Measurements for determination of the calibration data of the SDR-Kits mixed Male Calibration kit

Preface:
SDR-Kits now introduces a mixed male calibration kit consisting of the Rosenberger male load and male short, in combination with a Fairview male open endcap. Also included is a Rosenberger female-female adaptor:

For the task I used the VNWA in combination with my recently acquired HP85033C 3.5mm calibration kit, which also includes twice of each phase matched, male and female APC-7 to 3.5mm adaptors. That allows for accurate measurements of delays of any type of SMA thru adaptors such as male-male, female-female and male-female, just by exchanging the gender for one of the APC-7 to 3.5mm adaptors, after a full calibration of the VNWA. Off course, the 3.5mm calibrations standards can be used directly with the VNWA but then direct delay measurements of symmetrical thru adaptors are not possible. Both the 3.5mm male and female short have identical delays of 16.695ps and likewise the 3.5 mm male and female open have an identical delay of 14.491ps and C0=53x10(-15)F C1=150x(-27)F/Hz and C2=0 , C3=0. Male 3.5mm load DC resistance was measured to 49.932 ohm and female load measured to 50.065 ohm with 0.01% accuracy.

Test equipment for 0.01% precision measurement of load DC resistance

A further detailed description of the HP85033C and how to use it and how to evaluate the measured response to be found at http://www.hamcom.dk/VNWA/How to use and verify HP35033C.pdf

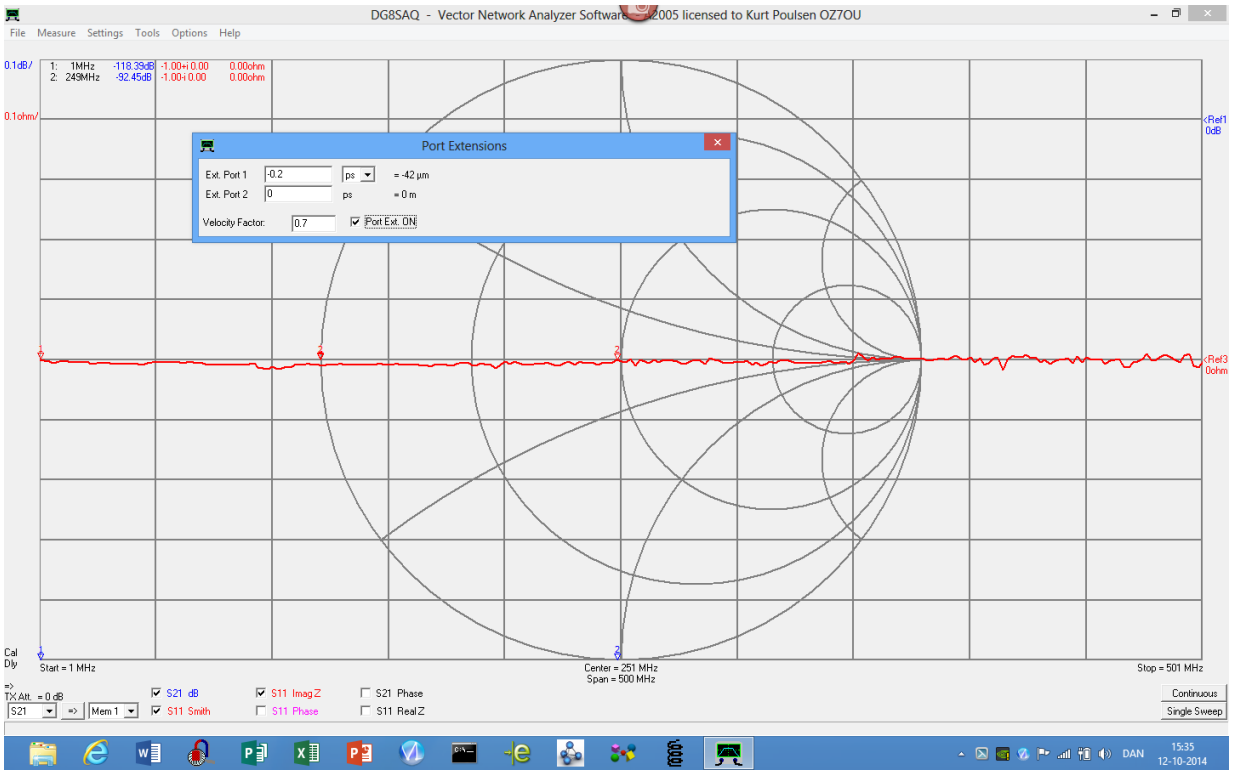
Thus an APC-7 front end was made for the VNWA, to utilize all the features of my HP85033C calibration kit.

The APC-7 to 3.5mm female flange fitted to the VNWA with a SMA male-male adaptor

Measurements performed for the Male mixed calibration kit

The VNWA ready for calibration and measurements of the male mixed calibration kit

After a complete calibration with the HP85033C male calibration standards the first item to be measured is the delay of the Rosenberger male short.
The VNWA settings are span 1 to 501MHz with step size 2MHz and thus 251point needed. 100mS per point selected.

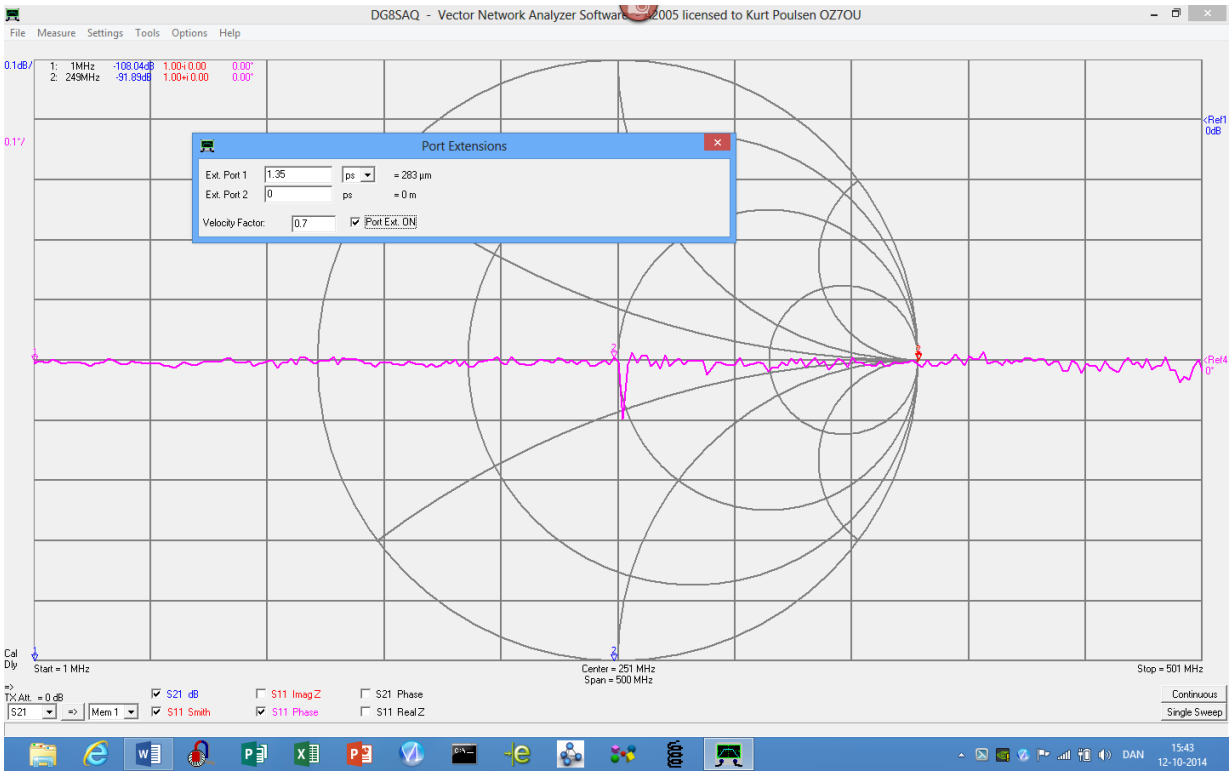


Rosenberger Male Short 1and 2 had an extension port1 delay of -0.2ps – a bit surprisingly that they were not 0 or slightly positive. The reason: The shorting disk is not thick enough to be a fully short. More on that in the special document for the HP85033C document mentioned earlier. A previously purchased male short (two years ago) from Fairview Microwave has an extension port1 delay of -0.1ps.

Summary for the Rosenberger male short:
Use a delay of +0.2ps

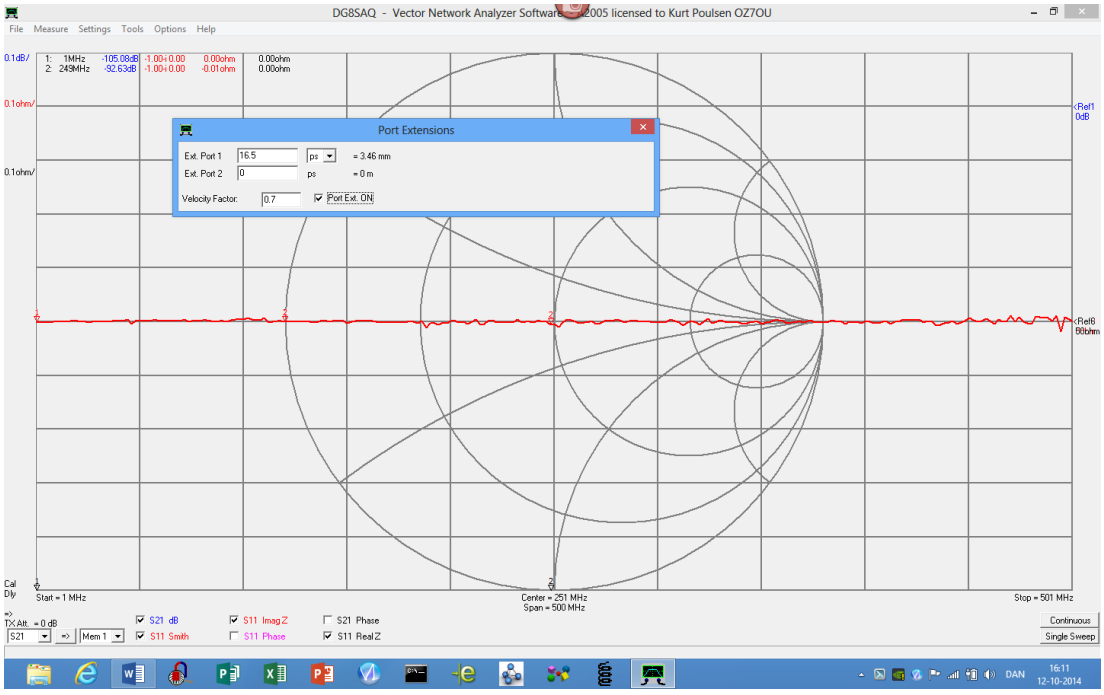
Next item to measure was the Fairview Male Open endcap.

PLEASE OBSERVE THE SILICON PAD INSIDE THE ENDCAP MUST BE REMOVED ELSE STRANGE RESULTS WILL BE OBTAINED.



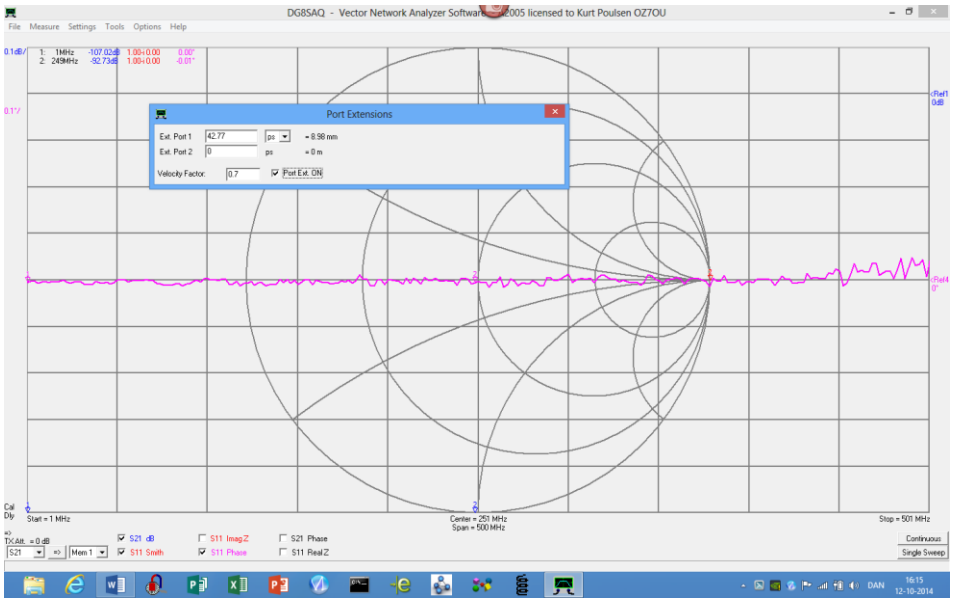
Fairview Male Open 1 and 2 endcap had a delay of **1.35ps**. Even if totally removed the delay is the same (not adding to the fringe capacitance). Result of simulation in Quickfield for SMA female as open is 1.32ps so value correct.

Next test is a check of swapping the female APC-7 to 3.5mm adaptor with the male APC-7 to 3.5mm adaptor and use the HP85033C 3.5mm female short fitted. Then the delay should be exactly 16.695ps provided the APC-7 to 3.5mm adaptors are completely phase matched.



The result is a delay of 16.5ps (should be 16.695ps) and 0.195ps difference exist. However at several repeated subsequent tests they are either identical or less than + - 0.1ps difference in delay. It all depends how hard/correct the APC-7 adaptors are tightened with the wrench/spanner and being properly adjusted in radial position during mating. It is a matter of experience and a duplication test for 8 pc. Amphenol Connex female short showed repeatability 0.05ps.

Next item to measure is the Rosenberger female-female adaptor used as open



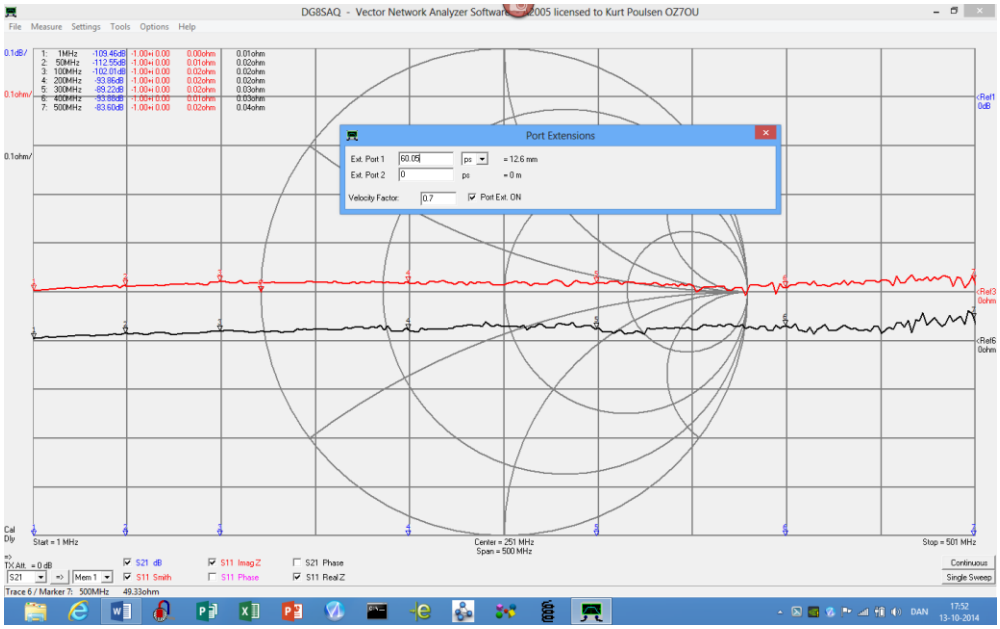
Male APC-7 to 3.5mm adaptor with thru1 as open.

Delay measures to **42.77ps** for Thru_ref and with fringe capacitance delay of 1.35ps a "true delay" of 41.42ps is calculated. S21 delay measurements will shortly be shown and with different results and an explanation why to be given.

Two more female-female adaptors measured, one from the SDR-kits female calibration kit of Rosenberger parts, called thru2 (**42.1** – 1.35=40.75ps) and one used for all previous tests through several years called thru1 (**42.5**-1.35=41.15ps).

Summary for Rosenberger female-female adaptor used as open: use average delay 42.46ps

Next step is to test how the three Rosenberger female-female adaptors delay vary when terminated with the HP85033C 3.5mm male short calibration standard and measured as a short.



Quite interesting is the response as not being a straight line. The delay determined as the Ext Port Delay needed to adjust for a flat response above 50 MHz. The curved part is partly due to a lower velocity factor at low frequencies and partly the characteristics impedance for the female-female adaptor is deviating slightly from 50 ohm.

Thru1 S11 delay at 1MHz measured to be 60.05-16.695=43.355ps. Thru2 measured to 60.05-16.695=43.355ps and Thru_ref to 60.05-16.695=43.355ps !!

All identical which just indicates that the Z0 of the adaptors are pretty identical but deviate from 50 ohm

but below a study indicates by more carefully examination differences exist.

Further investigations for the frequency dependent delay above observations using ZPlot by AC6LA

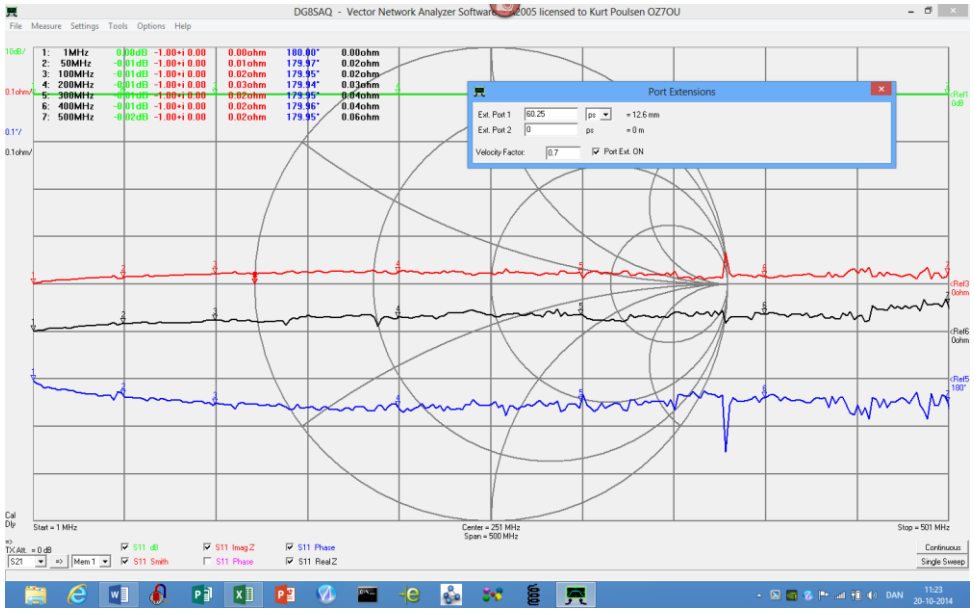
The test repeated for finding the additional delay for 4 pc. Rosenberger female-female adaptors terminated with the HP85033C 3.5mm male calibration standard having a delay of 16.695 ps.

S11 delay	Thru_ref	Thru1	Thru2	Thru-old	average
At 1MHz	60.25ps	60.1ps	60.15ps	60.35ps	60.21ps
+delay	0.05deg	.05deg	0.05deg	0.05deg	0.05deg
>50MHz	60.39ps	60.24ps	60.29ps	60.49ps	60.35
S21delay	42.5ps	42.5ps	42.3ps	43ps	42.43ps
S21+16.695ps	59.195ps	59.195ps	58.995ps	59.695ps	na
Z0	50.8 ohm	50.75 ohm	50.95 ohm	50.5ps	na

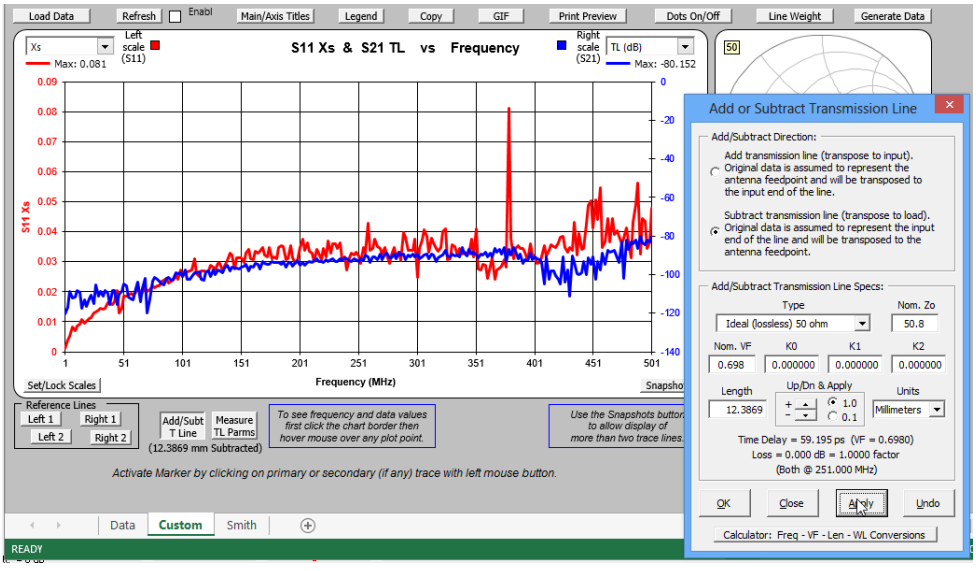
Note S21 delay for Thru-old not measured accurately and not at the same time as the 3 other thus to be excluded for the S21 average.

Note: *The S21 Thru delays are found later in this report.*

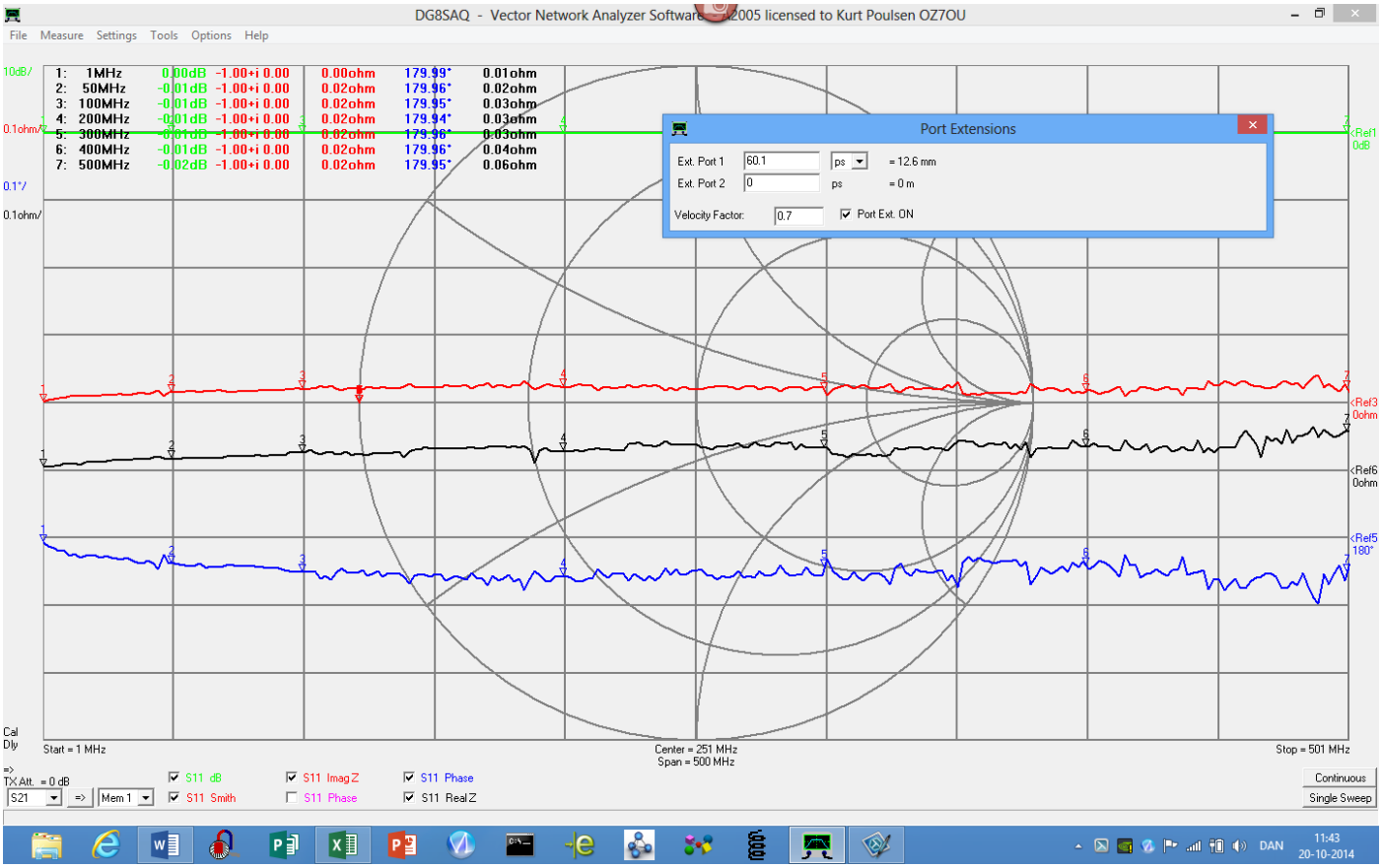
This test is a demonstration of the influence of the Z0 deviation from 50 ohm for the female-female thru adaptors and why the only delay to rely on is the S21 delay. Similar observations can be made for any other adaptor in reflection mode .



