

VNA Master™ Testing Port Extension Cable

Introduction

When conducting measurements in the field, the reliability of your instrument (handheld VNA) is essential. Instructions for verifying the functionality of a VNA can be found in the maintenance manual. Unfortunately, there is a multitude of factors outside the instrument that can significantly affect your measurements. Many of these factors will make it look like the instrument is not functioning correctly.

High-quality port extension cables can make all the difference when performing measurements in the field. Conversely, poor quality and damaged port extension cables often are the leading cause of poor measurements.

Challenges

Using a test port extension cable is a common practice in the field. It allows the user to make a direct connection to the device-under-test (DUT) in cases where the VNA cannot connect directly to the device. Testing the port extension cable allows the user to know the following:

1. The quality of the test port cable
2. How stable is the cable when in use
3. If the cable is damaged

Poor Quality Accessories Attached to Port Extension Cables

The DUT may often have different connectors than the VNA and adaptors are needed. For example, Figure 1 shows an SMA cable with N-type adaptors. Unfortunately, poor-quality adaptors can significantly impact the measurements.

Port Extension Cable

Poor Quality Cable

Figure 1 shows a low quality port extension cable with connector adapters. The port extension cable appears to perform well initially (blue trace) showing the return loss. However, upon further investigation, by moving the cable around, the return loss increased dramatically (yellow trace) as seen in Figure 2. The measurement should be less than -15 dB, and anything larger is considered bad; ideally, the lower the number, the better. Therefore, when performing measurements in the field, the port extension cable must remain phase stable when moved around; phase-stable port extension cables are critical.



Figure 1. SMA Cable with Adaptors on Both Ends

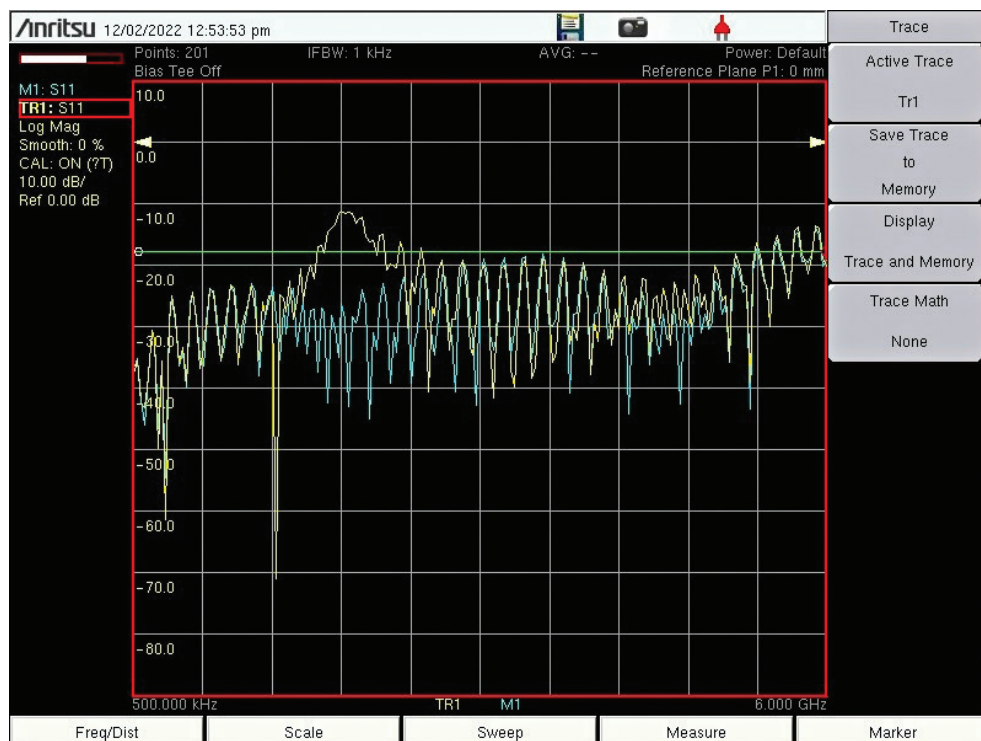


Figure 2. Blue Line is S11 of Homemade Extension Cable; the Yellow Line is S11 when the Cable was Moved Around

High-Quality Cable

With high-quality phase stable cables in a field environment, the movement of the port extension cable will not affect the VNA’s calibration or measurements. This allows the operator to make measurements with confidence.



