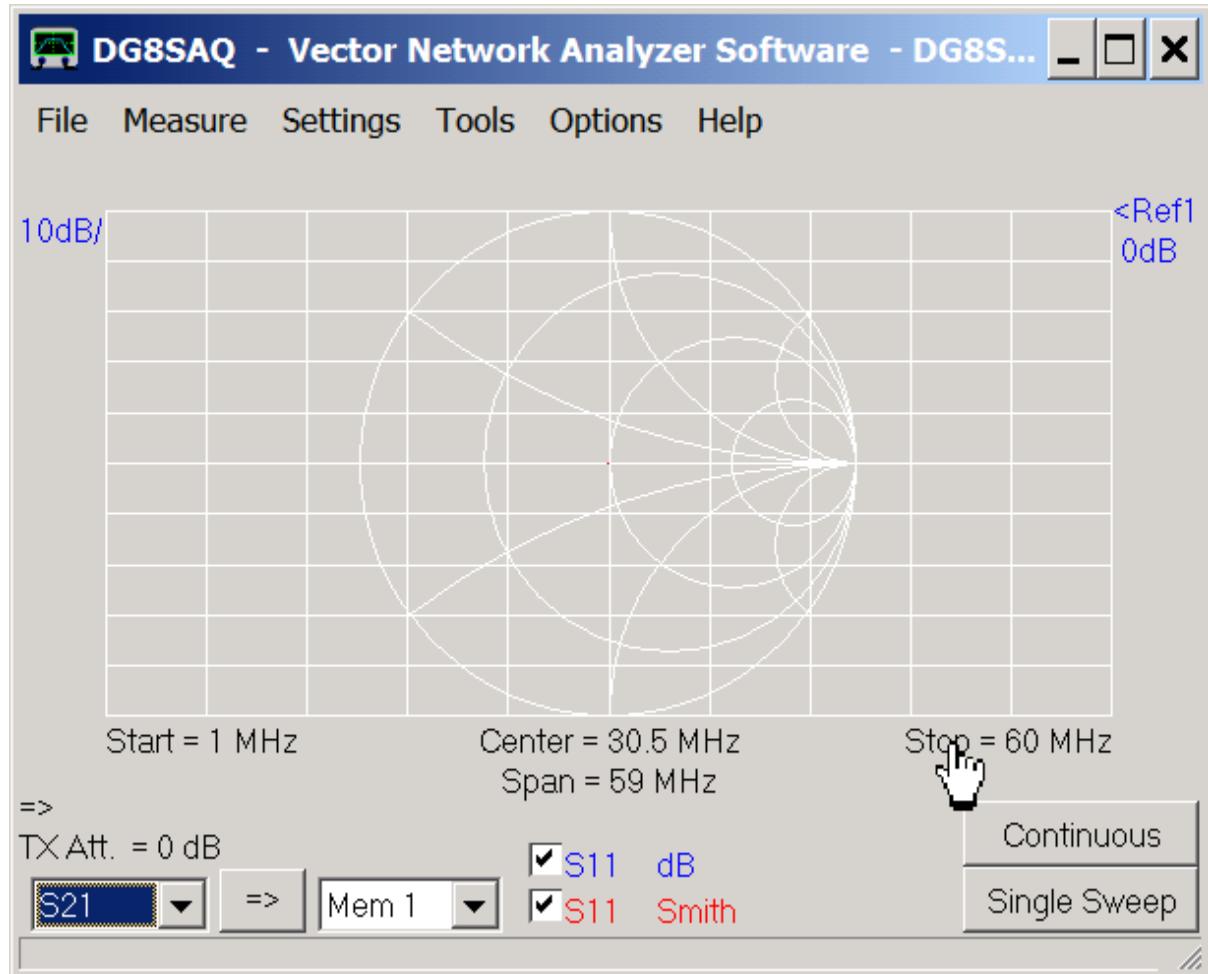


## Example: A simple one port measurement

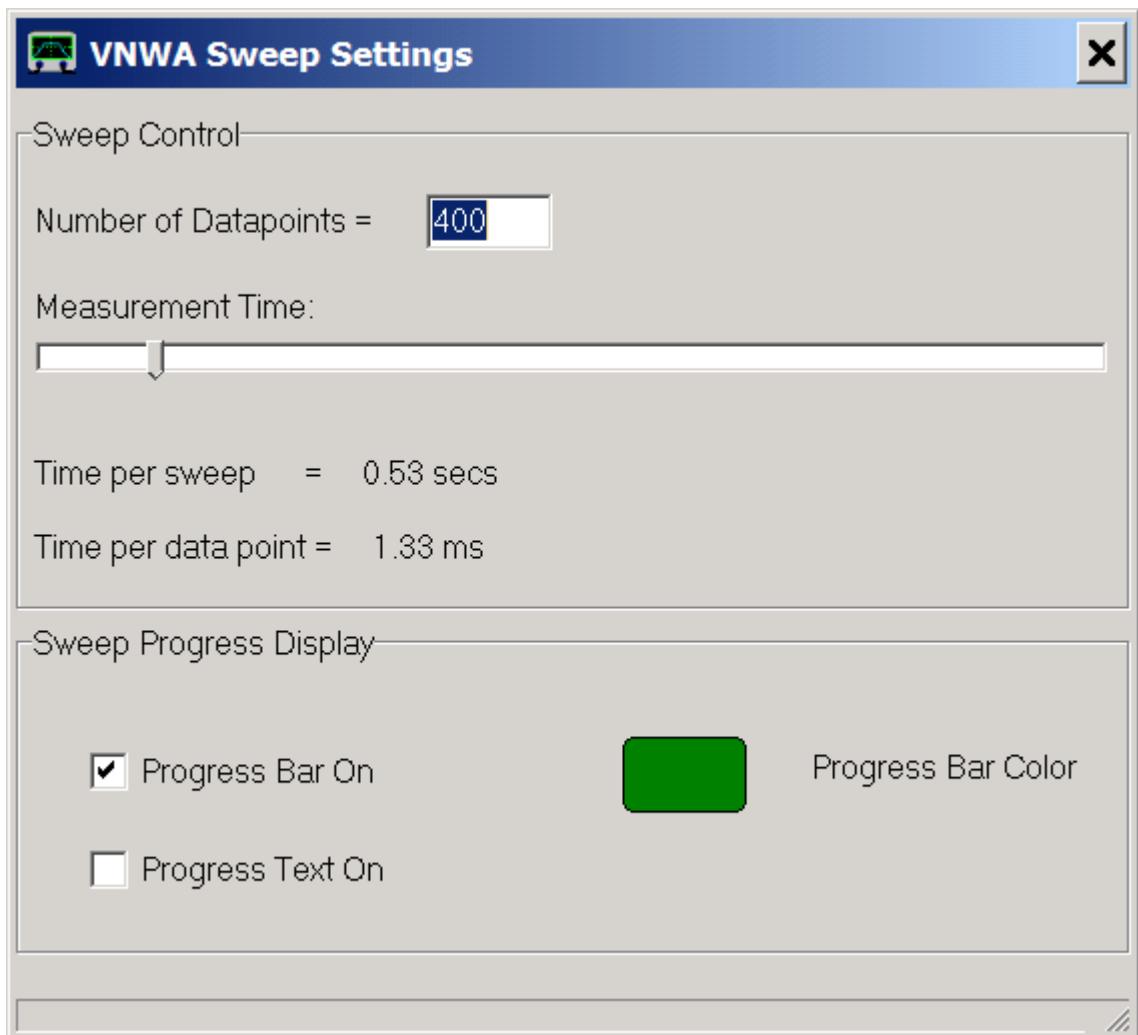
The following example demonstrates how the VNWA can be used to measure a little loop antenna for 13.5 MHz and extract its electrical properties.

