

NanoVNA H4 Vector Network Analyzer

AD6AE

This article covers setting up and saving four test configurations:

- (1) Default 'Antenna Analyzer' on power-up
- (2) Single band antenna measurement setup
- (3) Measuring coax or insertion loss
- (4) Measuring coax length or distance to a fault.
- (5) 'Extra' VNA tips and notes that are good to know.



NanoVNA H4 Showing 'Port Savers'

This article is focused on the new user and applies specifically to VNA Model H4; Menu Maps may differ between makers and, if like mine, won't even be the correct one; so, I've included one in Figure 1b. that may apply; if not, it will be close. Copy and Paste it. It will expand to a full page guide. Initially, the **Menu Map** is intimidating; after using it a few times, it won't be.

*Video links in the examples, give a better, more detailed explanation. Most videos are for older models and may differ slightly. First, watch the video, become familiar with it; then perform setup steps that have been taken from that video; **However**, there is one Exception: Example 1 does not fully reconcile with the video by W2AEW; rather it configures a default, full-featured, antenna analyzer, on power-up that is versatile and user friendly.*

What is a VNA? A Vector Network Analyzer (VNA) is a specialized instrument used to measure the electrical properties of radio frequency devices; components, cables and antennas. A NanoVNA is a smaller, hobby-level device with many of the same features as the professional units; is portable, easy to use, and has reasonable accuracy for a much, much lower cost.

Home Menu Definitions.

- **DISPLAY:** Assigns measurements to different traces and charts; moveable markers and scale per division values.
- **MARKER:** Assigns up to 8 markers that indicate readings at selectable frequencies for analysis and comparison.
- **STIMULUS:** Sets frequency at fixed, sweep or span ranges. The maximum sweep range is currently 10KHz to 1.5GHz.
- **CALIBRATE:** Establishes a 'Reference Plane' which is the boundary between the VNA port and the outside world. Calibrating compensates for the effects of the internal measuring circuitry that affects accuracy. To ensure accuracy, Calibration must be done when any changing frequency, cables or external hardware setups for the DUT on either ports 1 or 2. **Calibrations are done in a specific order: Open, Short, Load, Isolation and Thru. O.S.L.I.T..** Isolation and Thru - are for calibrating the RX port, Port2 (S21) when measuring devices with both an input and an output; like a coax cable, filter or amplifier.

If temporary recalibration is required, just recalibrate and continue testing. If you want to make it permanent; be sure and tap 'Reset' to clear the old calibration data. Resetting will only affect old calibration data – NOT the setup configuration. if you don't reset, you may get errors.

- **RECALL:** Up to seven test setups (0-6) may be saved, then recalled without having to repeat the setup process.

- **MEASURE:** The VNA can function as a Resonance, Inductance or Capacitance meter; Cable or Crystal tester.
- **MicroSD CARD:** If one is installed, S1P and S2P (measurement) files and screenshots can be saved to it for sharing or archiving. Info is iffy on larger cards but it definitely handles a 32 GB SD card.
- **CONFIG:** User interface: Screen Touch Control/Test, Firmware Version, Brightness, Date/Time, Comm Ports, etc.

Sub-menu Definitions Used in this Article.

- **Trace:** 4-colors available; each one can be assigned to display any of 20 parameters (SWR, SMITH, R, Z, X, Phase, etc.). To turn a trace off; **Tap:** display, Trace, (tap twice to turn off, once to turn on), Back, Back, Home Menu, screen.
- **Start/Stop:** Sets stimulus (frequency ranges or sweep spans) to measure responses of a Device Under Test (DUT).
- **Sweep Points:** An adjustable number of samples that can be taken within a stimulus range (usually set to 401).
- **Search (Maximum/Minimum):** A marker assigned to a trace that will lock onto and follow the max or min value.
- **Scale:** Assign values to horizontal grid lines for each trace. Must be reenabed each time upon power-up.

Experiment: Set up the NanoVNA; connect it to a DUT, length of coax or antenna; go thru the menu settings, make changes and see what happens and get familiar with it. It can't be 'bricked.' If you don't save changes, they will be gone when powering off. Currently, memory locations can be overwritten and updated but not erased without resetting all seven memory locations; hence, a stimulus range will always be displayed in the box and indicating that it's calibrated.

