# Calibration and measurements in time domain with the vector analyzer

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# 1 Introduction

The aim of this paper is getting to know how does the vector analyzer works in time domain. In order to do correct measurements, it has to be calibrated and when done, being able to understand how to do proper measurements with the tools provided.

# 2 Calibration

To calibrate correctly, these steps have to been followed:

- Select 'S Parameters' in the main menu.
- Select 'Freq' and then set 'Start freq' at 10 MHz and 'Stop freq' at 3 GHZ.
- Select 'Sweep' then click on 'Number of points' this must be selected based on the precision required. In this example the configuration will be set at 401 points.
- Select 'Trace' then in 'Transform menu', select 'Transform setup'. Once in, we have to select 'Low Pass Impulse' and set 'Start' and 'Stop' time will be selected based on the measurement element and its final length, in this example, the configuration will be from -2.5ns to 2.5ns.
- To have a better view of the measurement trace, select 'Format' click 'more' and then select 'Real'. Figure 1 is what has to be seen.
- A pulse is wanted to be seen, so click 'Cal', then click 'Calibration Wizard', and select the properties in order to what it is wanted to be measured. In this case, it has been selected only one male port. Once the calibration is finished the next figure has to be seen: Figure 2.

# 3 Measurements

When the calibration has been done, components could be measured. For example if a cable is not working correctly, it can be said how long is it and where it does not work as it should. What it can be done is measure the length of the cable. In order to do this, we have to select 'Analysis' then click 'Transform', 'Transform Setup', 'Dist Marker Setup'. In this menu, the automatic mode and meters units have to be selected and 'Speed factor' has to be changed to 0.75. When finished, with the marker, we will be able to know how long it is. As we can appreciate in: Figure 3.

Before selecting a part of the cable, it can be seen in Figure 4 that due to connectors and other kind of components, can make our measurements, less precise. So the recommended procedure when a cable or

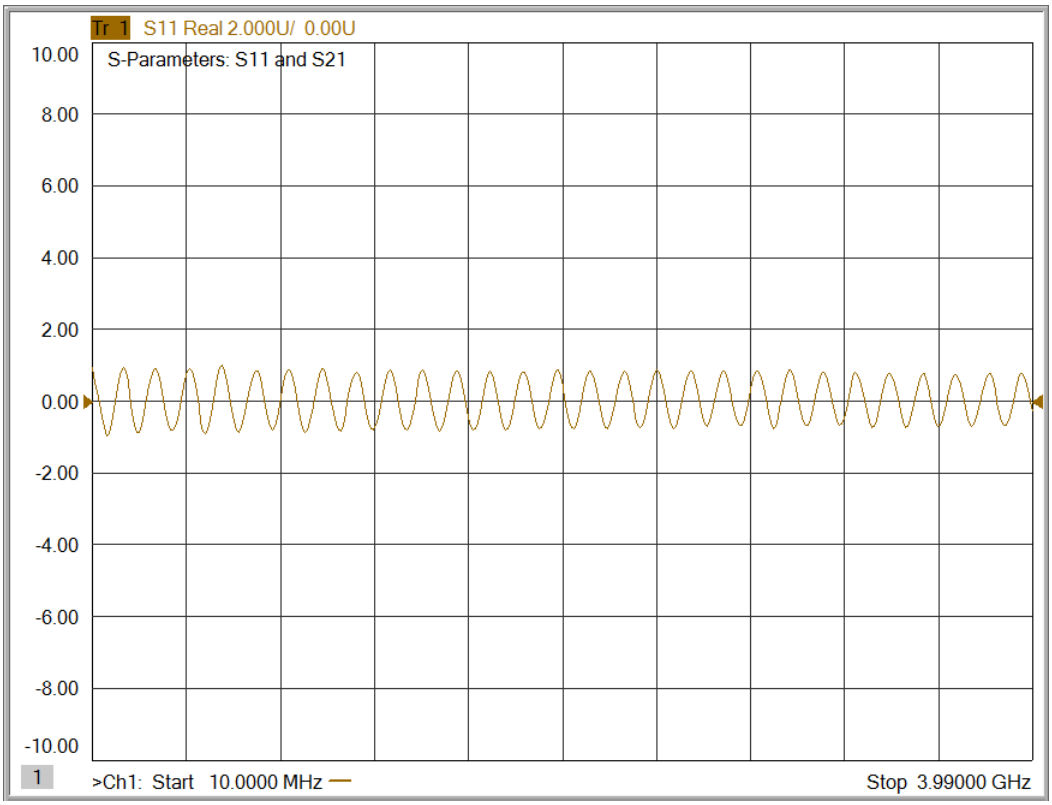


Figure 1: Real format

a part of a cable wants to be tested is to press 'Analysis', 'Gating'. In this menu we can select the cable without the connectors in order to have more precision. Reducing the spam is easier to see 'gate start' and 'gate stop' with the aim of selecting the right part of the cable. Once selected 'gate start' and 'gate stop', the part of the circuit wanted to be measured should be seen.