### 1. Setting up

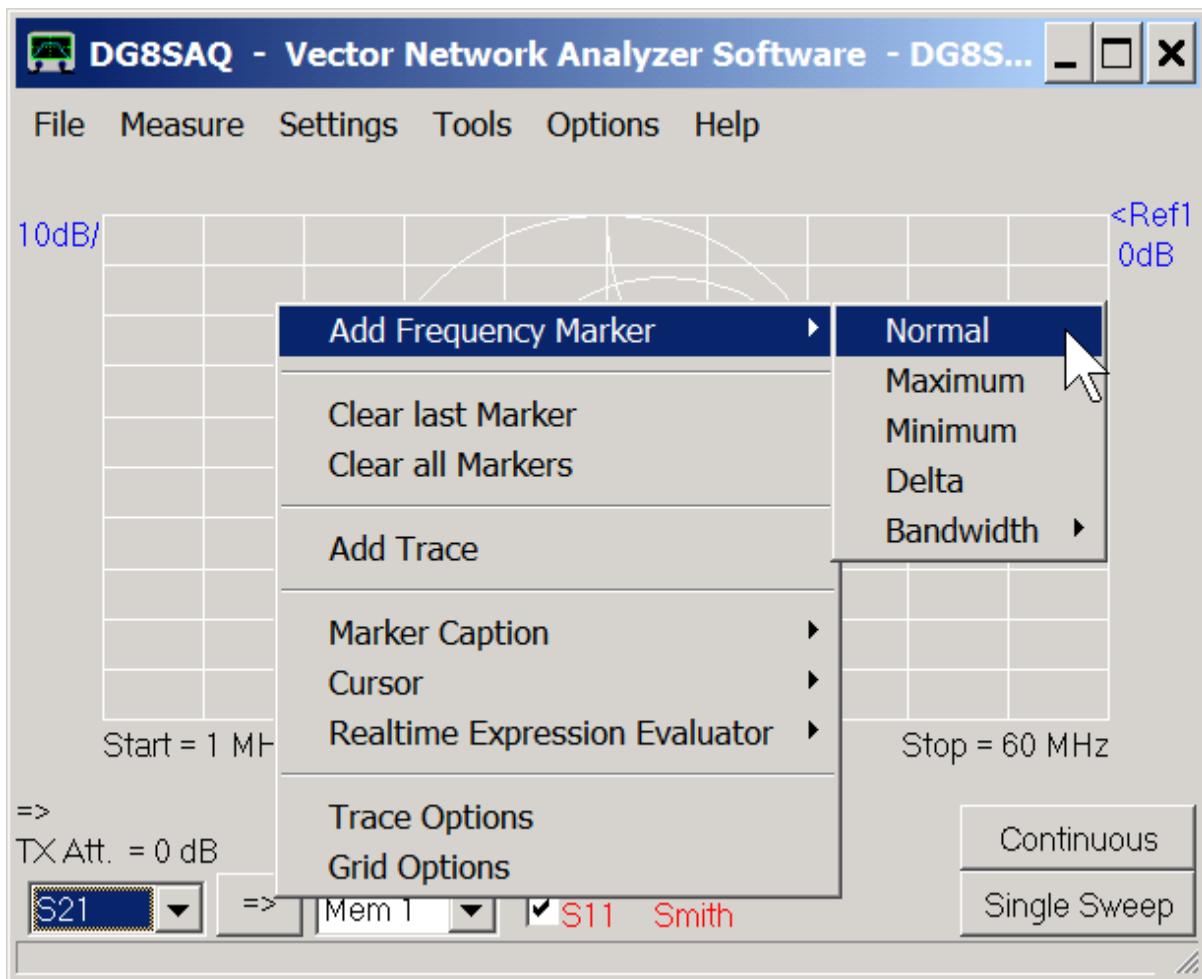
We set the instrument to the desired frequency range e.g. by double-clicking the "Stop" label or by simply pressing the f-key on the keyboard.



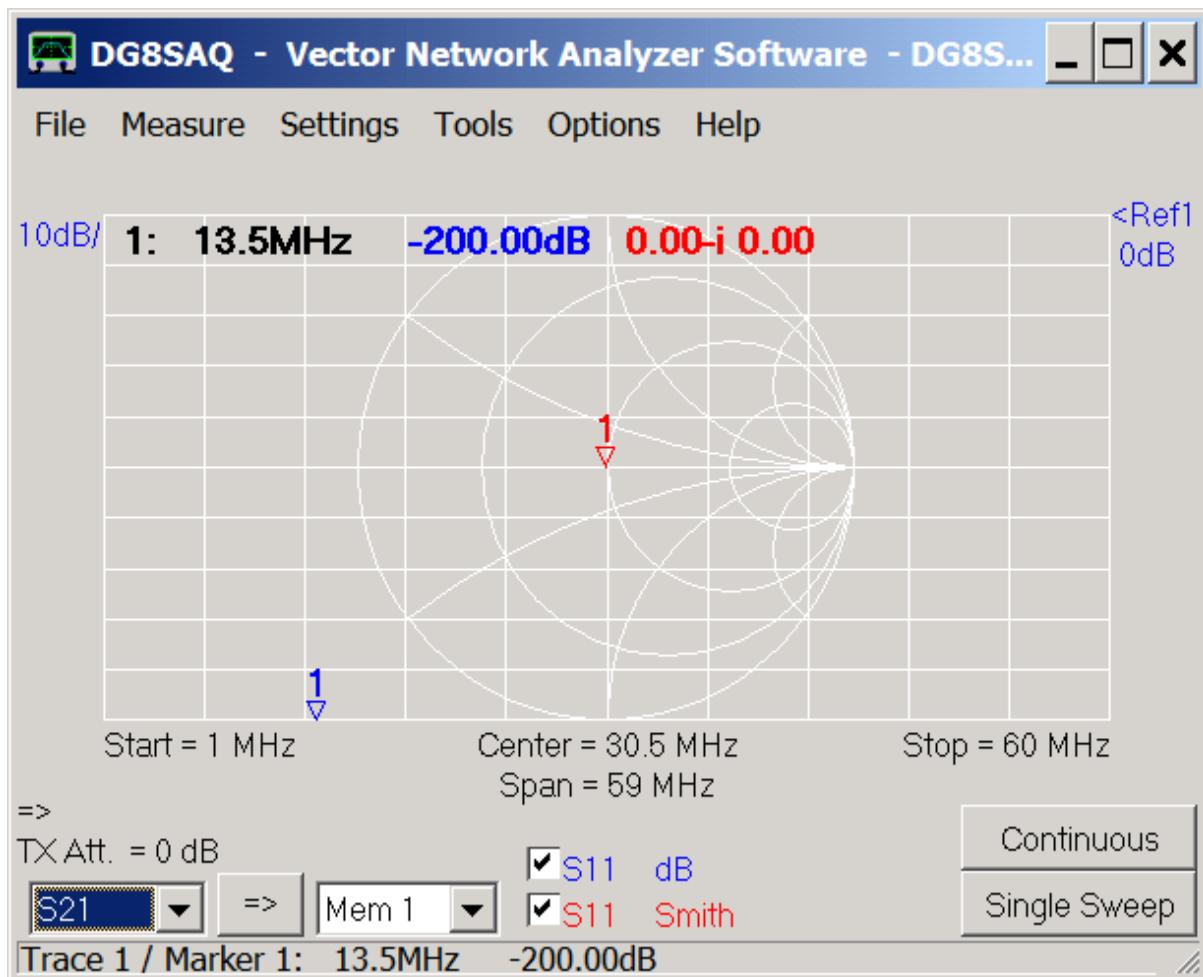
Also, select S11 for both traces as shown above. Select Settings-Sweep or press the s-key on the keyboard to choose reasonable sweep parameters:



Next we place a marker by right-clicking onto the main drawing grid:



Here it is:



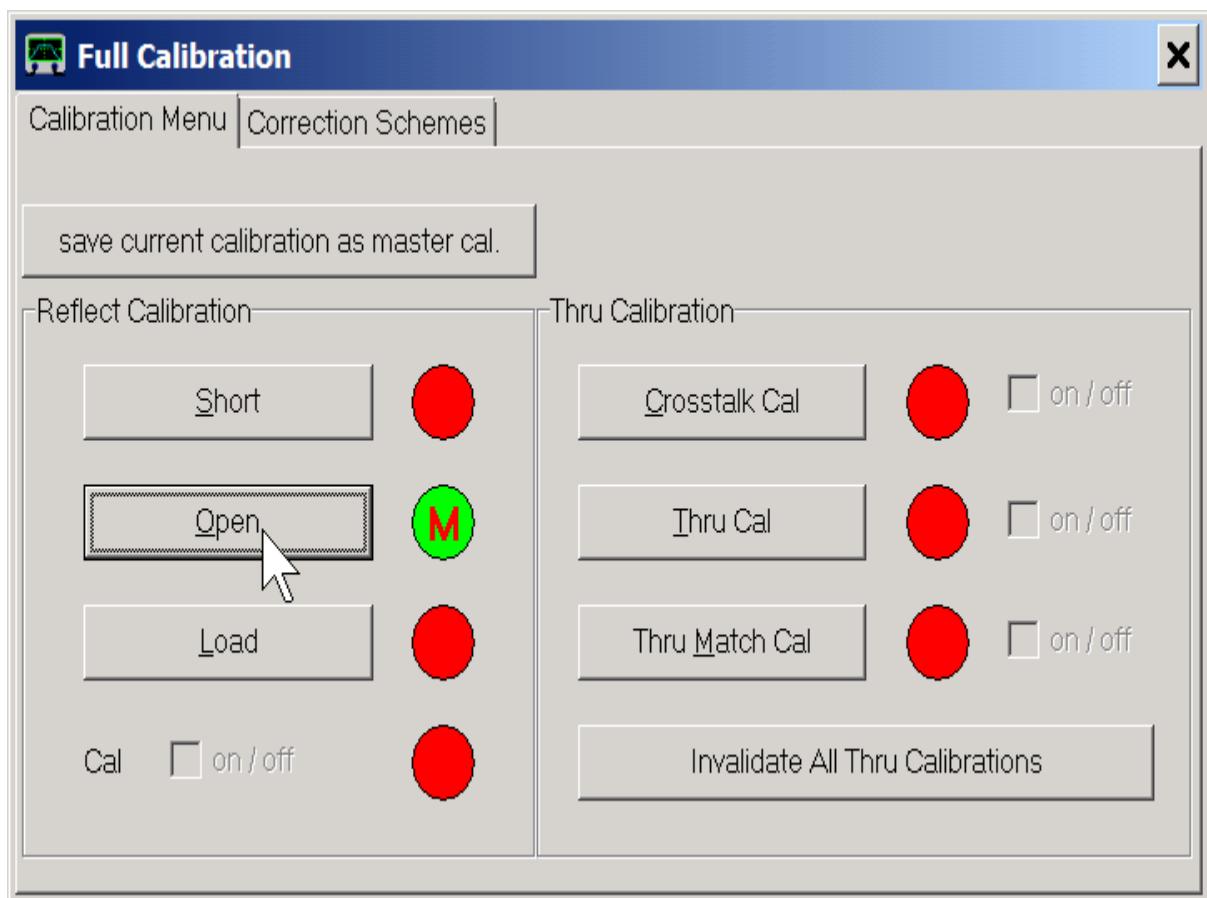
Now we are ready to calibrate the VNWA for a one-port measurement, also called reflection measurement.

## 2. Calibration

This example demonstrates how to calibrate a male test cable end with male calibration standards. We connect our test cable to the VNWA TX port and we connect our open calibration standard (in this case a female-female through connector) to the other end of the test cable:



We select "Measure-Calibrate" or simply press the c-key on the keyboard, press the "Open" button, confirm that the open standard is connected and observe the instrument measuring the standard. When the measurement is completed, the red Open light turns green:



Cal  on / off

Invalidate All Thru Calibrations

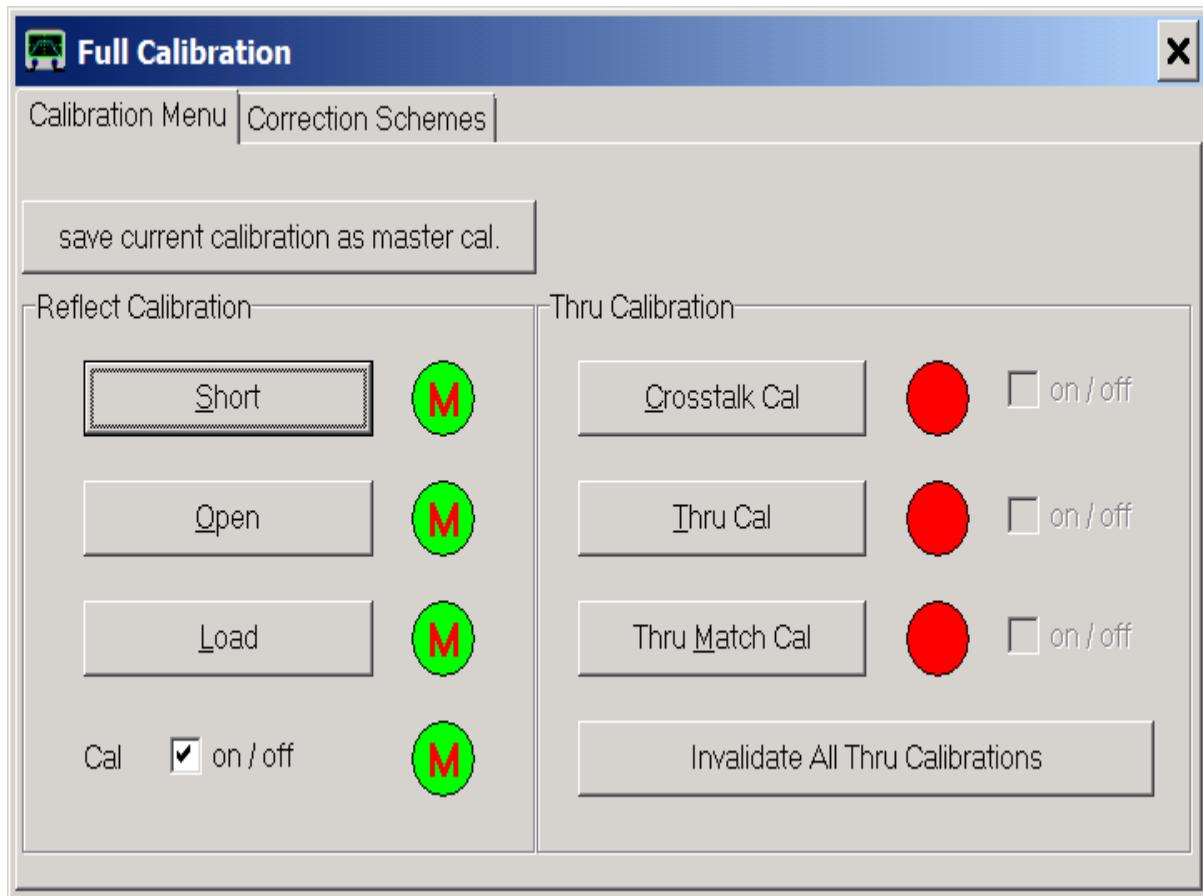
In similar fashion we measure the load calibration standard...