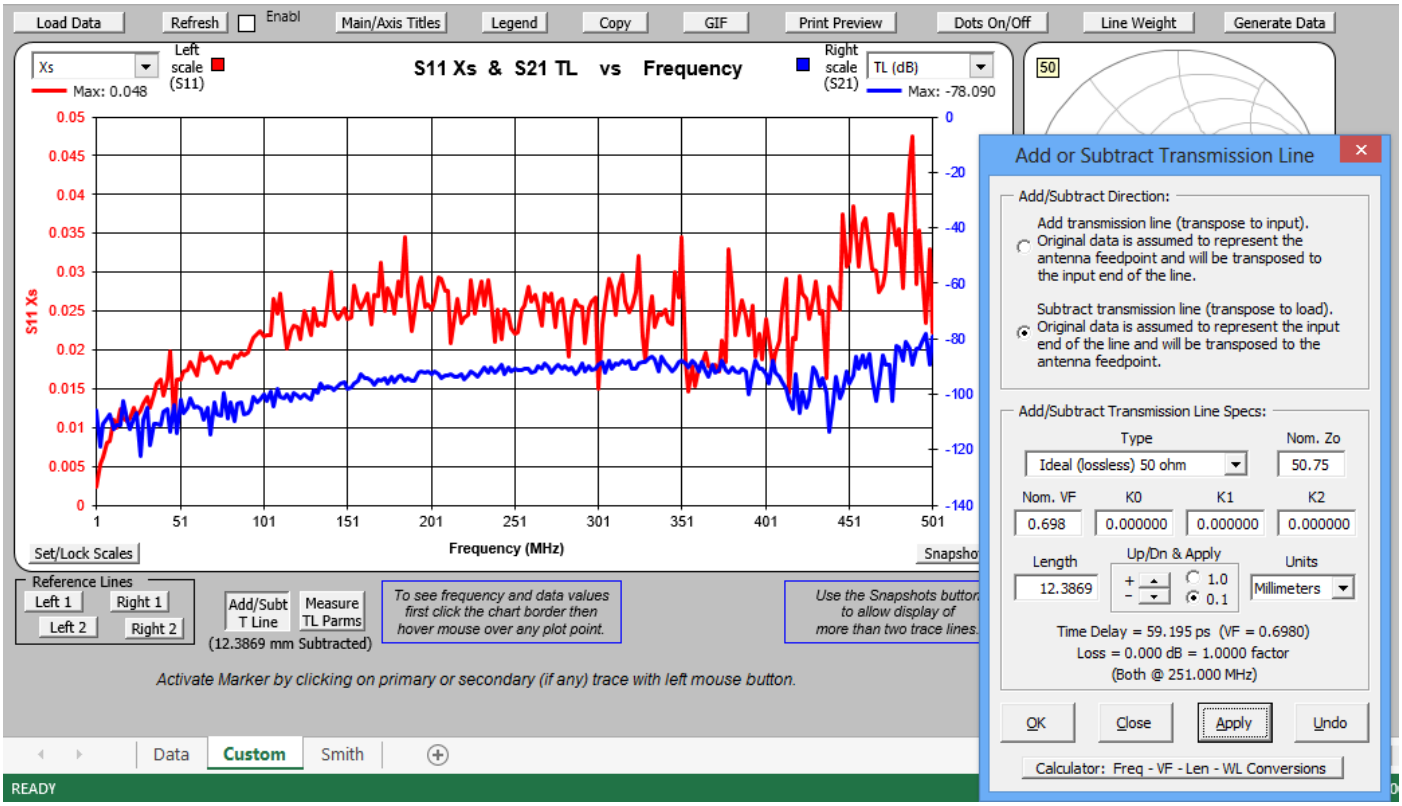
For Thru_ref the delay of Extension port1 delay is modified until a flat response is obtained for high frequencies and additional phaseshift recorded.



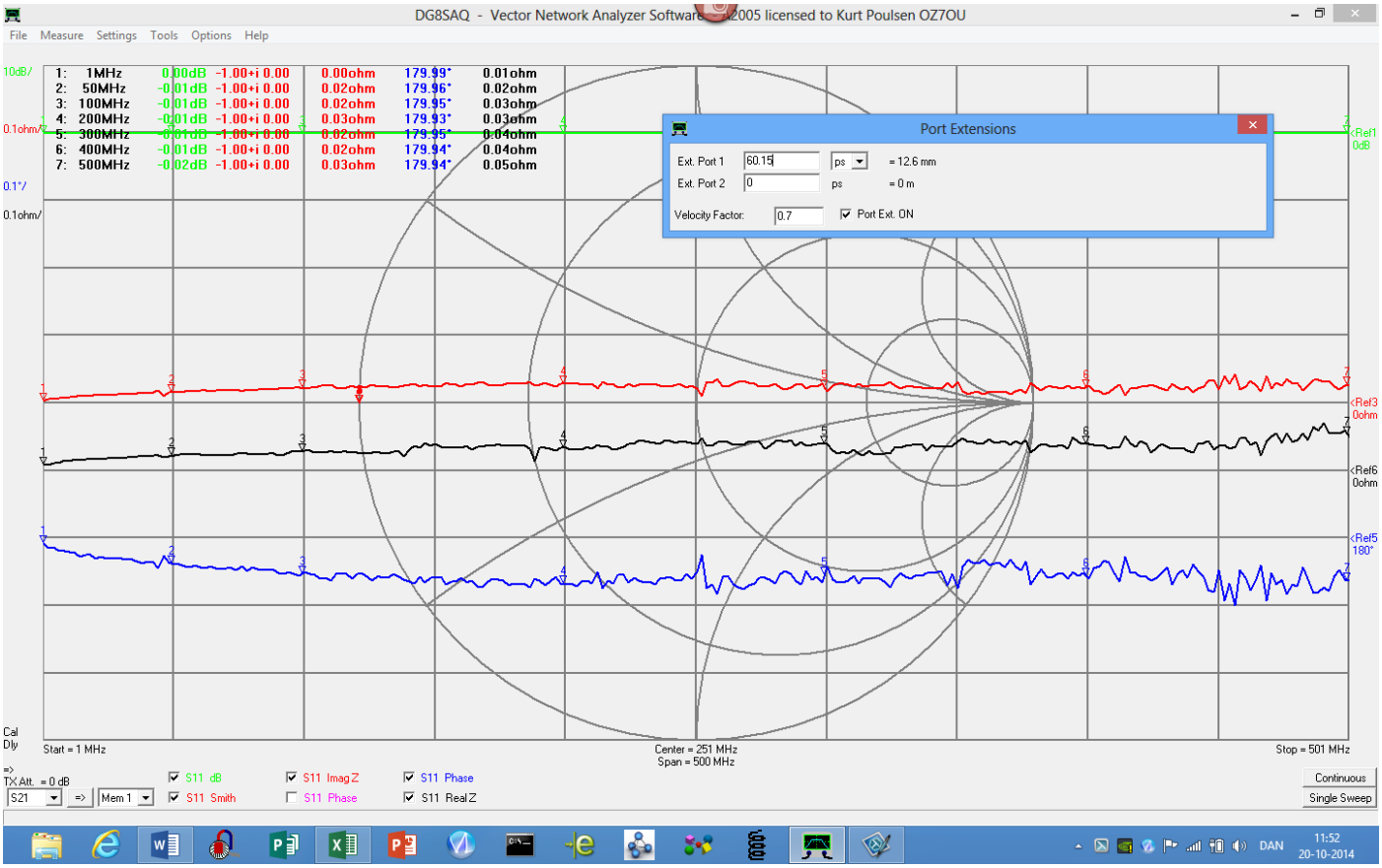
For Thru_ref its S21 delay + 16.695pd entered as Length and Nom. Z0 changed to flat response for high frequencies



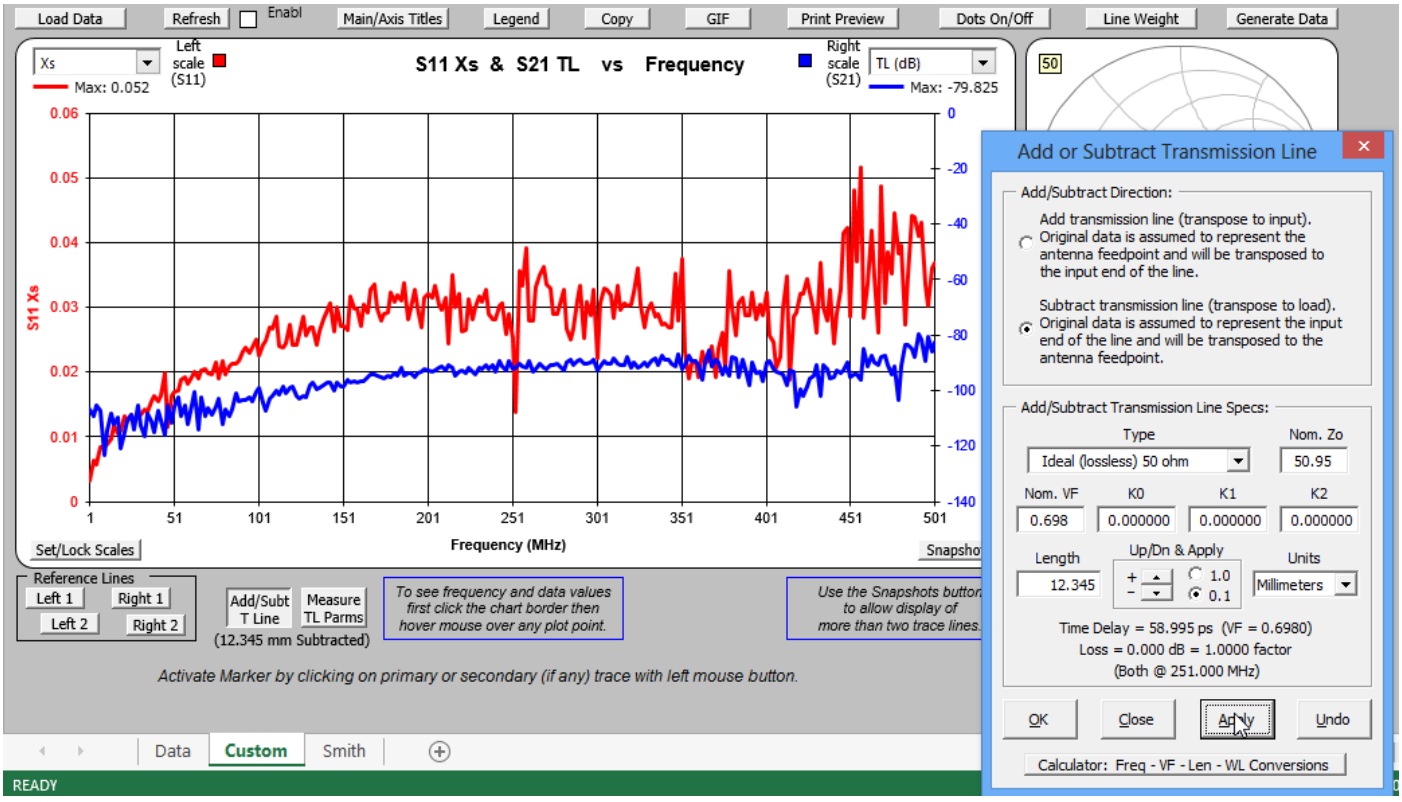
For Thru1 the delay of Extension port1 delay is modified until a flat response is obtained for high frequencies and additional phaseshift recorded



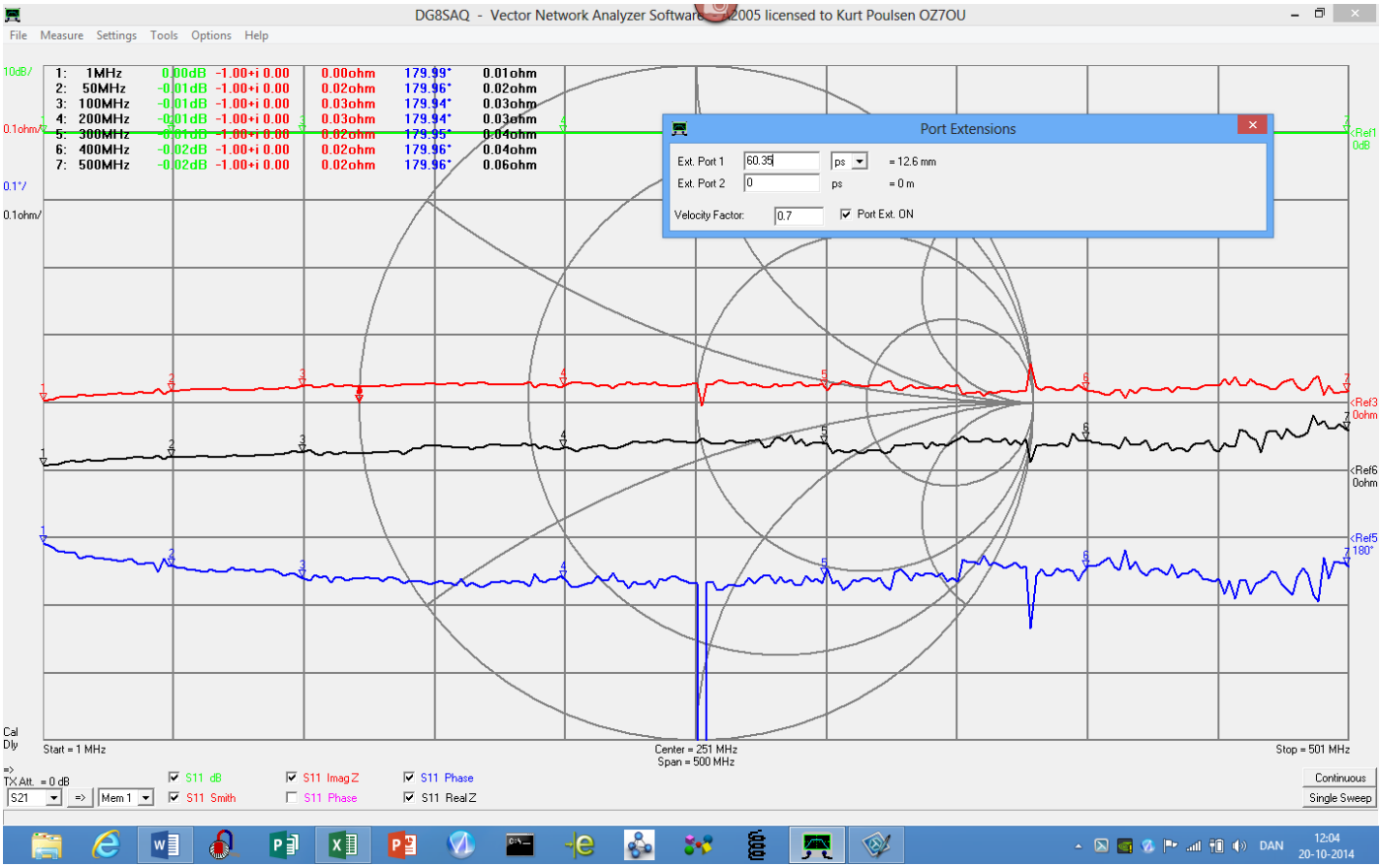
For Thru1 its S21 delay + 16.695ps entered as Length and Nom. Z0 changed to flat response for high frequencies



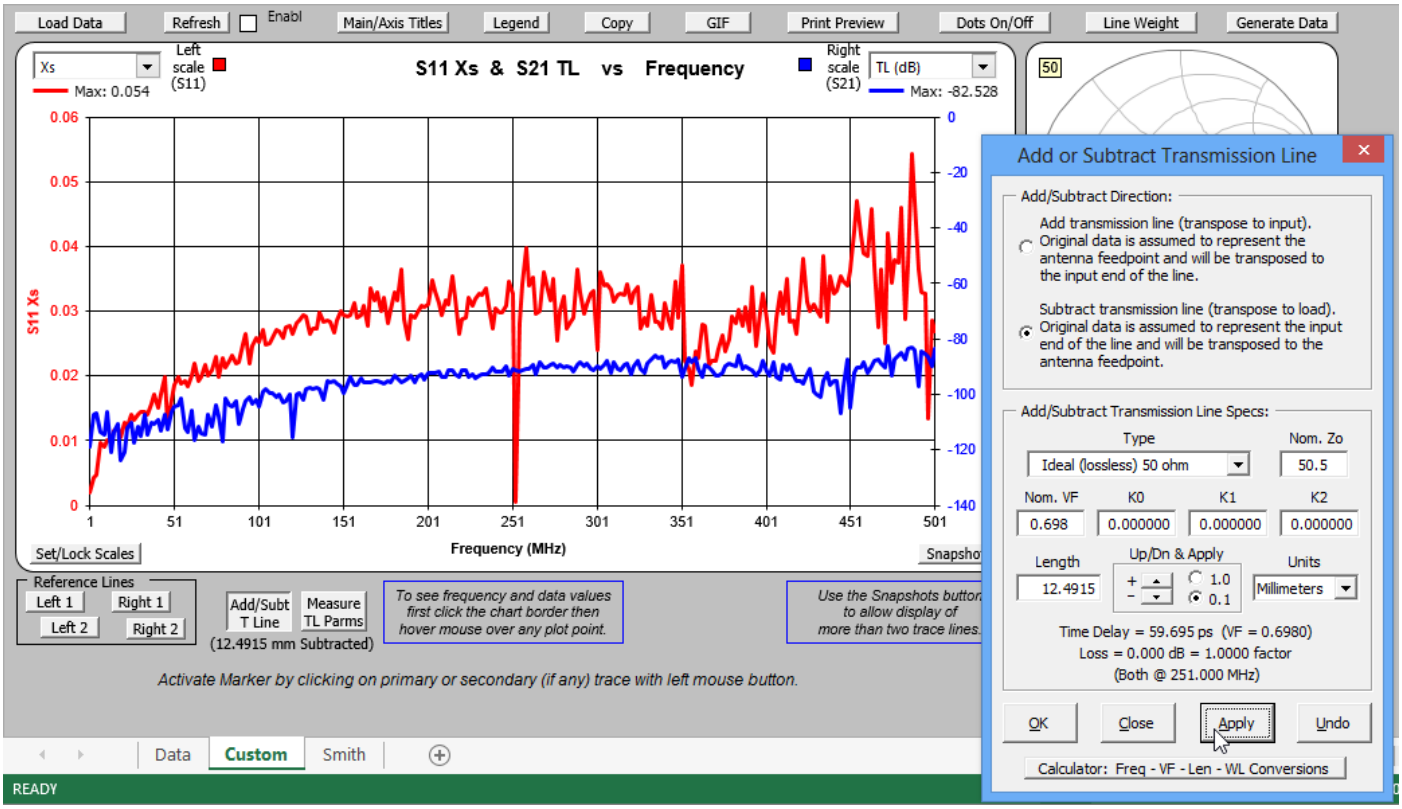
For Thru2 the delay of Extension port1 delay is modified until a flat response is obtained for high frequencies and additional phaseshift recorded



For Thru2 its S21 delay + 16.695ps entered as Length and Nom. Z0 changed to flat response for high frequencies

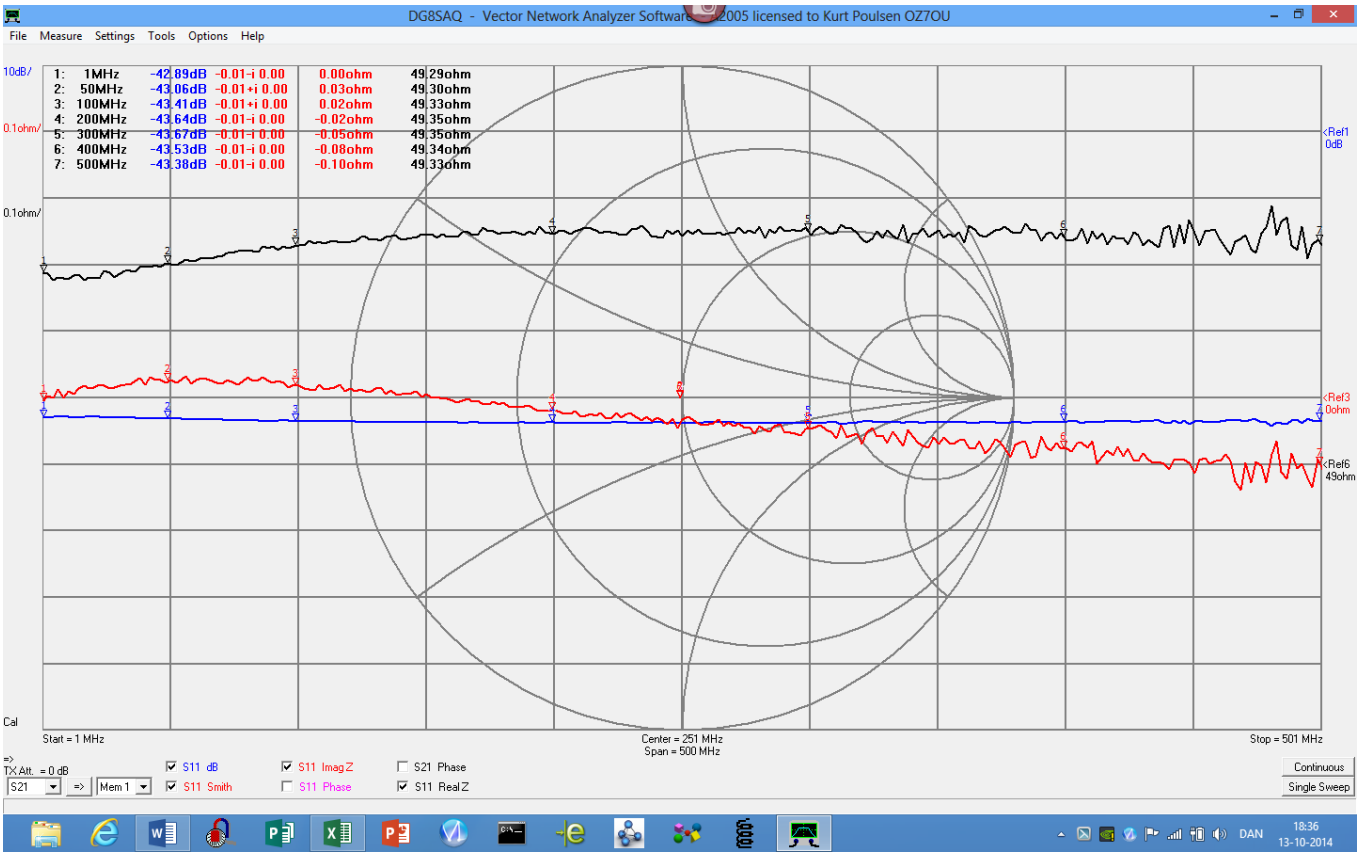


For Thru-old the delay for Extension port1 delay is modified until a flat response is obtained for high frequencies and additional phaseshift recorded

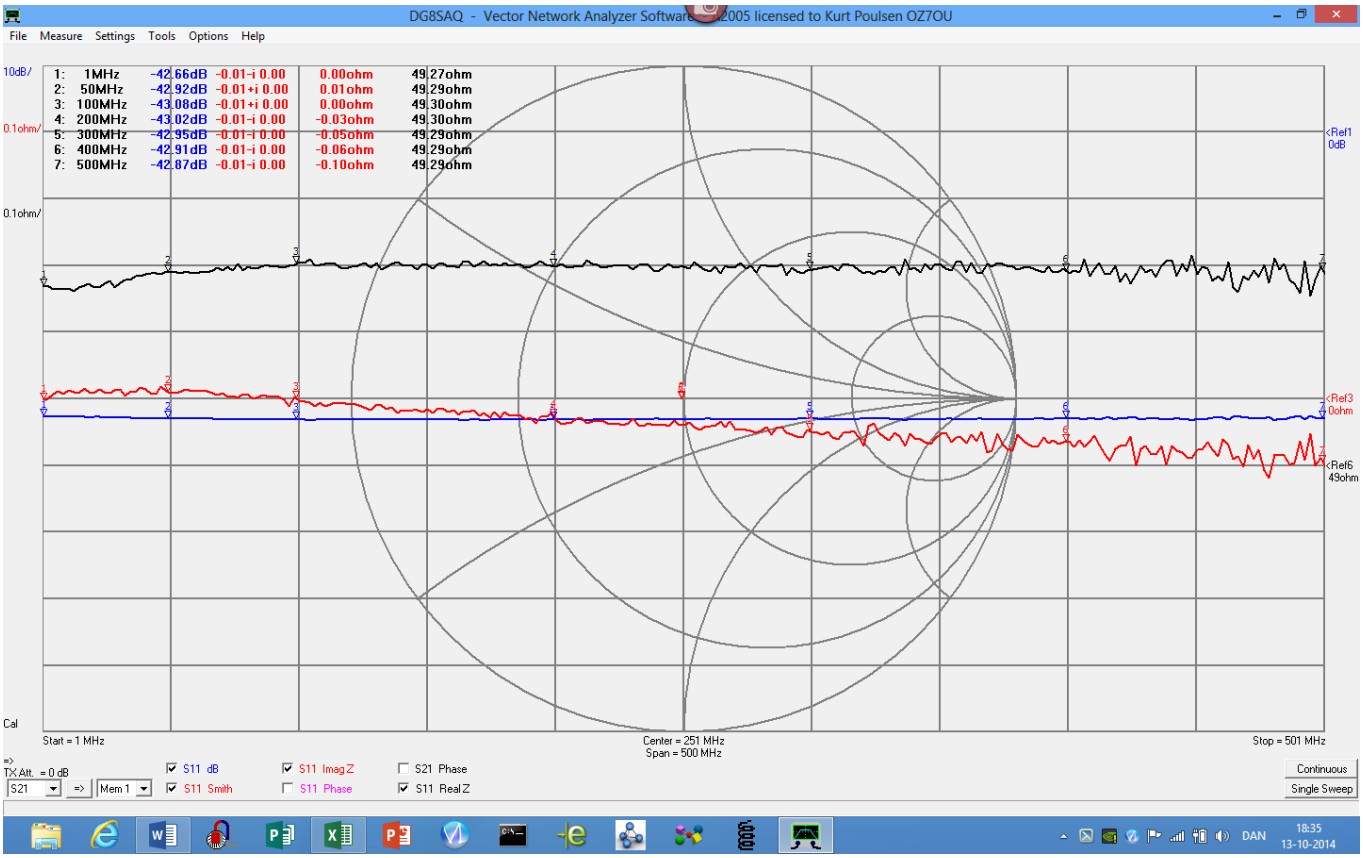


For Thru-old its S21 delay + 16.695ps entered as Length and Nom. Z0 changed to flat response for high frequencies

