

## How to improve the Dynamic Range of the VNWA Using Averaging and Smoothing

Few days ago Gerfried Palme DH8AG forwarded to me some measurements, done for a 2.4GHz Filter, using the method I earlier described, but he had added a wideband amplifier between the Filter Output and the VNWA RX input.

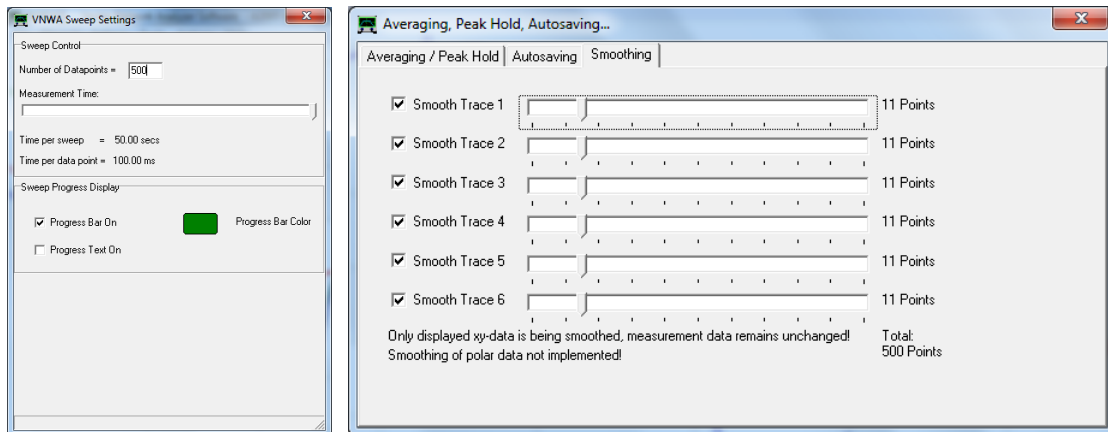
As the filter used in front of the DUT, to clean up the TX spectrum, and used while doing the S21 calibration, is filtering out the strong Fundamental RF DDS signal (below 600MHz), is allowing the insertion of such a Wideband Amplifier, as the amplitudes are many dB below the -17dBm level the VNWA delivers for the fundamental RF DDS.

**Despite the VNWA calibration does not operate correctly when a unidirectional amplifier is in the path between the TX and RX port**, as the reflection during S21 Calibration is from the Wideband amplifier and not the VNWA RX port, it still works, provided the Wideband amplifier is having a close to 50 ohm input impedance.

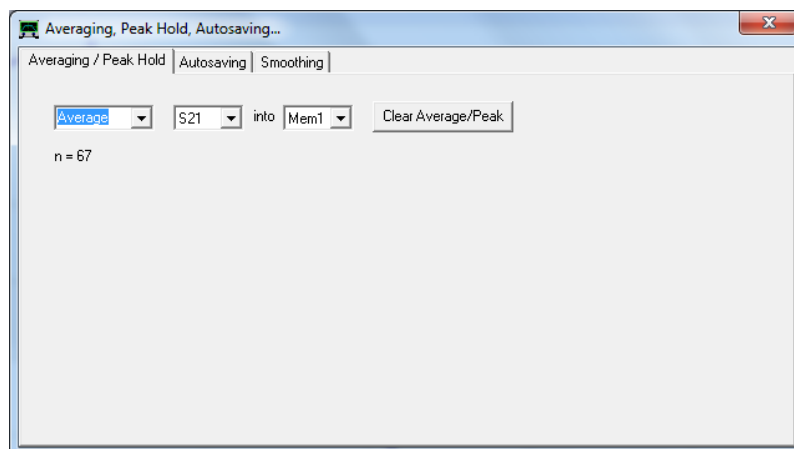
I simple had to try out again the measurement I made in the document [http://hamcom.dk/VNWA/How to measure filters at around 2.45GHz.pdf](http://hamcom.dk/VNWA/How%20to%20measure%20filters%20at%20around%202.45GHz.pdf) to see what could be improved, with respect to the S21 dynamic range, and used a poor wideband amplifier (MAR3) made from t a junk PCB from a “retired” 900MHz Basestation, with a gain in the region of 20-25dB at 2.5GHz.

What Gerfried also did was to use average and smoothing (during an entire football game - Dortmund against Bayern München, as Gerfried is from Dortmund) which gave considerable improvements in the S21 dynamic range of the VNWA.

See below how I did setup the VNWA:



1. Number of points 500, and time per point 100mS, both for S21 Calibration and measurements.
2. Smoothing used with 11 points out of the 500 which does not harm the measuring result, but gives a much nicer trace. You may play with this setting both during /after the measurements take place.