... and the short calibration standard:

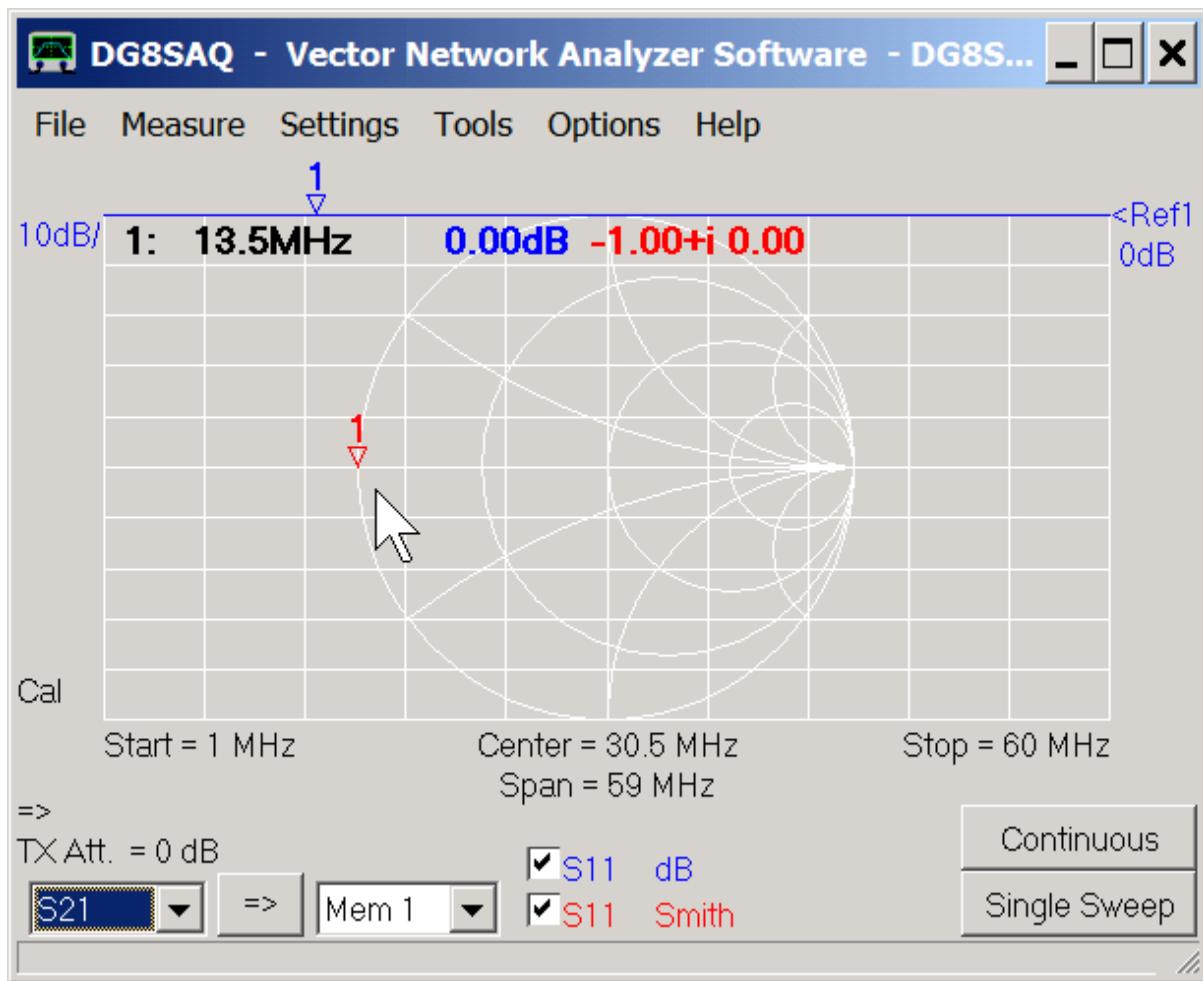


Finally, all reflect calibration lamps should be green:

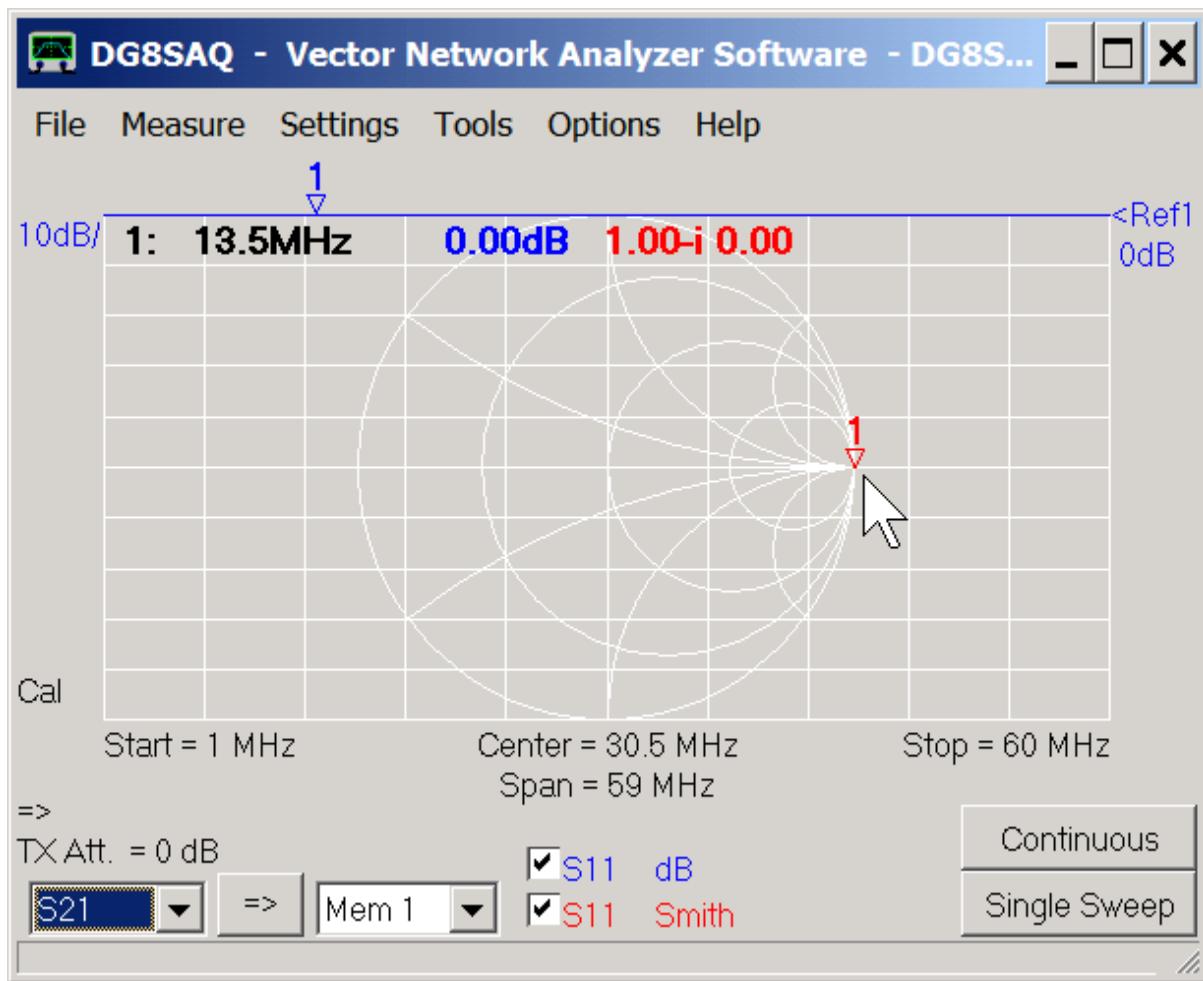


We close the calibration window and double-check the calibration by measuring the calibration standards. Observe the red Smith chart trace.

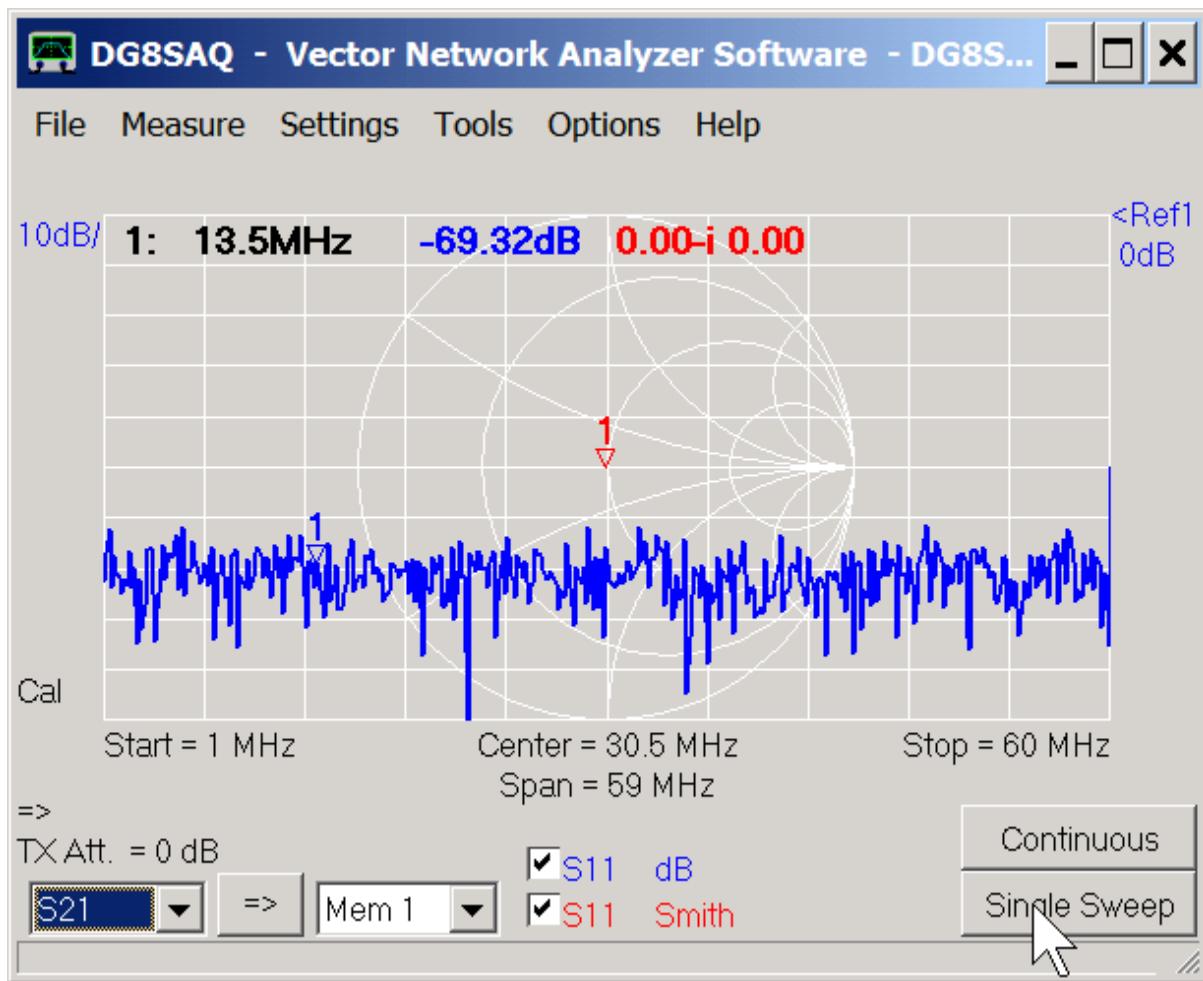
The short calibration standard should yield a dot at the left edge of the Smith chart (reflection coefficient -1, red marker value). Without the marker, the dot would be barely visible:



The open calibration standard should yield a dot at the right edge of the Smith chart (reflection coefficient +1):



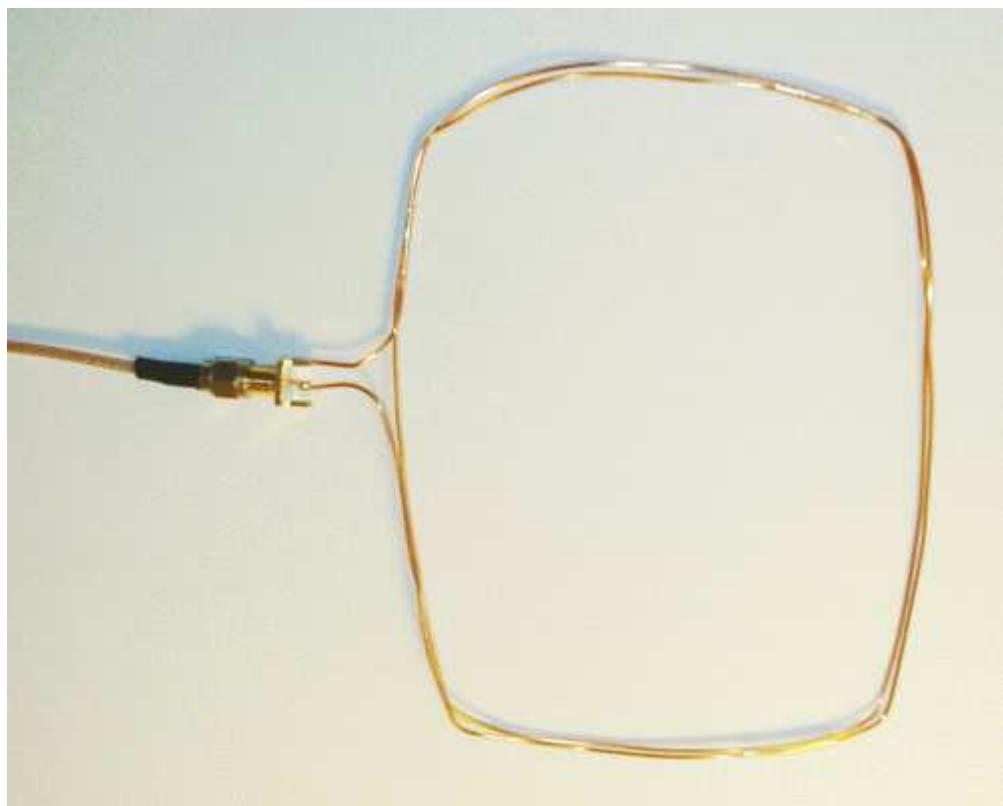
The load calibration standard should yield a dot at the center of the Smith chart (reflection coefficient 0):



