

## ***The NanoVNA Part Two - Calibration and VSWR Measurements. By: Barry Rushford VE6BGR***

The following gives a brief overview of some of the basic steps for setting up and using the NanoVNA for VSWR measurements. For this discussion, I will be using the NanoVNA alone in order to become familiar with the menus and the calibration process.

### **Calibration:**

The most important part of the setup is the process of calibration. The following is my preference for calibrating the unit but there are certainly different methods that could be used. The most important thing that needs to be considered is that without proper calibration, the measurements taken will not be accurate and could lead to errors or assumptions about the results. My preference is to calibrate the unit utilizing the 5 memory locations (labeled RECALL 0 to 4) with an SMA cable attached to the ports that will be used for each measurement. This is required for a repeatable calibration point for the unit to operate from and provide consistent measurements. As most of my testing is done on the amateur frequencies, I keep RECALL 1 to 4 assigned to the different amateur bands and utilize RECALL 0 for use as required for other functions. The following are my frequency allocations

RECALL 0 - 50KHz to 200MHz

RECALL 1 - 3.5MHz to 4.0 MHz (80m band)

RECALL 2 - 7.0MHz to 7.3MHz (40m band)

RECALL 3 - 14.0MHz to 14.35MHz (20m band)

RECALL 4 – 144MHz to 148MHz (2m band)

### **Calibration Setup:**

As stated, the calibration is the most important part of the setup process. I use a 6-inch SMA to SMA cable and calibrate at the end of this cable. Any measurements I take are then taken from the end of this SMA cable to ensure a proper calibration point (ie. the VNA is calibrated for the end of this cable). Keep in mind that if you check an antenna that is connected to a length of coax, the calibration is set for the end of the SMA cable, and your measurement will include both the coax and the antenna. If you choose to test just the antenna, then the SMA cable should be

connected directly to the antenna or calibrate the VNA at the antenna end of the coax. The affect of adapters on the calibration can usually be ignored as long as they are adapters only.

If you are only doing VSWR measurements, you only need to calibrate the CH0 port, however, if you plan on keeping the memory storage fixed, it pays to calibrate the CH1 port as well with the TRANSFORM and THRU calibration and then the VNA is setup for all applications.

1. To calibrate RECALL 0 for 50KHz to 200MHz, connect a 6-inch SMA cable to CH0 and and a 6-inch SMA cable to CH1. Select STIMULUS from the main menu.
2. Enter the START frequency of 50KHz and the STOP frequency of 200MHz.
3. Go back to the main menu, select RECALL>RECALL 0.
4. Go back to the main menu and select CAL
5. Select RESET. This resets RECALL 0 memory and must be done for proper calibration.
6. Return to main menu and select CAL. Select CALIBRATION from this menu.
7. Place the open termination on the CH 0 cable and select OPEN.
8. Place the short termination on the CH 0 cable and select SHORT.
9. Place the load termination on the Ch 0 cable and select LOAD.
10. Place the load termination on the CH 1 cable and select ISOLN.
11. Connect CHO to CH1 by using an SMA bullet on the ends of the two SMA cables and select THRU.
12. Select DONE
13. Select SAVE 0 then back twice to the main menu.

If you choose to do what I have done, you will repeat this process for each RECALL memory.

