

NANO VNA CALIBRATION AND LOGMAG MEASUREMENTS

(02/22/25)

This document explains how to set up, and then use, a NANO VNA to measure RF coax cable loss and the effects of ferrite chokes on wiring. The information provided applies to NANO VNA units using firmware released between 12/01/22 and 06/01/23. Some minor menu differences may be seen on newer or older units. Hardware versions H, H4, F and SS2-N are included.

(1) SET THE TEST FREQUENCY RANGE

- a. Touch anywhere on the screen to bring up the option menu.
- b. Select the STIMULUS button. If it is not displayed on the menu, select the BACK button until STIMULUS is visible on the menu.
- c. Input the START frequency using the numeric keypad displayed on the screen. Use A good value would be 3.0Mhz.
- d. Touch anywhere on the screen to bring up the stimulus menu.
- e. Input the STOP frequency using the numeric keypad displayed on the screen. A good value would be 60.0 Mhz.
- f. After the range is set, the start and end frequencies will be displayed at the bottom of the screen. If they are not displayed with the correct frequencies, repeat the test frequency setup procedure.

(2) CONFIGURE THE MEASUREMENT TRACES

- a. If a menu is not displayed, touch anywhere on the screen to bring up the option menu.
- b. Select the BACK button until the DISPLAY button is seen. Select the DISPLAY button, and then the TRACE button. This will cause the TRACE menu to open.
- c. Select the TRACE 0 button until the button is yellow, and the check box is checked. This enables trace #0.
- d. Select the TRACE 1 button until the button is gray in color.
- e. Select the TRACE 2 button until the button is gray in color.
- f. Select the TRACE 3 button until the button is gray in color.
- g. At this point, only trace #0 (yellow) will be displayed with a checked check box.
- h. Select the BACK button to display a menu with the FORMAT button shown.
- i. Select the FORMAT button. A new menu will be displayed. Click on LOGMAG until it is checked. This sets up Trace #0 to show log magnitude.
- j. Select the BACK button.
- k. Select the CHANNEL button until S21(THRU) is shown in blue, under the CHANNEL text.
- l. Select the BACK button.

- m. If the trace configuration was successful, S21 LOGMAG 10dB/ -xxxxxxdB should be displayed in yellow at the top of the display. A yellow colored LOGMAG line should be near the bottom or bottom of the screen.
- n. The unit is now configured to only show LOGMAG in dB, on Trace0. Other traces can also be enabled, but are not necessary to measure coax cable loss.

(3) CONFIGURE MARKERS

- a. Eight different frequency markers may be set. Each shows a >M1: xxxxxxxx MHz line of text on the screen. These may be used, but are often distracting. The unit is most readable when only marker 1 is enabled. This will display a text display for where marker 1 is located on the frequency axis, and measured amplitude of the signal at that marker's frequency. The marker frequency can be adjusted using the scroll wheel.
- b. If a menu is not displayed, touch anywhere on the screen to bring up the option menu.
- c. Select the BACK button until the DISPLAY button is seen. Select the MARKER button. Select the SELECT MARKER button, and then select the MARKER 1 button until it enters automatic mode, with an A in the MARKER 1 check box.
- d. Select the BACK button to return to the operational screen.
- e. An S21 LOGMAG /xxxx message should be visible in the top left corner of the display. If it is not, repeat the marker setup.

(4) CONFIGURE TRACE 1 SCALE IN dB

- a. If a menu is not displayed, touch anywhere on the screen to bring up the option menu.
- b. Select the BACK button until the DISPLAY button is seen. Select the DISPLAY button, and then the SCALE button. This will cause the SCALE/DIV button to become visible at the top of this menu.
- c. Select the SCALE/DIV button. A keypad will be displayed on the screen. The default scale per division is -10dB, but that is high for coax cable loss measurements, but low for ferrite choke measurements. A 5.0 or 2.0 dB/division is better coax and 10.0 to 15.0dB for choke measurements. Enter 5.0, then the enter button. The dB per division loss will be displayed on the right side of the screen. If the scale/div was set correctly the values will be between +5 and -30 dB.

(5) CALIBRATE THE NANO VNA

- a. Connect the RF adapters that will be used, to the top SMA Port1 and bottom Port2 VNA connectors.
- b. Touch anywhere on the screen to bring up the menu.
- c. Select the BACK button until the CALIBRATE button is displayed It will be four down from the top on this menu. Select this CALIBRATE button.