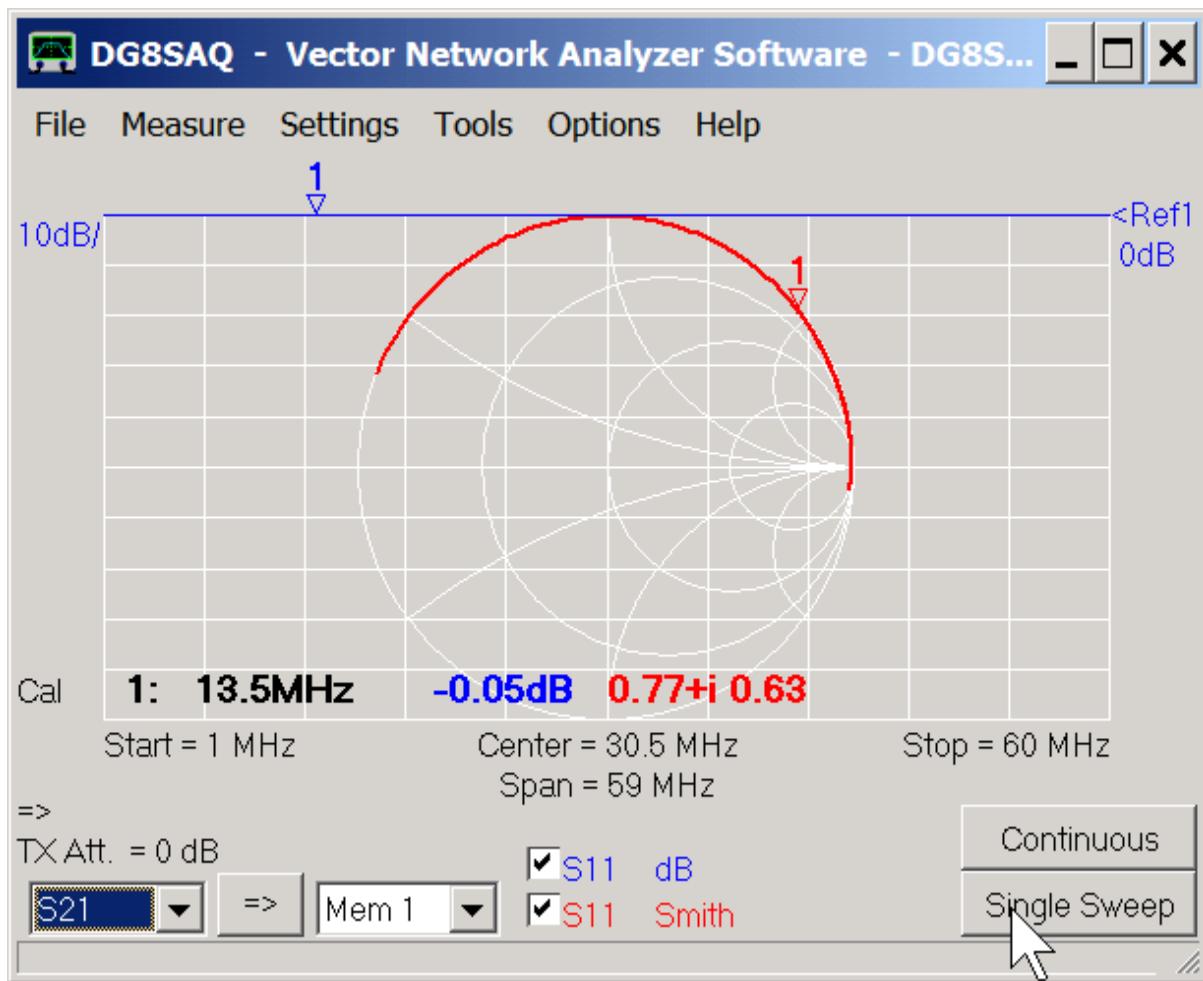
The dB scale trace shows that the measured reflection coefficient is not exactly zero but very very small due to noise.

### 3. Measurement

Next, we connect our loop antenna to be tested to the end of the test cable...



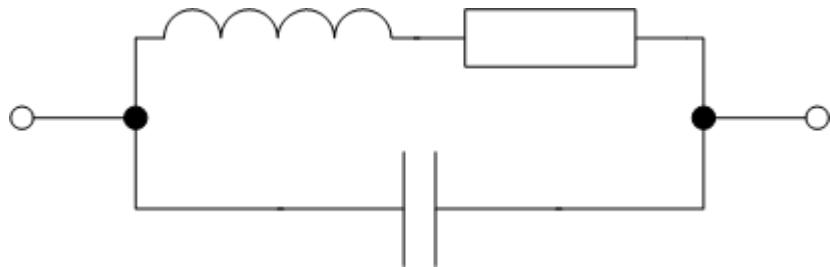
... and measure it:



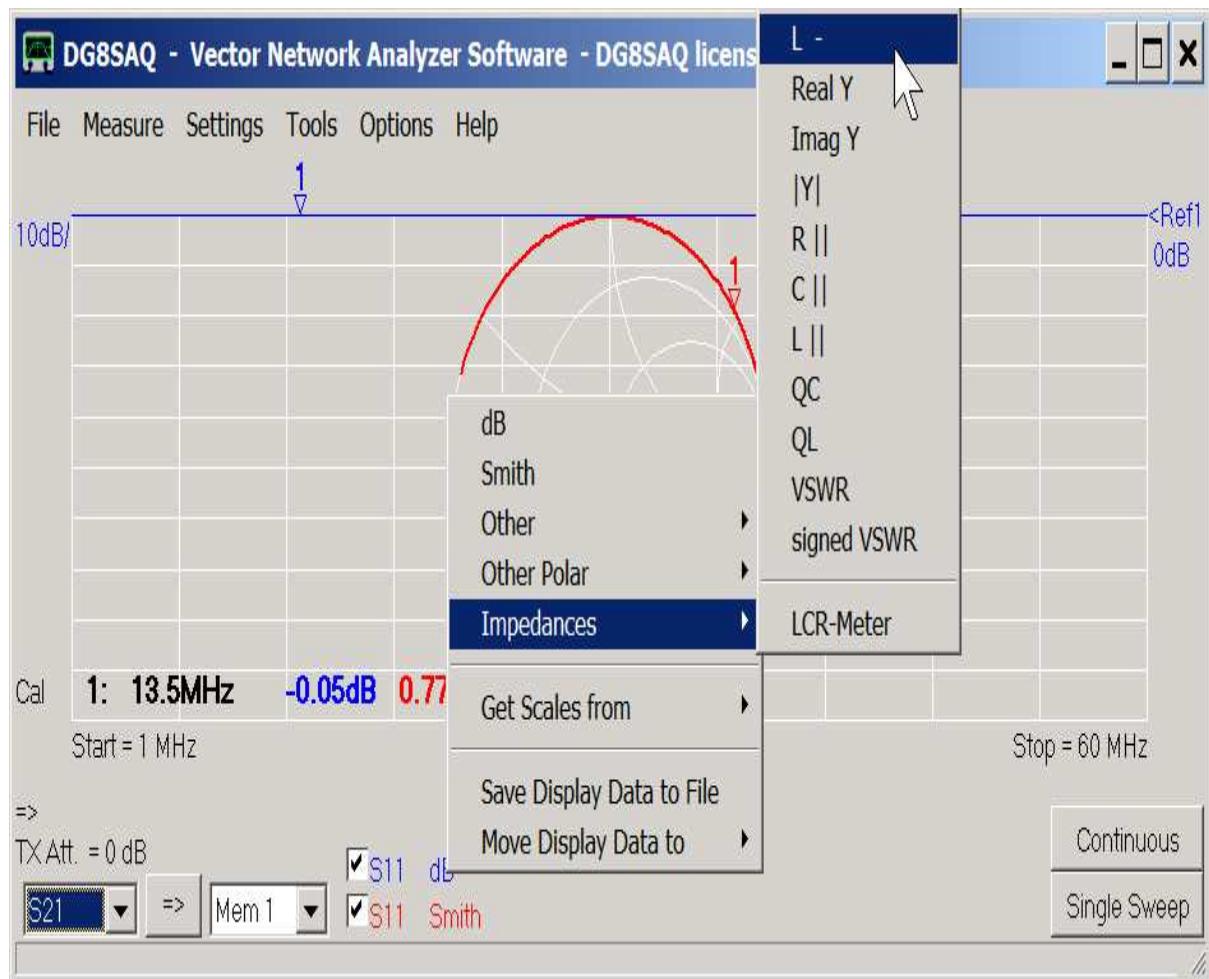
The antenna looks pretty much like an inductor with the red Smith chart trace circling mostly at the upper edge of the Smith chart. The blue trace shows that almost all power is reflected by the antenna (absolute value of reflection coefficient close to 1 = 0dB) if connected to the 50 Ohms source impedance of the VNWA.

#### 4. Parameter extraction

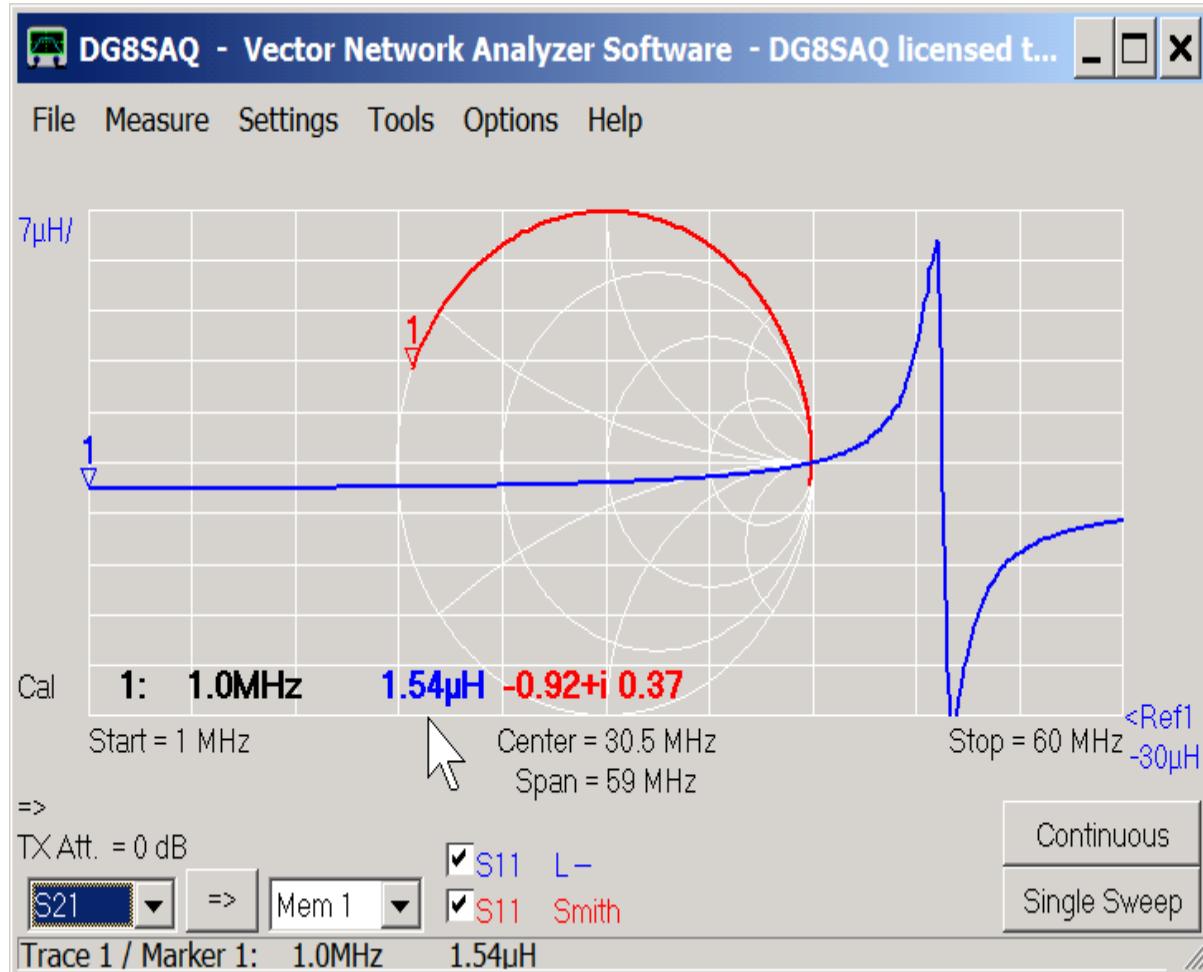
The antenna can be described quite accurately by the following equivalent circuit:



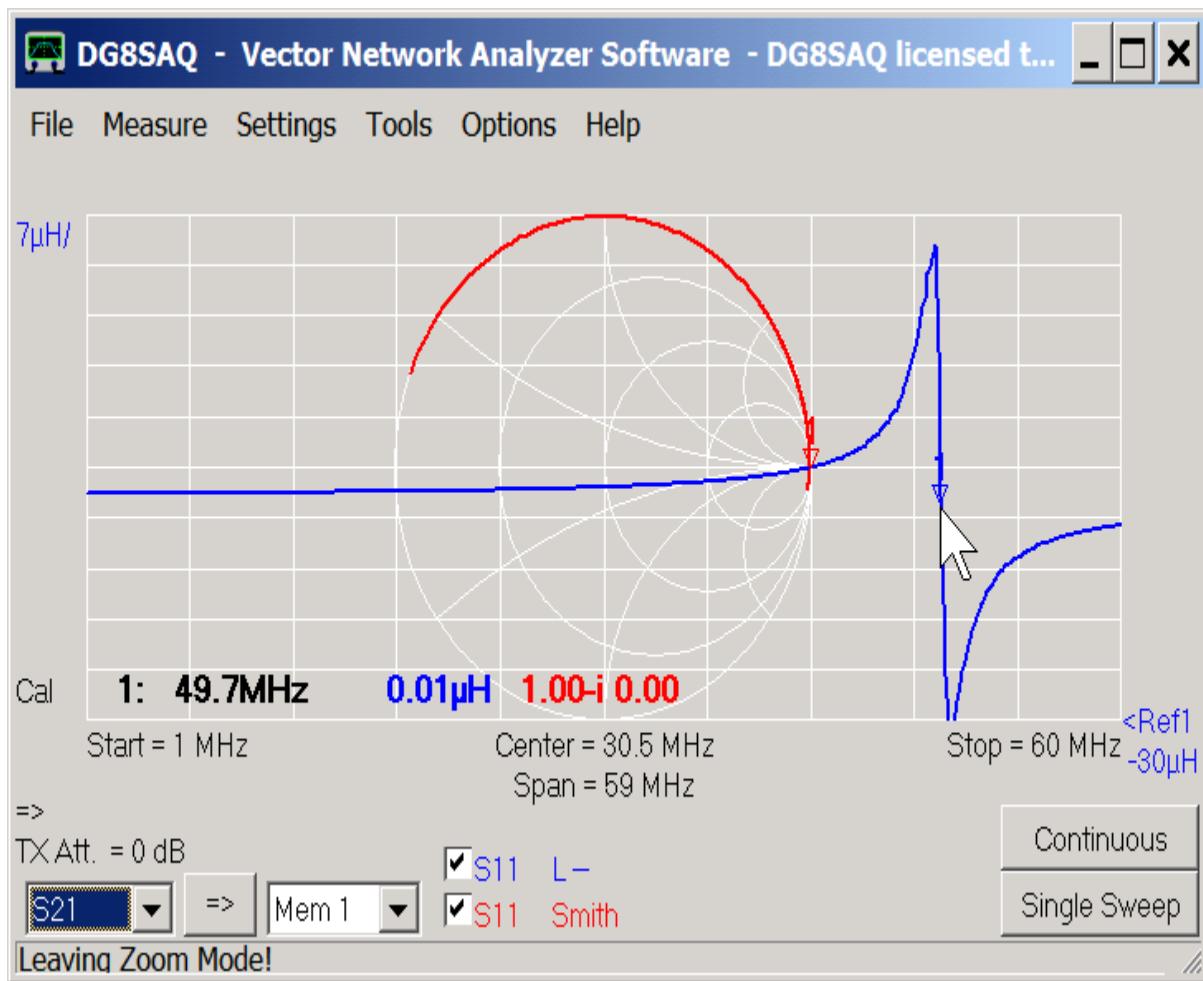
In order to obtain the inductance value, we switch trace 1 to display the series inductance calculated from the measured reflection coefficient S11 by right-clicking onto the dB label on the bottom:



The dominating contribution to the reflection coefficient at low frequencies comes from the inductance. We therefore move the marker with the mouse to the left and read off the inductance value at low frequency to yield  $L=1.54\mu H$ :



Next, we read off the parallel resonance frequency caused by the parallel capacitor by finding the frequency where the inductance value becomes zero between the resonance peaks to be  $f=49.7MHz$ .

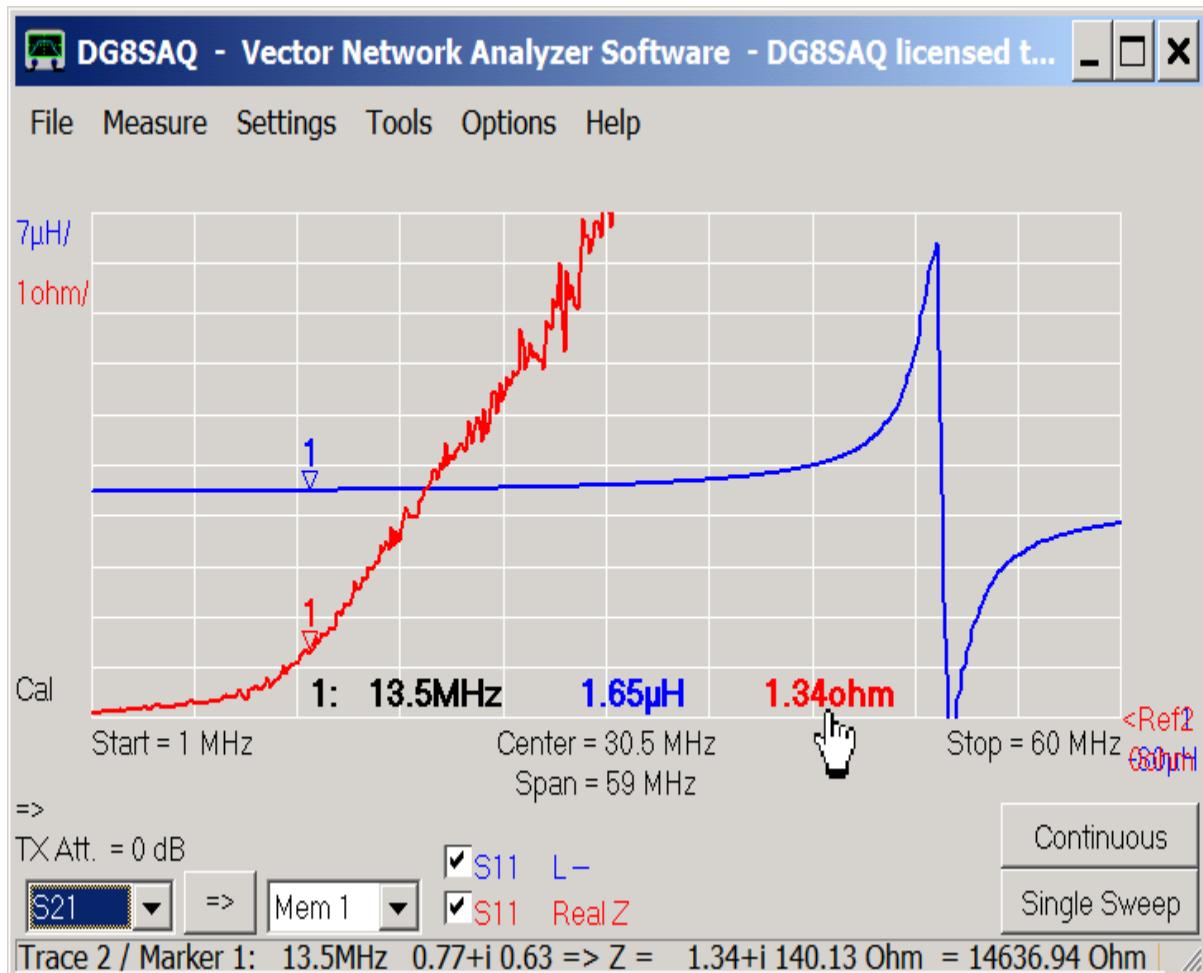


From this we can calculate the capacitance value using the parallel tank circuit formula ...

$$2\pi f = \frac{1}{\sqrt{LC}}$$

... to yield C=6.7pF.

Finally, we determine the real part of the antenna impedance at the nominal transmit frequency of 13.5MHz...



... to yield 1.34 Ohms.

Using these values we can calculate a matching network to match our antenna to e.g. 50 Ohms output impedance of a transmitter.