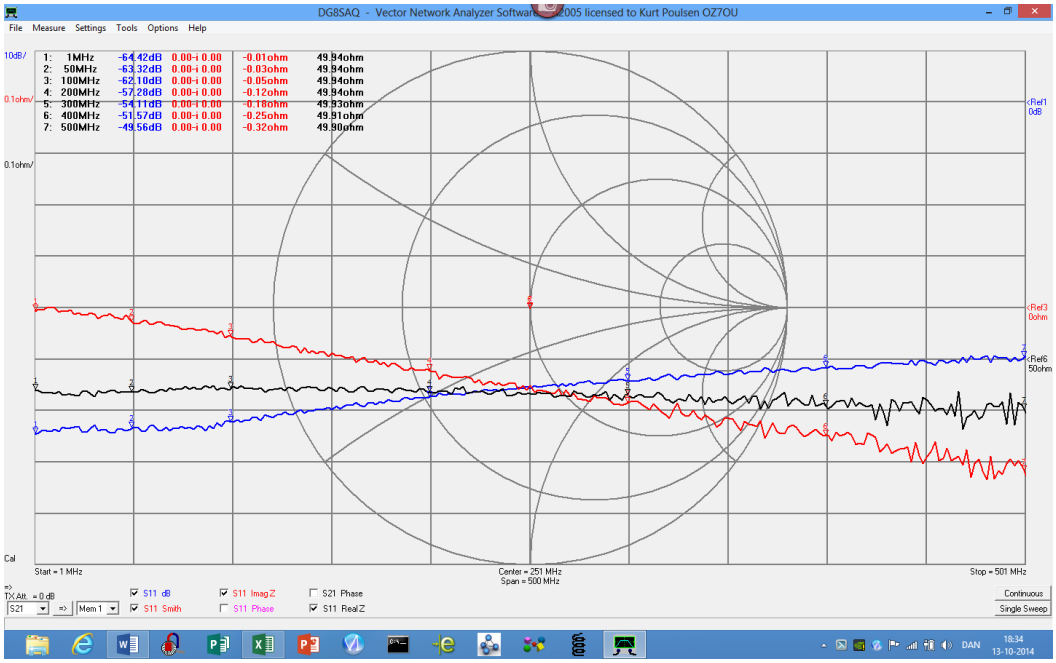
Next item to measure is the Rosenberger Male Load



Rosenberger male Load1 measured. DC resistance measured to 49.257ohm

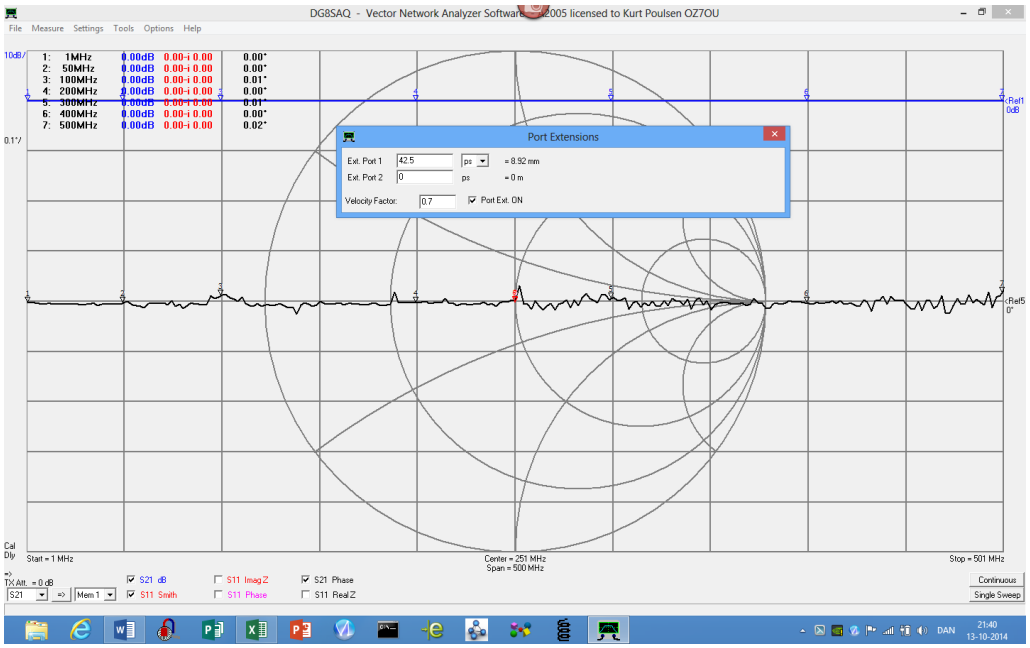


Rosenberger male Load2 measured DC resistance measured to 49.24ohm



Rosenberger male Load_ref measured DC resistance 49.906 ohm
The Load1 and Load2 are from same series production whereas the Load_Ref is from a production 2 years back in time.
The curves look quite dramatic but remember the resolution is 0.1ohm and the return loss is in excess of 40dB so well within specification. However, the results indicates an influence from a kind of impedance transformation and subject for further study to found out.

Next to test is the S21 delay for the three female-female adaptors



The Rosenberger thru1 adaptor has a delay of **42.5ps**. The thru2 adaptor has a delay of **42.3ps** and the thru_ref has a delay of **42.5 ps**. As seen the deviation is very small, as when measuring s21 delay there is only minor influence due to the actual characteristic impedance of the thru adaptor deviating from 50 ohm, whereas when measuring open and short there exist reflection and subsequently impedance transformation, due to even small deviation from 50 ohm. A proof of this statement follows as the ZPlots from AC6LA is an excellent tool for such analysis and to be enabled within the VNWA software.
Summary for the Rosenberger female thru adaptors: Use a delay of 42.43ps + - 0.1ps
(However see the repeated test to examine the influence from the adaptors Z0 and how deviation can change the delays, and where a ***repeated S21 delay measurement shows a different average of 42.86ps but as seen below not believed to be fully correct)*.**

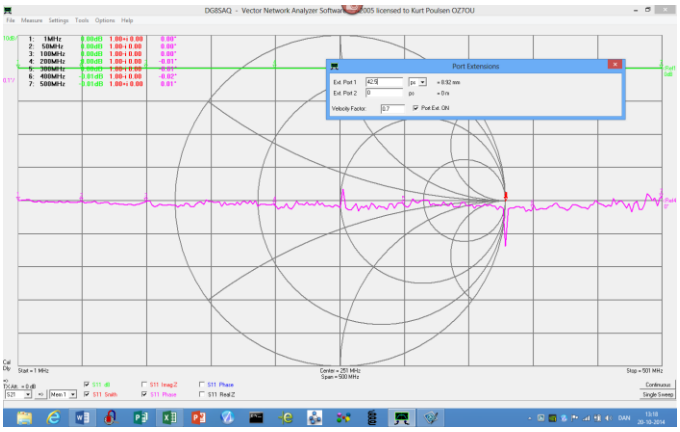
A second attempt was made to find the correct delay for the Rosenberger female thru adaptor used as open standard taking into account the frequency dependent delay

above mentioned measurements have too large an uncertainties so the reason might be that the velocity factor influence has not been taken into account . So a third attempt is done using a more carefully adjustment of the Ext. port1 delay and search for flat response above 200MHz where other test have proven that no further delay increase takes place as function of changes in the velocity factor being lower at low frequencies and impedance transformation within the adaptor take place due to deviation of the Z0 from 50 ohm.

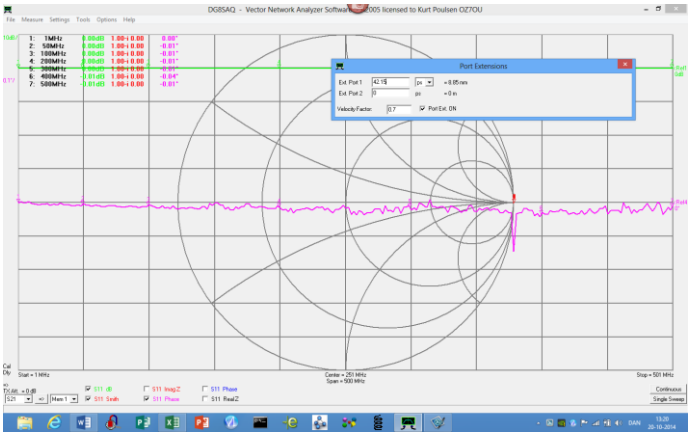
	Thru_ref	Thru1	Thru2	Thru-old	Average
At 1MHz	42.5ps	42.15ps	41.75ps	42.8ps	42.3ps
+dealy	0.01deg	0.01deg	0.01deg	0.01deg	0.01deg
>50MHz	42.53ps	42.18ps	41.78ps	42.83ps	42.33ps

These tests are more trust worthy and are close to “old data” from the previous calibration sheet version 3 of 2013.

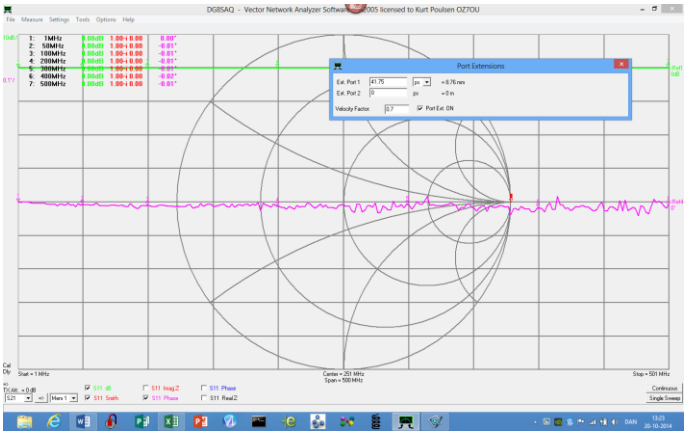
Below images are the measured adaptors delays and from the phase information the additional delay for high frequencies where no further delay increase take place are found.



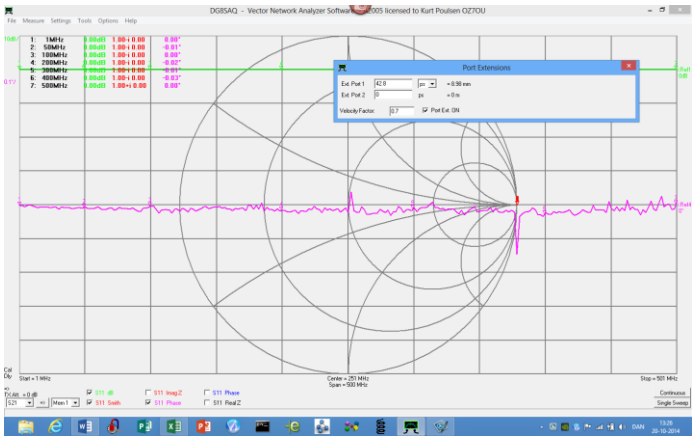
Thru_ref



Thru1



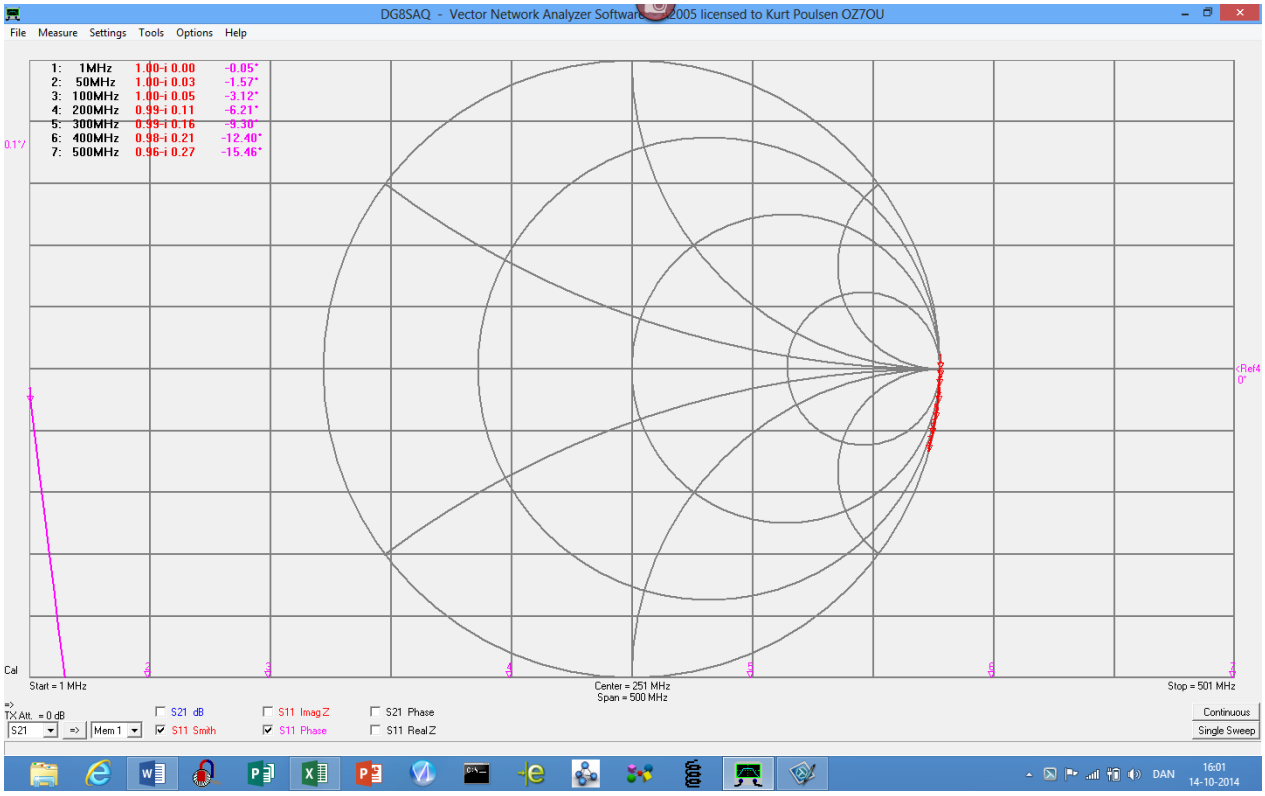
Thru2



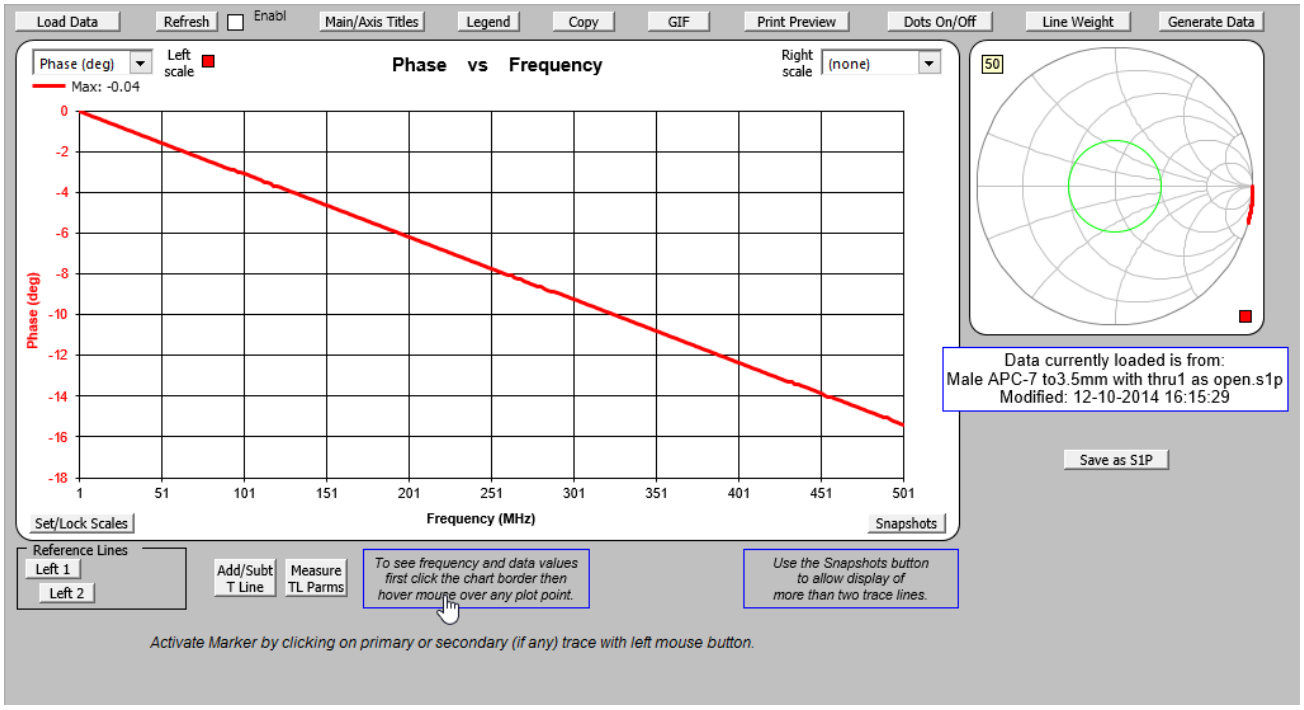
Thru-old

Investigation of the found delay for female-female adaptor used as open standard which for thru1 was found to be 42.77ps incl. fringe capacitance of 1.35ps explained earlier in this report (page4). Zplots used by AC6LA is used for this investigation.

By loading the data again, from a stored touchstone file, without enabling the Ext Port 1 delay, we see in below shown image. By invoking ZPLOTS we will be able to analyze the effect of the Z0 impedance of the thru adaptor.
A warning !!! In ZPlots use the Load data function, and find the touch stone file in question. By using the refresh button the loaded data the VNWA screen traces into the ZPlots are incorrectly transferred and lead to errors, Only after a fresh WNWA sweep is performed the refresh is possible to use and ext. port1 delay must not be enabled.

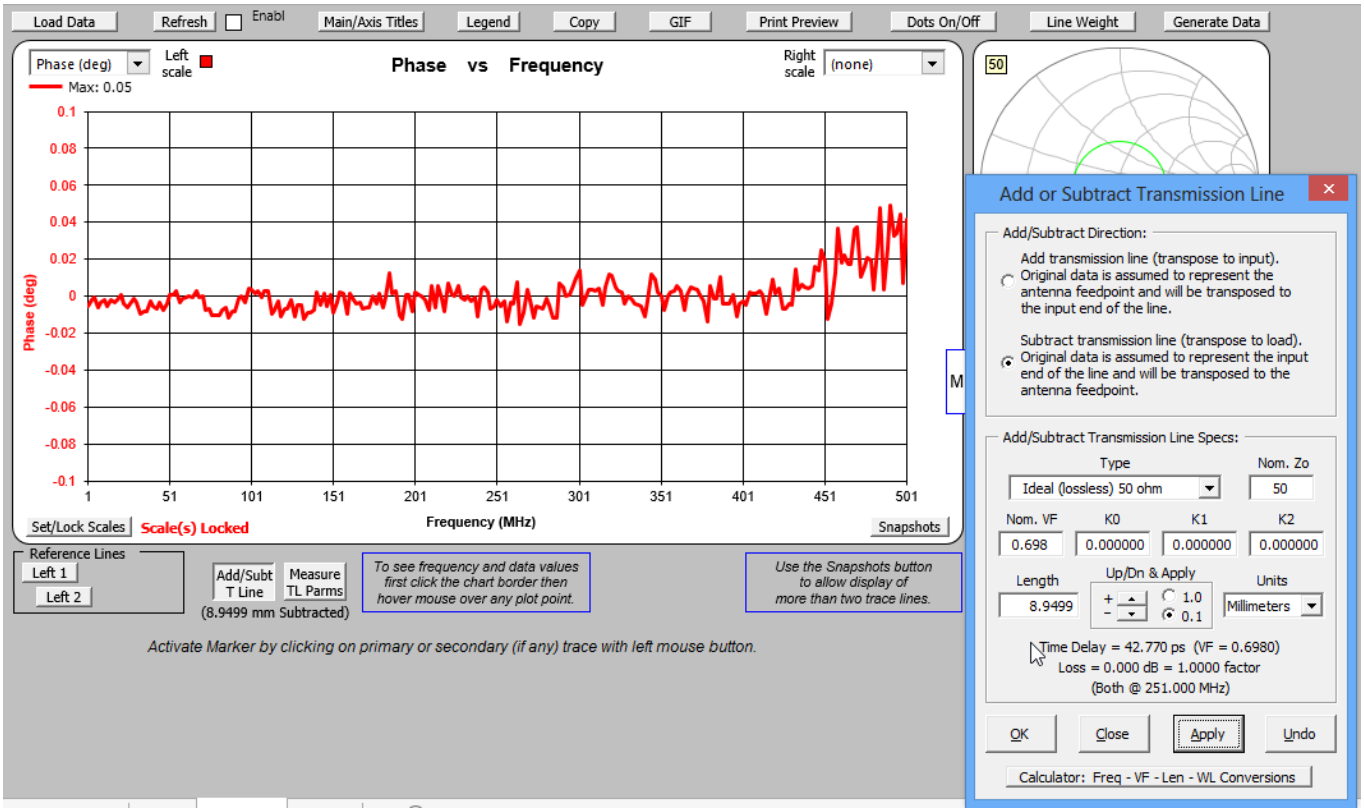


Below seen the same trace in ZPlots and be enabling the Add/Subt T line we can transpose the measurements back to the calibration plane of the APC-7 to 3.5mm adaptor until phase is 0 degree for all frequencies

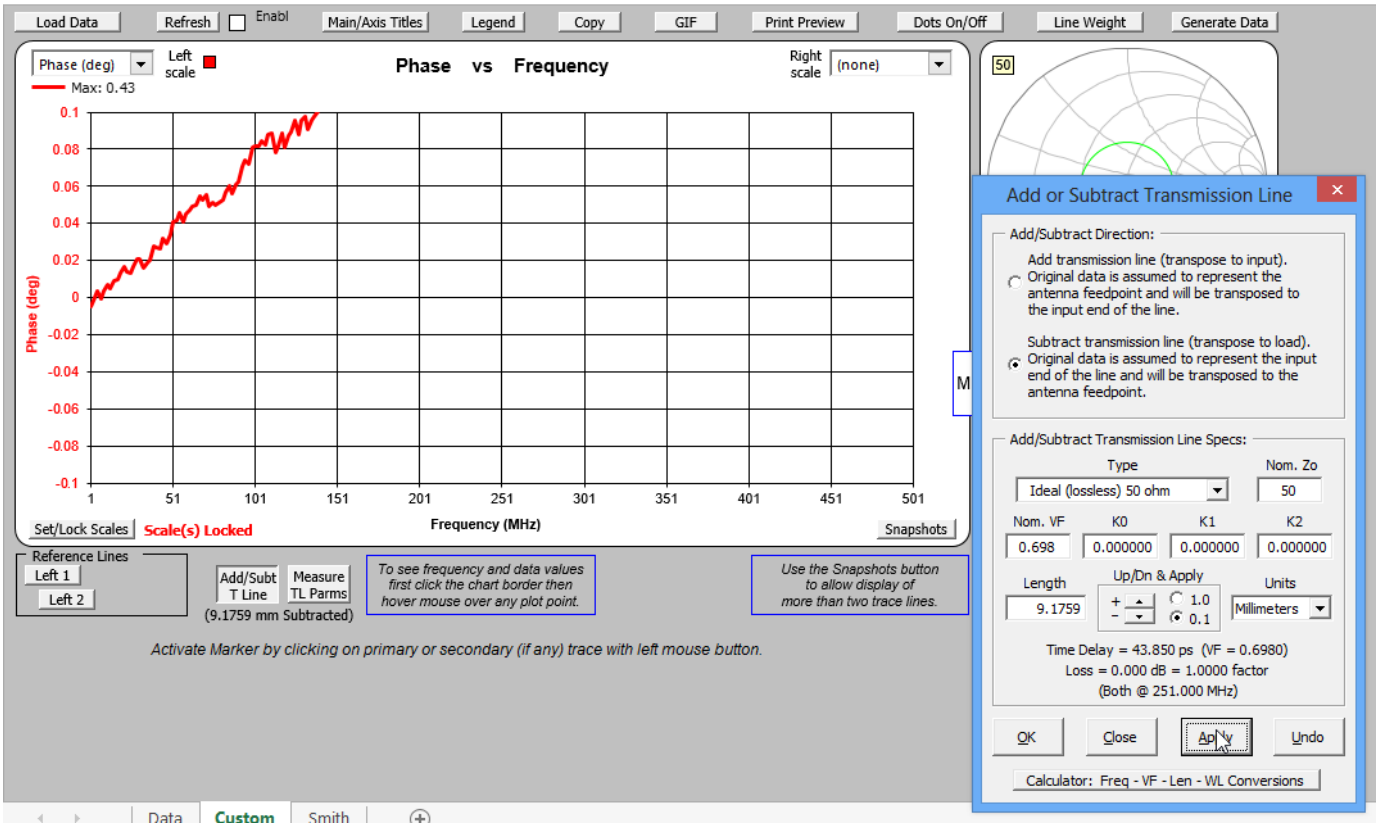


We select Nom. VF to 0.698 for PTFE (can be left as default 0.66 as we only deal with delay settings) and leave Nom. Z0 as 50 ohm

Below seen is the trace when adjusting the length to the same delay as measured and the expected trace is observed

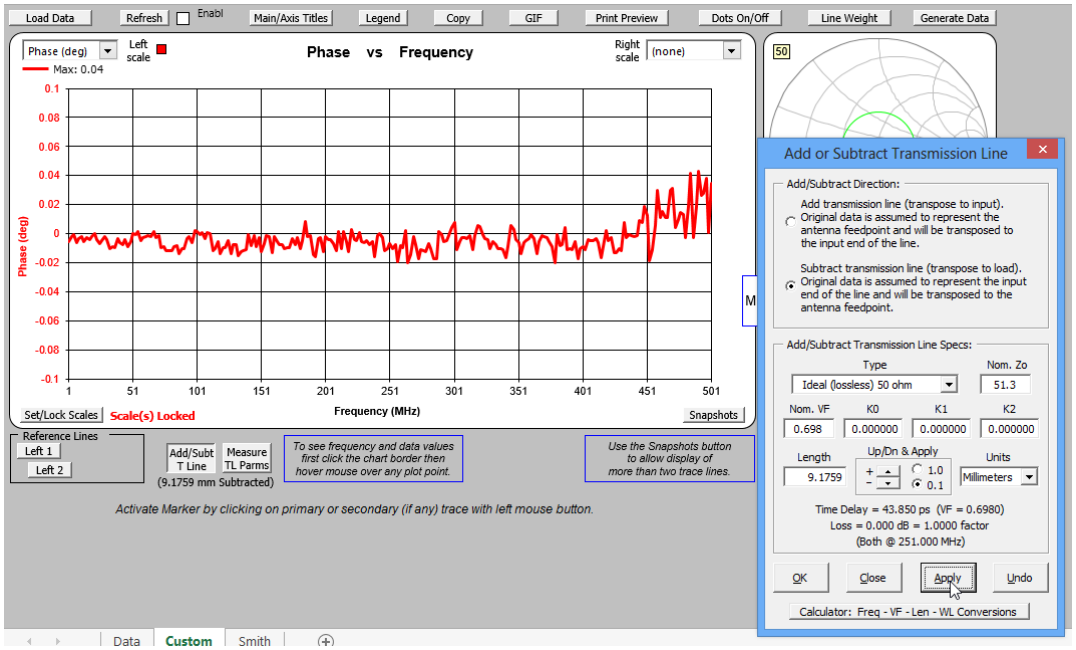


Below the delay setting changed to what S21 delay measurement was showing (42.5ps) and add the 1.35ps for the fringe capacitance total equal to 43.85ps.