Figure 1a shows a typical NanoVNA kit. **Figure 1b** shows the included Menu Map that may or may not apply to your model – mine didn't. So, one has been included that may match. Copy & Paste it; when expanded, it will fill a regular page.



Fig. 1a

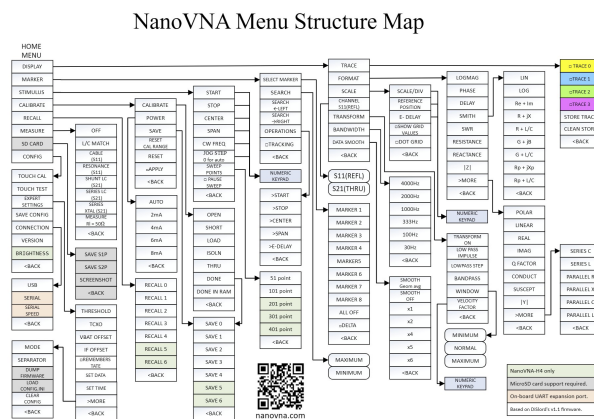


Fig. 1b

EXAMPLE 1. Power-On Default Configuration as an Antenna Analyzer

SWR-Yel Resistance-Blu Smith-Grn Impedance |Z|-Magenta

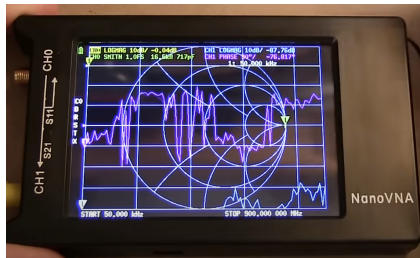


Fig. 2a Factory



Fig. 2b Custom (Scale shown is SWR)

Why a VNA needs to be calibrated & how to calibrate a NanoVNA by W2AEW:

<https://www.youtube.com/>

The following written setup follows the video thru Step 10. From Step 11 onward, it's configured as an antenna analyzer and will be saved in location 'Save0'. All traces may be assigned to display different parameters and scales. However, only one scale can be displayed at a time; others will have to be selected one by one. Notice the white lettering beside the parameters at the top of the display show the value per division in the same color as that trace. When selecting a trace as shown in Fig. 2b, an arrow of the same color will also appear to the left of the trace that's selected (Fig 2b).

NOTE: Tapping anywhere on the screen toggles menus on and off. Sometimes tapping on a menu selection automatically turns the menu off. Just tap on the 'screen' to continue if needed. To make permanent, 'Save' changes when finished.

Stimulus, Channel, Sweep Points

1. Tap: screen, (opens Home Menu).
2. Tap: Display, verify Channel is S11 (REFL), Back.
3. Tap: Stimulus, Start, (opens keypad), 1.8 M.
4. Tap: screen, Stop, (opens keypad), 30 M.
5. Tap: screen, Sweep Points, 401
6. Back, Back, Home Menu.

Calibrate, Assign Traces, Save to Location 0

7. Tap: Calibrate, Calibrate, **Reset**, Calibrate.
8. Attach **Open**, Tap: Open.
9. Attach **Short**, Tap: Short.
10. Attach **Load**, Tap: Load, Back, Apply, remove load. Tap: Back, Back.
11. Tap: Display, Trace, **Trace0**, Back.
12. Tap: Format, SWR, Back

13. Tap Trace, **Trace1**, Back, Format, Resistance, Back.
14. Tap: Trace, **Trace2**, Back, Format, Smith, Back.
15. Tap: Trace, **Trace3**, Back, Format, More, |Z|.
16. Tap: Back, Back, Back, Home Menu.
17. Tap: Calibrate, Save, **Save0**, Back, Back.
18. Home Menu, screen
19. Connect DUT.

Assigning Scale Values to Grid for any Trace

1. Tap: Display, Trace, (Trace#), (note arrow by color on screen) Back, Scale, Scale/Div, (opens Keypad), .25, Ent←, Screen, Show Grid Values, Back, Back.
2. Calibrate, Calibrate, Done, **Save0**, Back, Back.
3. Repeat steps 1-3 if scaling other traces

NOTE 1: On each power-up, to display scale values previously assigned to a trace: **Tap:** screen, Display, Trace, (verify that it's the correct one or select another). **Tap:** Back, Scale, Show Grid Values, Back, Back, **Tap:** screen.

