# From the Help Desk – October 2025

*Note – this is the second in 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:*** How can the length of a coil of wire be measured using the NanoVNA?

***A:*** Not just *any* coil or length of cable can be measured in this fashion. The cable under test *must* have at least two conductors, such as a length of coaxial cable, or window line, or even Cat-5 LAN cable with its four twisted pairs inside the jacket. The measurement test methodology utilizes a scheme known as *time domain reflectometry* or *TDR.* In this test, a relatively low-frequency signal is placed onto the cable under test, where it travels down the cable to the opposite end and is then reflected back toward the source. The time that it takes to make the round trip to the opposite end of the cable is then used, together with the cable's *velocity factor (VF)*, to calculate the length of the cable. The TDR function utilizes the NanoVNA's *TRANSFORM* function to support its calculations.

Velocity factor is a rating, expressed as a percentage of the speed of light, at which an RF signal will travel within a cable of a given type. The increased molecular density of the cable causes the RF signal to be slowed down in the cable as compared to the speed of light in free space. However, it is actually the material of the dielectric used in the cable construction that has the greatest effect upon the velocity factor of that cable type. Table 1 below provides VF's for many typical dielectric materials used in cable construction while Table 2 list the VF's for several common cable types.

The specific velocity factor of the cable to be tested must be known in order to properly calculate the length of that cable via NanoVNA TDR measurement. If you cannot identify the specific cable or cable type and do not have a datasheet for the cable, find the most similar cable in Table 2 below and use that VF value. If that is not possible, then just use the Table 1 VF value for the dielectric material used in the cable to be tested.

*Table 1 - VF's of typical dielectric materials*

| **Dielectric Material** | **Velocity Factor (%)** |
|---|---|
| Solid Polyethylene (PE) | 65.9 |
| Foam Polyethylene (FE) | 80.0 |
| Foam Polystyrene (FS) | 91.0 |
| Air Space Polyethylene (ASP) | 84-88 |
| Solid Teflon® (ST) | 69.4 |
| Air Space Teflon® (AST) | 85-90 |

*Table 2 - VF's for common cable types*

| Cable Type | VF % | Comments |
|---|---|---|
| Cat-3 | 58.5 | twisted pair 10BASE-T network cable |
| Cat-5e | 614.0 | twisted pair 100BASE-TX, 10000BASE-T network cable |
| Cat-6A | 65.0 | twisted pair 10GBASE-T |
| Cat-7 | 74-79 | twisted pair |
| OWL | 95-99 | ladder line 600-ohm air-insulated |
| Window Line | 91.5 | Wiremen 551 450-ohm |
| Twin-lead | 80.0 | Belden 9085 300-ohm |
| RG-6 | 83.0 | Belden 1189A |
| RG-6/U PE | 66.0 | Belden 8215 polyethylene dielectric |
| RG-6/U FOAM | 81.0 | Belden 9290 foam dielectric |
| RG-8 | 84.0 | Belden 9913 / Belden 9086 |
| RG-8 | 86.0 | Belden 7810A gas-injected high-density polyethylene (HDPE) foam |
| RG-8 | 82.0 | Wireman CQ106 |
| RG-8A/U PE | 66.0 | Belden 8237 polyethylene dielectric |
| RG-8A/U FOAM | 78.0 | Belden 8214 foam dielectric |
| RG-8/U | 84.0 | Belden 9913 10BASE2 generic network cable, foamed polyethylene |
| RG-8X | 82.0 | Belden 9258 foamed polyethylene dielectric |
| RG-11 | 83.0 | Belden 1523A |
| RG-11 FOAM | 78.0 | Belden 8213 foam dielectric |
| RG-11A | 66.0 | Belden 8261 |
| RG-11/U | 84.0 | Belden 9292 high-density polyethylene (HDPE) foam |
| RG-58A/U FOAM | 73.0 | Belden 8219 foam dielectric |
| RG-58A | 66.0 | Belden 8259 |
| RG-58A/U | 65.0 | 10BASE2 generic network cable |
| RG-58A/U PE | 66.0 | Belden 9201 polyethylene dielectric |
| RG-59A/U PE | 66.0 | Belden 8241 polyethylene dielectric |
| RG-59A/U FOAM | 78.0 | Belden 8241F polyethylene foam dielectric |
| RG-59 FOAM | 78.0 | Belden 8212 foam dielectric |
| RG-59B | 66.0 | Belden 8263 |
| RG-62A | 84.0 | Belden 9269 |
| RG-174 PE | 66.0 | Belden 8216 polyethylene dielectric |
| RG-174 FOAM | 73.5 | Belden 7805R foam dielectric |
| RG-213 | 66.0 | Belden 8267 solid polypropylene dielectric |
| RG-218A | 66.0 | formerly RG-17 |
| LMR-200 | 83.0 | Times Microwave RG-58 |
| LMR-240 | 84.0 | Times Microwave RG-8X |
| LMR-240UF | 80.0 | |
| LMR-400 | 85.0 | Times Microwave RG-8 |
| LMR-400UF | 85.0 | |
| LMR-500 | 85.0 | 0.500” diameter |
| LMR-600 | 86.0 | 0.590” diameter |
| LMR-1200 | 88.0 | 1.200” diameter |
| 1/2" hardline | 81.0 | 50Ω |
| 1/2" hardline | 81.0 | 75Ω |
| 7/8” hardline | 81.0 | 50Ω |
| 7/8” hardline | 81.0 | 75Ω |
| FSJ1-50A | 82.0 | |
| LDF4-50A Heliax | 88.0 | 0.500” diameter |
| LDF5-50A Heliax | 89.0 | 0.875” diameter |
| LDF6-50A Heliax | 89.0 | 1.250” diameter |
| HJ8-50B Heliax | 93.0 | 3.00” diameter air dielectric |
| Davis Bury Flex | 82.0 | |
| Twin-Shielded Twisted Pair | 66.0 | Belden 8723 polypropylene insulator |