When finished, 'Gate ON' has to be selected and gate effects have to be seen, so the effects of the parts which have not been selected, will be attenuated so we will be able to see the part selected in a more precise way. Figure 5.

In addition, the instrument to be measured can be matched without the need of placing a matching load (50 Ohms). The first thing to do is select 'Analysis', 'Transform', 'Transform OFF', because now we will see the effects in the frequency domain. If we select 'Gate OFF', it can be appreciated that all the power injected by the port one is reflected. Figure 6.

If the gate is activated, the port will be seen as it was completely matched without the necessity of adding a matching load because with the gate, the final part of the connector which is bad matched, will be filtered as we can appreciate in Figure 7. This is very useful because we will not have to dismount the whole circuit to study whether any part does or does not work correctly adding more precision to the measurements.

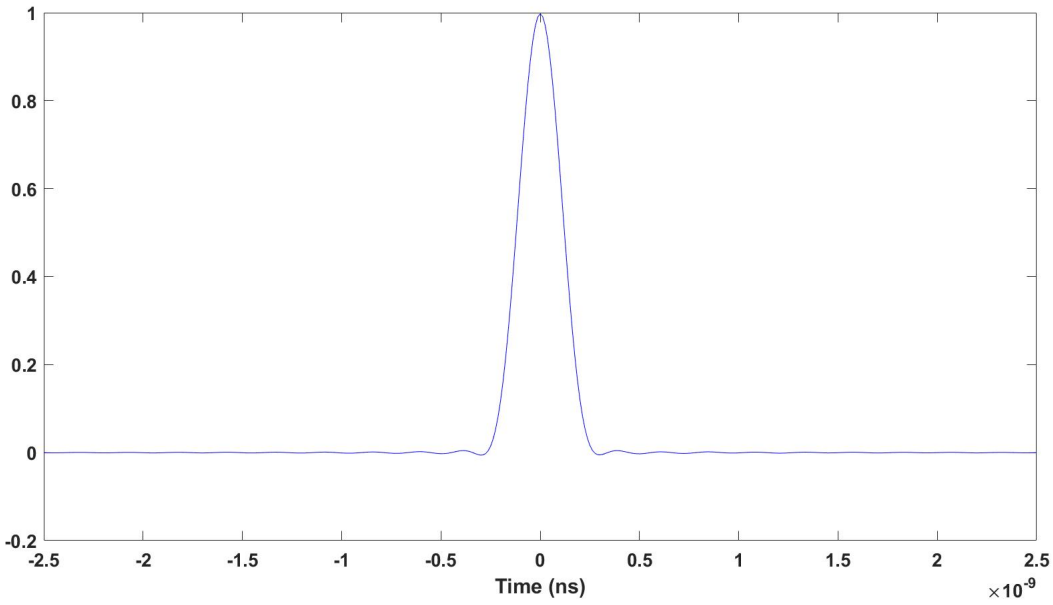


Figure 2: Calibration completed

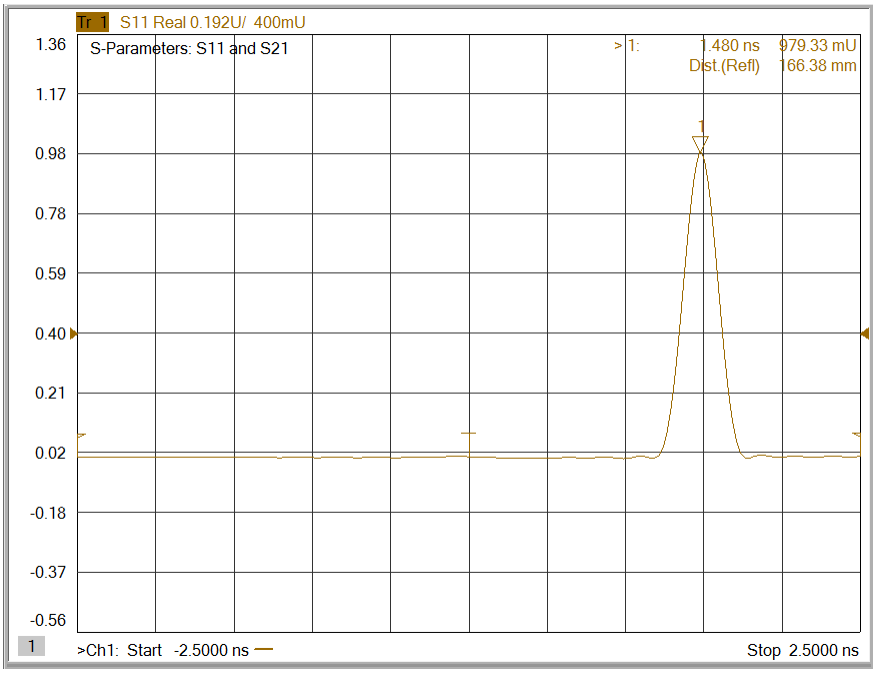


Figure 3: Cable length

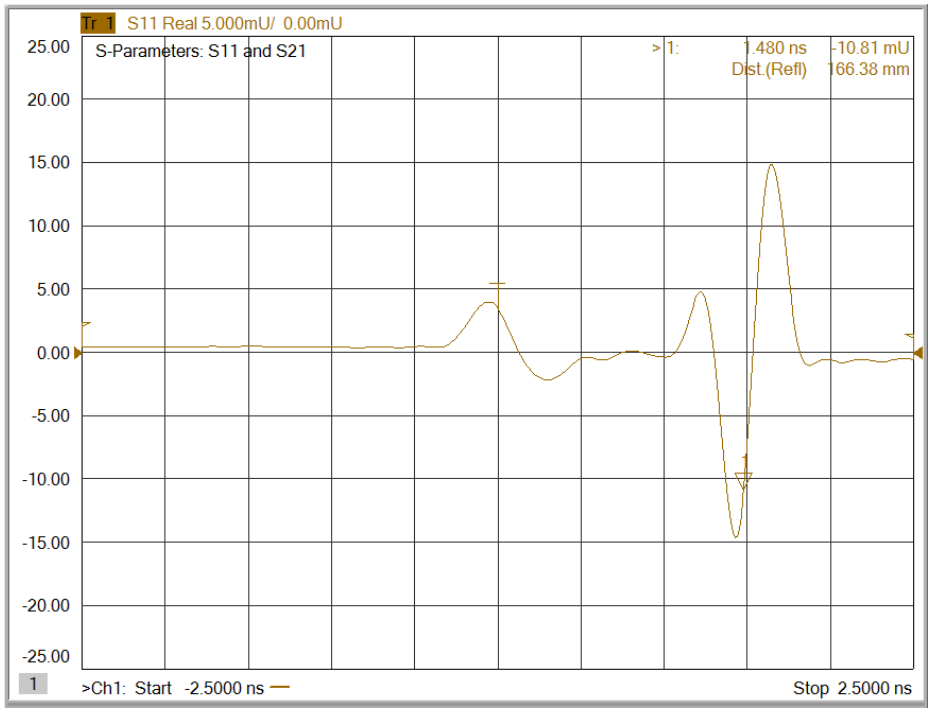


Figure 4: Gate not selected

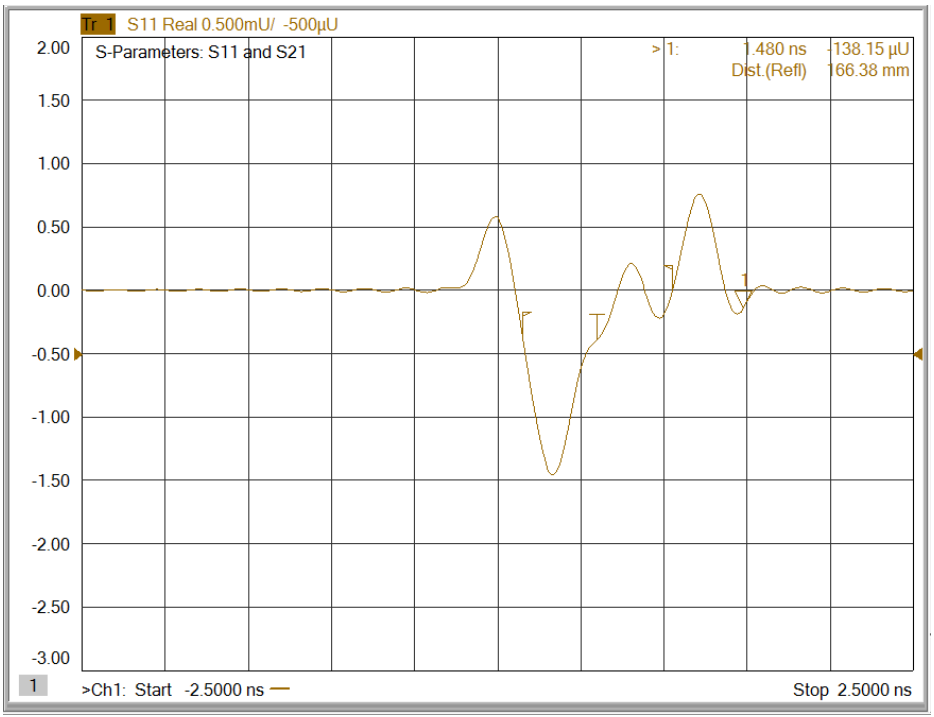


Figure 5: Gate selected

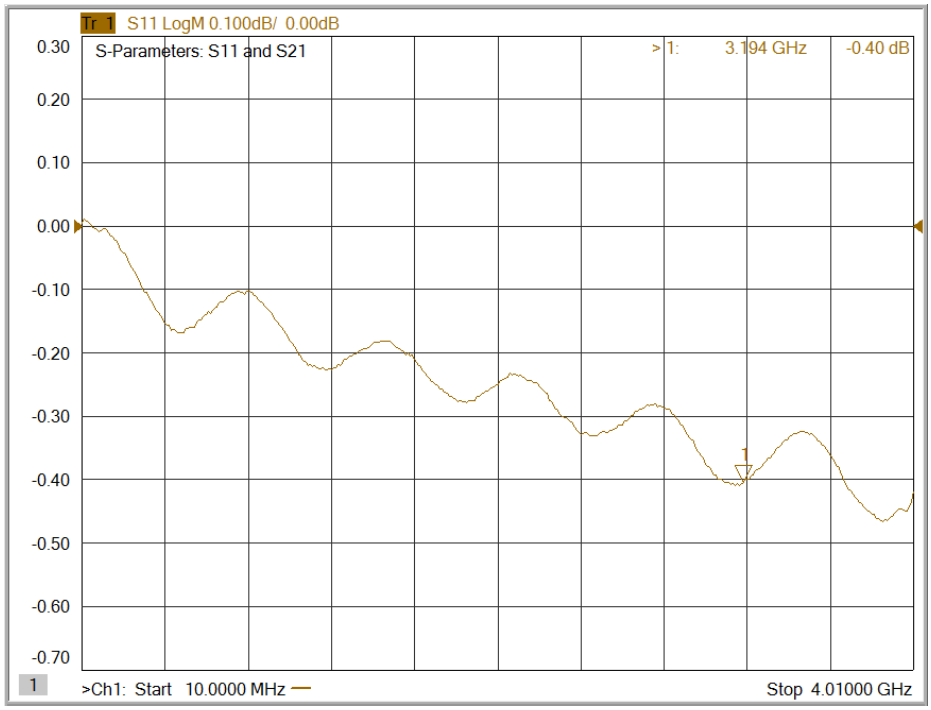


Figure 6: Reflection in port 1 when 'Gate OFF' selected.

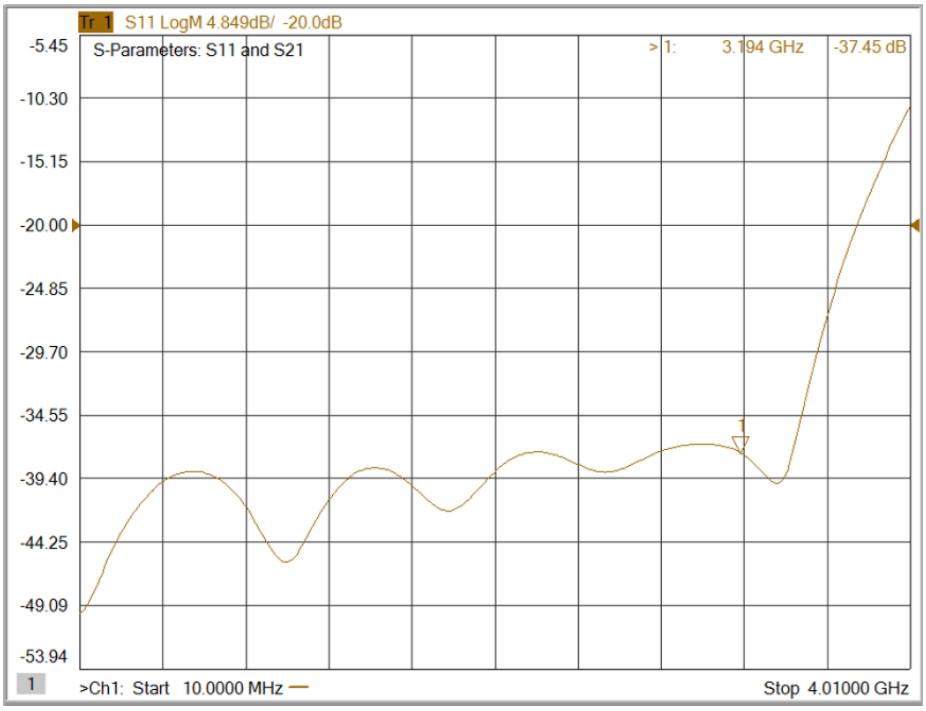


Figure 7: Adaptation in port 1 when 'Gate ON' selected.