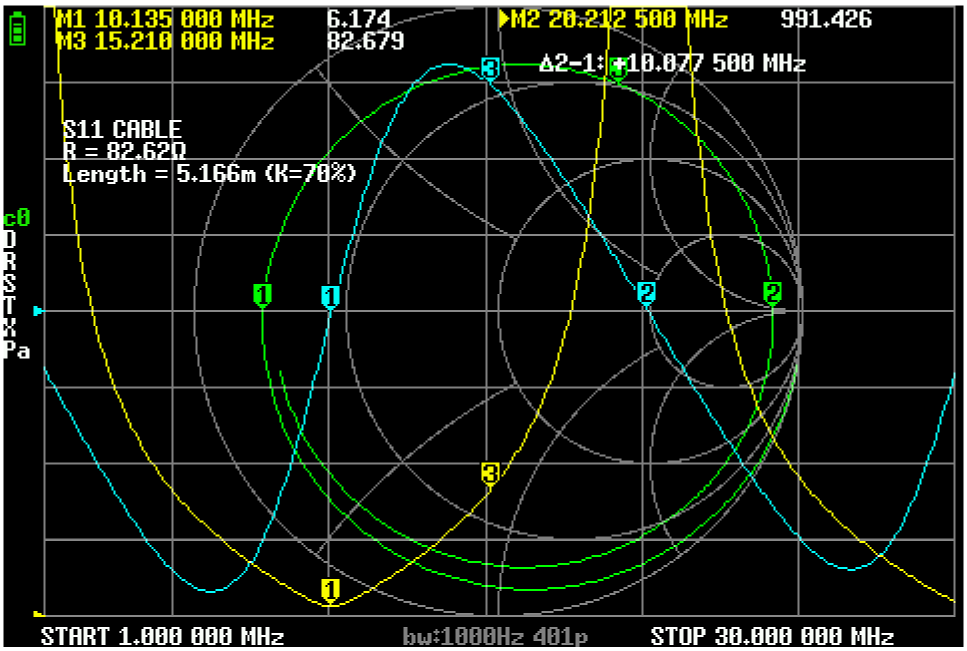
NanoVNA CH0 (S11) cable measure

DiSlord

Jul 19 #2947
Edited Jul 20

Research some methods for measure cable connected to CH0 (S11) port
Use NanoVNA H v1.0.68 or NanoVNA H4 v1.0.68 firmware.

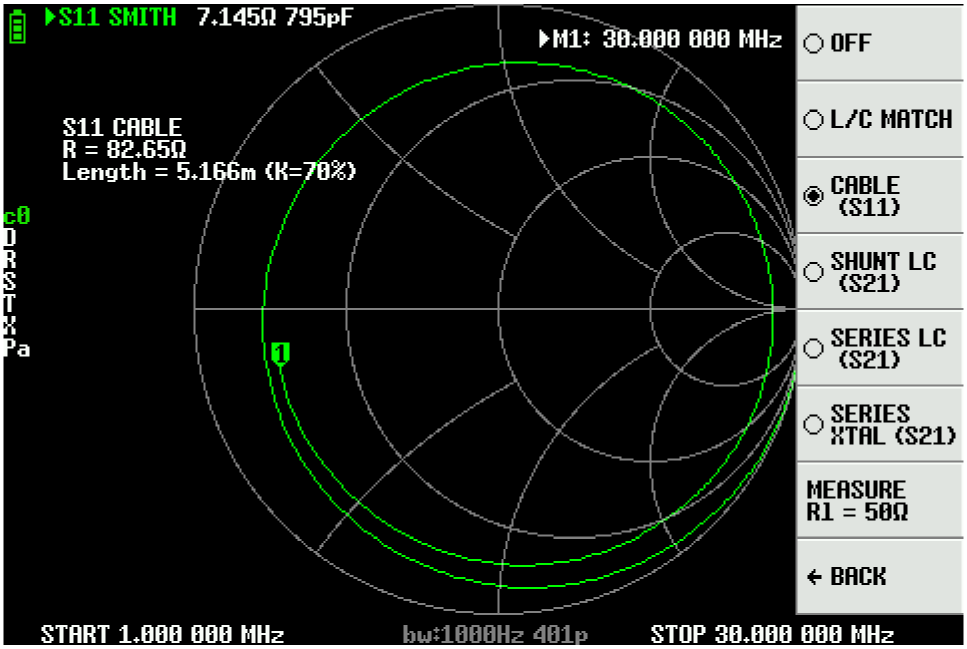
Here measure bad 75 Om cable image:
Yellow - |Z|
Blue - Imag
Green - smith