Above there is a considerable difference but by modifying the Nom. Z0 to a higher value the phase line can be brought to a horizontal line again.

The required change of Nom Z0 is 51.3 ohm to bring the phase in place as seen below



Whether that is the complete truth is not yet clear, as other factors may influence, if e.g. Z0 of the male APC-7 to 3.5mm does not have exactly the same Z0 as the female APC-7 to 3,5mm adaptor, used during calibration, whereby some additional impedance transformation might take place. APC-7 to 3.5mm adaptor swapping might be adding a small contribution.
A repetition using a calibrated APC-7 to 3.5mm male adaptor was performed and it showed better results.

No need to show images as after calibration of the APC-7 to 3.5mm male adaptor with the HP85033C female calibration standards the following open delays was measured but without consideration of the frequency dependent delay so result not accurate. **See earlier correct measurements page 11**.
*Thru1=**43.12ps** , Thru2=**42.40ps** , Thru_ref=**43.05ps** all included the endpoint fringe capacitance. **Average=42.86ps***

To have a better overview a table is shown below

Description Thru adaptor delay measurements	THRU1	THRU2	THRU_Ref	Average
APC-7 to 3.5mm swapped to male and thru fitted	42.77ps	42.1ps	42.5ps	42.46ps
A above less 1.35ps fringe capacitance	41.42ps	40.75ps	41.15ps	41.44ps
S21 delay at 1 MHz with APC-7 male calibrated on TX port	42.5ps	42.3ps	42.5ps	42.43ps
APC-7 to 3.5mm male calibrated S11 open	43,12ps	42.4ps	43.05ps	42.86ps
S11 delay as above minus S21 delay	0.62ps	0.1ps	0.65ps	0.46ps
APC.7 to 3.5mm male calibrated and thru terminated with the male HP85033 short	43.355ps	43.355ps	43.355ps	43.355ps
Above measurements used with ZPlots to find Z0 of the thru adaptors based on S21 delays (see next page)	50.7 ohm	50.85 ohm	50.7 ohm	na

Delay of the Rosenberger female thru adaptor when terminated with HP85033C 3.5mm male Short

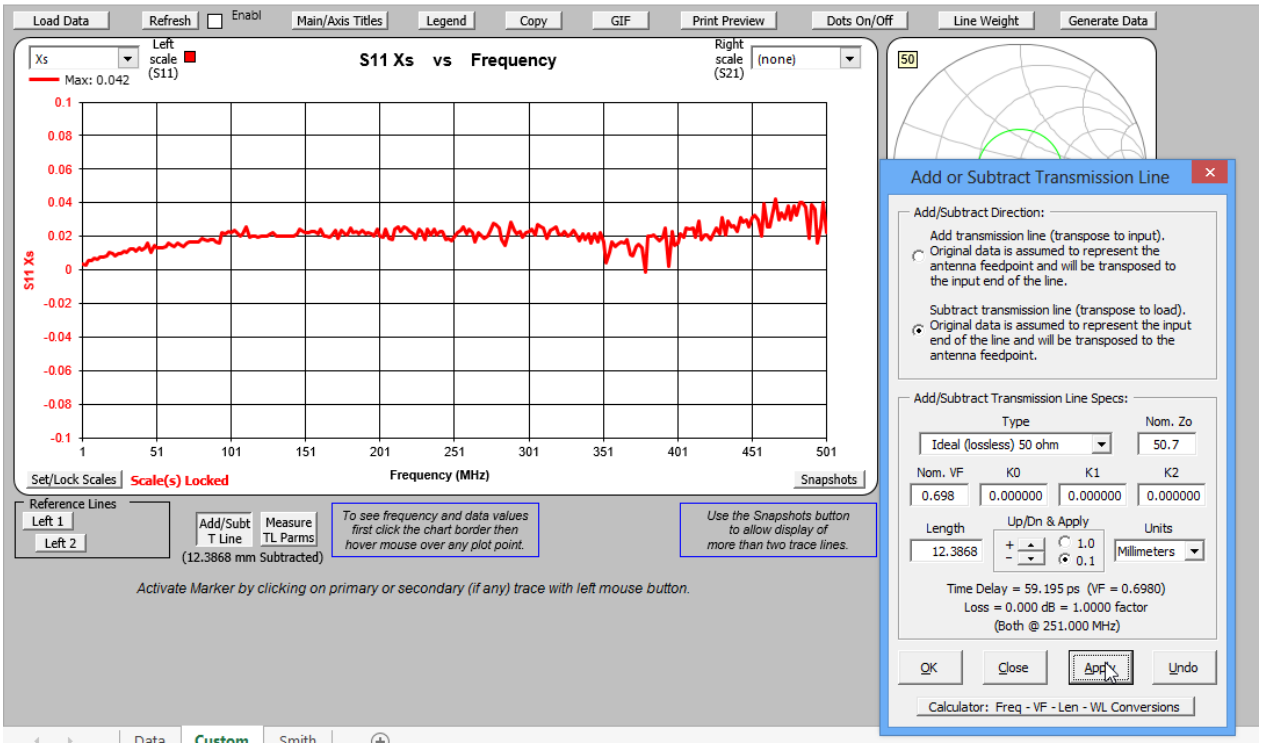
As above table shows the THRU2 is a bit shorter as open than the two others, but when terminated with the HP85033C male short they are identical but “too long” compared to S21 measurements. (data for S21 delay + 16.695 calculated in above table)

Using Z Plot on these measurements, it is possible to find the Z0 of the thru adaptors. In this case THRU1 is used.

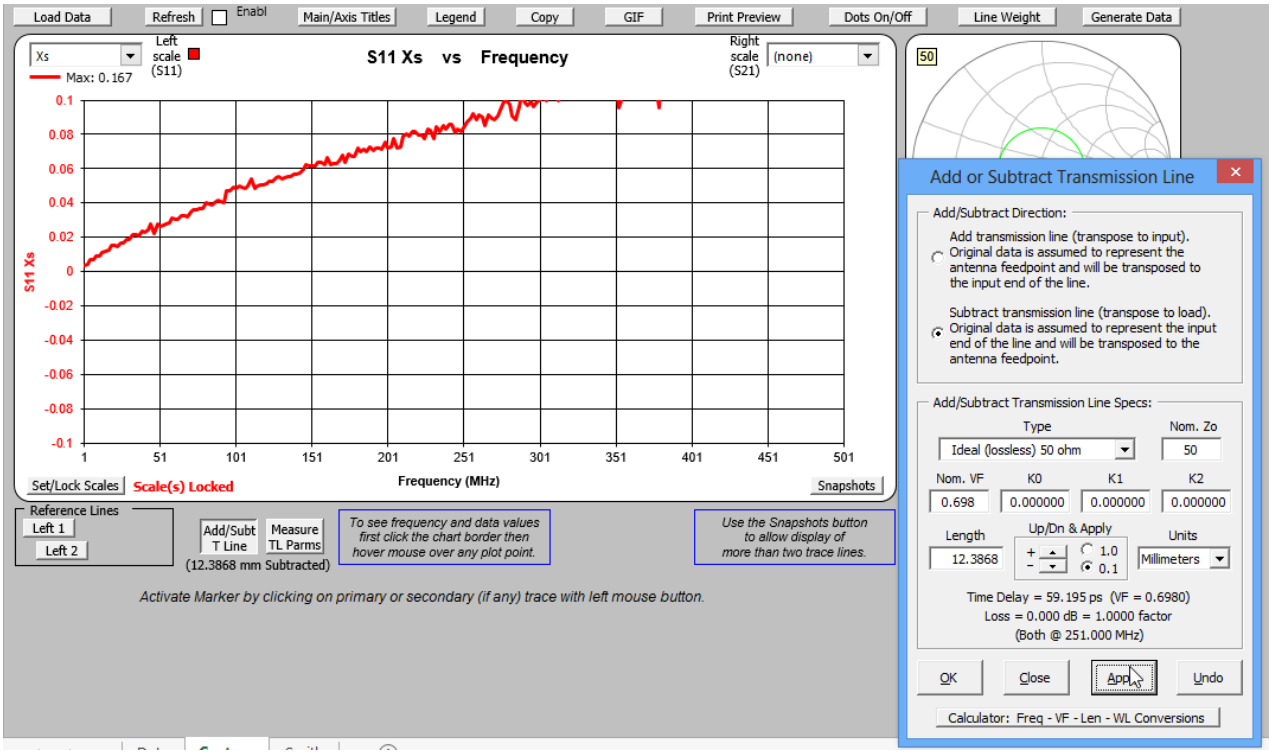
In below picture Nom. VF is set to 0.698 for PTFE and the length adjusted to the delay of 59.195ps being S21 delay of 42.5ps + 16.695ps for the male short, and the Nom. Z0 tuned to 50.7 ohm. On the next page shown same setting before the Z0 was tuned to 50.7 ohm.

Also note that the trace is adjusted to max flatness above 100MHz, due to VF being lower at low frequencies.

This test clearly demonstrates that S11 measurements are very sensitive to the characteristic impedances of any added adaptor, and especially a problem when adaptors are connected in series.

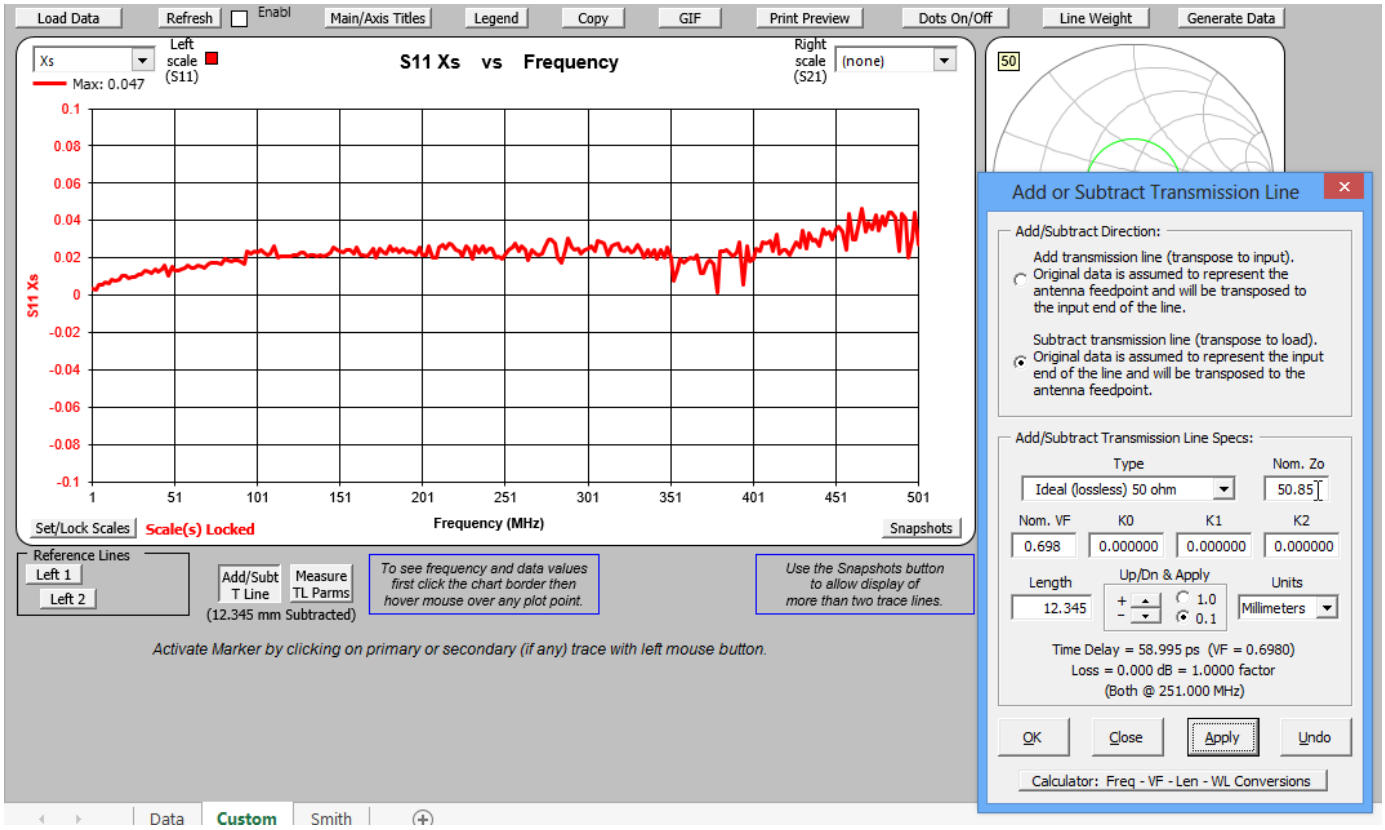


Above trace for THRU1 fully compensated

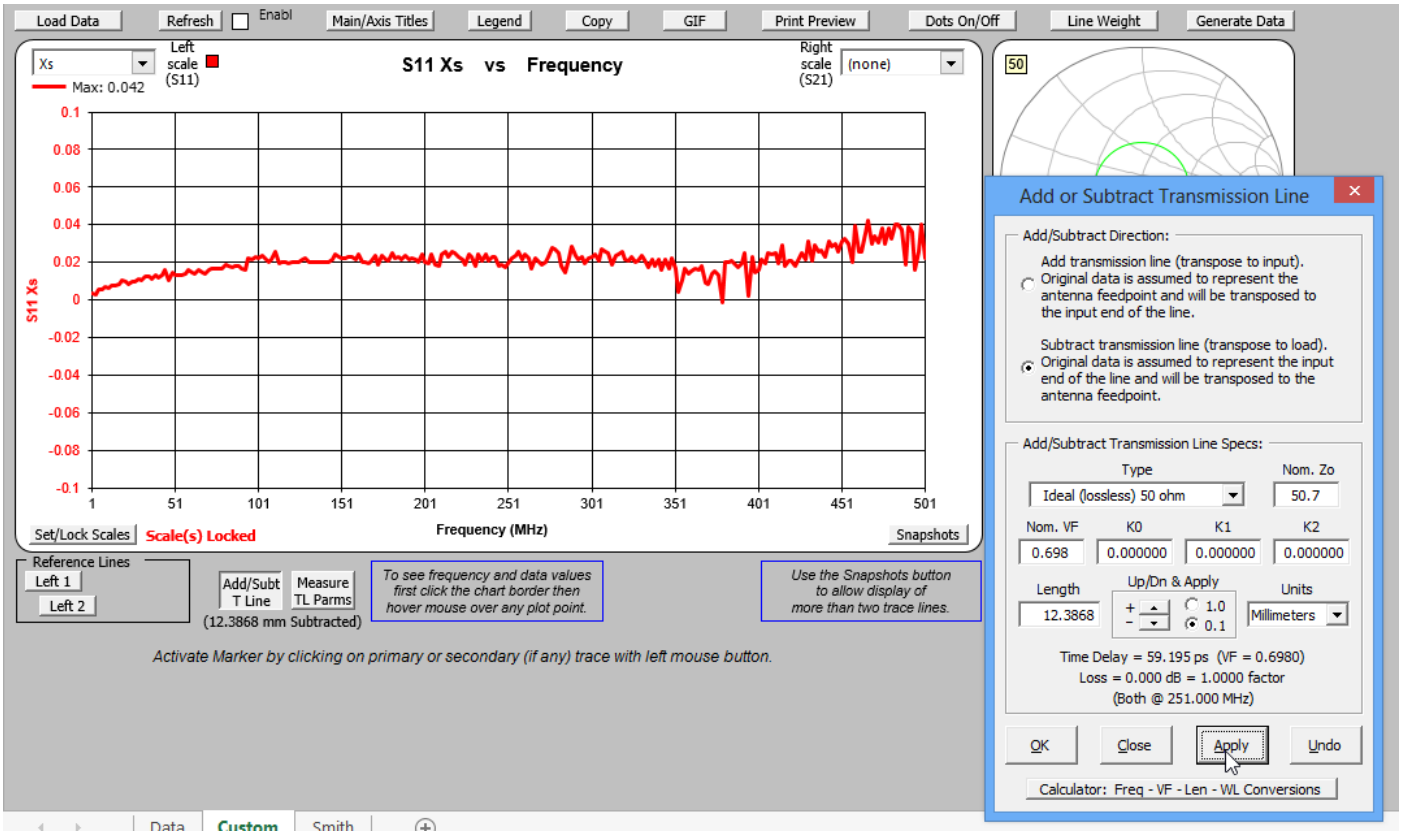


Above trace for THRU1 as seen before Nom. Z0 tuned to 50.7ohm

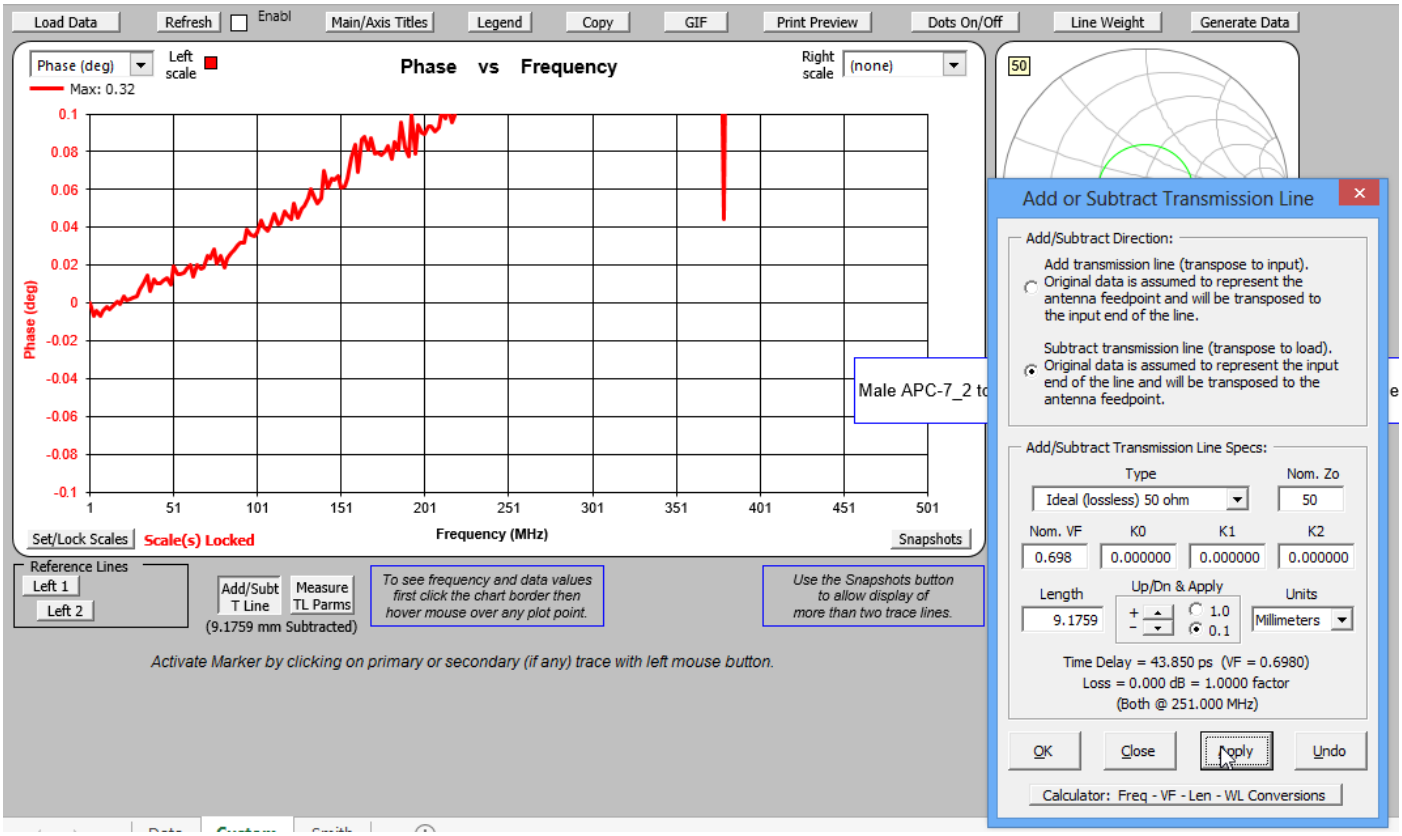
Below is the correction for the THRU2 adaptor having Z0=50.85ohm (delay 42.3 + 16.695=58.995ps)



Below is the correction for the THRU_ref adaptor having Z0=50.7ohm identical to THRU1

