Nano VNA's - a Must Have Item for the Ham Shack:

The amateur community has been turned on to something that can really help you measure your antennas and other tuned circuits. It is the NanoVNA. Barry VE6BGR has been playing around with one for about a year as I understand it and has shared his experience with it for us. NanoVNA's can be purchased on Amazon and other places for under $100. I hope you enjoy his great article…

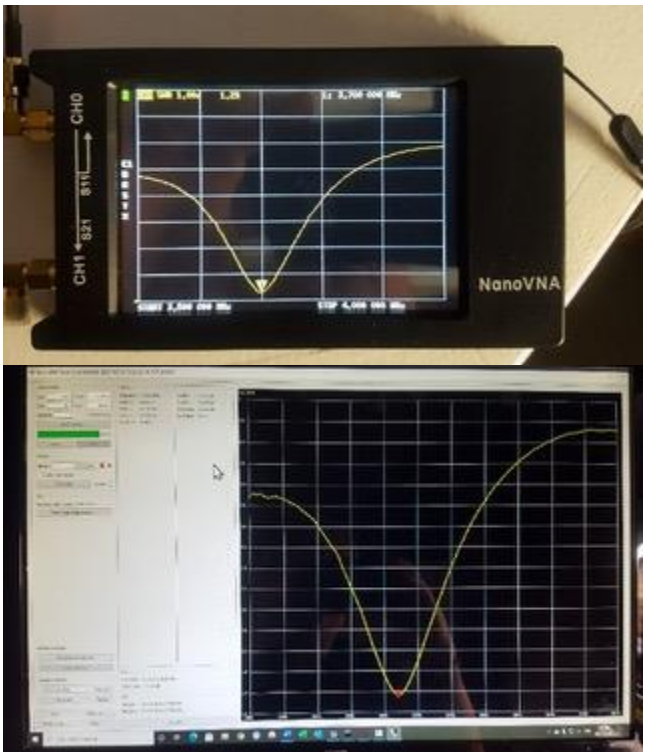
NanoVNA

The NanoVNA has emerged as one of the need-to-have items for the radio amateur. It has quicky become one of the most popular tools in the amateur toolbox and is starting to take over for a host of pieces of test equipment at a very reasonable price. It is currently available from dependable suppliers such as Amazon for approximately $125 and for less from suppliers "across the pond". As more people experiment with this device, new functionalities are emerging to make it a multi-purpose tool for the amateur radio hobby.

The NanoVNA is a simplified vector network analyzer that provides the basic functionality of the commercial analyzers and fits in your shirt pocket at an unbelievable low price when compared to the commercial units. The NanoVNA is an adjustable frequency source (50KHz to 1.5GHz depending on the unit you have) with sweep capabilities that is coupled to the output (CH 0) via a directional coupler that enables the unit to measure return loss (VSWR etc.) It also can measure signals on a separate input port (CH 1) for measuring filter characteristics etc. Both ports on the unit have an impedance of 50 ohms which makes it ideal for radio and antenna work. It has a 2 ¼" x 3 ¼" touch LCD touch screen for setting up the unit and viewing the waveforms from the device under test. It has an internal lithium battery that is rechargeable through its USB port and my experience is that it is good for approximately 3 hours of runtime on a charge. The unit can also be connected via its USB-C port to a PC, Android device etc. that interfaces with free software (NanoVNA Saver) that enhances the functionality of the unit with increased data points, more measurement algorithms and of course a larger screen size. I have found this software to be especially useful, easy to use and can save an unlimited number of setups and scans. There are several excellent documents online that describe in

detail the functionality of a vector network analyzer if anyone is interested in the technical details.

One of the primary uses of the NanoVNA is to measure VSWR. Below is a screen shot of my 80m loaded dipole. As you can see, this dipole has a narrow response but by using the NanoVNA, it is quite easy to trim it to cover the frequencies you use the most. Also below is a screenshot from the desktop software of the same antenna.



As you can see, the desktop software is superior to using the touch screen, but the touchscreen is more than adequate for using in the field.

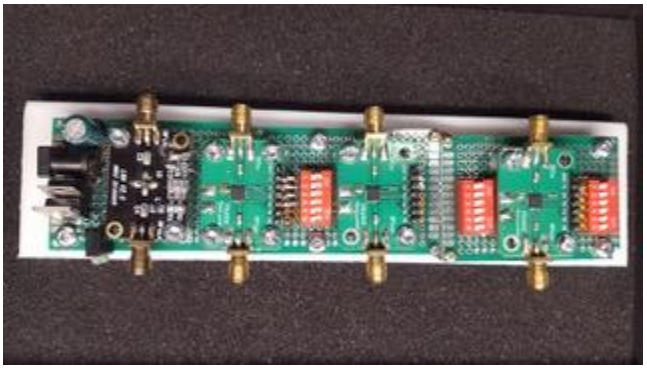
There are other numerous measurements that can be done with the VNA such as bandpass, low pass and high pass filter scans, tuned circuits, capacitance and inductance measurements, coax cable length and characteristics etc. The unit can also be used as a time domain reflectometer to estimate cable lengths and connector faults. The following is a partial list of some of the measurements that are available.

- Return loss
- Impedance

- Phase measurements
- Quality factor
- Group delay
- Gain

In addition, one of the display measurements available is the Smith Chart. This is an extremely useful display for those who are adventurous enough to get into the aspects of a Smith Chart. There are also several adjustable markers that can be applied that provides details of the marker location details.

One other feature that I use is that of a signal generator. The VNA has a CW mode that can be used to send a continuous signal output across the band of frequencies that are available from the unit. Unfortunately, the output level is not adjustable but by using an adjustable pad system, it is easy to get any level that you desire. The output of the VNA is approximately 0dbm from 50KHz to 250MHz and -10dbm from 250MHz to 500MHz. I have found the frequency output to be quite accurate and can always be checked against WWV. Below is a picture of an inexpensive pad/amplifier board that I have built to enable level control.



As with most devices, there are some issues that the user needs to be aware of. Calibration of the unit is especially important to get accurate results. The calibration needs to be carried out for any changes that you make to the operating conditions; however, this can be minimized to a certain extent with the five memory locations in the VNA or an unlimited amount of calibration files that can be used in the desktop mode. I have found this to be one of the more challenging aspects of using the VNA but once a person gets the hang of it, it is certainly manageable.

Also, the unit is a bit fragile, so care needs to be taken. The unit is in an enclosed plastic case but is not shock proof and the switches seem a little fragile so care must be taken. I have also attached a pair of SMA right angle connectors to the VNA ports to act as connector savers as there is number of times when the connectors are used for the calibration process. There is also a need for several adapters and cables to enable you to get connections from the SMA format to the more common connectors that amateurs utilize.

In conclusion, I have found this unit to be extremely useful. There is a learning curve that can sometimes seem a little extensive but there is several good YouTube videos and documents available online to aid with this. I found that learning one function at time makes it much easier as trying to understand it all at once can be frustrating. In addition, there are getting to be a few local amateurs who are gaining experience with the NanoVNA who will be glad to help. I am certainly not an expert but can be called upon at any time if anyone needs assistance.

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