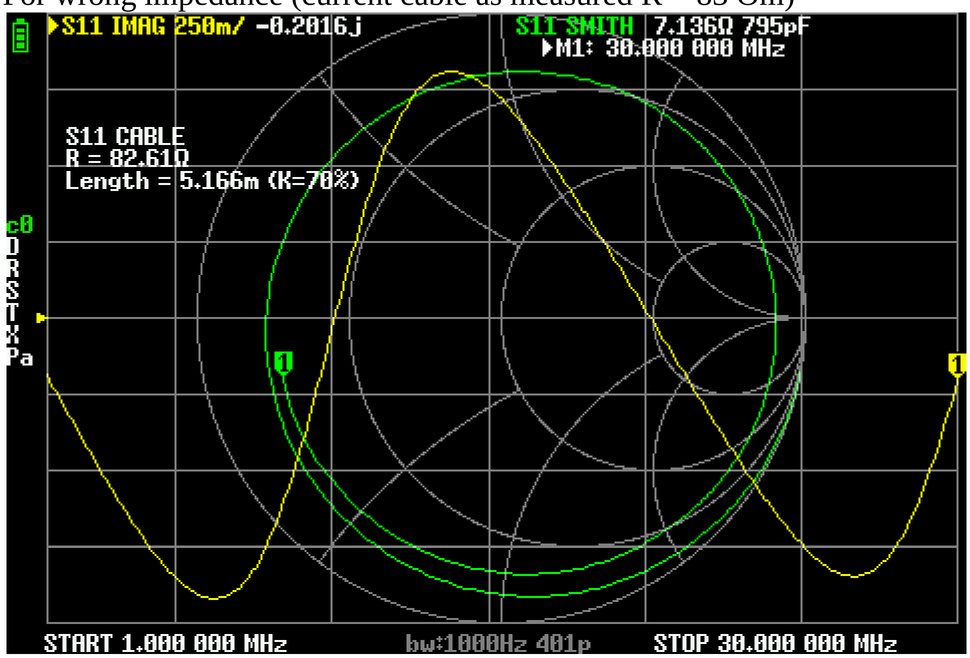
Measure cable impedance:
If set start = min freq stop any freq vs wavelength < cable length (on smith chart need see how it cross marker 1 position)

Need search first place vs imag = zero
This point allow get R, need get this point frequency divide it by 2 and measure |Z| at this frequency
Also this point can give cable length

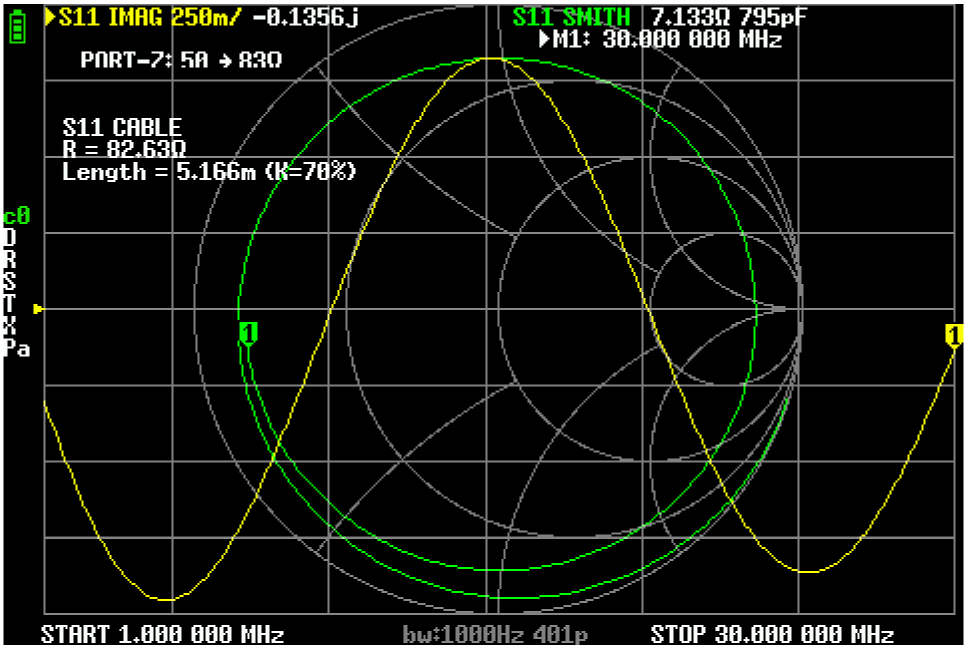
I add measure R and len to H4 (at this moment R measure not use any interpolation functions, so it depend from used range/points need add more functional for measure module), length use measure module bilinear interpolation and allow get good results not huge depend from range.