NOTE 2: Stimulus - Steps 3&4: if temporarily changing stimulus or test setup; just change it **without** saving. Readings in the low bands will be close but not accurate; on higher bands, the error will be greater and may require recalibrating. If temporarily recalibrating, but not saving, **do not** tap reset. Just return to measuring. If saving, upon 'Resetting', you must repeat the calibration process then save.

EXAMPLE 2. Configuring A Single-Band Test Setup Which also Demonstrates the Effects of a Tuner. W2AEW Antenna SWR and Effects of Tuning: [#314: How to use the NanoVNA to sweep / measure an antenna system](#)

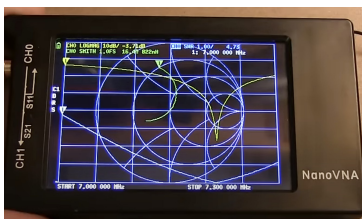


Figure 3.

Set Stimulus, Channel, Sweep Points

- | | |
|---|---|
| 1. Tap: screen, (opens Home Menu). | 5. Tap: Back, Back. |
| 2. Tap: Display, Channel S11 (REFL), Back. | 6. Tap: Display, Trace, Trace0, Back. |
| 3. Tap: Stimulus, Start, (opens Keypad), 7 M. | 7. Tap: Format, Logmag, Back. |
| 4. Tap: screen, Stop, (opens Keypad), 7.3 M. | 8. Tap: Trace, Trace1, Back, Format, Smith, Back. |
| 5. Tap: screen, Sweep Points, 401 (or choose) | 9. Tap: Trace, Trace2, Back, Format, SWR. |
| 6. Tap: Back, Back, Home Menu. | 10. Tap: Back, Back. |

Calibrate, Assign Traces, Save to Location of Choice

- | | |
|---|--|
| 1. Tap: Calibrate, Calibrate, Reset, Calibrate. | 11. Tap: Trace, Trace3, Back, Format, Z . |
| 2. Attach Open , Tap: Open. | 12. Tap: Back, Back, Back, Home Menu, screen. |
| 3. Attach Short , Tap: Short. | 13. Tap: Calibrate, Save, Save(#) , Back, Back. |
| 4. Attach Load , Tap: Load, remove. | 14. Home Menu, Tap: screen. Attach DUT. |

Settings are saved for 40 meter band tests

EXAMPLE 3. W2AEW Measuring Coax Or Insertion Loss using a NanoVNA <https://www.youtube.com/>

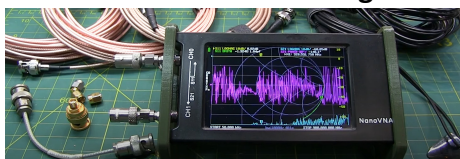


Figure 4. Showing, Cables, Adapters, OSL Standards and a short 'Thru' Coax Jumper

NOTE: The vertical white letters shown on the left side of the screen above indicate the test is Calibrated and memory location where settings are saved (0-6). If the unit is temporarily recalibrated for tests and NOT saved, letters will be red. If changes are made but not saved, they will not affect the current settings and will be lost when powering off.

The Jogging (rocker/pushbutton) switch is located on the top right of the VNA; it's also a push button when in 'Configure' Mode

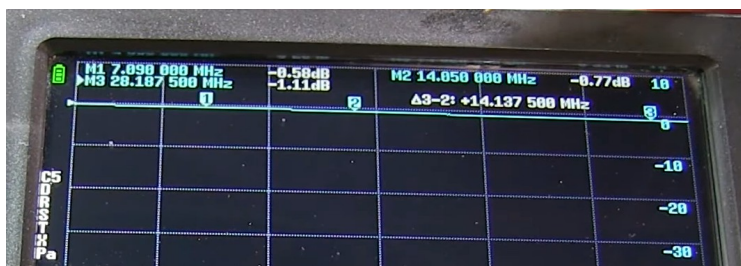


Figure 5. Showing losses (dB) in a 25-foot length of RG-174 cable for 7(M1), 14(M2), and 28(M3)MHz

1. Tap: screen, (opens Home Menu)
2. Tap: Stimulus, Start (opens keypad), 1 M;
3. Tap: screen, Stop, (opens keypad), 30 M.
4. Tap: screen, Home Menu, Tap: Back
5. Tap: Calibrate, Reset, Calibrate, then **O.S.L.**

