# From the Help Desk – December 2025

*Note – this is the fourth of an ongoing series of related articles that will each take a look at some facet of radio selection, installation, or operation as suggested by actual questions received from Club members or other amateur operators.*

***Q:*** I keep hearing about the need to calibrate my NanoVNA before using it. What is this all about, and how does one calibrate a NanoVNA?

***A:*** The NanoVNA is an incredibly powerful tool for the radio amateur, and even more so when the price of the tool is considered. However, any tool is only as good as its sharpest edge, and the sharpest edge of the NanoVNA is found in that condition where it has been properly calibrated for the task at hand,

What's it all about? Simply put, while the unit has been factory calibrated and is electronically "adjusted" to give the best results possible, those results can be skewed by certain operating conditions. The calibration process is designed to "zero out" the specific circumstances that would otherwise skew the measurement results displayed on the NanoVNA. Any time that we change the NanoVNA connection plane or the stimulus frequency to be used, we must perform a calibration in order to garner proper accuracy under the current test conditions.

To better understand the need for calibration, let's explore the operational conditions of the NanoVNA. Suppose that you are about to use the NanoVNA to determine a complex impedance of an antenna system, as displayed on a Smith chart. Radio theory tells us that making a change to the length of an antenna feedline will not affect the VSWR of that antenna system, but it *will* affect the impedance of the system. Remember that the impedance inverts every $\lambda/4$ of feedline length, and that the impedance repeats every $\lambda/2$ along a feedline. Thus, if we add a segment of feedline equal to anything *less than* $\lambda/2$ in length, we will end up with a different impedance. This is pretty clear, and is black-letter law as related to radio theory. It does not stop there, however.

If we want to measure the complex impedance of an antenna system via the NanoVNA, we must, as a part of that measurement, connect the antenna system to the NanoVNA. If, in doing so, we add a length of coaxial cable between the antenna system feedpoint and the NanoVNA, we will have the same effect as if we were simply adding feedline length to the antenna system – it will change the overall impedance of the antenna system.

So… in order to "see" just the actual impedance of the antenna system and *not* to have that impedance padded by the connecting cable, we must have a means of "zeroing" out the effect of the connecting cable. That method is what we call *"NanoVNA calibration."*

It is important to understand that the calibration is to be made to the connection plane at which the antenna system under test will be connected. In this manner, the "zero" point is at the far end of the connecting cable, and that cable length will therefore not be taken as a part of the antenna system – it will effectively be invisible to the NanoVNA.

Calibration is done by use of a set of so-called *“calibration standards”,* a set that consists of three different external resistances in a physical form that will allow the standards to be installed to the connecting cable at the connection plane to be used. The three resistances used most often are infinite resistance (open), zero resistance (short), and the characteristic impedance for the antenna system under test (load). More often than not, for amateur radio, that load value is fifty ohms. In addition to the three calibration standards, a calibration kit will also include a double-ended female adapter that will permit connection of two cables with male connectors to each other, and a pair of short connecting cables. Ideally, the calibration kit will also contain a second *“load”* standard, though this is not often the case. (More about that later.)

Anyone who works with multiple different cable types in conjunction with the NanoVNA will have a set of calibration standards for each connector type frequently used, and in both genders. My calibration kit includes standards in male BNC, female BNC, female UHF, male N, and female N. The NanoVNA normally ships with a set of male SMA standards. My plan is to expand my set further to include female SMA and male UHF standards, though I seldom have a need for those types.

The intent in having all of these different standards is that they will enable calibration right at the connection plane *without the use of adapters during the calibration process.* Even the length of cable adapters and gender changers will add effective feedline length to the overall net, and will therefore affect the final complex impedance measurement. That small length will make a difference if the intent is to design a matching network that will bring the antenna system impedance to a true and clean fifty ohms.

Let’s now look at the calibration procedure…

1. Install any needed or desired connecting cables for attaching the antenna system to the NanoVNA.
2. Determine what type of calibration will be made…
    a. if only Port S11 will be used, a single port calibration is acceptable; but
    b. if a through (Port S21) connection will be used, then a through calibration must be done.
3. Set up the NanoVNA for the test to be made, including setting up the…
    a. traces to be displayed;
    b. markers to be used;
    c. port and format to be used;
    d. any other specific settings necessary; and
    e. stimulus frequencies, either START and STOP or CENTER and SPAN.
4. Go to *CALIBRATE > RESET* to reset the calibration in preparation for the new calibration.
5. Go to *CALIBRATE > CALIBRATE.*
6. Install the *open* standard at the S11 connection plane.
7. Tap *OPEN* and wait for the check mark to appear;
8. Remove the *open* standard.

9. Install the *short* standard at the S11 connection plane.
10. Tap *SHORT* and wait for the check mark to appear.
11. Remove the *short* standard.
12. Install the *load* standard at the S11 connection plane.
13. Tap *LOAD* and wait for the check mark to appear.
14. If a single-port test is to be made, proceed to Step 15 below; if a two-port test is to be made, jump ahead to Step 18 below.
15. Remove the *load* standard.
16. Tap *DONE* and then select a suitable storage slot to save the calibration if so desired *(recommended)*.
17. Proceed to test(s) to be made.
18. Install a *load* standard to the second port, at the S21 connection plane. Note that this step requires the use of a second *load* standard, which may not always be on hand.
19. Tap *ISOLN* and wait for the check mark to appear.
20. Remove the *load* standards from the two ports.
21. Connect the two ports to each other at the connection plane, using the shortest connecting adapter possible.
22. Tap *THRU* and wait for the check mark to appear.
23. Disconnect the port jumper.
24. Tap *DONE* and then select a suitable storage slot to save the calibration if so desired *(recommended)*.
25. Proceed to the test(s) to be made.

The NanoVNA is now calibrated and ready for use. On-screen, along the left edge, will be a legend that indicates which stored calibration is in use, and if it is in use directly as stored, or if there is a change from the stored settings.

The legend starts out with the letter “C”. If the “C” is in upper case text, the calibration is in use exactly as it was saved. However, if the “c” is in lower case text, it indicates that the stimulus frequency has been changed from that which was stored. The numeral after the “C” indicates which specific memory storage slot is in use. If the calibration has not been saved to a slot, the numeral will be replaced with an asterisk (*).

In addition, there are some letters that appear in a column under the calibration indicator, as follows:

- D: directivity – indicates that directivity error correction is applied;
- R: reflection tracking – indicates that error correction is applied;
- S: source match – indicates that error correction is applied;
- T: transmission tracking – indicates that error correction is applied;
- X: crosstalk – a indicates that isolation (crosstalk) error correction is applied; and
- P: power – indicates power level set at time of calibration (a – automatic).

Other power levels that can be selected are 2mA, 4mA, 6mA and 8mA. These are selected under the *MENU > POWER* menu item. If the text in the calibration status indicator is red in color, the *“no calibration”* calibration status is indicated. A properly calibrated NanoVNA will show its calibration status in white text, but during the calibration process, the text will show in a red color until the calibration is complete.

I hope that this article makes your NanoVNA just a bit more friendly and useful. Proper calibration is absolutely necessary for any degree of accuracy to be achieved. Knowing how and when to perform the calibration makes you more adept at using the NanoVNA.