Now try understand how work Normalisation (impedance correction):
If measured DUT impedance = cal LOAD it Smith point around center smith, so real and imag part should look as sin or cos function
For wrong impedance (current cable as measured R = 83 Om)

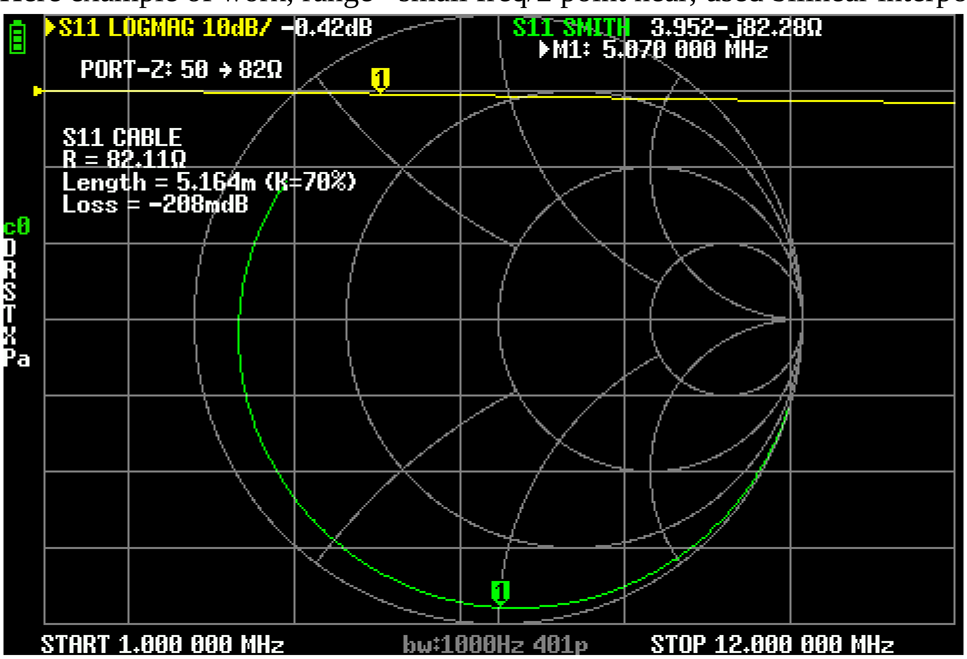


But after set Port Z: 50->83 Om, possible see correct round over Smith center, and real and imag part look as sin/cos function