Figure 3. 15NN50-1.5C Phase Stable Port Extension Cable

Figure 5 shows the return loss of a phase stable cable (15NN50-1.5C). For return loss for 15NN50-1.5C, the specification calls for –18 dB, as seen in Figure 4, showing that the cable is well within specification. Furthermore, moving the cable does not change the return loss measurement, as seen in Figure 5; the yellow trace is post-movement, and the blue trace is the initial measurement.

Specifications

Anritsu Cable Part Number	Frequency (GHz)	Connector “A”	Connector “B”	Length (meters)	Return Loss Match (dB)	Insertion Loss Full Cable (dB @ Max Freq)	Impedance (ohms)
15NNF50-1.5C	6.0	Precision N-male	Precision N-female	1.5	18	2	50

Figure 4.

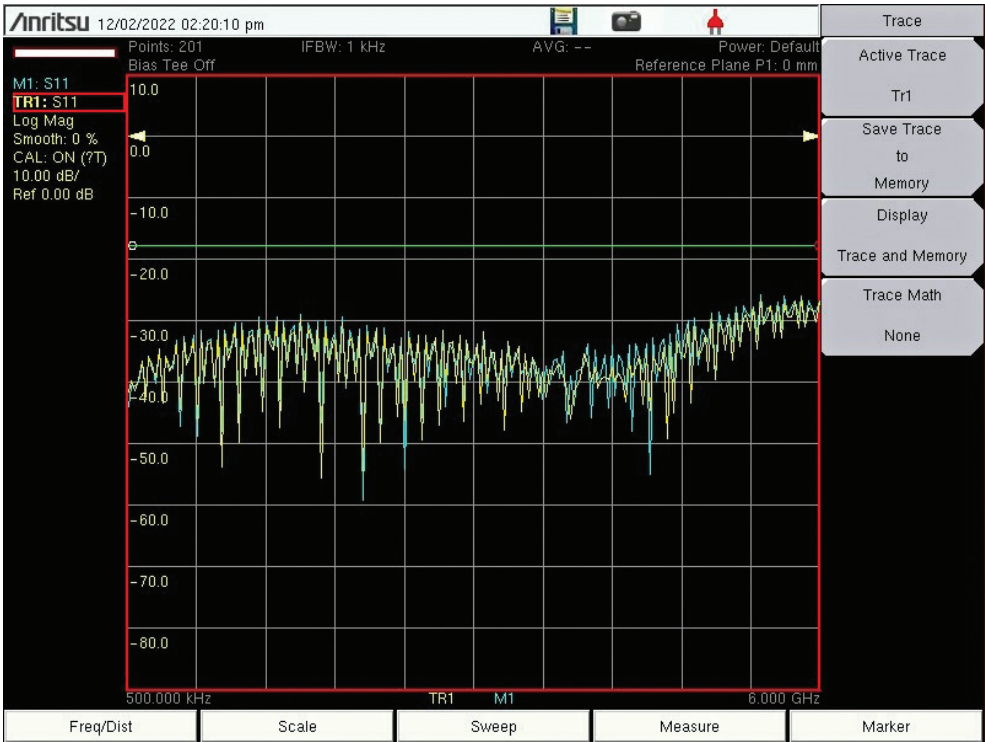


Figure 5. 15NN50-1.5C S11 Measurement with the Limit Line Set to –18db

Testing Port Extension Cable

Unfortunately, even the most ruggedized phase stable cables are susceptible to damage. As a result, they are the most common cause of poor measurements. Therefore, once the instrument has been verified to be in working order, the first item to test should be the test port extension cable. Although the cable may appear fine externally, performing a return loss test can reveal internal damage in the cable. Figure 6 shows the return loss (S11) between two test port cables; externally, they appear to be undamaged, but the measurements tell another story.