- d. A new menu will be displayed, with a CALIBRATE button in the top position. Select the RESET button on this menu to clear the previous calibration settings. The menu will remain unchanged.
- e. Select the CALIBRATE button. (This CALIBRATE button from the top on this menu.)
- f. Attach the open terminator to the top connector or adapter, then select the OPEN button. A blue line will expand across the top of the screen. The SHORT button will be highlighted when the open calibration is complete.
- g. Attach the short terminator to the top VNA connector or adapter, then select the SHORT button. A blue line will expand across the top of the screen. The LOAD button will be highlighted when the shorted load calibration is complete.
- h. Attach the 50 Ohm terminator to the top VNA connector or adapter, then select the LOAD button. A blue line will expand across the top of the screen. The ISOLN button will be highlighted when the 50 Ohm load calibration is complete.
- i. If you have two 50 ohm terminators, put one on each port. Otherwise move the 50 Ohm terminator to the bottom VNA connector, and select the ISOLN button. The THRU button will be highlighted when the ISOLN calibration is complete.
- j. Remove the 50 Ohm load from the top and bottom VNA connectors.
- k. **For the coax cable loss test:** Place a high-quality short coax jumper between the top and bottom VNA connectors. Select the THRU button. The DONE button will be highlighted when the THRU calibration is complete. Jump to step m to finish the calibration. (See FIG 2 and FIG 3)

NOTE: When a VNA calibration adapter is made for this test, it must be done using the adapter connectors that will mate with the cable end connectors. For example, if the cable has male PL-259 connectors, the calibration must be done using a male SMA (To VNA) to female PL-259 adapter (To cable under test). For this setup, an open circuit male PL-259 calibrator, a shorted male PL-259 calibrator, and a non-inductive 75 ohm male PL-259 calibrator, and a short PL-259 to PL-259 coax jumper cable are needed.

- l. **For the ferrite choke test:** Place a short stiff wire jumper between the top and bottom VNA connectors. Select the THRU button. The DONE button will be highlighted when the THRU calibration is complete.

NOTE: A short piece of the insulated center conductor from RG-58 coax, with SMA connectors in each end, works well. Do not leave the shield on. (See FIG 1 and FIG 6)

- m. Select the DONE button. After the DONE button is highlighted, and the jumper is still attached, the S11 LOGMAG line should be a straight line at the

0 dB level. If it isn't, the calibration was unsuccessful. Repeat the calibration process. If the calibration process was successful, the SAVE 0 through SAVE 6 menu will be displayed.

- n. Select the saved memory location where all of the configurations will be saved. The unit will return to the operational mode.

- (6) This completes the calibration process. You may continue on using these settings, or reload a previously saved configuration.

MEASURE THE SIGNAL LOSSES OF A COAX CABLE AND IT'S RF CONNECTORS

- (1) Calibrate the VNA, as described above. The settings used in the above listed calibration will be a good starting point for this measurement. Make frequency and scale adjustments as necessary.

NOTE: When a VNA calibration is made for this test, it must be done using the adapter connectors that will mate with the cable end connectors. For example, if the cable has male PL-259 connectors, the calibration must be done using a male SMA (To VNA) to female PL-259 adapter (To cable under test). For this setup, an open circuit male PL-259 calibrator, a shorted male PL-259 calibrator, and a non-inductive 75 ohm male PL-259 calibrator are needed. (See FIG 2 and FIG 3)

- (2) Reattach the VNA cable adapters that were used to calibrate the unit for this test.
- (3) Tap on the display if a menu is being displayed. The cable insertion measurement is now running.
- (4) The trace description label will be displayed in yellow at the top left. (s21 LOGMAG 5dB/ -xx.xxx) This shows the S21 thru mode, LOGMAG log magnitude measurement, xdB scale value per division, and the dB insertion loss at the marker frequency. (See FIG 4, FIG 5, and FIG 9)
- (5) The marker frequency will be shown in white at the top right. (>M1: xxx.xxx MHZ)
- (6) The start frequency, bandwidth, number of sample points, and the stop frequency, will be shown in white along the bottom of the screen. (START xxx.xxx MHz bw:1000Hz 101p STOP xxx.xxx MHz)
- (7) A yellow, #1 marker will be displayed along the trace. It will be located at the frequency shown in the M1 message. This is the white marker frequency label, located at the top right of the screen.
- (8) Use the VNA wheel to move marker M1 along the displayed measurement trace. The white M1 message will show the frequency, and the yellow LOGMAG message will show the coax loss at that frequency.

MEASURE THE EFFECT OF A FERITE ON A WIRE

- (1) Calibrate the VNA, as described above. The settings used in the above listed calibration will be a good starting point for this measurement. Make frequency and scale adjustments as necessary.