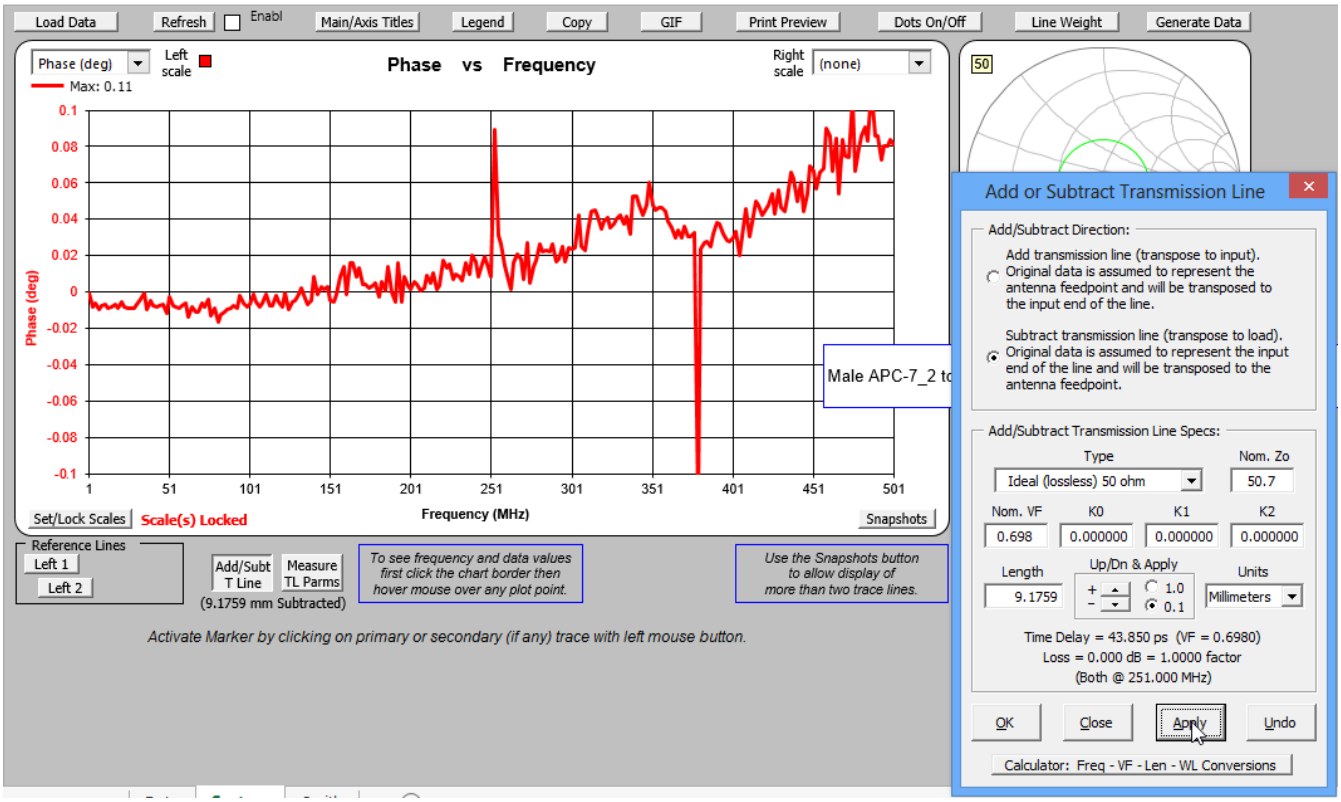


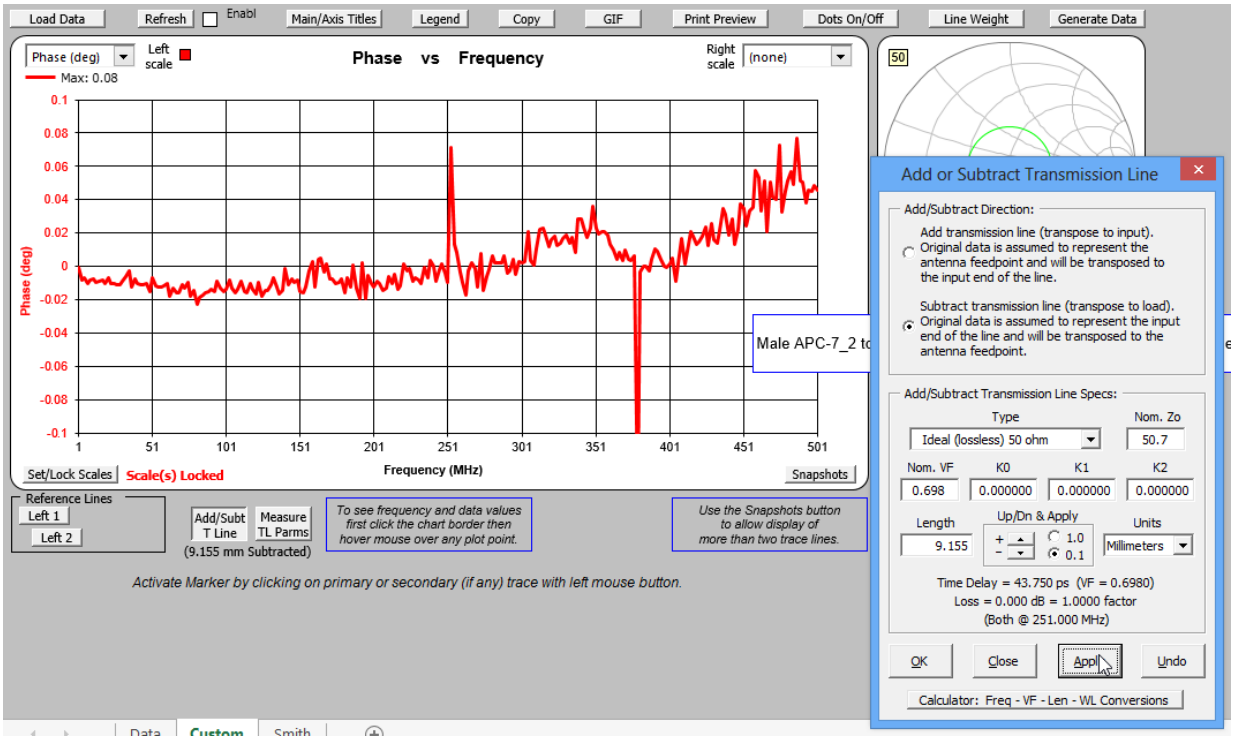
Now we know the Z0 of the adaptors we can return to study the Thru adaptors delay with ZPlots using the found Z0 and see if the delay corresponds with the found S21 delay by adding 1.35ps as the fringe capacitance delay.
For THRU1 the delay should be 42.5+1.35=43.85ps and we first leave the Nom. Z0 to 50 ohm



As seen, some modification will be needed and we now set Nom. Z0 to 50.7 ohm

Indeed, we are pretty close to the perfect result, so by setting the Z0 to 50.85 ohm or changing the delay to 43.75ps – a change of 0.1ps - we hit the perfection as the second image below demonstrates.

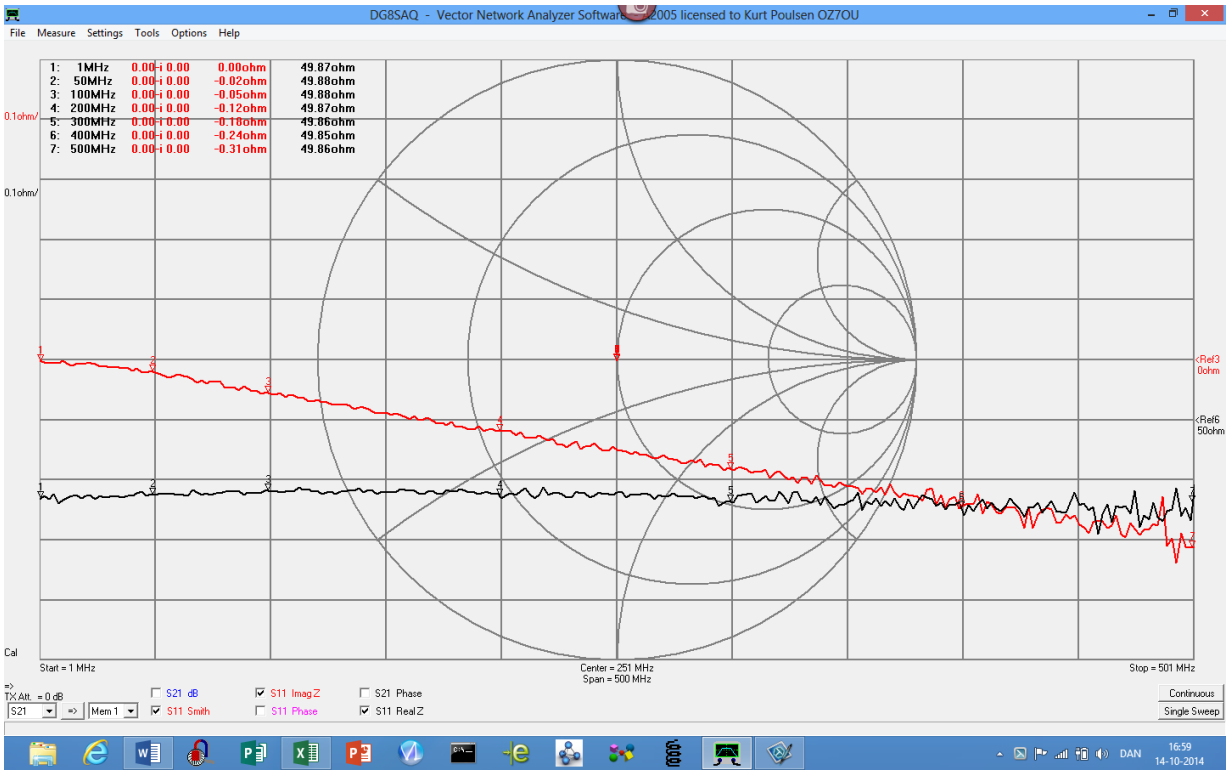




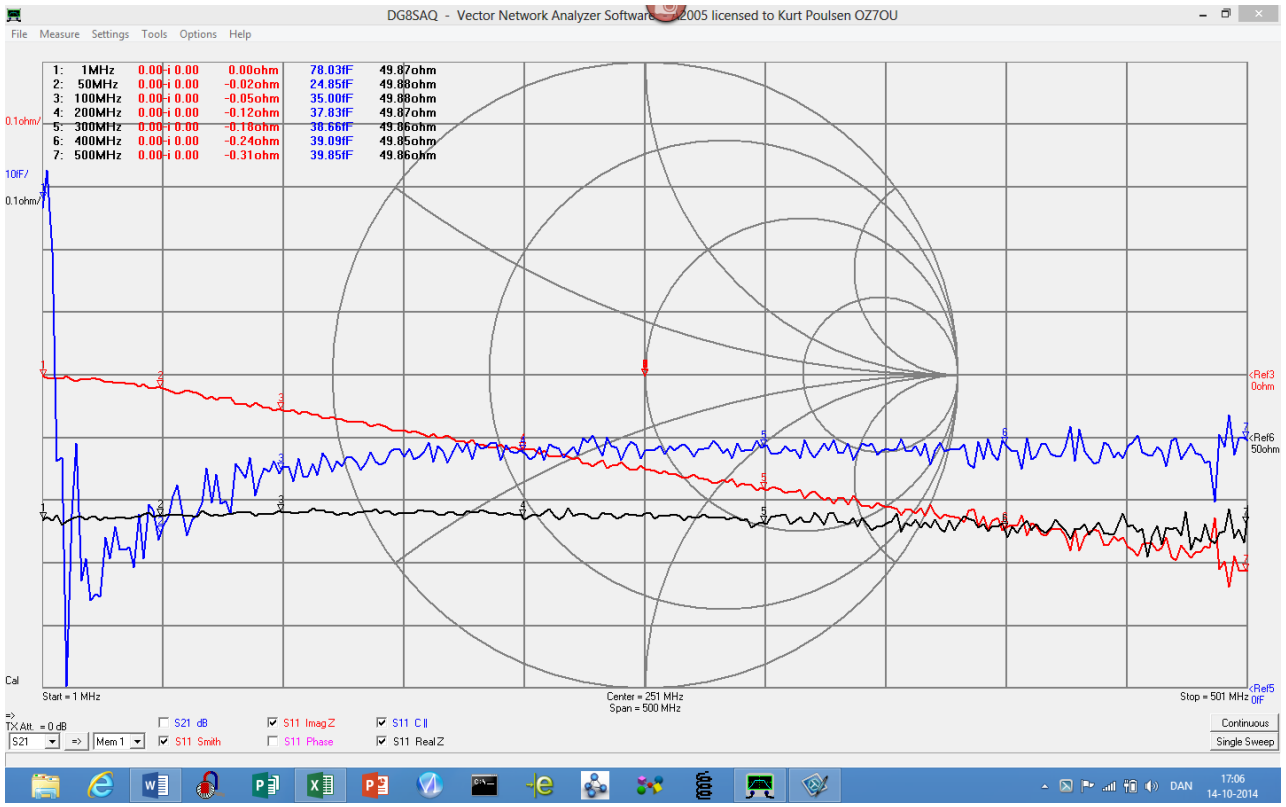
The very small differences – 0.1 ps correspond to a mechanical error of 0.02mm so we are dealing with the limits where even repeatability by removing and fitting an adaptor again can cause such errors, even when using a torque wrench as I do.
Just for completion of the subject the tHRU2 adaptor needed Z0=50.85 ohm as delay adjustment of -0.5 ps and the thru_ref adaptor with Z0 of 50.7 ohm needed an adjustment of the delay by -0.2ps
All in all very satisfactory result where measurements are pretty accurate and the S21 measurement of adaptor thru2 probably will show a slightly closer match to the other two thru adaptors.

What about the male loads and whether they are loaded with a fringe capacitance ??

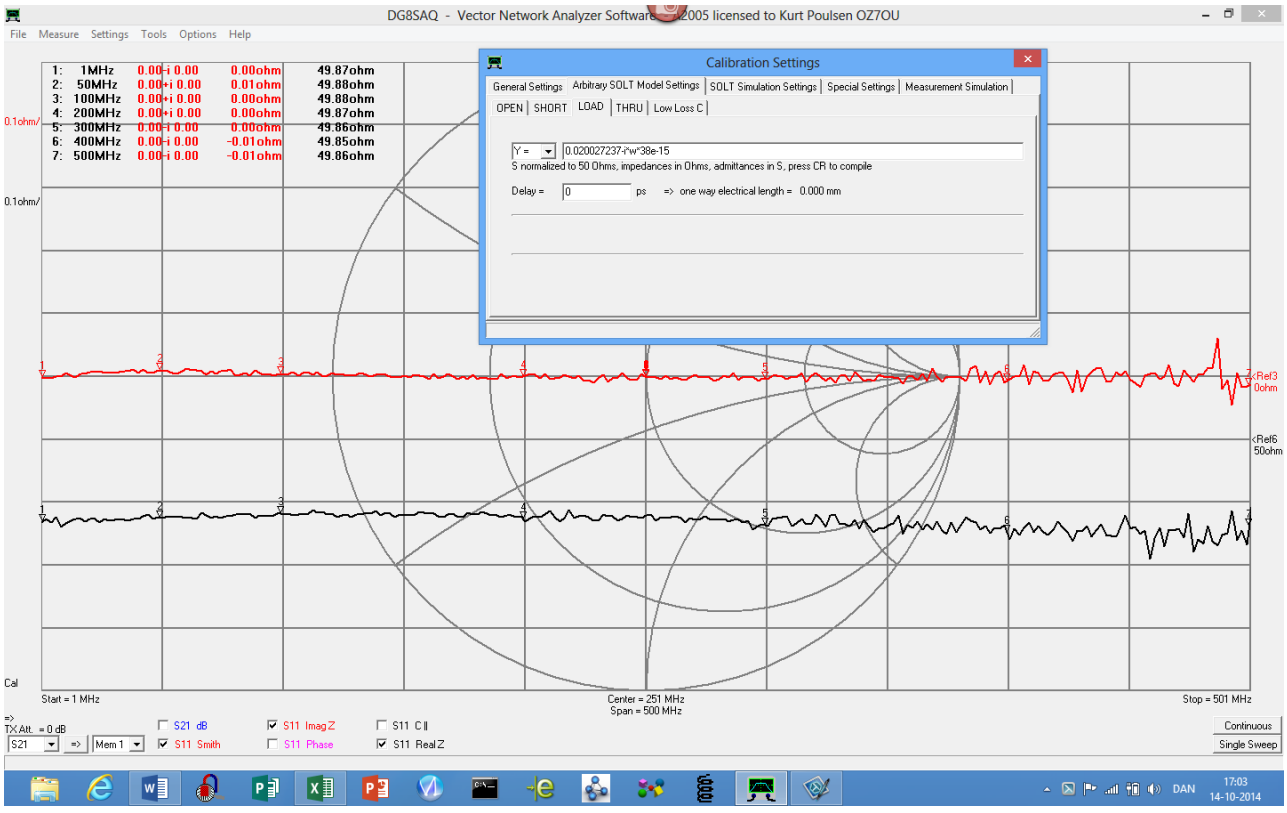
For that purpose, we need to calibrate the female APC-7 to 3,5mm adaptor and measure the Load in question and perform a Real Time Recalibration trimming/adding an additional fringe capacitance optimize the trace.
Load_ref is taken at first and below plot is shown before



By adding a C II trace the capacitance is measured to 38fF as seen below

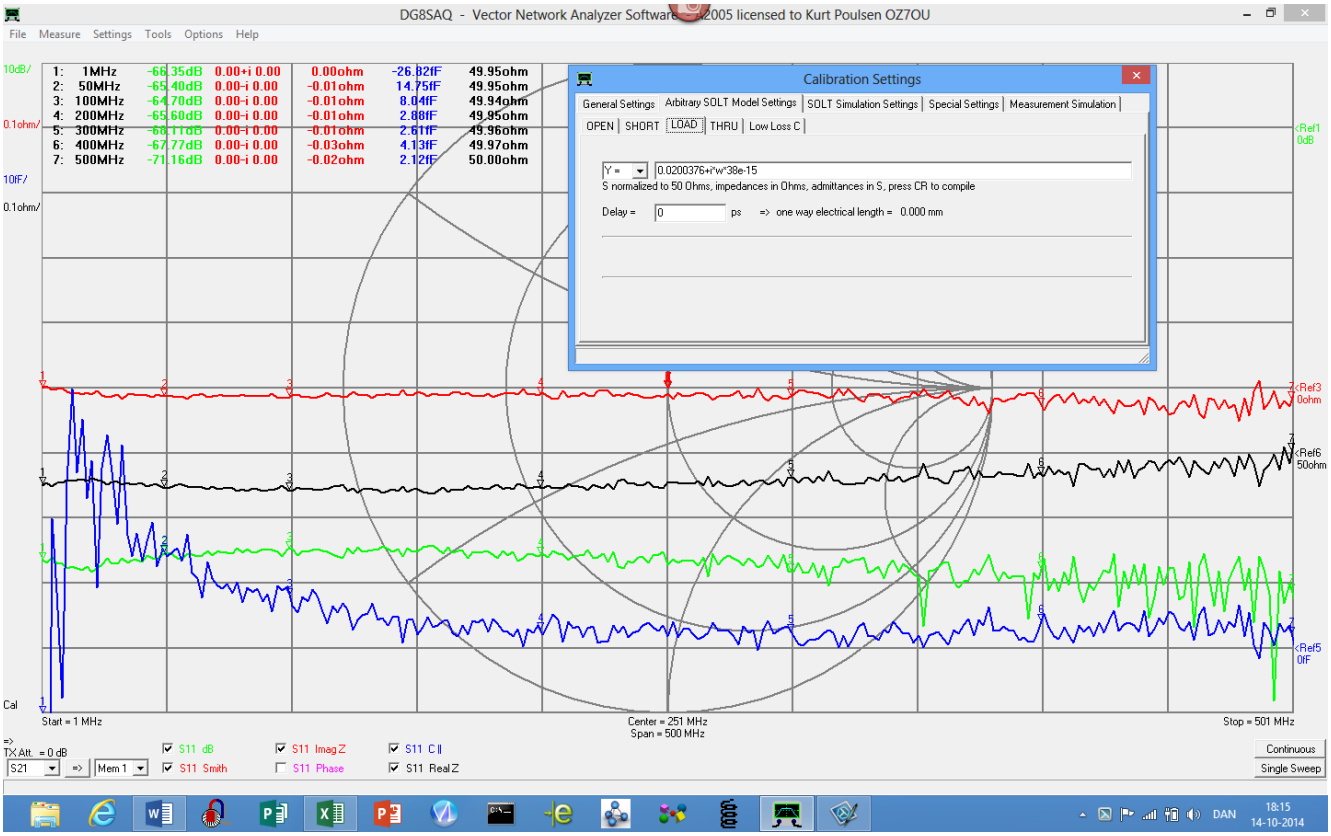


By enabling real time recalibration in the calibration setting under SOLT Simulation Settings we can add the conjugate capacitance in the load Y (admittance) expression as 0.020027237-**i*w*38e-15** and then observe the load is now perfect. We now have to disable the real time recalibration and change the load expression to the used Rosenberger load's DC conductivity (in my case 49.906 ohm =0.0200376 for Load_ref) and change the sign to + so the expression now is 0.0200376**+i*w*38e-15.** Then perform a recalibration of load only using the Load_ref for the Load calibration. When done we measure the HP35033C male load and observe the result .

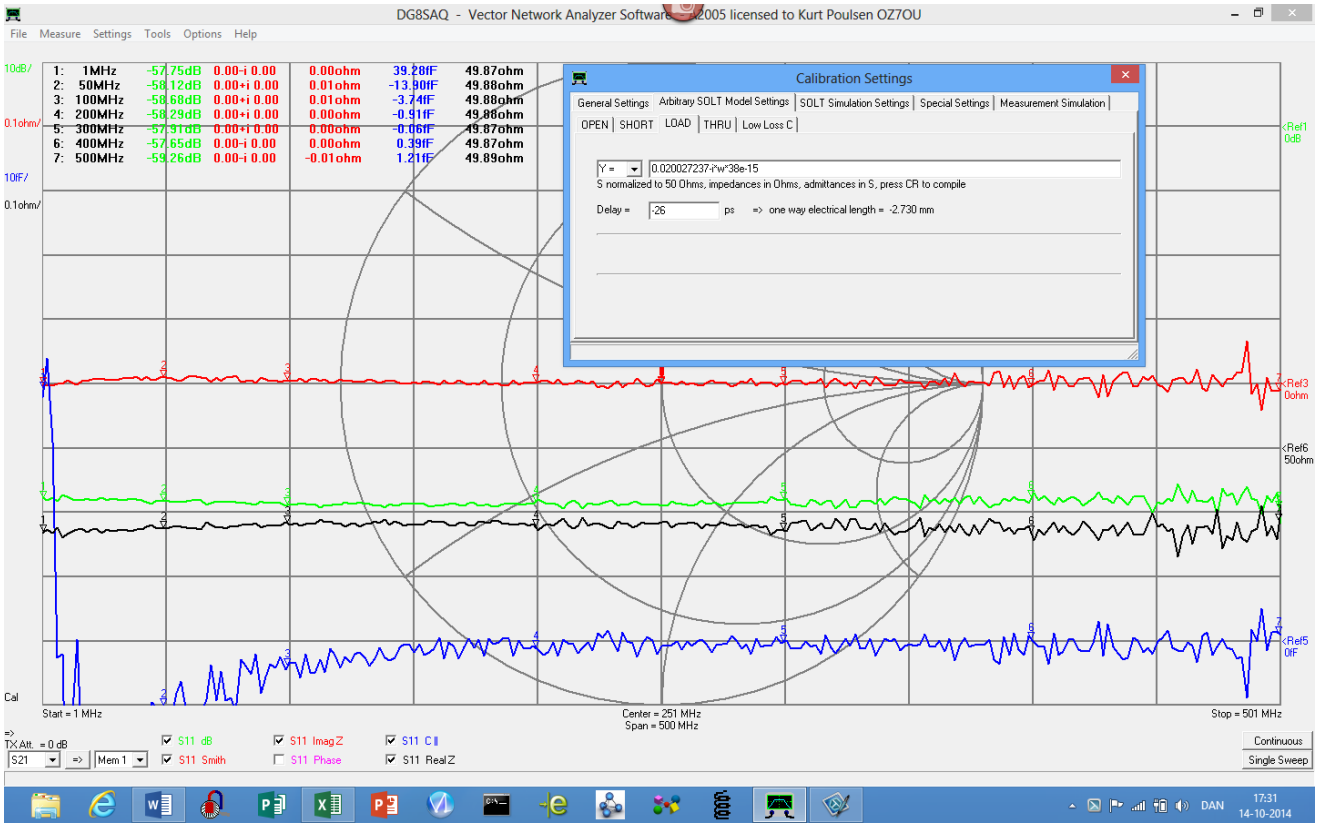


Above the CII determined for the Load_ref

As seen below a pretty impressive **success !!!! The HP85033C male Load measured and return loss -65dB to -70dB as very close to calculated -63.36dB for the HP85033C male load of 49.932ohm.**



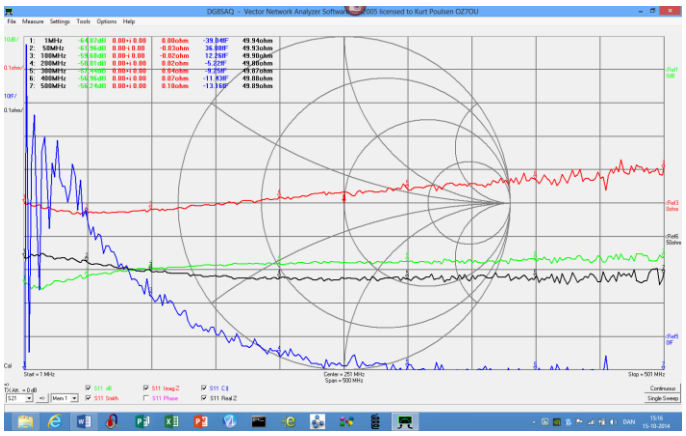
A further optimization might be possible by introducing a conjugate delay for the load during realtime recalibration to flatten out the RealZ and CII traces at higher frequencies However probably not worth the effort as test show no real improvement and 26ps to high a value worsening the result. Again the internal Z0 of the Rosenberger Load probably also deviates from 50 ohm.



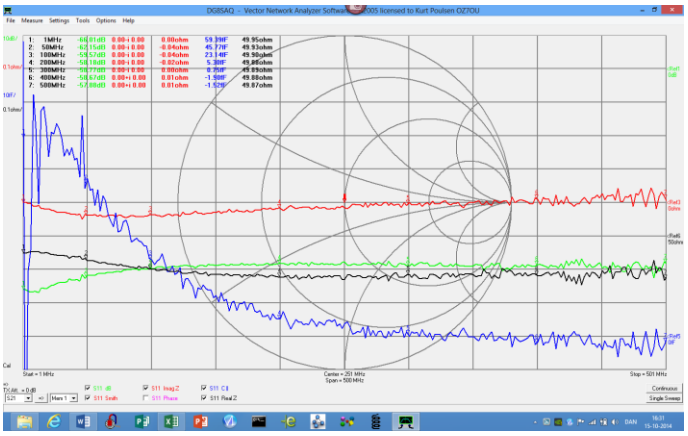
As the Load_ref used is pretty close to 50 ohm being 49.906 ohm other Rosenberger male loads with lower resistance values might behave differently.

The Rosenberger male Load1 (49.257 ohm) and Load2 (49.24 ohm) is also tested the same way. Two more Rosenberger loads are tested called Load_48.951ohm and Load_49.271ohm. Numerous experiment indicated that no general method is possible for fully compensate completely for fringe capacitance and the impact from the Z0 of the Loads transmissions line as the thick film load is offset by some 7 mm inside the Load. Best general solution determined to be a delay of 35ps and no CII value. Each load needs its separate solution but as seen below results the return loos is no worse than 60dB for 4 of the 5 tested Rosenberger male Loads and the last one better than 50dB. So in general far better than needed in general use.