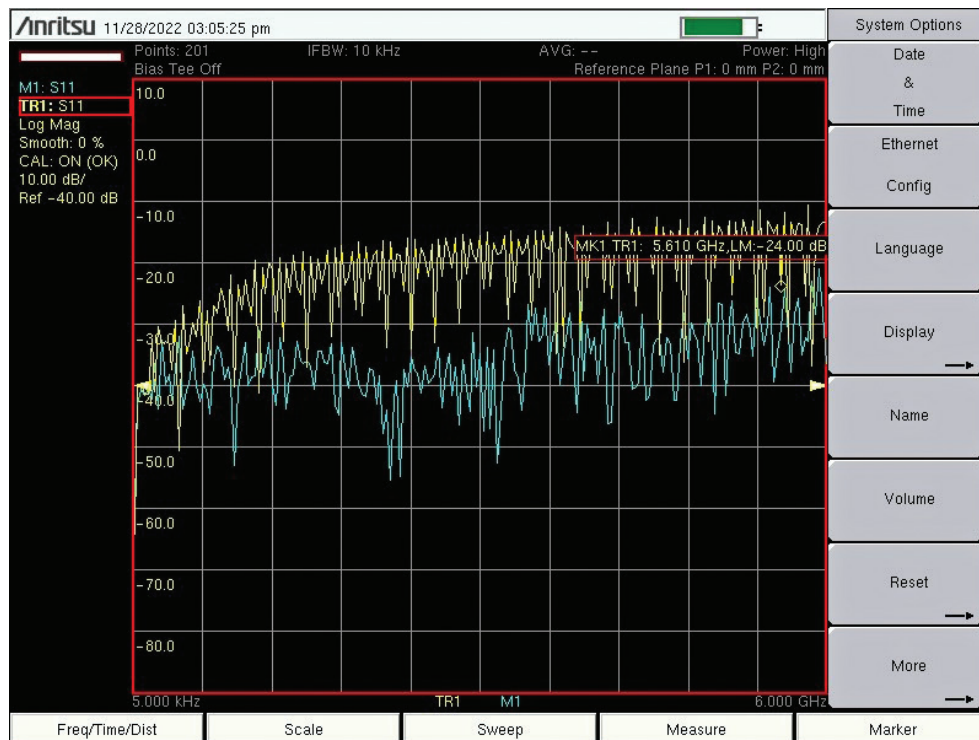


Figure 6. S11 on a Undamaged Cable (blue trace) and S11 on a Damaged Test Cable (yellow trace)

Test Procedure

The first step in this process is to calibrate the VNA Master at the port. Since we are testing the test port extension cable, we must ensure that the reference plane starts at the port; any port extension cable can introduce errors. For 15NN50-1.5C, the specification can be seen in Figure 4; the VNA master should only sweep the cable's specified frequency range (6 GHz in this case).

The next thing to do is to set the limit line to make the testing easier. The user can bring up the limit line setup by selecting the “shift” and “six” keys to take the user to the limit menu, as seen in Figure 7. Next, the user can turn on the audio notification if the measurement is above the threshold. To set the limit line, the user needs to hit the “limit edit” button and then the “amplitude” button, as seen in Figure 8. Next, refer to the cable’s Technical Data Sheet (TDS) to find the cable’s acceptable return loss, as seen in Figure 4, and enter the number as the amplitude.