With Menu still displayed, set Up Port2 (S21) for 'Isolation' and 'Through'

1. Move Load from Port1 (S11) to Port2 (S21)
2. Tap: ISOLN, remove Load
3. Attach a short coax between Port1 and Port2
4. Tap: THRU, Done, **Save(#)**

Set Up The Display

1. Tap: screen, (opens Home Menu)
2. Tap: Back, Display, Trace.
3. Tap traces 0,2,&3 twice to turn, leaving only Trace1

Set markers for 7, 14, & 28.5 MHz

4. Tap: Back, Back, Select Marker, Marker1, Tap: screen

Jog Marker1 to desired frequency in 7 MHz band

5. Tap: screen, (opens Marker Menu)
6. Tap: 'Marker2', Tap: screen

Jog Marker2 to desired frequency in 14 MHz band

7. Tap: screen, (opens Marker Menu)
8. Tap: Marker3, Tap: screen

Jog Marker3 to desired frequency in 30 MHz band

9. Tap: screen, verify near 0-dB numbers beside markers at top of screen, remove short coax
10. Connect cable(s) to be tested between Ports 1&2.

EXAMPLE 4. W2AEW Measuring Coax Length or Distance to a Fault (TDR)

<https://www.youtube.com/>

(TDR: Time Domain Reflectometer or Reflectometry)

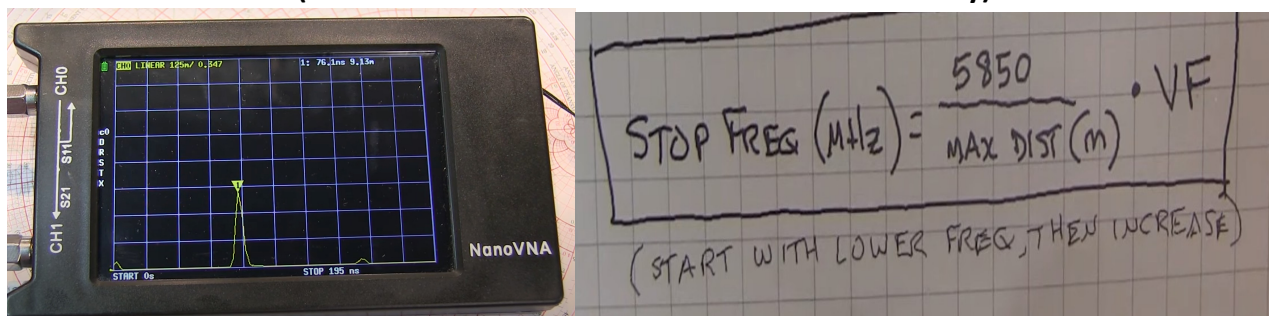


Figure 1. Coax Length In Meters (Shown on Top Right of Screen)

Measuring Coax Length or Distance to Fault

1. Tap: screen, (opens Home Menu)

2. Tap: Display, Trace, turn off all except Trace0,
 3. Tap: Back, Transform, Transform On, Low Pass Impulse.
 4. Tap: Velocity Factor, opens keypad, 80, x1, Format, More, Linear. (VF of RG-8x is ≈ 80)
 5. Tap: Back 3 times, Home Menu
 6. Tap: Stimulus, Start, keypad, 50 K.*
 7. Tap: Stop, keypad, 200 M. (see below**)
 8. Jog marker to far right of screen; shows max. length or distance to fault in meters that can be measured.
 9. Tap: Back, Marker, Search, Maximum.
 10. Tap: screen, attach open ended cable; read length to end of cable or distance to fault (1m=3.28F).
- 1.
 2. *Set Stimulus Start frequency as low as possible for testing short cables or detecting short distances to a fault. **Stimulus Stop frequency determines the maximum length of coax or distance-to-fault that can be tested. Higher=shorter distance; Lower=longer distance. His VNA shows only 101 points; to set points higher: **Tap:** Stimulus, Sweep Points, (select), Back, Back, Home Menu, screen. Save changes.
 3. **EXTRA 1. To clear an old calibration and update it for an existing memory location:**
 4. Tap: Screen, Calibrate, Calibrate, Reset, Calibrate, (Attach 'Open') Open, (Attach 'Short') Short, (Attach 'Load') Load, Done, Save (back to the same memory location), screen. Screen should show a white capital 'C' (and memory slot #) on left side.
 5. **EXTRA 2. Turning Off an Unwanted Trace:**
 6. Tap: screen, Display, Trace (tap twice to turn off any not needed), Back, screen.
 7. **EXTRA 3. Recall of a Previously Saved Setup:**
 8. Tap: screen, (Opens Home Menu) Display, Recall, (tap location) Back, screen. **Note:** For my H4 version, memory locations cannot be renamed but will display the latest stimulus range.