For Load1 two calibration made with no CII and no delay and 35ps delay. Then measurement of the HP85033C male load Standard of 49. 932ohm was made in both cases. Result seen below

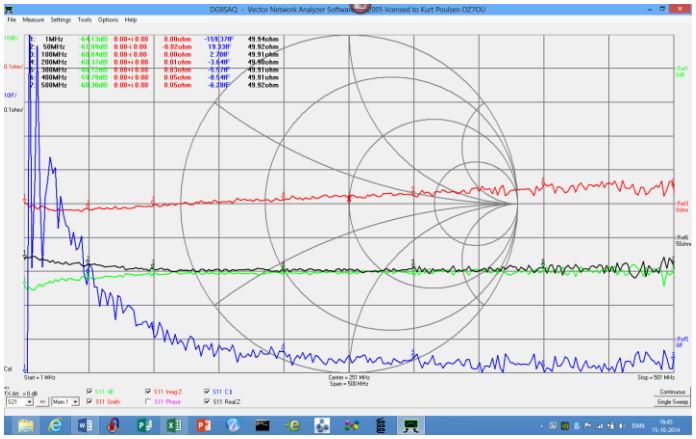


0ps

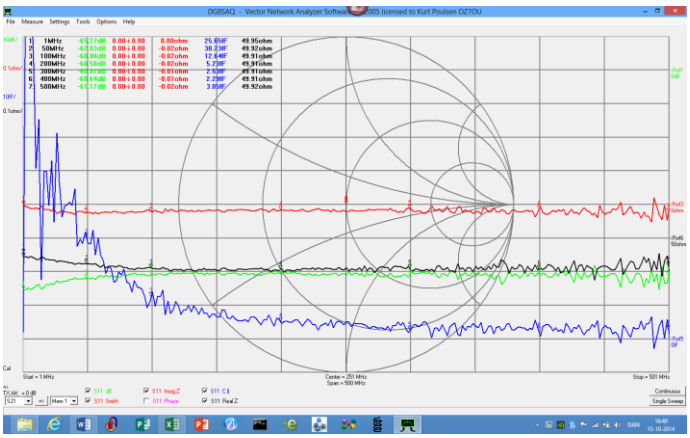


35ps

For Load2 two calibration made with no CII and no delay and 35ps delay. Then measurement of the HP85033C male load Standard of 49. 932ohm was made in both cases. Result seen below

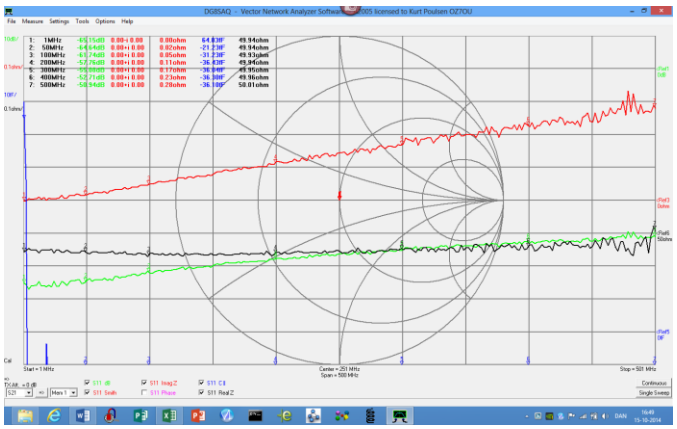


0ps

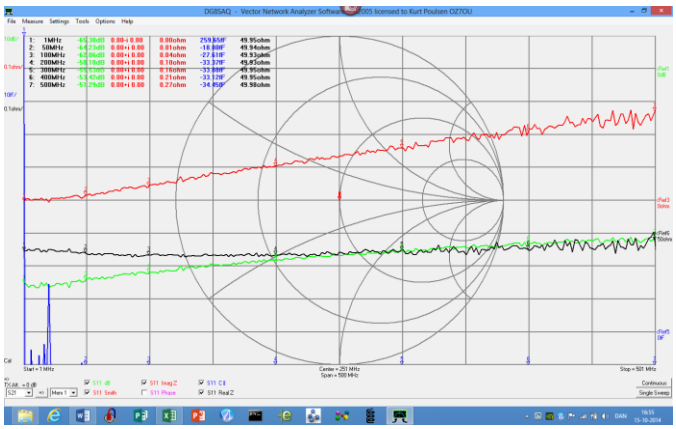


35ps

Load_ref

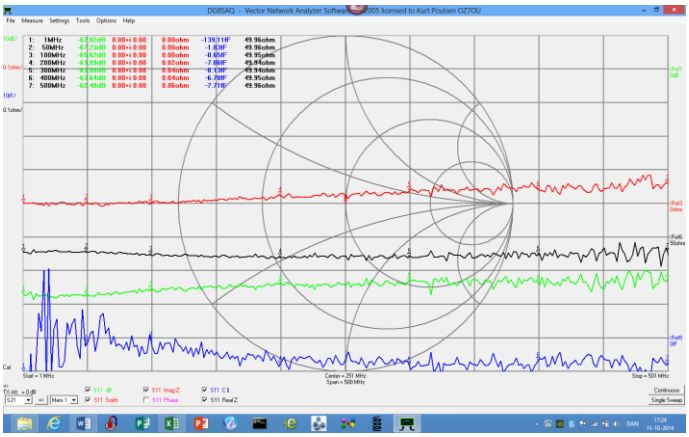


Ops

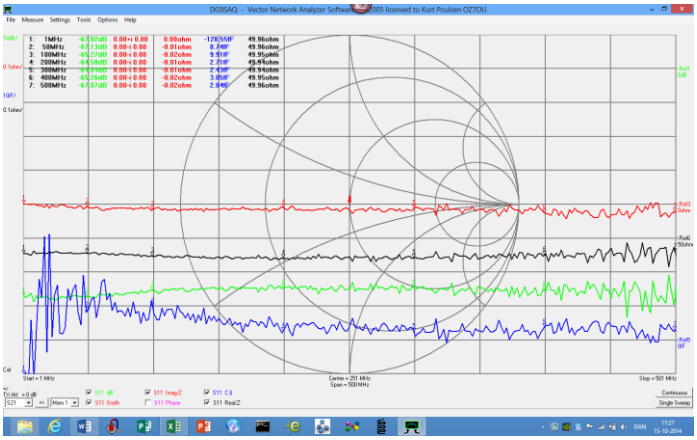


35ps

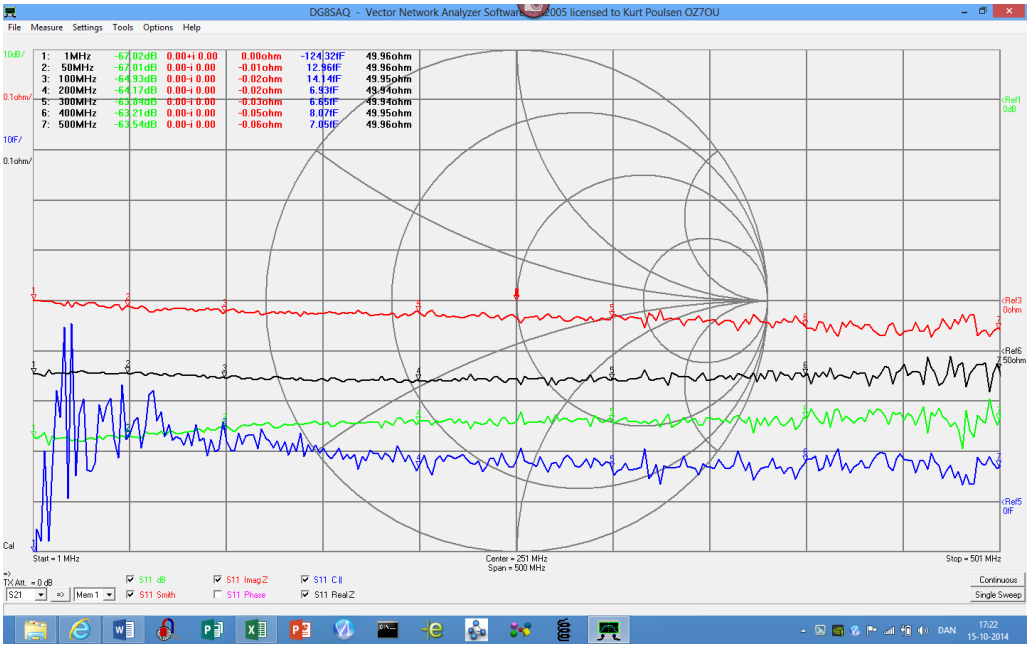
For Load_48.951ohm tree calibration was made with no CII and no delay and 25 versus 35ps delay. Then measurement of the HP85033C male load Standard of 49. 932ohm was made in both cases. Result seen below



0ps

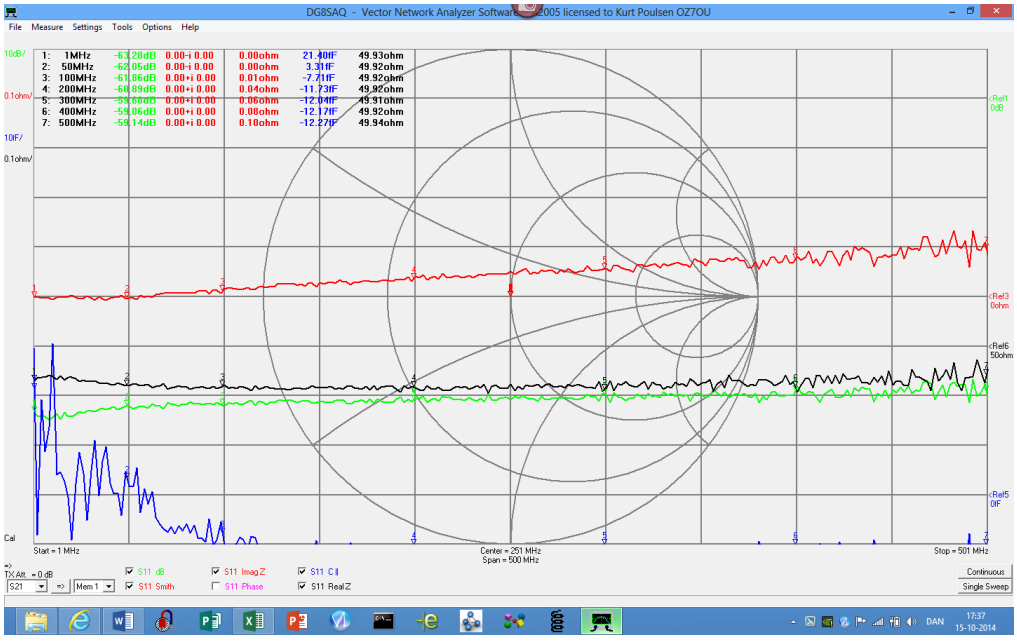


25pS



35ps

For Load_49.271ohm one calibration made with no CII and 35ps delay. Then measurement of the HP85033C male load Standard of 49. 932ohm made in both cases. Result seen below



35ps

Summary so far:

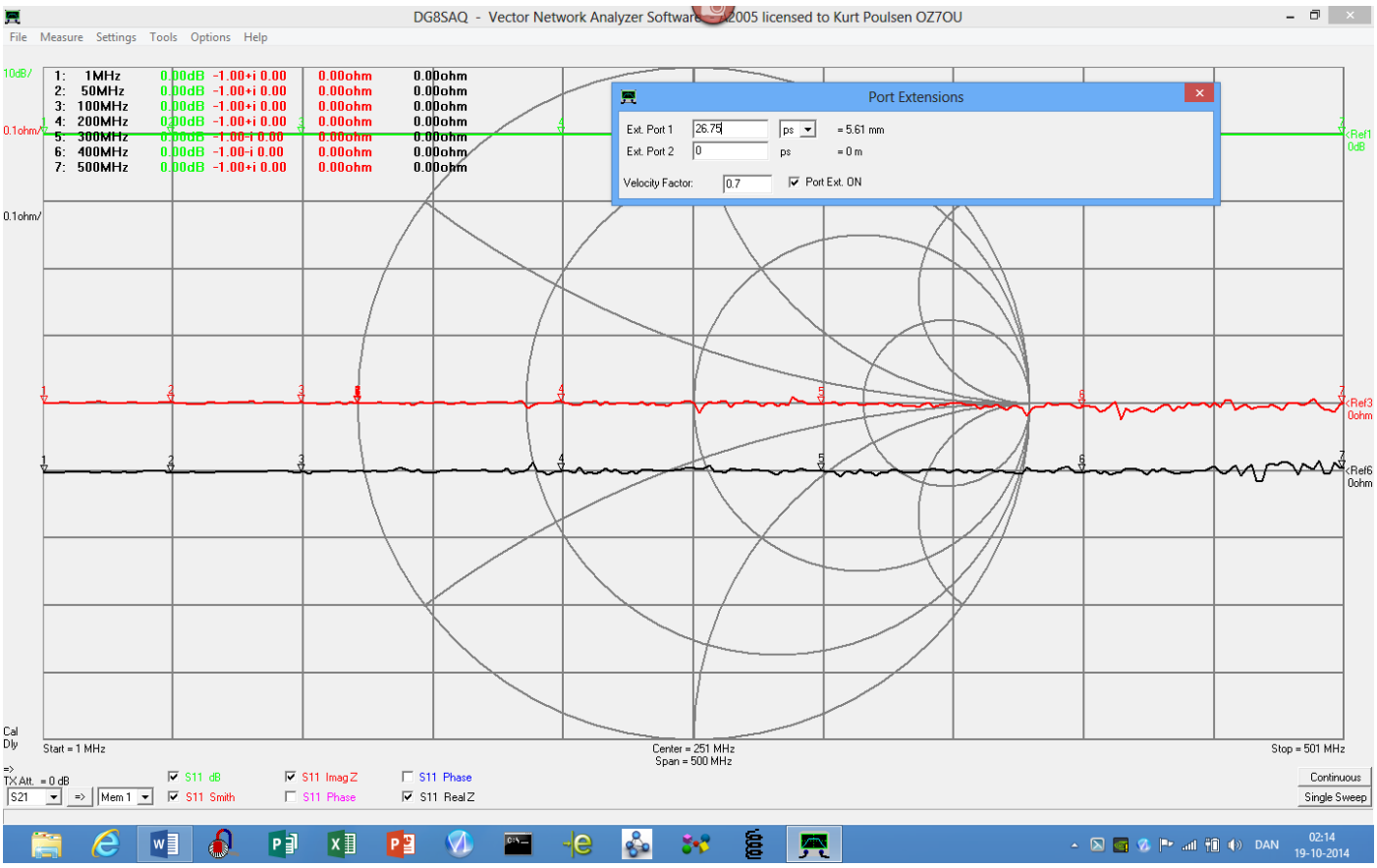
- Accept the measured delays for S21 of thru adaptors as being accurate.
  Use average = 42.43ps + - 0.1ps as was found.
- Accept for open and short adaptors the measured delays despite they differ from the expected values, because the Z0 of the adaptors differ from 50 ohm causing these differences.
  Female-female as open:
  - **Use Average=42.3ps + - 0.2ps at 1MHz**
  - Average=42.35ps + - 0.2ps >50MHz
- **Male Short: Use delay= -0.2ps**
- **Male Open: Use delay= 1.35ps**
  By using these values, the calibration will be closely identical to the calibration using the HP85033C 3.5mm calibrations standards.
- Accept to use to use the measured DC resistance for the **Rosenberger male loads** and use a **CII of 35fF** and no delay to facilitate a calibration accuracy with return loss of better than -60dB when measuring the HP35033C calibration Load standard.
- In general the measured data are with a high degree of accuracy when defining the HP35033C calibration as a valid master which of course is a truth with certain reservation, but I have no better alternative ☺.

Further investigation of the Rosenberger Female calibration kit

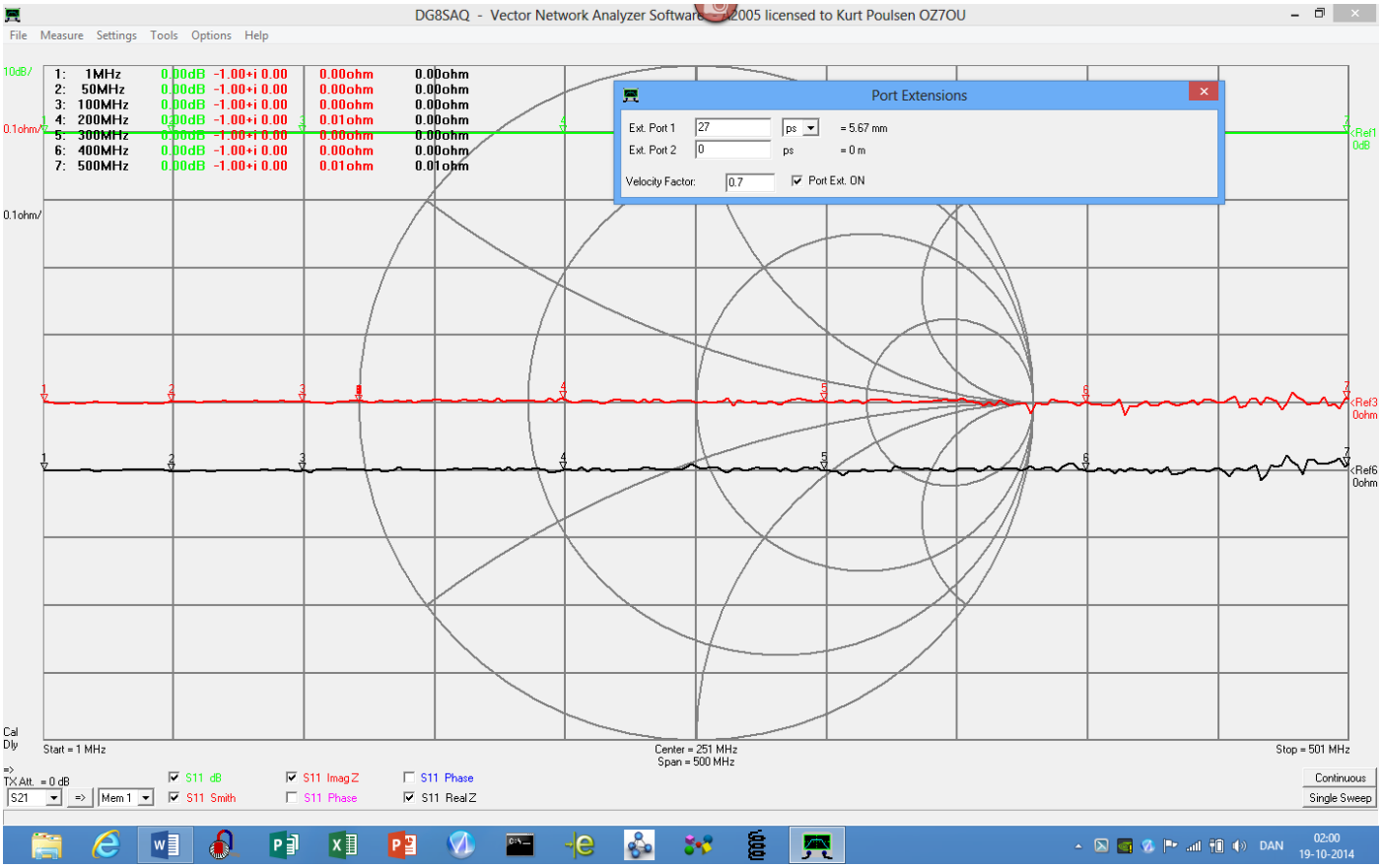
As the SDR-Kits Rosenberger female calibration kits also contain a female short, a female load and a male-male adaptor these items will also need a brush up using the HP85033C calibration kit.

The Female Short:

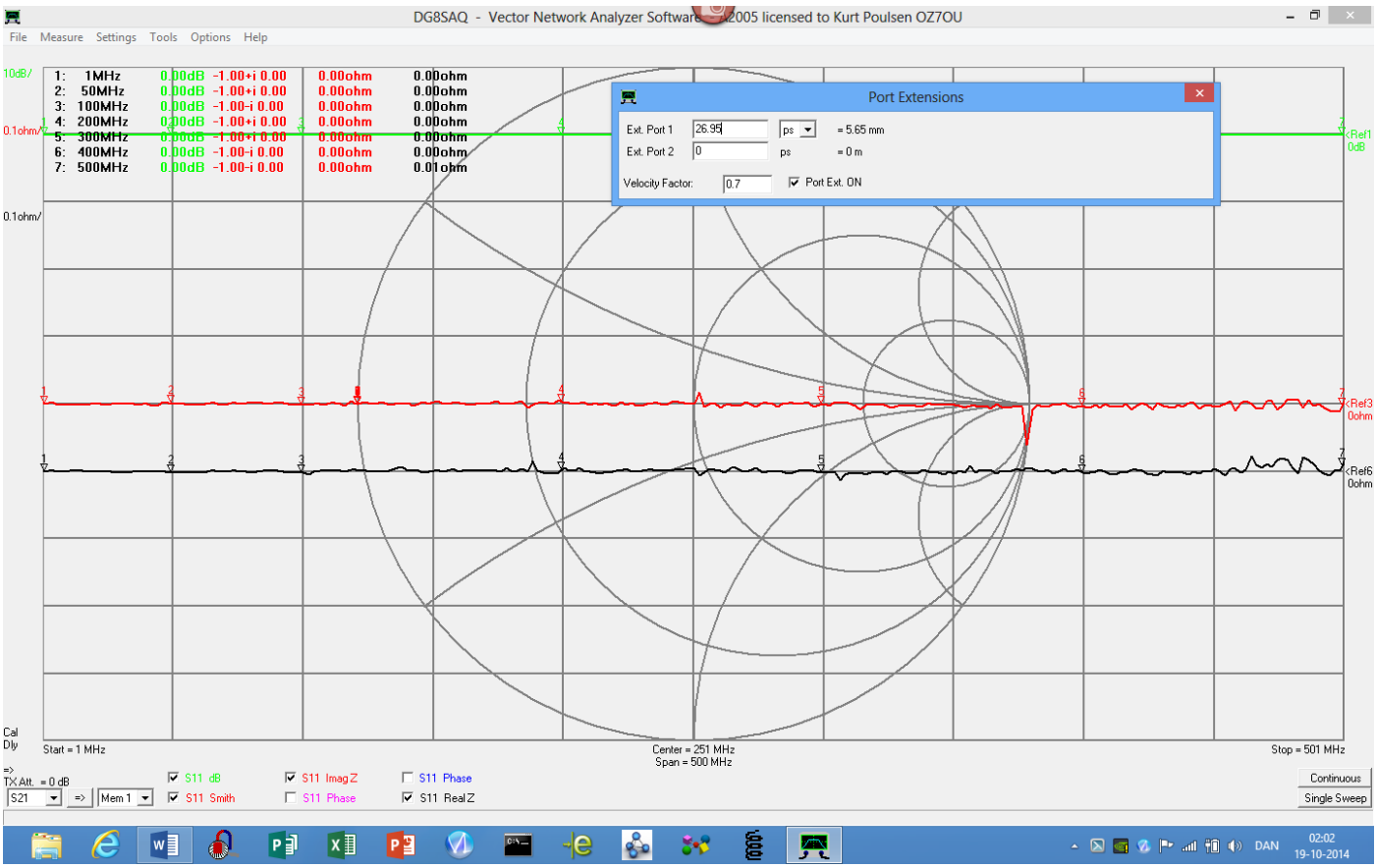
	FS_ref	FS_red	FS_black	FS dot2	Average
delay	26.75ps	27ps	26.95ps	26.95ps	26.91ps



