

NanoVNA Tweezers Setup Reference

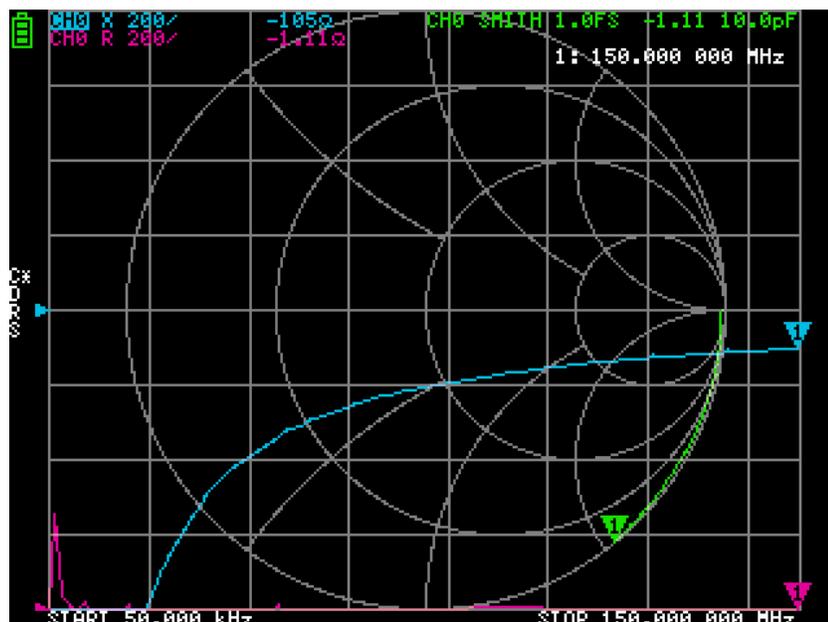
Prior to calibration the frequency spectrum segment for measurement must be decided upon. The *nanoVNA* is designed to provide 101 frequency steps per sweep. For tweezer calibration any spectrum segment between 50KHz and 150MHz can be specified. Although it can be convenient to sweep a wide spectrum segment if it is too wide the gaps between the resulting large frequency steps may result in a failure to make measurements at some important frequencies of interest. For example if set for a wide 50KHz to 150MHz sweep the resulting 1.5 MHz step size could be too large to properly measure components intended for use in a relatively narrow bandwidth circuit.

For the purposes of this article it is apparent calibration should be done for at least two sweep ranges. A range of 50 KHz to 150 MHz would cover the HF/VHF segments in roughly 1.5 MHz steps and a range of 50KHz to 15 MHz would cover the LF/MF/HF segments up to the 20 meter band with roughly 150 Khz steps. These two ranges will be used here with some minor exceptions as found necessary for particular cases.

Any of the 5 *nanoVNA* memory locations can be used for storing calibration and display setup settings. For the purpose of explanation here memory 1 will be used for storing the wider 50K-150 MHz sweep setup data and memory 2 for the narrower 50 KHz-15 MHz low frequency segment. Note that memory 0 which is automatically loaded as default during power-up was left available for the more conventional coaxial connection VNA applications. Consequently it is important to remember that for this explanation context each *nanoVNA* power-up cycle for tweezer testing will require using the menu to recall the tweezer data and settings from either memory 1 or 2 as needed.

For the clearest component value readability it is desirable to have the SMITH trace values shown in the top right corner of the screen, as shown in figure 1, away from the Smith chart circle clutter. The trace *FORMATS* functions as shown below will provide the top right display of the component value once LOGMAG trace 0 is disabled after calibration as recommended below. For starters all traces must be set to channel 0 and the scales set as shown. It may be desirable to change the scale and the stop/start frequencies as required to match DUT characteristic ranges.

Figure 1: NanoVNA - Screen Settings Setup Showing 10pF Capacitor Measurement. Sweep 50KHz to 150 MHz



Initially the *nanoVNA* menu selections should be set as follows:

- *DISPLAY>TRACE:*
 - Trace 0, Yellow: LOGMAG; scale 10/
 - Trace 1, Blue: REACTANCE; scale 200/
 - Trace 2, Green: SMITH; scale 1/
 - Trace 3, Red: RESISTANCE; scale 200/

Note: All traces must be set to channel 0.

- *STIMULOUS>*
 - START
 - 50K
 - STOP
 - 150M (or 15M for the low band)

The following checks and procedures help ensure successful calibration and measurement accuracy:

- Confirm that all the SMA connector retaining nuts are snug. This is very important and note that the nuts can work loose thus should be checked periodically. (There are somewhat pricey torque wrenches available online designed specifically for tightening SMA connectors to proper torque specification.)
- To minimize hand effect capacitive coupling to the tweezer tips grasp the tweezers quite high, with thumb and index finger, around the mid point of the tweezer arms.
- Hold the tweezers vertical, i.e. perpendicular to the calibration box PCB whilst alternately connecting to the OSL reference chips as directed by the *nanoVNA* firmware calibration function steps.
- To reduce screen clutter during calibration traces 1 & 3 should be disabled so that only the trace 0, LOGMAG and trace 2, SMITH traces remain.

Similar to regular SMA coaxial calibration recommendations upon selecting the DONE menu item after calibration the achieved accuracy should be confirmed. This is accomplished by sequentially connecting the tweezers to the OSL SMD references in sequence whilst viewing the Smith chart and return loss traces to confirm:

- When connected to OPEN check that the trace is just a small dot is at the right hand intersection of the Smith chart outer circle and the zero reactance horizontal center line.
- When connected to SHORT check that the trace is just a small dot and is located at the left hand intersection of the Smith chart outer circle and the horizontal zero line.
- When connected to LOAD check that the trace dot is in the center of the Smith chart circle and again it should be just a very small dot, not a small circle.
- While connected to the LOAD reference ensure the LOGMAG return loss trace is more negative than -40 dB across the entire spectrum sweep width.