9.

10. RESOURCES

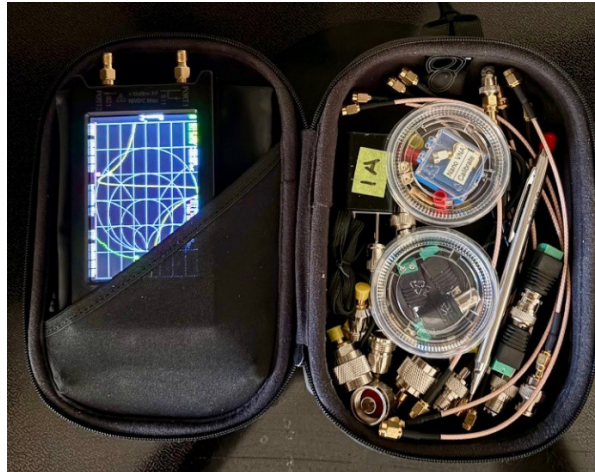
11. Updates and tips will appear in forthcoming newsletters.
12. Videos are presented by two well-qualified, Electrical Engineers in 1-3 below.
13. Detailed Overall Instruction:
 1. Ralph Gable nanoVNA: A Practical Menu Walk Through: https://www.youtube.com/watch?v=_96N3oGFatE
 2. Ralph Gable VNA Playlist: Begin with; "VNA What Is It?": [\(1\) VNA - YouTube](#)
14. Detailed Specific Application:
 3. W2AEW NanoVNA Playlist: [NanoVNA - YouTube](#)
15. General Stuff
 - NanoVNA.com: [About NanoVNA | NanoVNA](#)
 - NanoVNA Users Guide (translated): [NanoVNA User Guide-English-reformat-Oct-2-19.pdf](#)
 - NanoVNA Menu Structure Map: [NanoVNA Menu Structure Map | NanoVNA](#)
 - Understanding S-Parameters: [Understanding S-Parameters: S11, S22, S12, and S21 | Test & Measurement World. Understanding S-parameters | Rohde & Schwarz](#)
 - Kindle: <https://www.amazon.com/guide-NanoVNA-Christoph-Schw%C3%A4rzler-ebook/>
 - E-book: <https://www.amazon.com/NanoVNAs-Explained-practical-Network-Analysers-ebook/>
 - Users Group (Create an Account) – Lots of info in there: nanovna-users@groups.io | [Topics](#)

- **NanoVNA Saver:** [NanoVNASaver | NanoVNA](#) (Writeup forthcoming)
- **NanoVNA's & Books:** R&L Electronics. [Search Results -> nanoVNA : R&L Electronics, Amateur radio store](#)
- **Reputable Sellers List:** [tinySA | Main / Buying the tinySA](#), Aursinc on Amazon, SeeSii store on Amazon
- **SMA Adapters, M-F used as Port Savers, Adapters and Adapter Kits; RG-316 cables, pre-made:** Amazon
- **NanoVNA H4:** [Amazon.com: AURSINC Upgraded NanoVNA-H4 Vector Network Analyzer, Latest V4.3 10KHz-1.5GHz](#)
- **NanoVNA; Hard Case:** [Amazon.com: Honlyn Headphones](#)
- **FYI: Google** any parameter listed in the Menu Map for an expanded description of what it is and how it's used. Start the search with: NanoVNA, what is or define (menu name in question).

16.

17. Learn It – Apply It - Have Fun With It

18.



19.

20. NanoVNA H4 Kit & Accessories in a Headphone Hard-case

21. Add a drawstring bag or pouch to better protect the VNA

22.

23. 73's

24.

25. Read Widely – Question Everything