Average set to S21 to MEM1

**Else three Plot Traces used.**

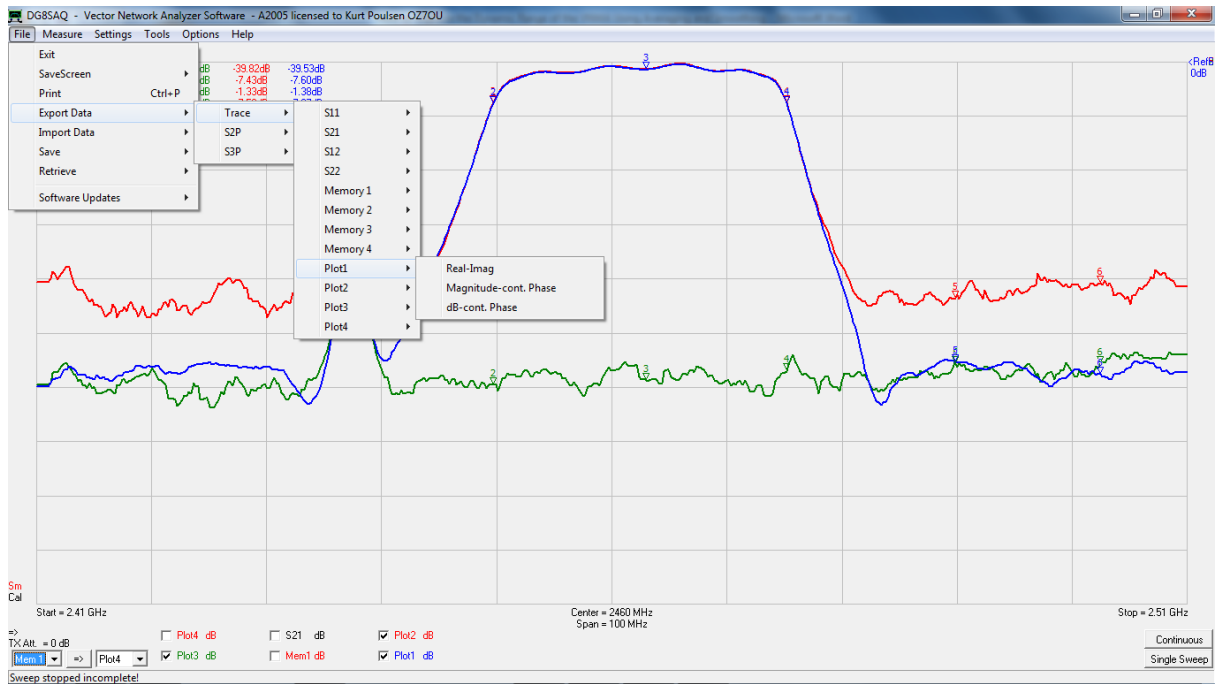
Red trace is S21dB (the live trace) transferred to Plot1

Blue Trace is Averaging/Smoothing over 400 Sweeps (while I was sleeping) by transferring MEM1 to Plot2

Green Trace is the Noise Floor (averaged over 100 sweep) while connection between DUT and Wideband amplifier disconnected and after clearing the Averaging, by Transferring MEM1 to Plot3.

As seen below the improvement in dynamic range is approaching 15dB. As said the Wideband Amplifier used is far from ideal so with a proper "lownoise" Wideband Amplifier it might even be improved further.

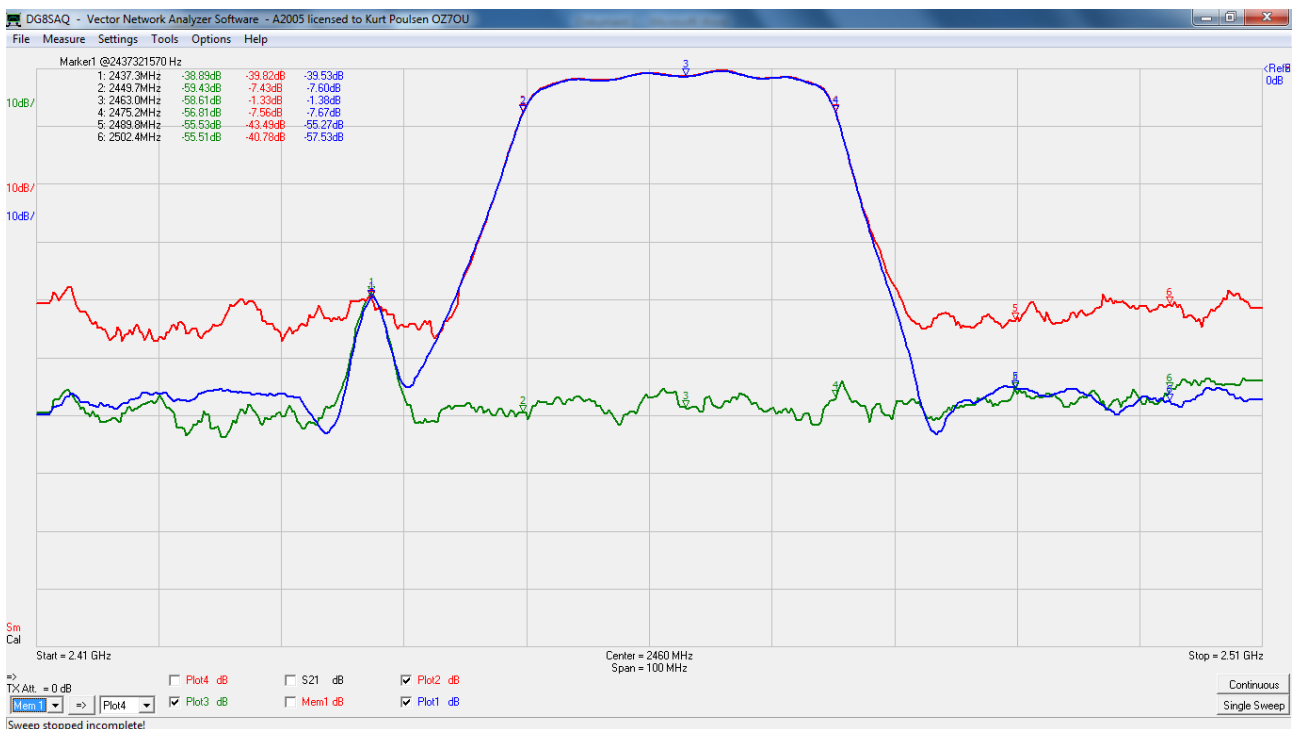
The results can be stored as Touchstone files as seen below, one plot trace at a time.