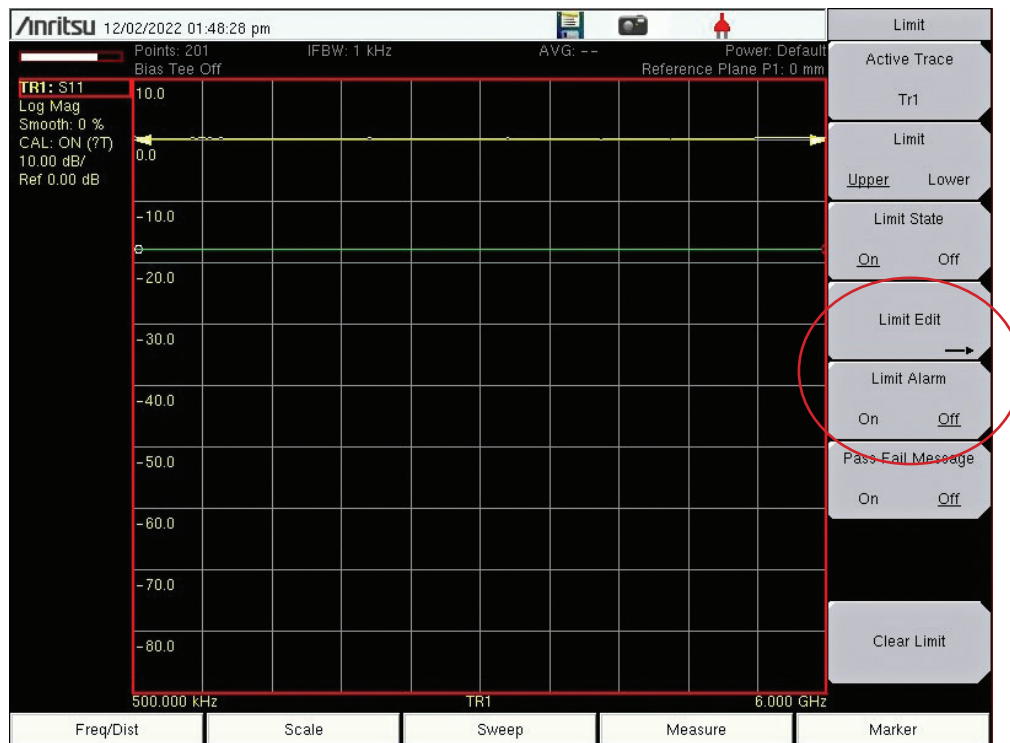


Figure 7. Limit Menu

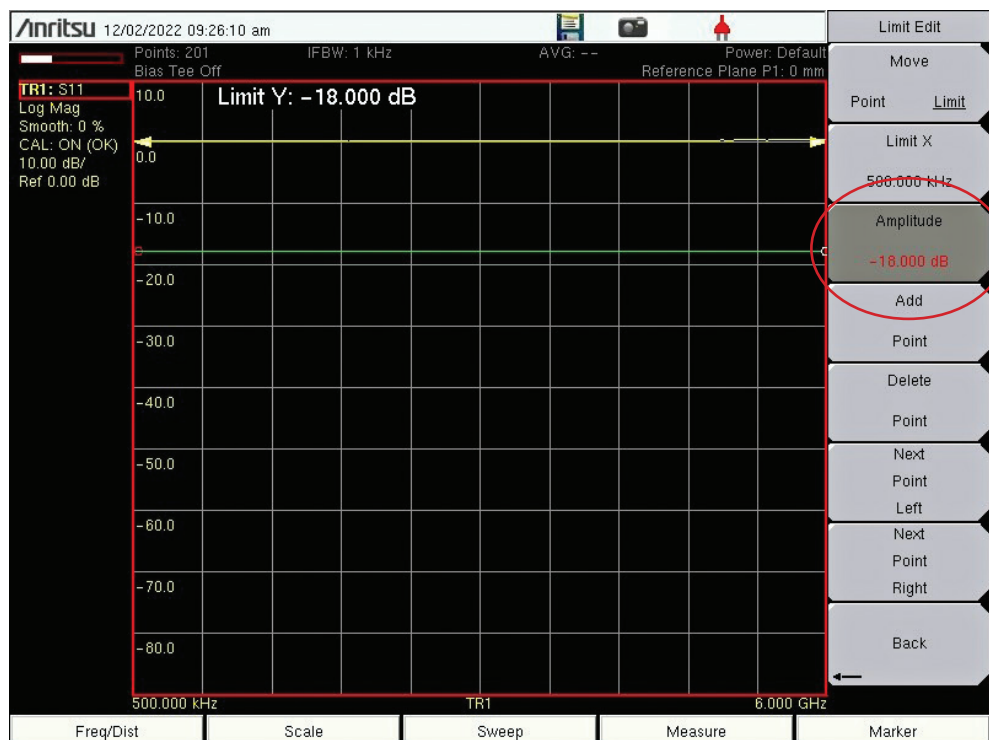


Figure 8. Limit Edit Menu

Take the test port cable being tested and connect it to the VNA master. The user can determine whether the cable is good or bad by performing a return loss measurement. Return loss is a one port (S11) measurement; make sure you insert the cable into a port that has been calibrated. Terminate the test cable's open end with a precision 50 Ohm load such as the load from the calibration kit. Select the "measure" button to select the type of measurement to perform (S11), as seen in Figure 9. The results should be below the limit line.

