Feedline Length Measurement Methods

Measuring the length of a segment of coaxial or open wire transmission line is relatively easily using an antenna analyzer like the RigExpert AA650 Zoom or a NanoVNA device. This article will attempt to explain the process using each of these tools.

It is understood that in each case, the tool must be in proper calibration prior to the test being made. *"Proper calibration"* means that the calibration was done with any test lead extensions and adapters in place on the test port(s), thus making the calibration point that at which the coaxial cable will be connected to the measuring system. Doing this negates the extension cable length and thus removes that length from the final test result, providing a more accurate final length indication. It is also expected that the user has at least a basic familiarity with the test equipment being discussed herein.

NanoVNA H4 (version 4.3 MS)

Length or *Distance to Fault* Using *Transform Function*

Begin by disabling all traces except *Trace 0*. Then, with *Trace 0* set to *Channel 0* (which may be labelled as *Port 1* or as *Port S11*), set the *Trace Format* to *"Linear".* Then select *"Transform",* and set the *Velocity Factor* to the correct value for the cable at hand. For example, for a standard solid-dielectric coaxial cable, that value would be between 65% and 70%, usually 66%. Enter the value as a whole number. After that, select the *Low Pass Impulse* option, and then turn the *Transform* "ON".

Next, select *Stimulus* and then set the *Sweep Points* option to its highest value, *e.g.,* 301 or 401 points. This will permit a more accurate measurement than will a lower *Sweep Points* value. This brings us to the most accuracy-critical aspect of the NanoVNA setup for cable length measurement, which is the *Stimulus* range, or device frequency sweep range. Ideally, we want to start at DC if possible. This, however, is not possible with the NanoVNA (with most firmware versions), so we will set the *Stimulus Start* value to the lowest setting permissible, which is 50kHz. We do this by selecting *Stimulus* > *Start* and then tapping, in sequence, "5", "0" "k". Setting the *Stimulus Stop* value requires a little bit of thought, guesswork, and calculation. Think about the process and the approximate maximum anticipated length, and then make your best guess as to that value. Then, use that guess to calculate the *Stimulus Stop* frequency.

It must be understood that the *Stimulus Stop* frequency value will determine the length measurement "distance" range and the resolution or accuracy of the measurement within that range. A higher *Stimulus Stop* frequency will yield a shorter measurement "distance" range, while a lower *Stimulus Stop* frequency will yield a longer measurement "distance" range.

With that in mind, as well as your best guess estimate of the approximate maximum length of the cable to be measured, we can calculate an appropriate *Stimulus Stop* frequency using the following formula:

$$\mathrm{FREQ_{STOP}} = (5850 / \mathrm{DIST_{MAX}}) \times \mathrm{VF}$$

where:

$FREQ_{STOP}$ is the *Stimulus Stop* frequency value in megahertz (MHz);

$DIST_{MAX}$ is the best-guess maximum anticipated length value *in meters* of the cable to be measured; and

VF is the cable type's Velocity Factor expressed in decimal format, *e,g,,* a VF of 85% is entered as 0.85 for this equation.

Example

We wish to determine the *Stimulus Stop* frequency value for a solid polyethylene dielectric coaxial cable that is estimated to be about 100 feet long. We estimate a bit longer for range, using 125 feet and converting that value to meters, and then we substitute our known values into the formula to get the following:

$$FREQ_{STOP} = (5850 \,/\, DIST_{MAX}) \text{ x } VF$$

$$FREQ_{STOP} = (5850 \,/\, 38) \text{ x } .66$$

$$FREQ_{STOP} = (153.947) \text{ x } .66$$

$$FREQ_{STOP} = 101.6\text{MHz}$$

If we then input the calculated value as the *Stimulus Stop* frequency, we will be ready to go. Select *Stimulus* > *Stop* and tap, in sequence, "1" "0" "1" "." "6" "M" to enter the frequency and complete the setup. Connect the coaxial cable to be measured to the adapter at Port 0, and then read the length in meters from the upper right-hand corner of the NanoVNA screen.

I have found this measurement method to be quite accurate, and I probably use the NanoVNA for this task much more than I do the RigExpert AA650 Zoom. However, that tool, too, is accurate and useful in the absence of a NanoVNA. The procedure for this measurement with the RigExpert family of antenna analyzers is basically the same, regardless pf the specific model. I will be describing the procedure for the AA650 Zoom, as that is the model that I have on hand.

RigExpert AA650 Zoom

Cable Length & VF

The function for measuring cable length (and velocity factor) is found on the ***Tools*** menu of the RigExpert antenna analyzer. The ***Tools*** menu can be accessed quickly and easily by pressing the **F** + **8** key combination.

With the subject cable connected to the analyzer, select the ***Tools*** menu, and then select ***Cable length & VF*** from that menu. Press the ▲ button on the analyzer, and then edit the velocity factor of the cable under test. Next, press the ✓ key to start the measurement. The result, reported as a cable length in meters, will be displayed on screen. That's all that there is to it!

I am not quite sure why I usually use the NanoVNA, other than the fact that my NanoVNA is always ready to go, but I store my RigExpert without its battery installed, so it seems like more trouble to get the RigExpert out. Actually, the RigExpert is much easier to use for this test.