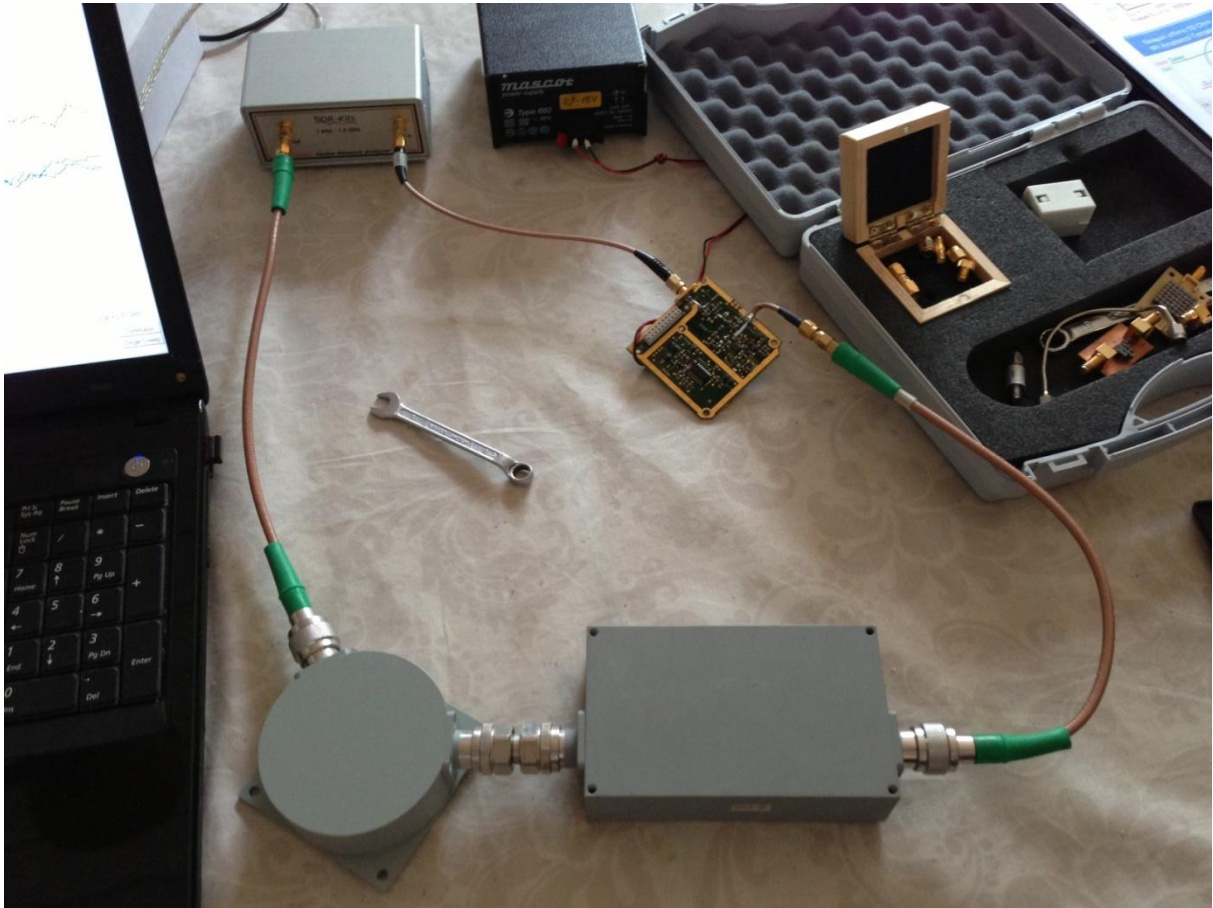
Below picture shows that the side response at marker 1 is not a filter response but a VNWA generated Spurious or even a signal from my WiFi in the house 😊

A hint about number of traces for the Averaging:

Beyond 25 sweeps the improvements seem to fade out and beyond 100 is not giving any more improvements.



## The setup



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