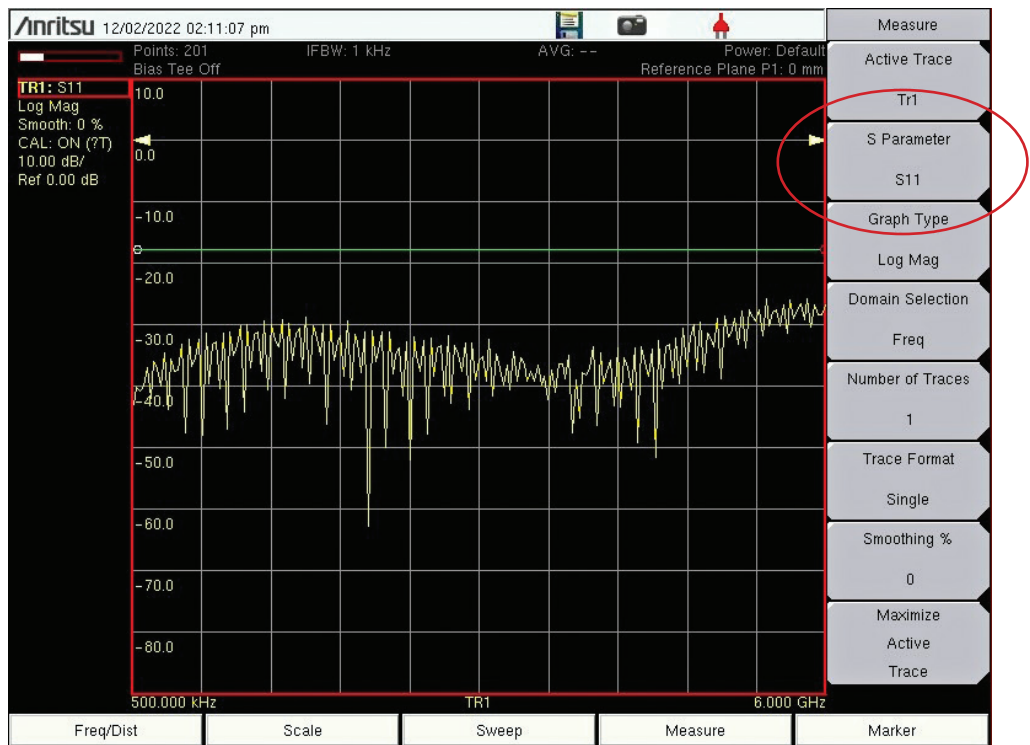


Figure 9. Measure Menu

The next step is to save the active trace into memory. To get to the trace menu, press “shift,” then the “five” key labeled as trace. From there, press the “save trace into the memory” key. Next, select the “display” button and select memory trace and live trace. The screen on the VNA master should look like Figure 10.