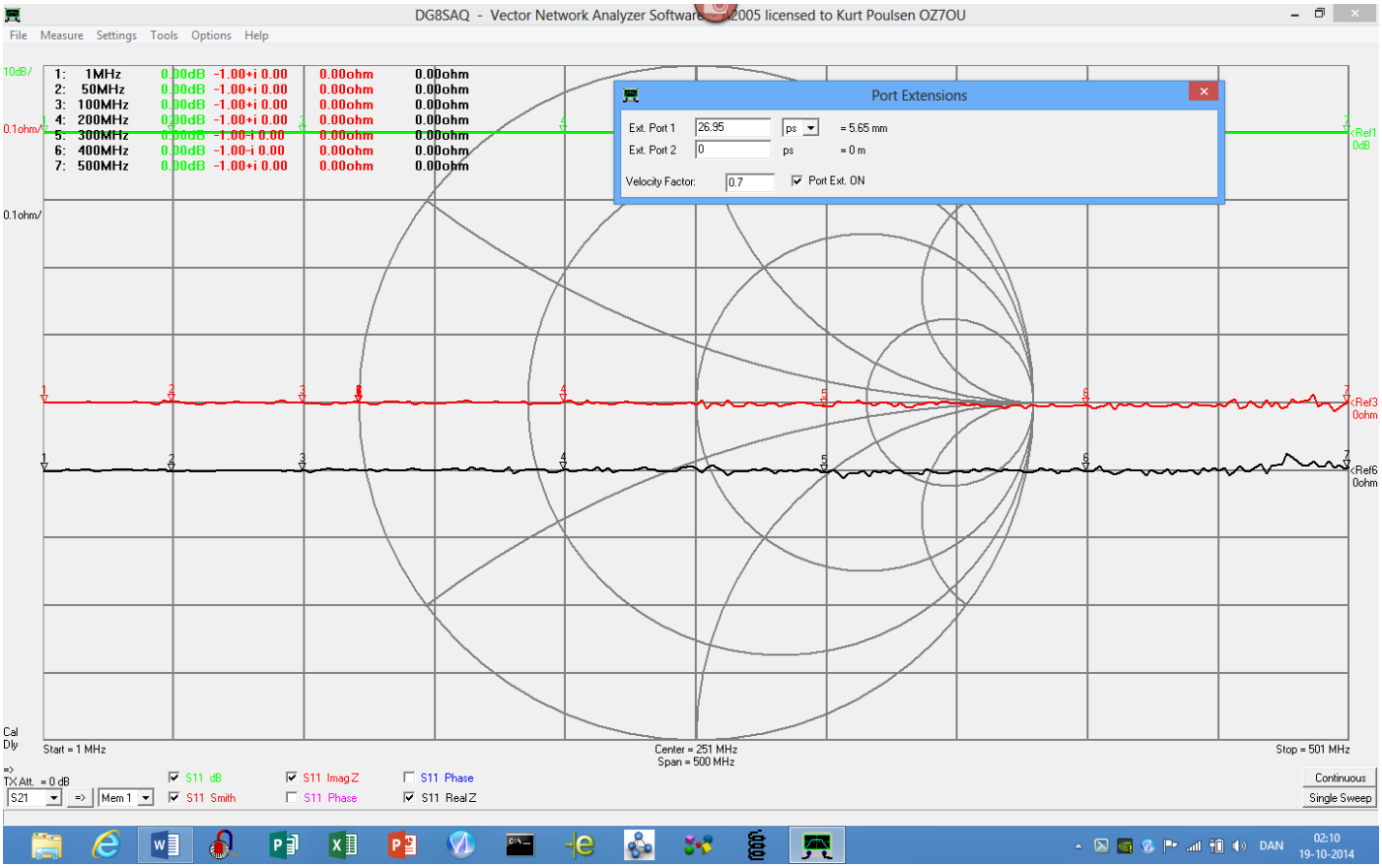
FS_ref



FS_red



FS_black



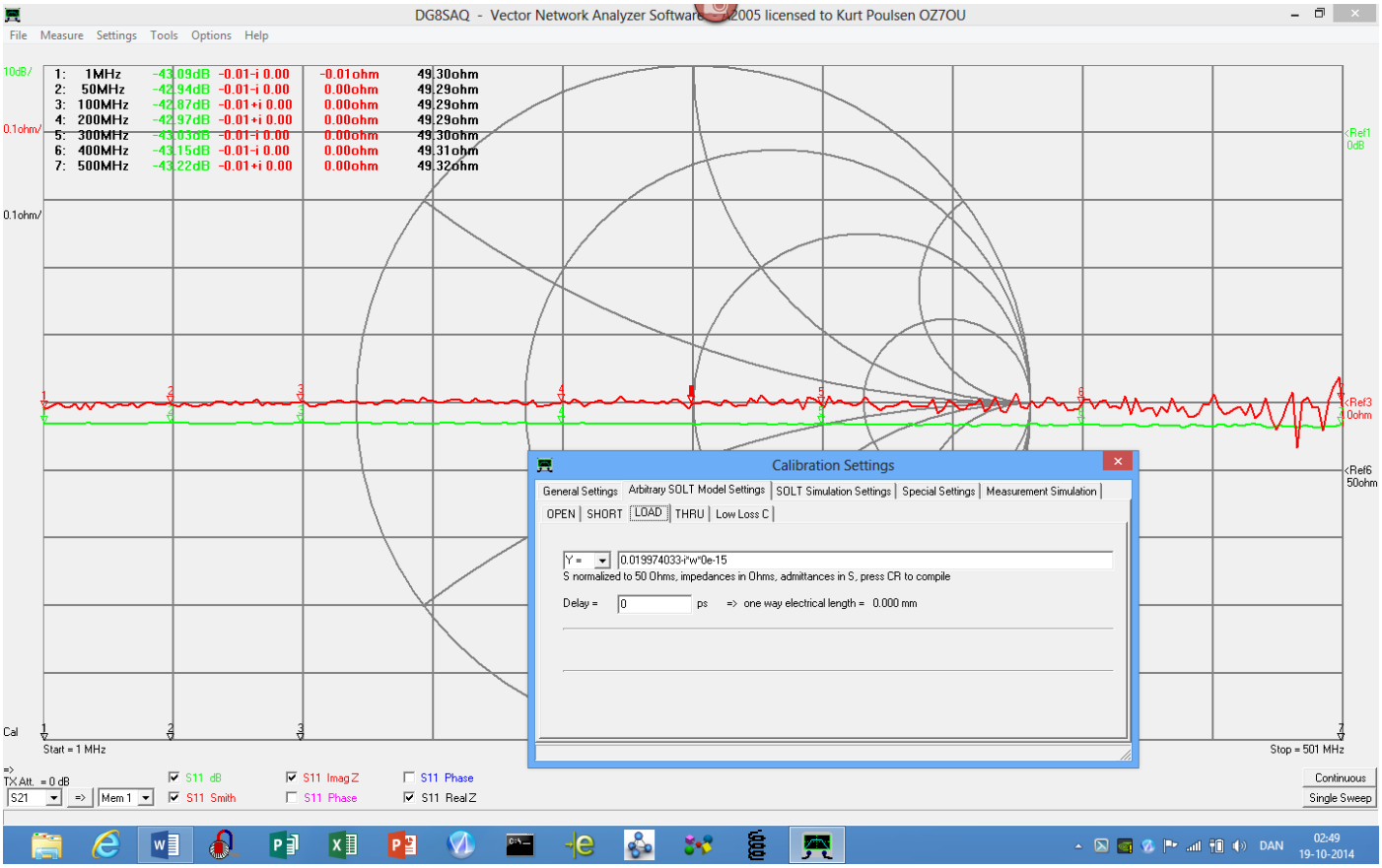
FS dot2

Summary for female short:
Use average: 26.91ps + - 0.15ps

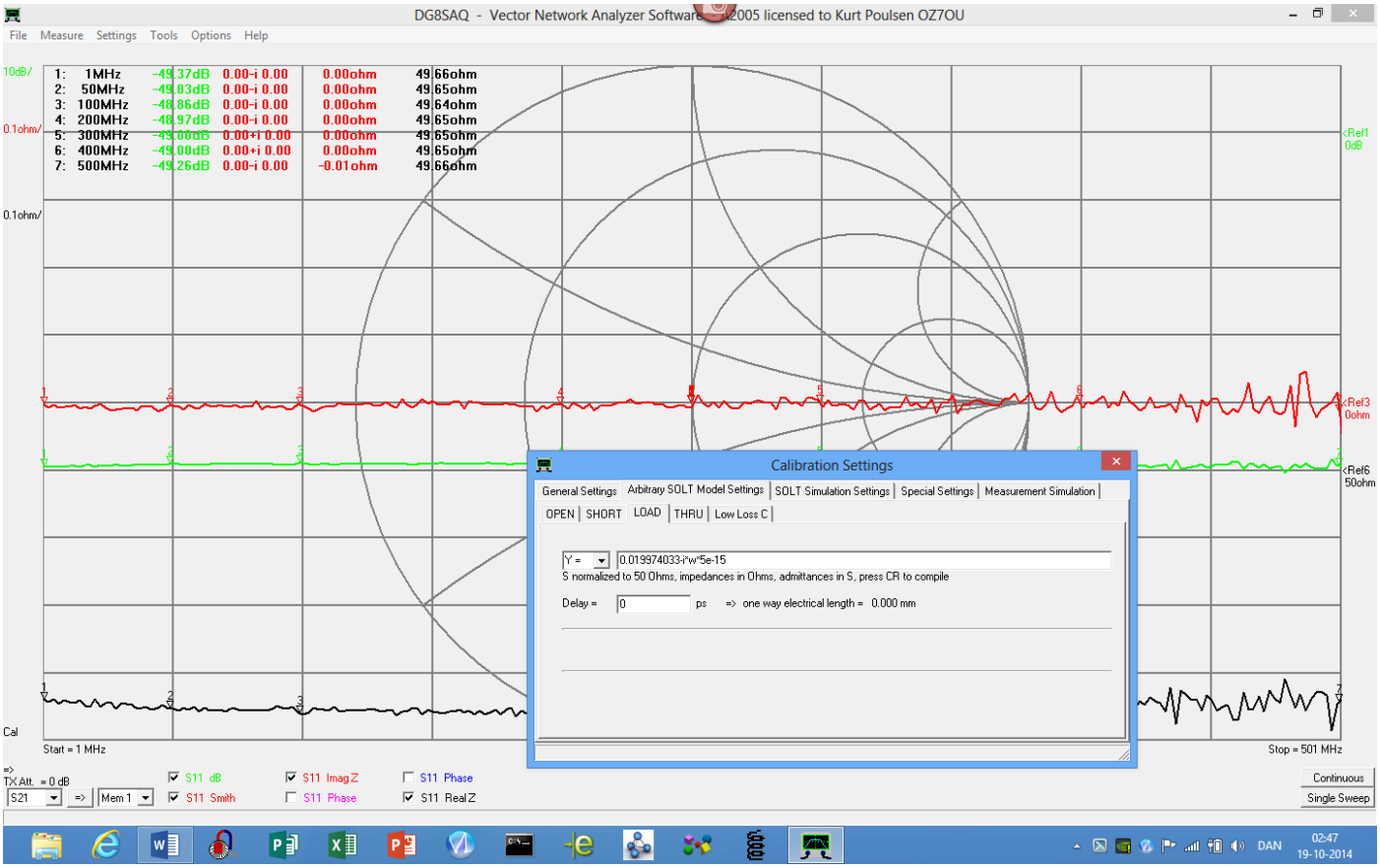
The Female Load:

	FL_ref	FL dot2	FL dot3	FL dot4	Average
Load value	**49.290 ohm**	**49.654 ohm**	**49.422 ohm**	**49.481 ohm**	
CII fF	**0fF**	**5fF**	**5fF**	**4fF**	

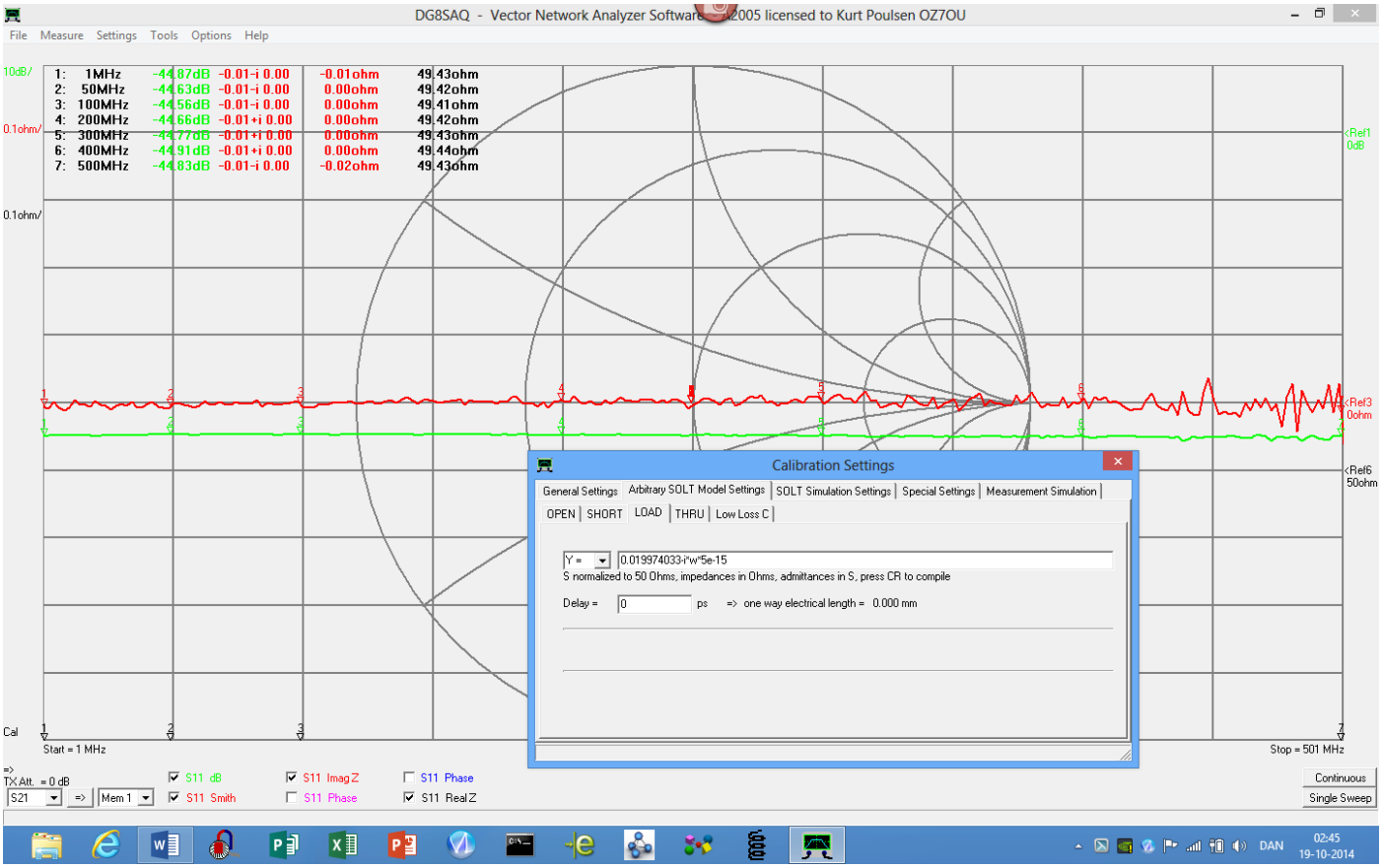
As documented below the Rosenberger female load is an excellent load requiring nearly no CII to be perfect. It is found that 2fF is a good choice so thus recommended.



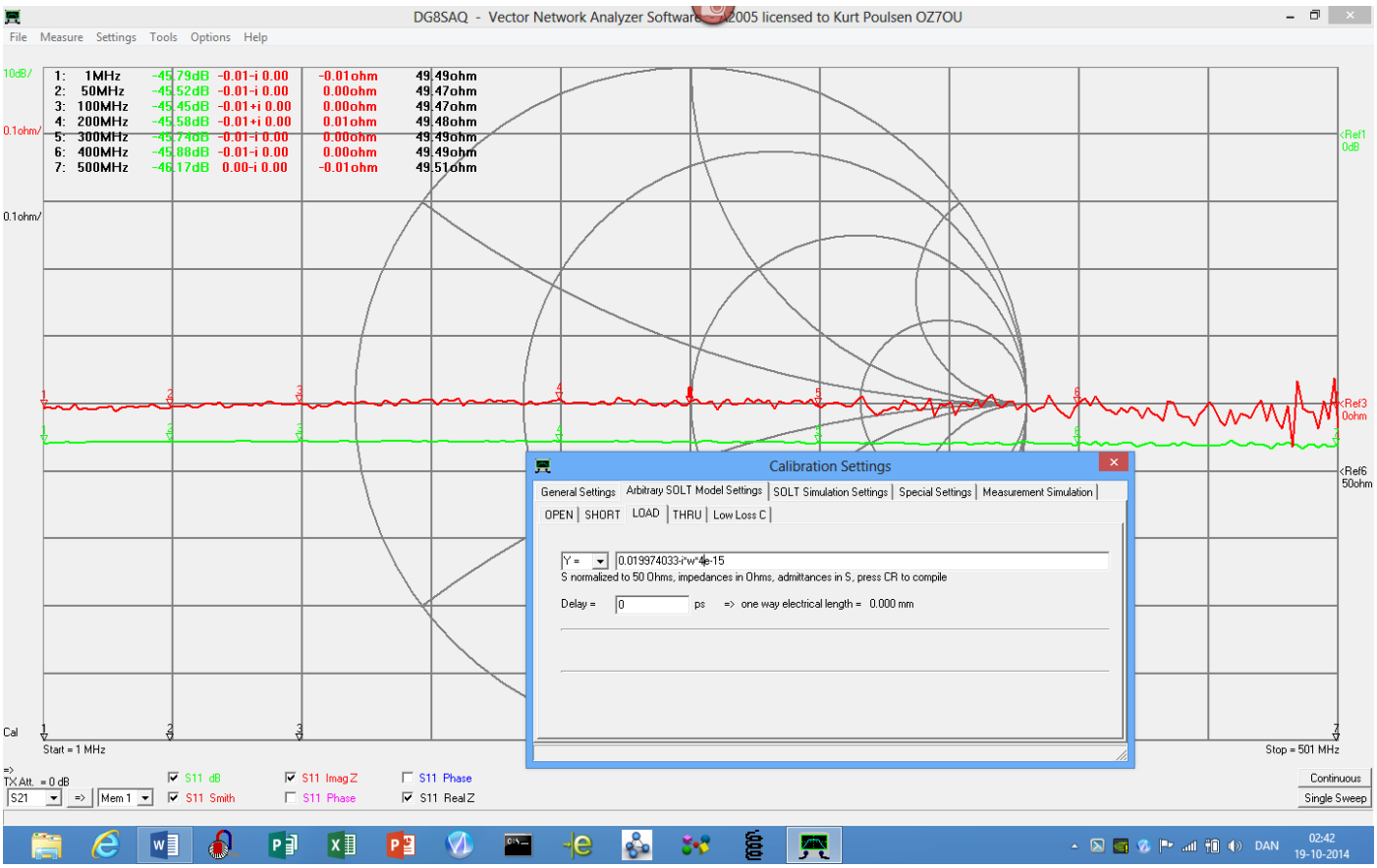
Female load FL ref measured and needs no CII to be optimum



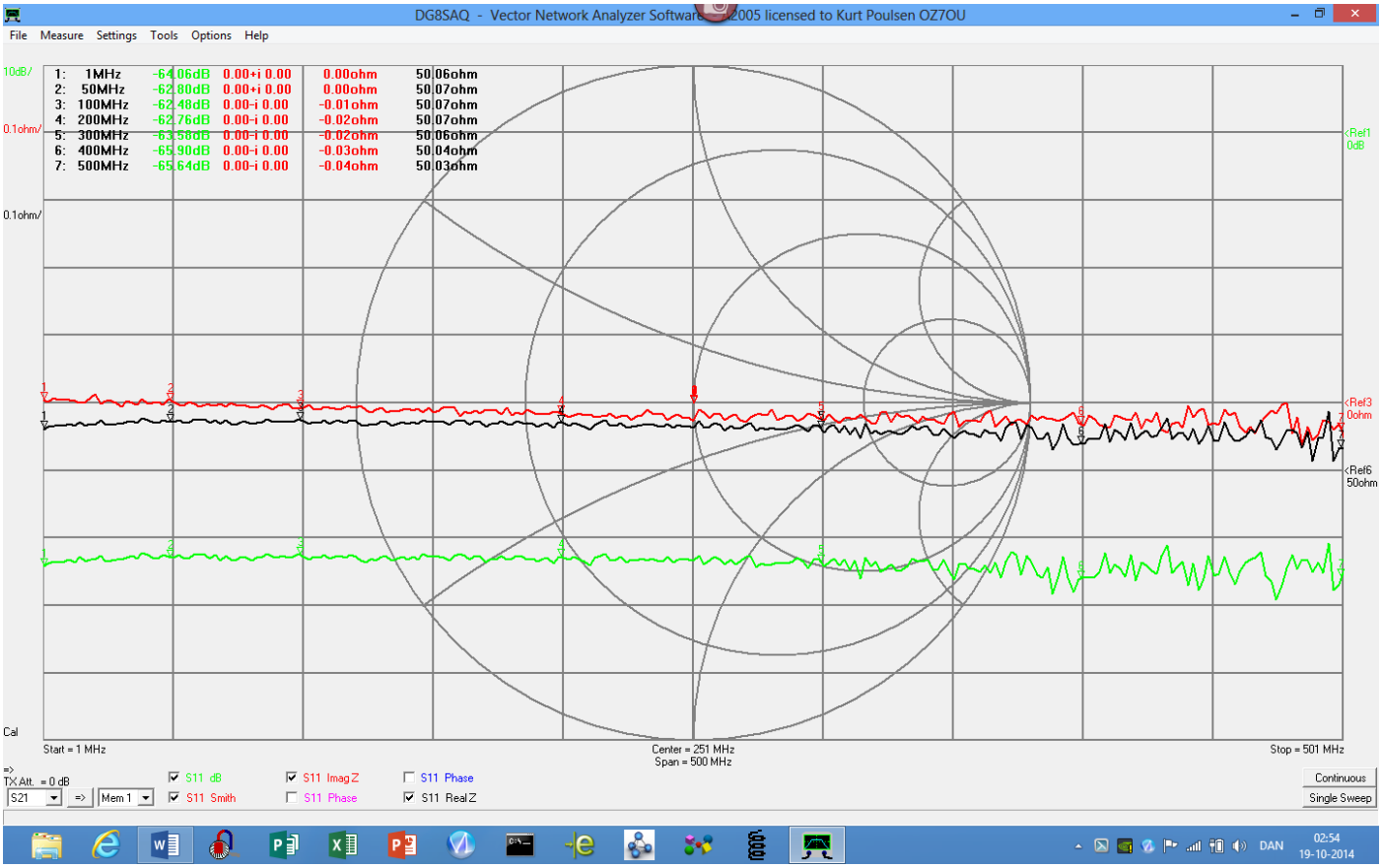
Female load FL dot2 measured and optimum for CII = 5fF



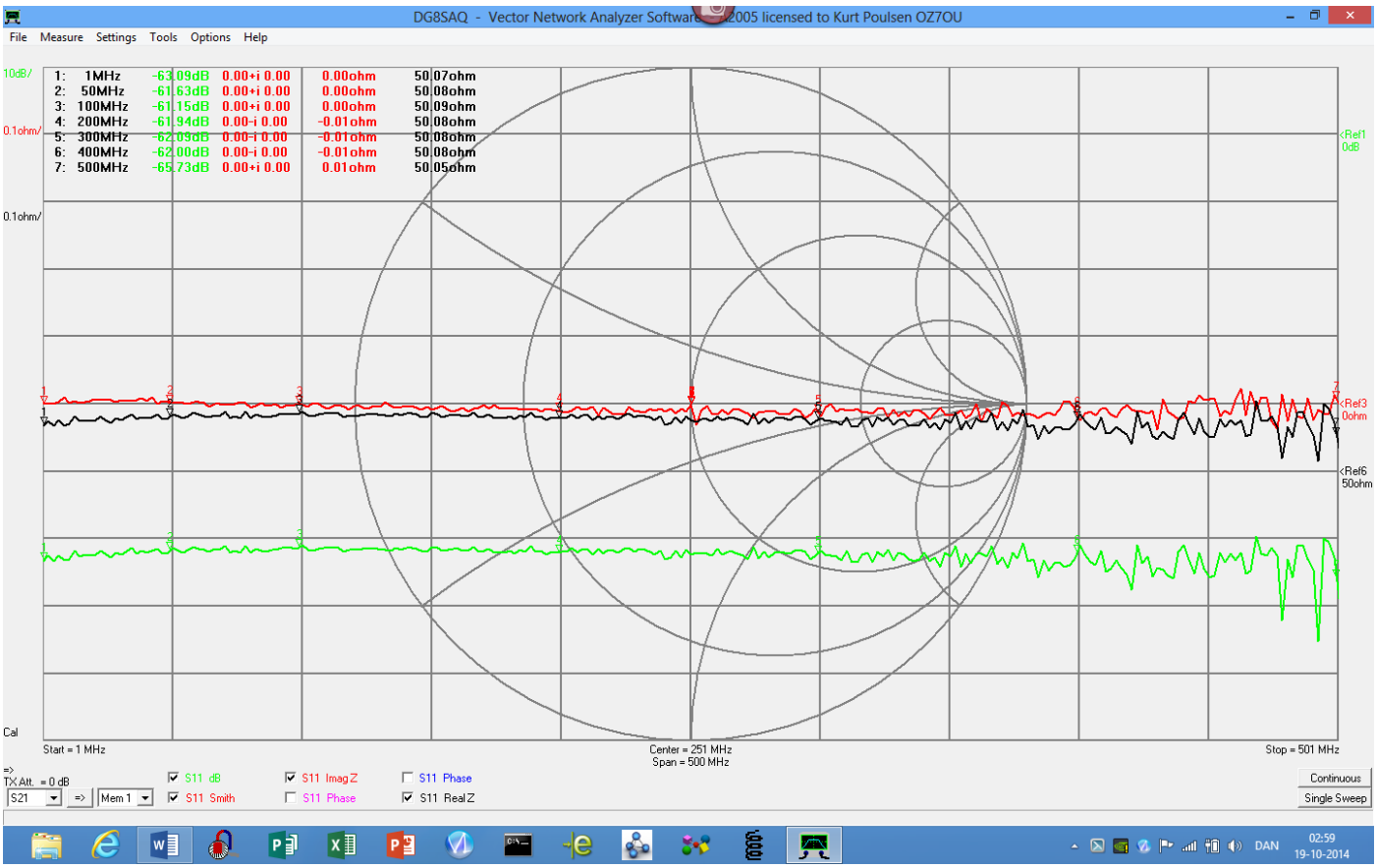
Female load FL dot3 measured and optimum for CII = 5fF



