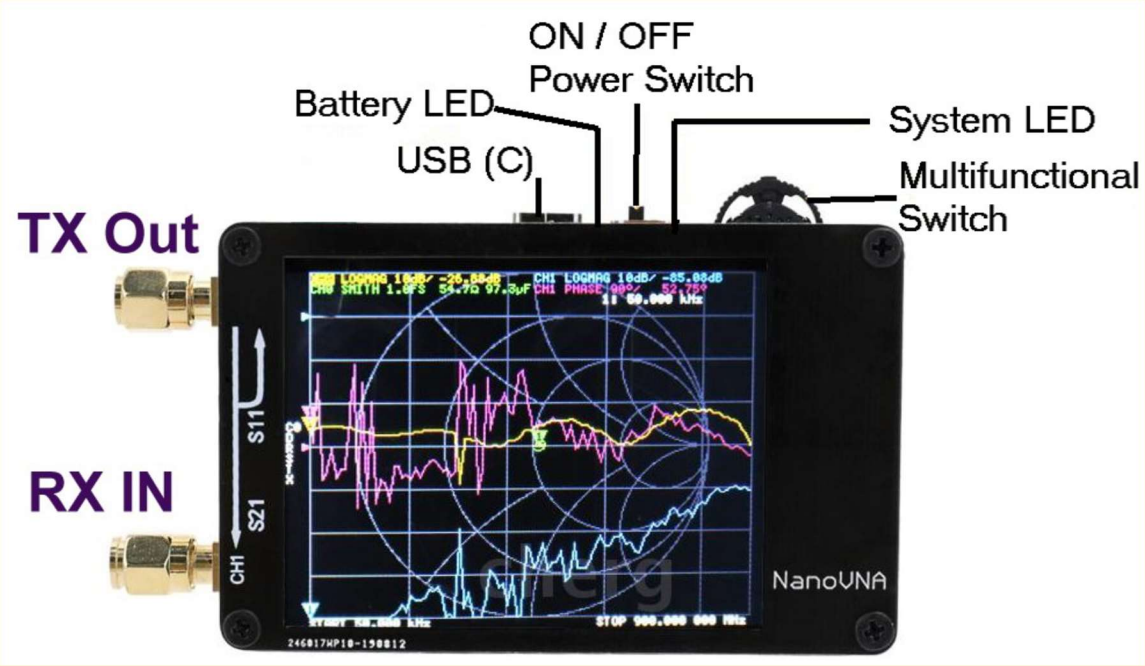
WSPR Directional Pattern Of Phased Andtennas



SWR – 2 Phased 14AVQ Verticals - WBØNPN



A flash drive has been added to the box containing the VNA. It contains two of the programming manuals that have been developed for the unit, and information for adding and using the computer program.



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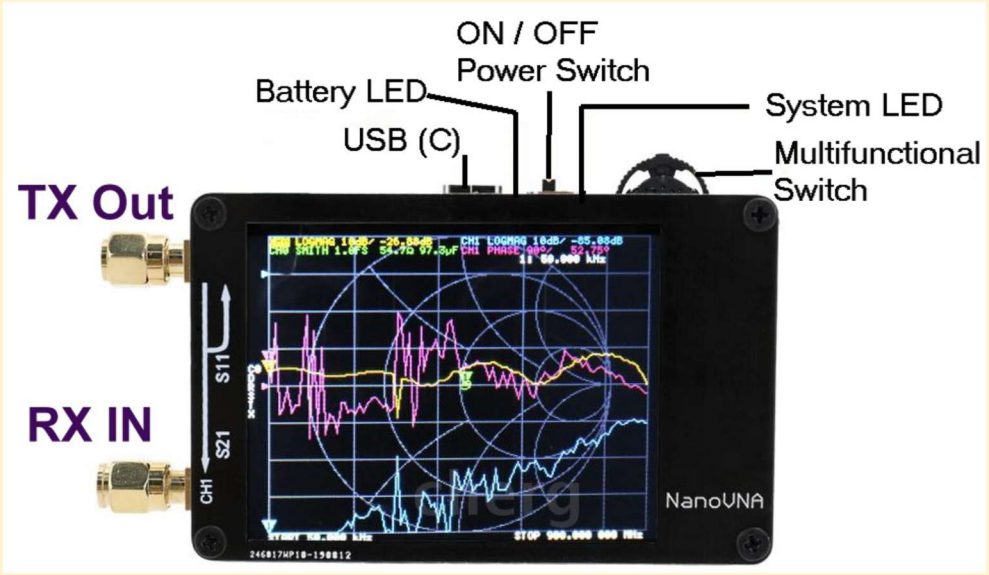

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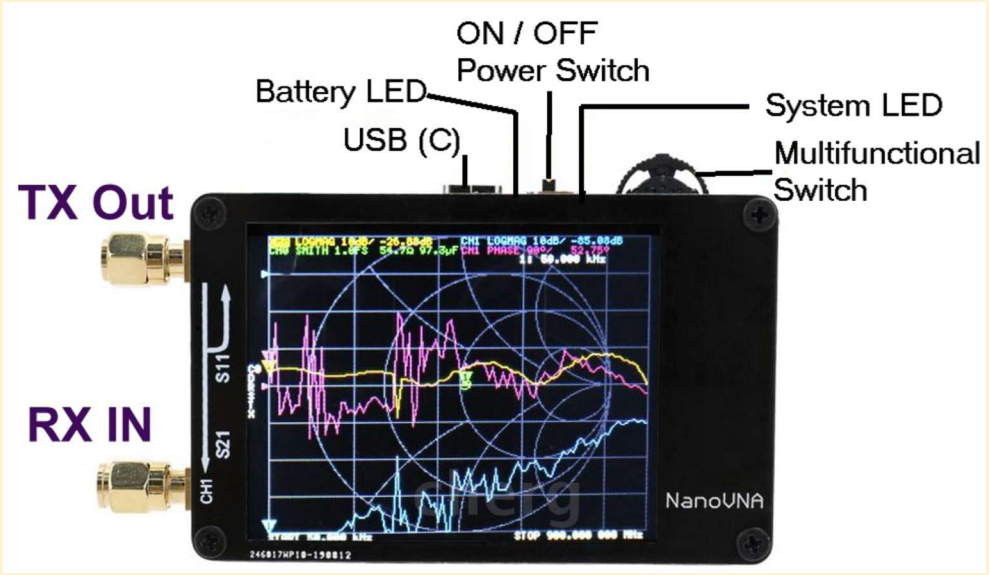
But Wait – There's More


ARISS 20th Anniversary Celebration
20th Anniversary!
Surrey, UK: July 29-30,1998
RS0ISS
NA1SS
17 серия 2/12

NanoVNAH-4

Vector Network Analyzer – The Final End



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