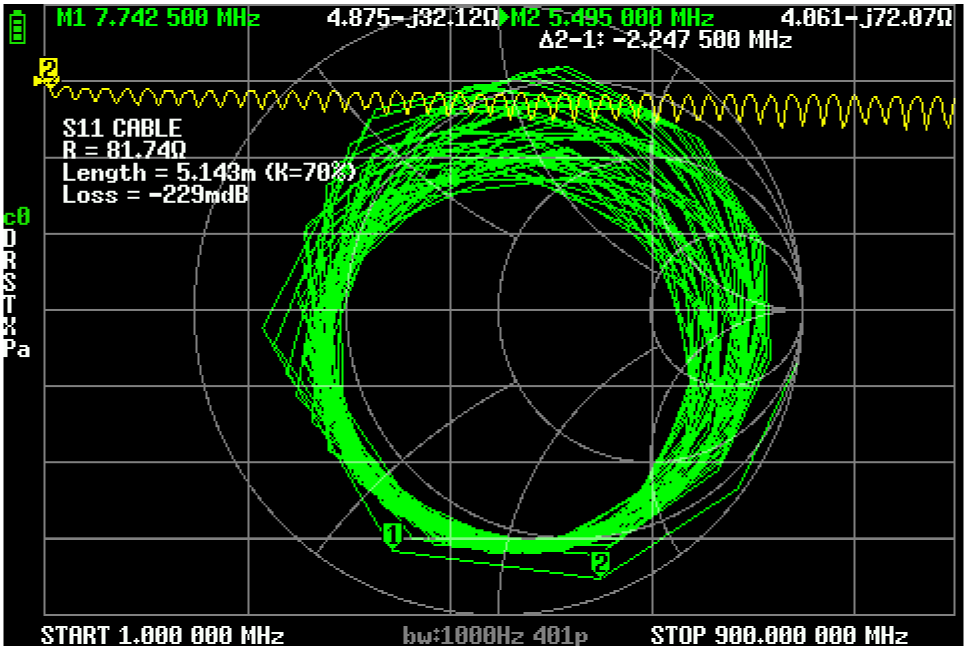


Add bilinear interpolarion for get measured data (before only for search), this allow get more clean result:
- on close point error exist always
- on linear interpolation if real value R = 82, if select big range (1500M) R = 78, if select 900M range R = 80;
- on bilinear interpolation R = 81 for 1500M range, and 81.6 on 900M

Here example of work, range ~small freq/2 point near, used bilinear interpolation and calculaded 82.11Om



And here is big range, exist only 2 points near for calculation (marker 1 and marker 2) but bilinear interpolation calculate R = 81.74 Om very close result



Added cable loss measure at active marker point, simple use S11 loss / 2

PS velocity factor (K=70%) can change in DISPLAY->TRANSFORM->VELOCITY FACTOR

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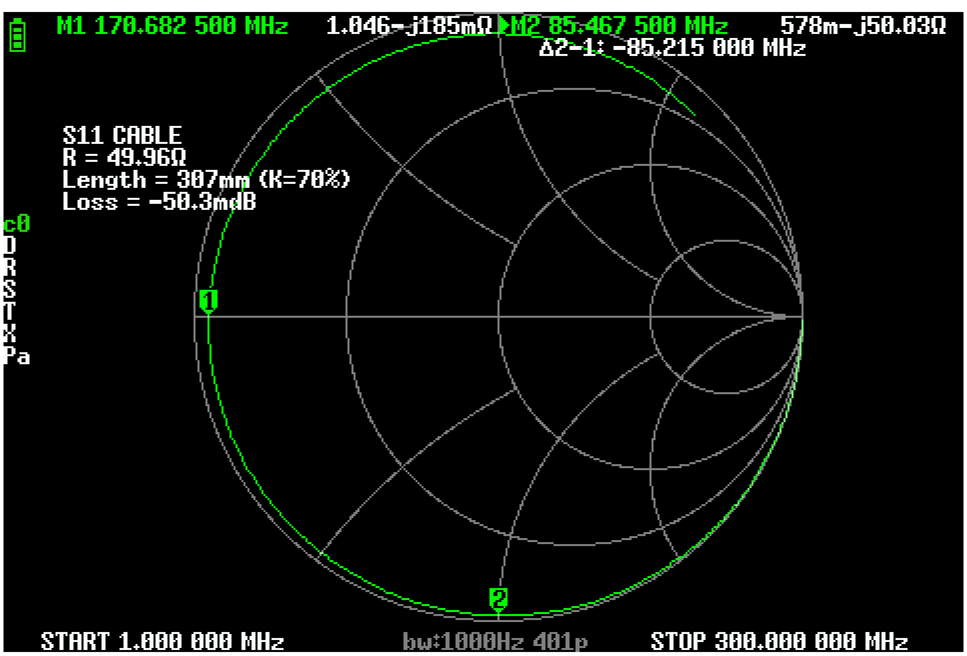
2021-07-22, 17:09 # 5483

DiSlord

I see this when measuring the whole cable, it is connected to port CH0 (measured with parameter S11), the other end of the cable is empty, the length of the cable is approx. 30 cm



Click on the image for a larger version. Name: nanovna-h4_screen_2021-07-21_17-00-15.png Hits: 52 Size: 7.6 Kb ID: 360863

The measuring range is chosen so that the blacksmith rotates 180 degrees clockwise, the most important point of this measurement being at the 1st marker.