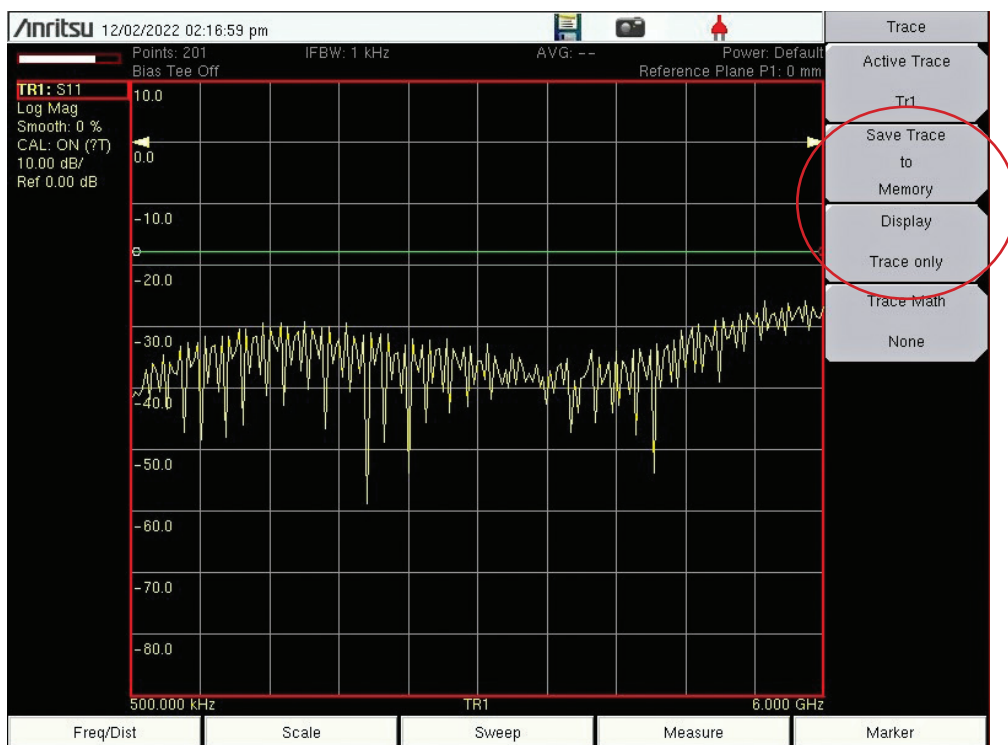


Figure 10. Trace Menu

While monitoring the screen, move the test port extension cable around. The measurement should remain the same, as seen in Figure 10. If the measurement changes like in Figure 11, then the test cable is bad. In addition, the measurement must never be over the limit line set.

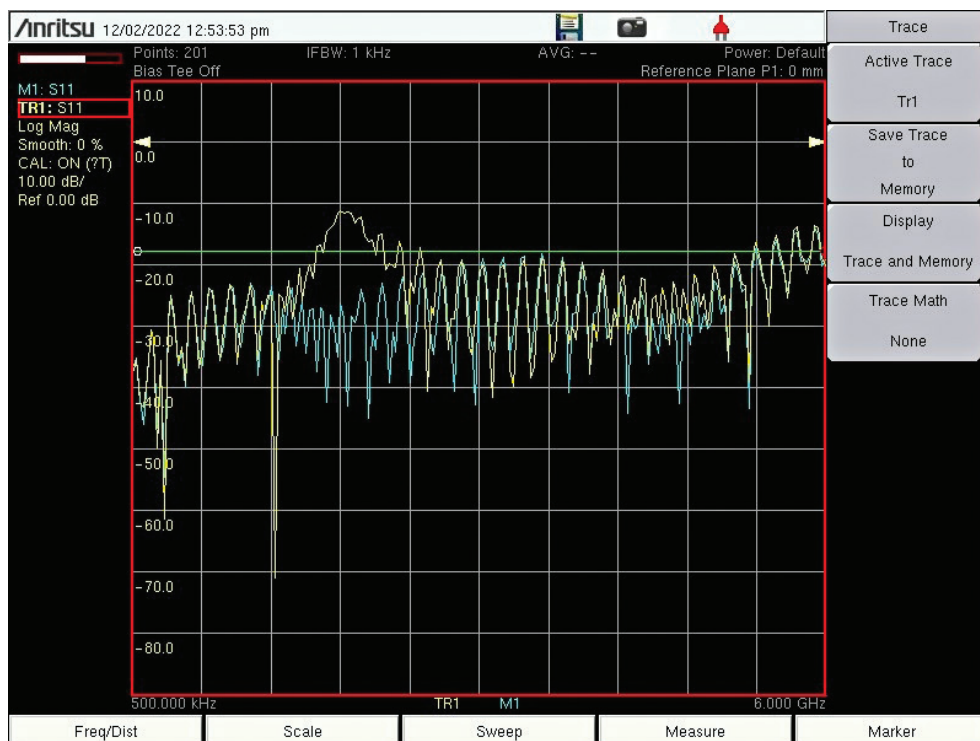


Figure 11. Blue Line is S11 of Homemade Extension Cable; the Yellow Line is S11 when the Cable was Moved Around

Summary

High-quality port extension cables are important accessories when it comes to accurate VNA measurements. For example, Anritsu's family of phase stable port extension cables will ensure high-quality measurements and will not adversely affect the measurement results. Damaged and poor-quality port extension cables are often the main cause of poor measurements. It is important to test port extension cables when looking for the root cause of poor measurements.



Specifications are subject to change without notice.

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