RECALL 1 – 3.5MHz to 4.0MHz

RECALL 2 – 7.0MHz to 7.3MHz

RECALL 3 – 14.0MHz to 14.35MHz

RECALL 4 – 144MHz to 148MHz

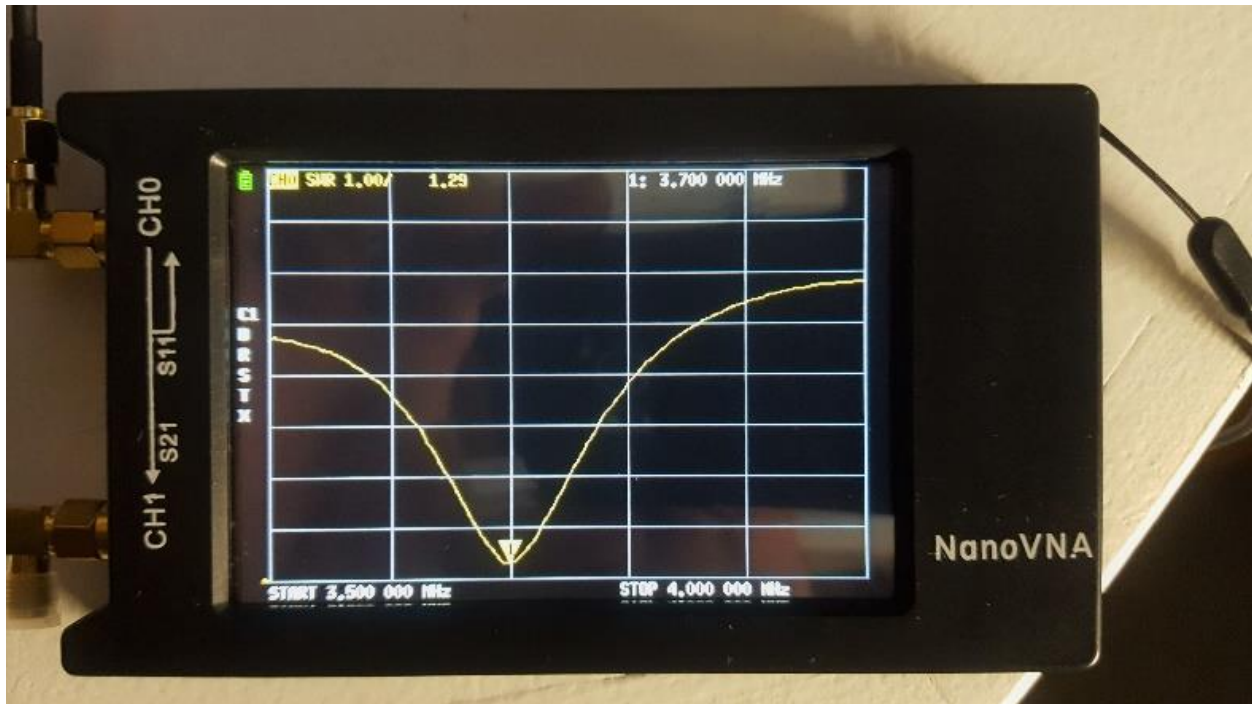
You of course can setup the VNA in any manner that suites your needs. When you select the recall memory location, all the information that you setup is displayed on the screen. Note that the letters down the left side of the screen have significance as to the state of the calibration and the parameters that the VNA is using. You can check the meanings of these letters (also including upper and lower case) on any of the many websites' explaining how to use the VNA. The VNA retains this calibration in its memory and the calibration does not have to be redone each time you use the VNA if the frequencies and cables (calibration point) remains the same. I do check mine from time to time to ensure that nothing has been inadvertently changed.

### **Checking the VSWR of an Antenna:**

Once the calibration has been completed, VSWR measurements can be undertaken. For doing VSWR measurements select DISPLAY>TRACE>TRACE 0. Return to the previous menu and select FORMAT>SWR. This sets up TRACE 0 with a marker labelled #1. Additional traces and markers can also be added as desired at this point. The following is the measurement process.

1. Connect CH 0 SMA cable to the antenna or coax feeding the antenna using appropriate adapters.
2. Select the RECALL memory location for the desired frequency band.
3. The VSWR waveform will be displayed on the screen and the VSWR for the antenna can be read from the graph scale.
4. The marker can be moved with the thumbwheel switch to the desired sweep location and the VSWR and marker frequency read from the readout on the top of the screen.
5. If more resolution is required, the STIMULUS>START and STOP frequencies can be changed if they are within the band of frequencies set in the RECALL frequency settings without having to recalibrate.

Below is screenshot of my 80m loaded dipole antenna. The START and STOP frequencies are shown at the bottom of the screen. The marker frequency is shown at the top right of the screen (1:3.700000MHz). The SWR at the marker location is shown at the top left of the screen and is the SWR measured at the marker frequency (1.29). Additional traces and markers can be defined and added at any time to obtain any other information you may want to observe. (The Smith chart is an interesting one to observe here as it does provide several parameters on one chart.)



This covers the basic calibration method and VSWR measurement process with the NanoVNA. The NanoVNA can also be used with the desktop NanoVNA-Saver application for measuring VSWR but requires a different calibration and measurement process but this is a conversation for another day.

I would appreciate any upgrades to this process or errors I may have made in the description. Do not hesitate to give me a call if you are having any problems with the setup and measurement process and I will try my best to help.

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