At this point, the signal has reached the end of the cable and is reflected, while the reflection is exactly half the period of the wave and will travel to and from the end of the cable. This means that by knowing the frequency and shortening factor, you can calculate the length of the cable. Therefore, when measuring the parameters of the cable, this point should be, and this should be the first such point from the minimum (as the frequency increases, the blacksmith rotates an additional 360 degrees).

To calculate the wave impedance, divide the frequency at that point by 2 and look at what is on the blacksmith (this is marker 2 on the screen), see what is in the imaginary part of marker 2, - 49.96 Ohm , this wave impedance ... It's simple. nana makes it for you, and more precisely because you still know how to interpolate the data (after all, the measurement points don’t always fall in the right place)

Cable loss, it is also simple, the loss is a measurement of the active marker frequency, the signal has reached the end of the cable and returned, the level of the returned signal is known to us, so the loss is half S11 log core at this frequency (it is in simplified form, because if well you look, then the S11 log core looks like a wave and I have to average it, but I don't do it yet)

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2021-07-22, 18:02 # 5485

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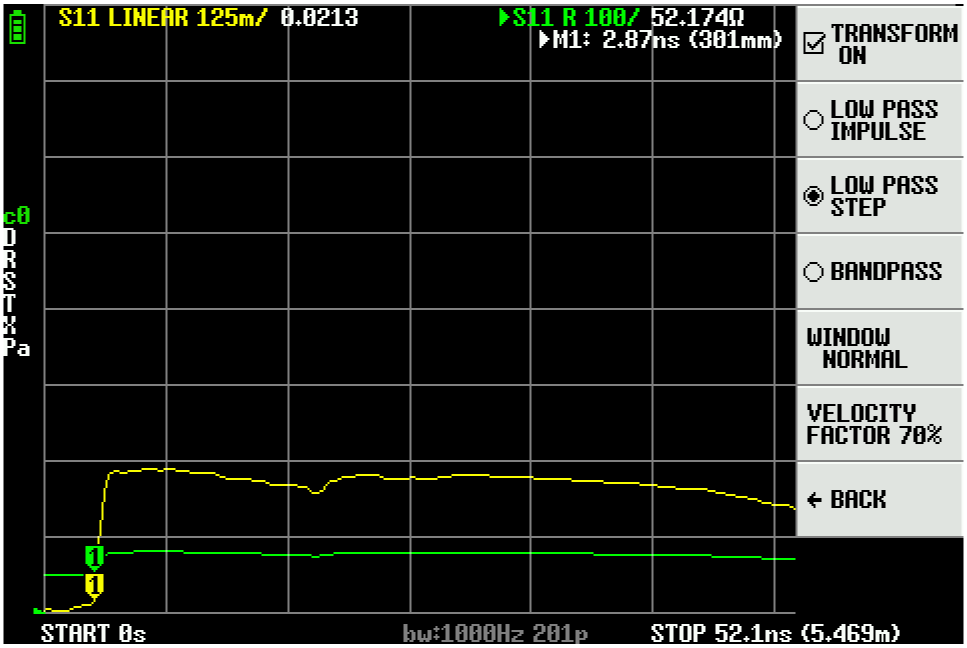
Now let’s look at another TDR method

Measure a slightly more complex system:

A 30 cm long and 50 Ohm characteristic impedance cable is connected to the device, and a 5.1 m long and 82 ohm characteristic impedance cable is connected.

On the device, set the range from 1 to 1500 MHz, turn on the S11 linear and R graphs