NOTE: When a VNA calibration is made for this test, it must be done using a short piece of unshielded wire. Keep the shape of the loop as uniform as possible while making measurements. Also avoid having the wire loop in close proximity to any metal surfaces. (See FIG 6)

- (2) Reattach the VNA unshielded test wire that was used to calibrate the unit for this test.
- (3) Tap on the display if a menu is being displayed. The cable insertion measurement is now running.
- (4) Place the ferrite chokes over the wire. (See Fig 7 and FIG 8)
- (5) The trace description label will be displayed in yellow at the top left. (s21 LOGMAG 5dB/ -xx.xxx) This shows the S21 thru mode, LOGMAG log magnitude measurement, xdB scale value per division, and the dB insertion loss at the marker frequency.
- (6) The marker frequency will be shown in white at the top right. (>M1: xxx.xxx MHz)
- (7) The start frequency, bandwidth, number of sample points, and the stop frequency, will be shown in white along the bottom of the screen. (START xxx.xxx MHz bw:1000Hz 101p STOP xxx.xxx MHz)
- (8) A yellow, #1 marker will be displayed along the trace. It will be located at the frequency shown in the M1 message. This is the white marker frequency label, located at the top right of the screen.
- (9) Use the VNA wheel to move marker M1 along the displayed measurement trace. The white M1 message will show the frequency, and the yellow LOGMAG message will show the coax loss at that frequency.

OPTIONAL SETTINGS

- (1) SAVE CONFIGURED SETUP
 - a. If a menu is not displayed, touch anywhere on the screen to bring up the option menu.
 - b. Select the BACK button until the DISPLAY button is seen. Select the CALIBRATE button, and then the SAVE button. This will cause the SAVE 0 through SAVE 6 button menus to be shown. Select one of the SAVE x memory locations. Select SAVE 6 for this example configuration.
 - c. Select the BACK button to return to the operational screen.
 - d. The unit configuration has been saved for future use.

(1) RECALLING A PREVIOUSLY SAVED CONFIGURATION (OPTIONAL)

- a. When the unit is turned on, the default configuration saved in SAVE 0 is automatically recalled. It is good practice to save your most used settings in SAVE 0. Typically, SWR, and Z, for a frequency window in the Ham Band, with scale parameters in the frequency range that you use.
- b. When previously saved configurations are desired, touch anywhere on the screen to bring up the option menu.
- c. Select the RECALL button. This will display seven previously saved configurations, in SAVE 0 through SAVE6 order. The currently active configuration will have a checked box next to it. The previously save start and stop frequencies are displayed under each SAVE x, to make it easier to remember what each button represents.
- d. Select the saved box containing configuration for the setup that you want to use. Verify that the correct traces, their measurement types, and the start and end stimulus values are correctly displayed on the screen.
- e. Select BACK, and then select anywhere on the screen. This will return the unit to the operational window.

(2) SCREEN AND MEASUREMENT RESOLUTION (OPTIONAL)

- a. Different manufacturers of VNAs all provide multiple versions of their products. (SS2-N, H, H4, F, etc) The resolution of the data sampling and screen display can be adjusted to better meet the needs of the measurements being taken. Lower sampling numbers provide quicker sampling and graphic displays, but the displayed charts will be more jagged for larger differences between the start and stop scan frequency. Typically, 100 or 200 samples are sufficient for Ham users.
- b. If a menu is not displayed, touch anywhere on the screen to bring up the option menu.
- c. Select the BACK button until the DISPLAY button is seen. Select the DISPLAY button, and then the STIMULUS button. This will cause the SWEEP POINTS box to be displayed on the menu. The currently selected sampling number will be displayed in blue, below the SWEEP POINTS label.
- d. Select the SWEEP POINTS button. Several sampling option buttons will be displayed. The number of buttons and the number of points will differ between VNA types.
- e. Select an XXX POINT point button, and then the BACK button. Select BACK again, and you will be returned to the main menu.

CALIBRATION NOTES

- (1) Recalibrating the VNA is required whenever changes are made to the PORT 1 and PORT 2 connectors or adapters, and whenever the start and stop scan frequencies are changed.
- (2) When doing a THRU calibration for coax loss measurements, use a short, high quality coax cable.
- (3) When measuring the effects of coax chokes, use the same wire for the calibration jumper, as that which the choke will be fitted over. Use unshielded wire that will retain its shape. Movement of the wire, or repositioning it while making measurements, will cause slight variations in the insertion loss caused by the choke.