Before we can make the measurement, we have to do some basic mathematics. The math is used to determine a suitable STOP frequency for the RF sweep that will be used for the test; the sweep START frequency is generally set at 50kHz.

The STOP frequency chosen will determine the maximum distance range and resolution for the test being made. The higher the STOP frequency is, the *shorter* the total distance capability will be, while a lower STOP frequency will provide for a longer total distance measurement capability.

Although it is not the best choice for a calculation constant, the value 6000 is an easy value to remember and is also an easy value for working out arithmetic results. We will use that value to determine our STOP frequency, dividing 6000 by the estimated maximum length to be measured in meters. The equation to be used is as follows:

$$Frequency_{STOP\ (MHz)} = \frac{6000}{maximum\ length\ in\ meters}$$

where we use 6000 as the dividend and the maximum length in meters as the divisor. For example, if we are anticipating a maximum length that is just under 300 feet, we might choose 100 meters as the divisor, giving us a STOP frequency of 60MHz.

Once the NanoVNA is properly calibrated and configured, we will be able to read the calculated length directly from the NanoVNA display. Before we can begin, however, we must also prepare the cable to be tested for the measurement process. If the cable has a connector installed to at least one end of the cable, we can use that connector to attach the cable to the NanoVNA by way of suitable adapter(s). On the other hand, if the cable is unterminated, it must be prepared by exposing and stripping both conductors of the cable to be tested, so that alligator clips can be attached to those conductors. Then, we would use a suitable adapter that will connect to the NanoVNA and has alligator clips at the opposite end. For example, I have a twelve-inch length of RG174 cable that has a male SMA connector at one end and alligator clips at the other end. Similarly, I have another one, this time of RG-58 cable, that has a male BNC connector at one end and has alligator clips at its opposite end. These adapter cables are suitable for this type of test measurement. Note that is it advisable to use the mated wires of a single twisted pair when making TDR measurements on cables like Cat-5 LAN cable, *e.g.,* the blue and blue/white or the orange and orange/white wire pairs. When measurements are being made on double-shielded coaxial cables, use the center conductor and the inner-most shield layer for the TDR measurement.

Follow the procedure below to make the TDR measurement with your NanoVNA. Note that these steps are specific to the NanoVNA H4 with firmware version 1.2.40 installed. The procedure for other NanoVNA models and firmware versions should be very similar.

## Procedure

1. Go to *MENU* > *DISPLAY* > *TRACE* and turn off all traces except *TRACE 0.*
2. Go to *MENU* > *DISPLAY* > *FORMAT S11 (REFL)* > and select *REAL* or *LINEAR.*
3. Go to *MENU* > *DISPLAY* > *MARKER* and make sure that only *MARKER 1* is selected and active.
4. Go to *MENU* > *STIMULUS* > *START* and set the *START* frequency to 50kHz.
5. Go to *MENU* > *STIMULUS* > *STOP* and set the *STOP* frequency to the value determined using the simple equation discussed above.
6. Go to *MENU* > *DISPLAY* > *TRANSFORM* > *VELOCITY F* and enter the appropriate velocity factor value for the cable under study.
7. Go to *MENU* > *DISPLAY* > *TRANSFORM* and select *LOW PASS IMPULSE.*
8. Go to *MENU* > *DISPLAY* > *TRANSFORM* and set the *TRANSFORM* function to *ON.*
9. Install (to port S11) any adapters needed to connect the cable to be tested to the NanoVNA.
10. Perform a proper calibration of the NanoVNA at that connection plane.
11. Save the calibration to a suitable slot in the NanoVNA.
12. Connect the cable to be tested to the NanoVNA to port S11.
13. Go to *MENU* > *DISPLAY* > *MARKER* and tap *SEARCH until it shows SEARCH MAXIMUM*.
14. Read the displayed propagation time and the calculated length in meters from the *MARKER 1 (M1:)* field at the upper-right corner of the NanoVNA display screen.

## Conclusion

I hope that this article will help to make your NanoVNA more useful to you as well as helping to improve your NanoVNA operational skills. The NanoVNA is an incredibly useful and powerful tool for the radio amateur to have in his/her tool arsenal. Knowing more about how to use the NanoVNA makes it just that much more valuable. This particular use of the NanoVNA will help you to identify the lengths of all of those many assorted cable sections that we all have sitting around our shacks.