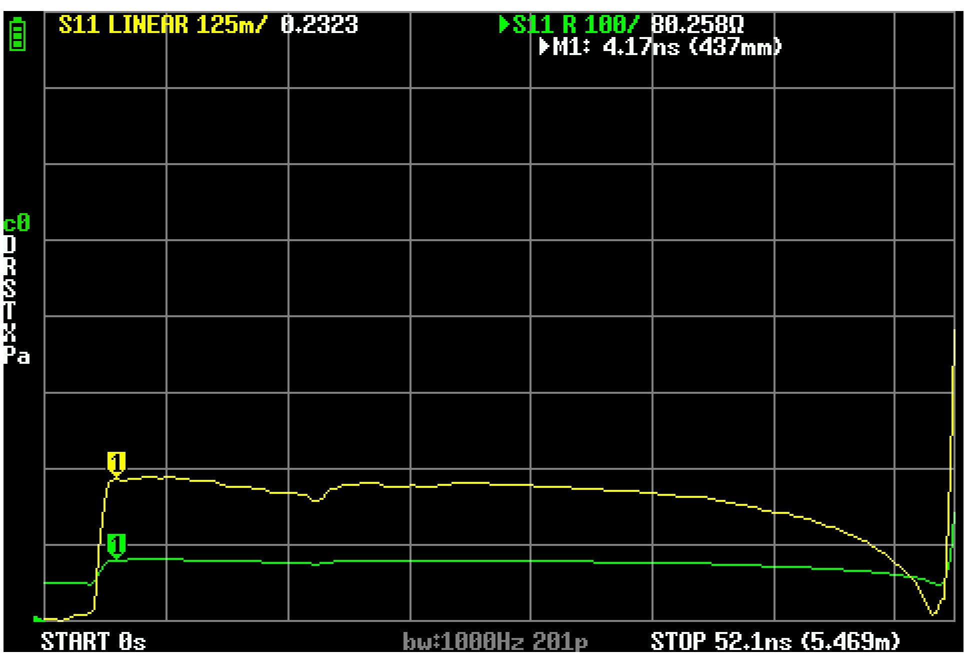
Turn on the Domain Conversion option and make the settings as in the screenshot (I have chosen the number of points so that the required measurement extends across the entire screen, with a larger number everything will be the same, but the result is left)



Click on the image for a larger version. Name: nanovna-h4_screen_2021-07-21_17-47-02.png Results: 39 Size: 5.7 Kb ID: 360865

Now let’s look at what we measured, marker 1 on the screen is in the 30cm position and R in this 50th section

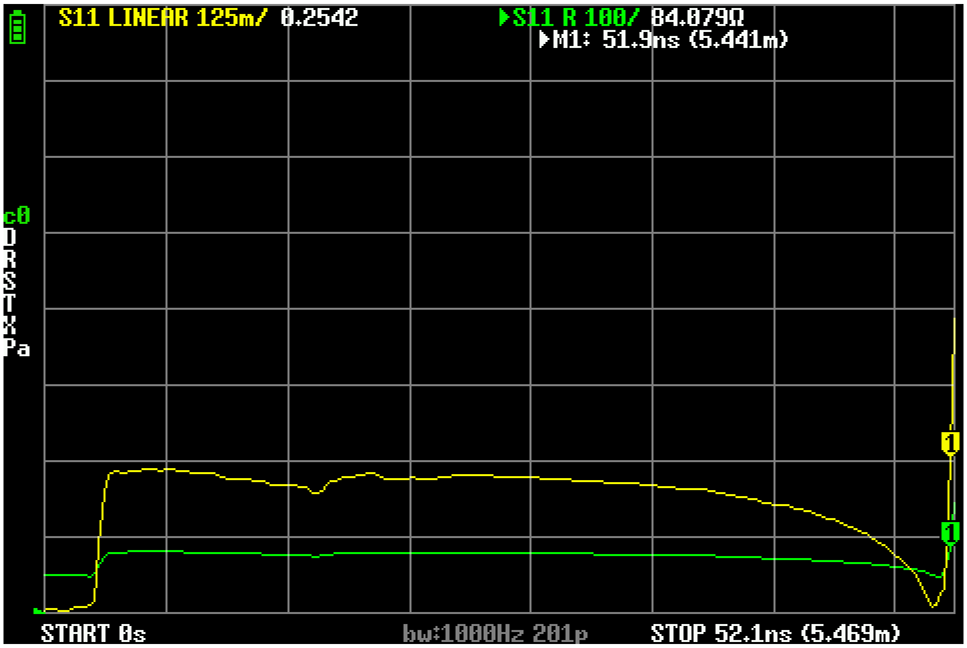
Move the marker to the right



Click on the image for a larger version. Name: nanovna-h4_screen_2021-07-21_17-51-20.png Hits: 30 Size: 4.7 Kb ID: 360867

We see R = 80 ohms, hmm interesting

We are even further right until the next race



Click on the image for a larger version. Name: nanovna-h4_screen_2021-07-21_17-52-57.png Hits: 33 Size: 4.8 Kb ID: 360868

We see a length of 5.44 meters.

We draw conclusions, you see an R = 50 ohm cable for the device in the 0-30 cm section, then 5.44-0.30 = 5.1 meters R = 80 ohm cable.