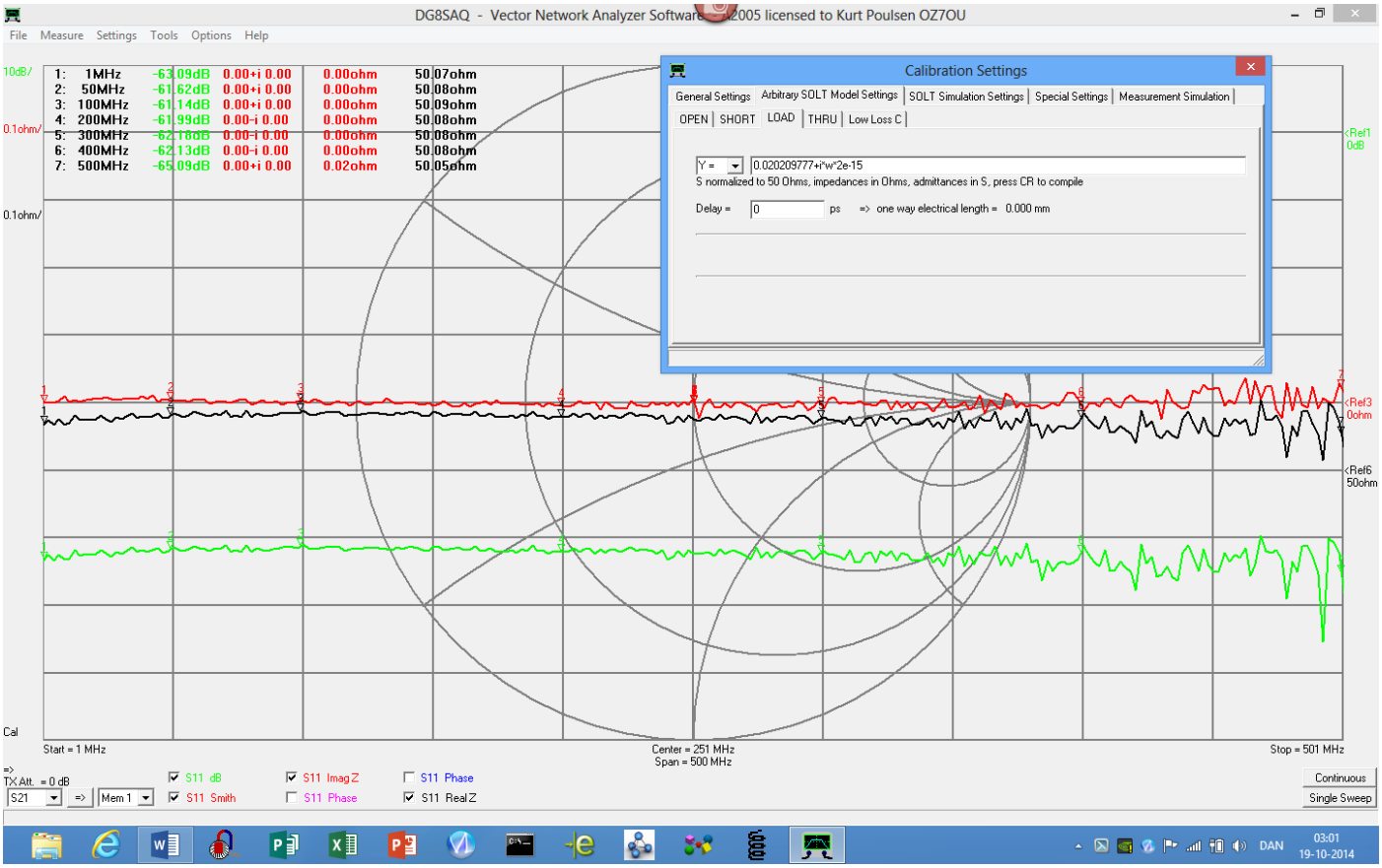
Female load FL dot4 measured and optimum for CII = 4fF



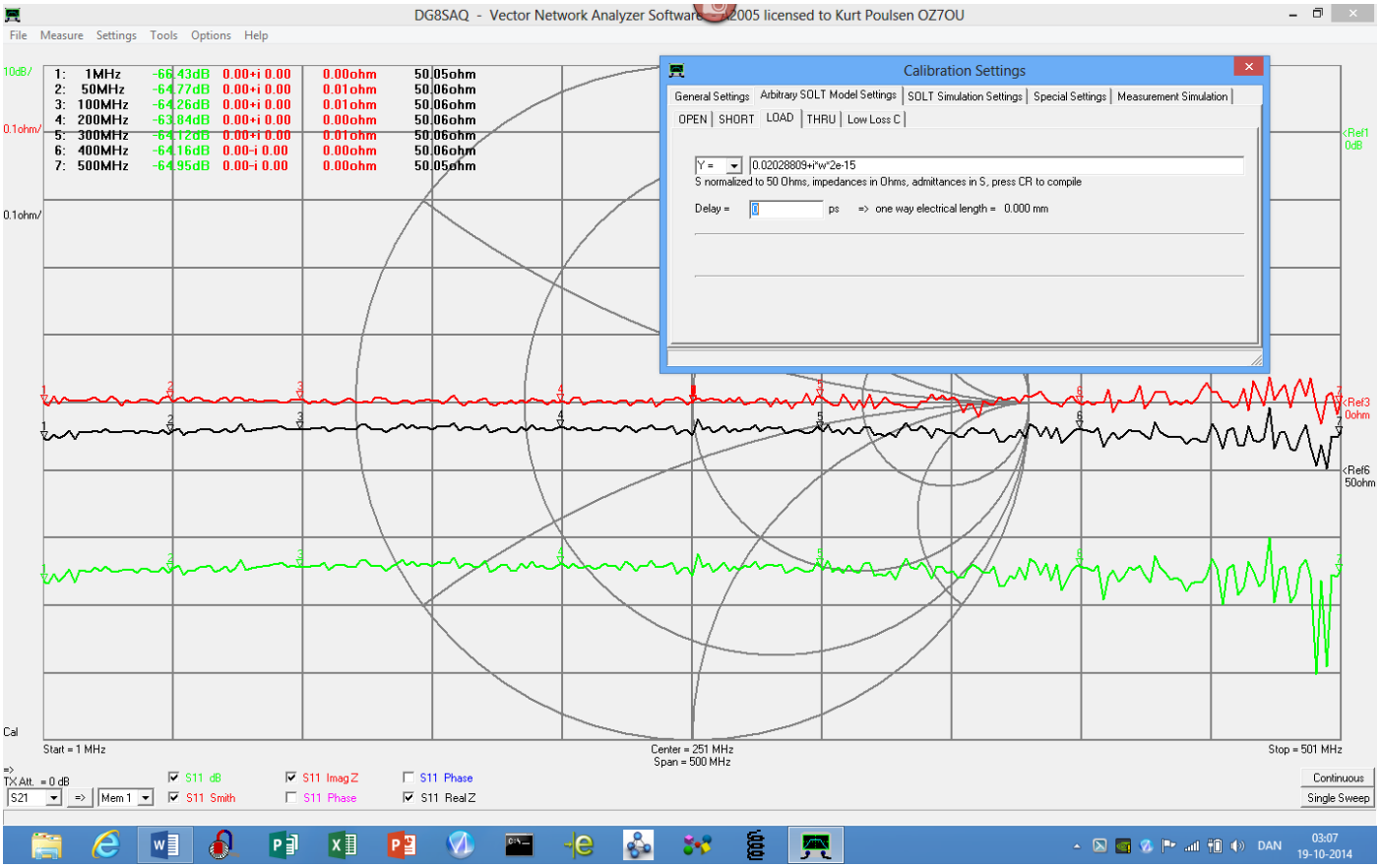
HP85033C load measured and CII 4fF used in calibration setting for FL-ref



HP85033C female load measured and CII 4fF used in calibration setting for FL dot4 load as calibration standard



HP85033C female load measured and CII 2fF used in calibration setting for FL dot4 load as calibration standard



HP85033C female load measured and CII 2fF used in calibration setting for FL_ref load as calibration standard

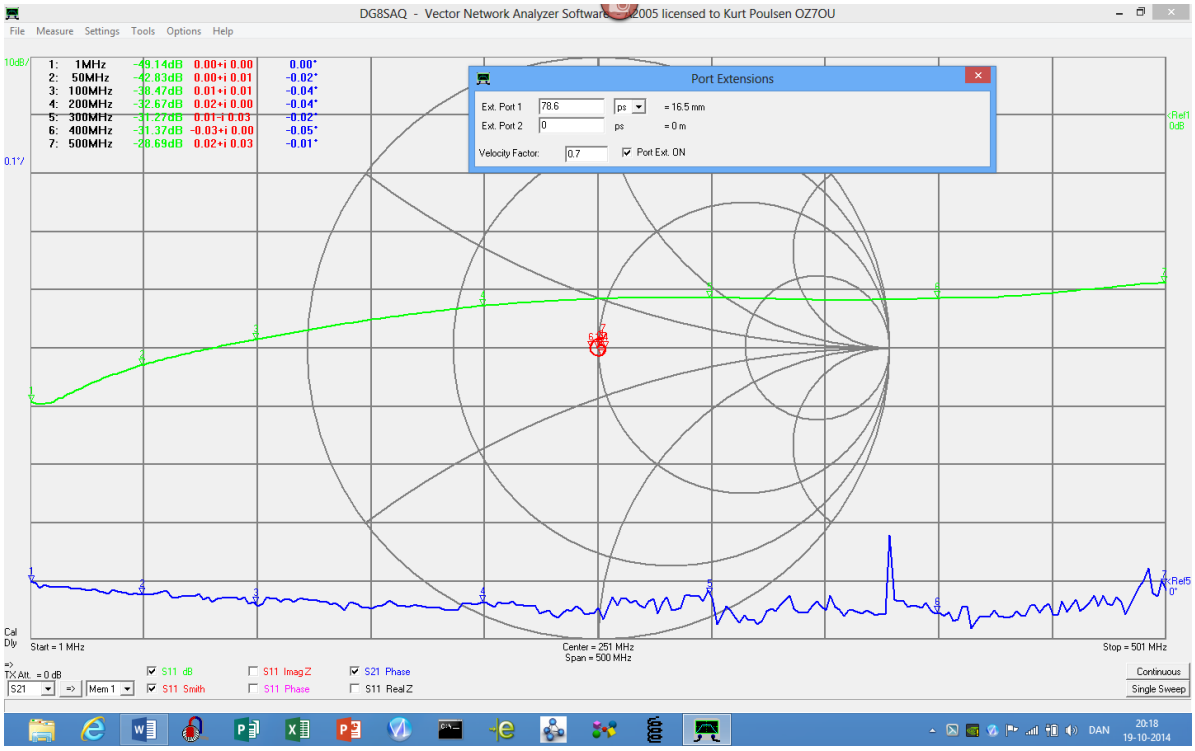
Summary for female load:

Used accurate measured DC resistance and a CII value of 2fF

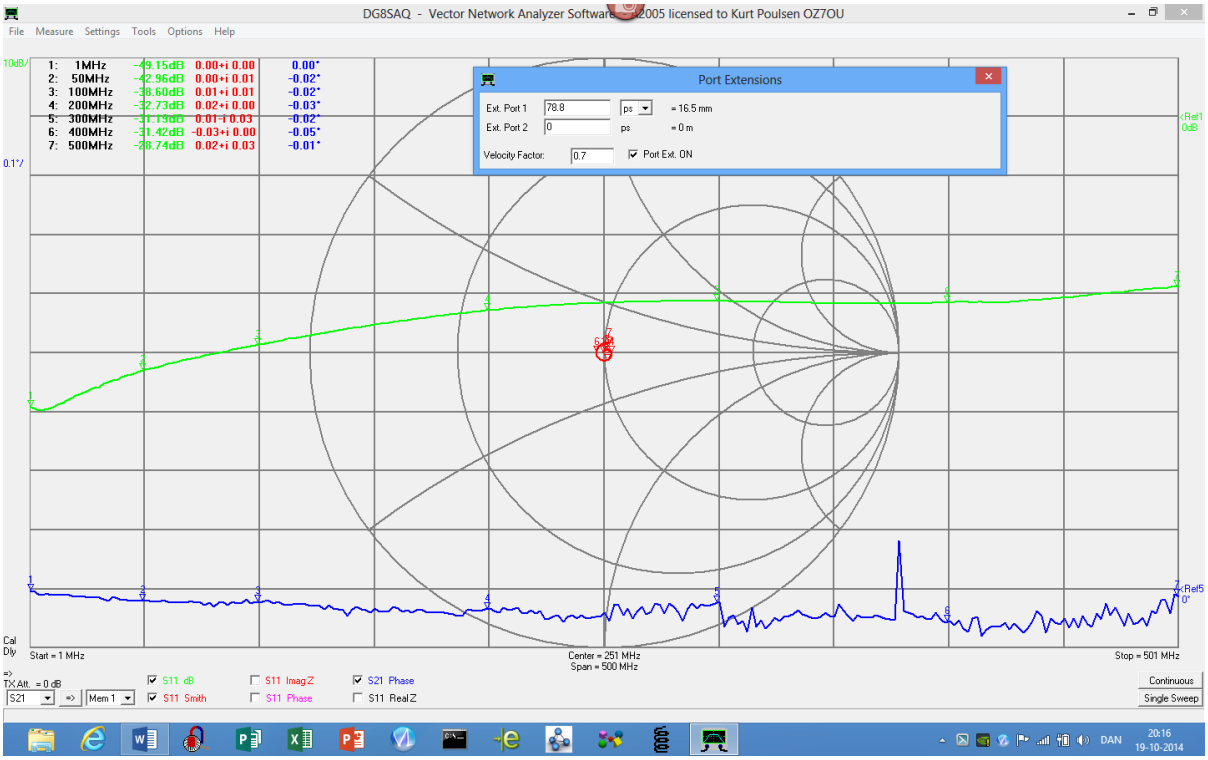
Measurement of the Rosenberger male-male adaptor

S21 delay	MT dot1	MT dot2	Average
S21 Delay at 1MHz	78.60ps	78.80ps	78.70ps
+delay >50MHz	0.04deg	0.04deg	0.04deg
S21 Delay >50MHz	78.71ps	78.91ps	78.81ps

In contradiction to the Rosenberger female-female thru adaptors which had very little additional delay for high frequencies, these Rosenberger male-male adaptors are causing more reflections and have to a larger extend deviations from 50ohm regarding the adaptors Z0.



Rosenberger male-male Thru MT dot1



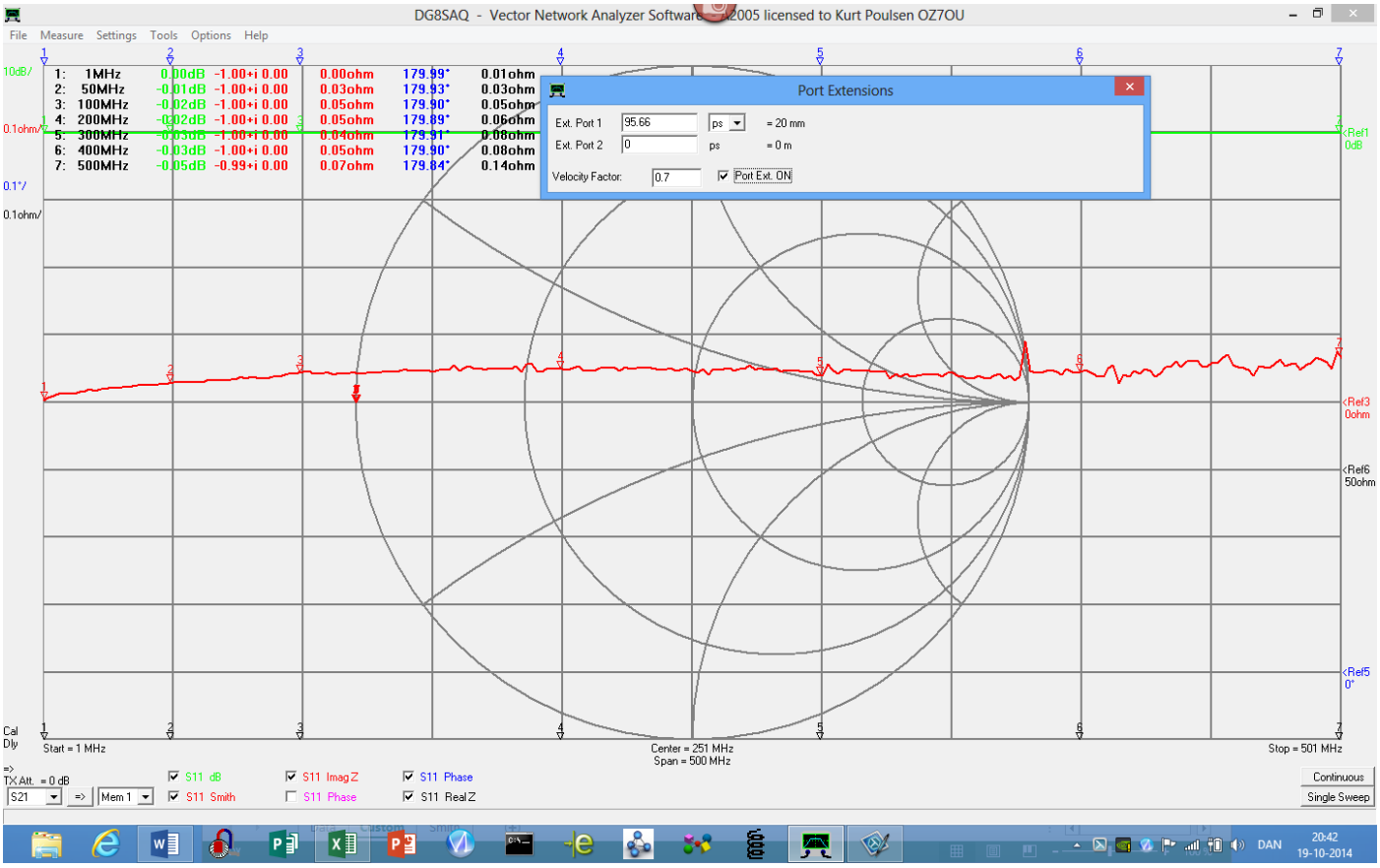
Rosenberger male-male Thru MT dot2

Investigation of the Rosenberger male-male adaptor when measured as a short terminated with HP85033C female short standard

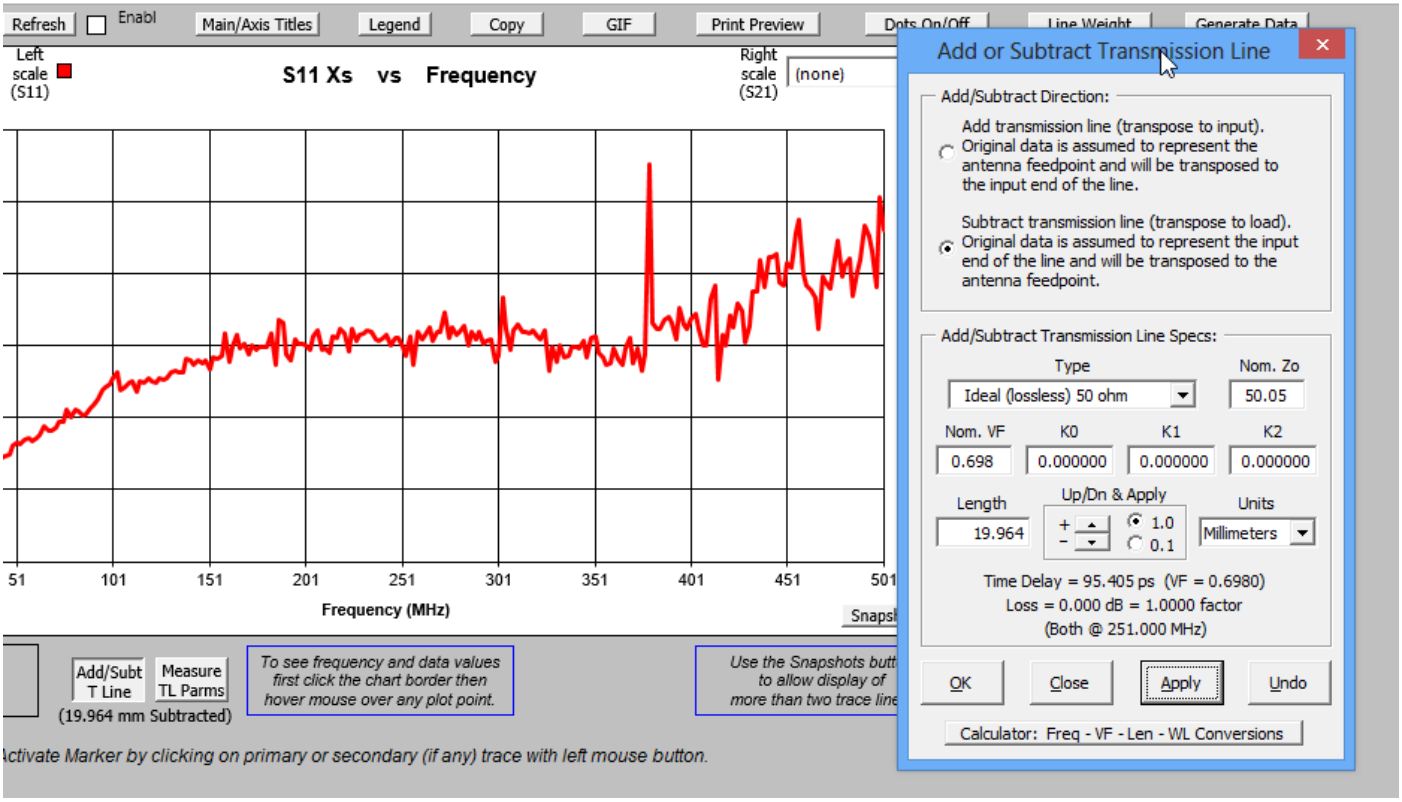
	MT dot1	MT dot2	Average
S11 Delay at 1MHz	96.66ps	96.66ps	96.66ps
+delay	0.1deg	0.1deg	0.1deg
S11 Delay >50MHz	96.94ps	96.94ps	96.94ps
>50MHz S21 delay+16.695ps	95.405ps	95.605ps	95.405ps
Z0 for >50MHz conditions	50.05 ohm	49.41 ohm	na
1MHz S21 delay +16.695ps	96.295ps	96.495ps	96.395ps
Z0 for 1 MHz condition	49.6 ohm	49.5 ohm	na

Again it is demonstrated that just very minor changes to Z0 of the adaptor have a great influence on the delay either terminated with a short or left open. In addition, the Rosenberger male-male adaptor has a higher delay above 50MHz . Only images are shown for the MT dot1 as MT dot 2 showed identical behavior and just are the used data recorded in above table. The method in ZPlot is to enter the S21 Delay plus the delay of the HP85033C female short standard terminating the male-male adaptor. The VNWA calibrated using the APC-7 to 3.5mm female adaptor using the HP85033C male calibration standards

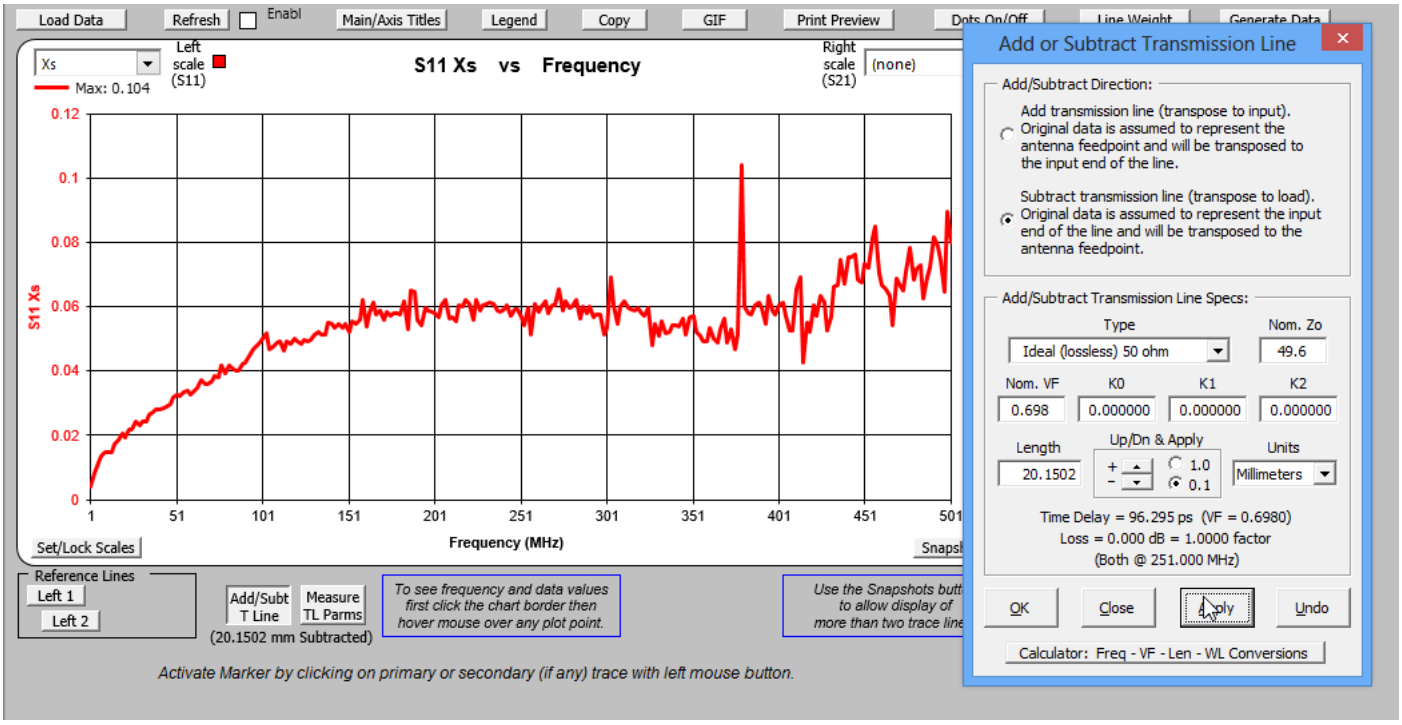
No images are presented for the Z0 determination at S21 delay + 16.695ps at 1MHz



Above image counts for both adaptors



For MT dot1 the >50MHz S21 delay + 16.696ps entered as Length and Z0 corrected to flat response above 200MHz



For MT dot2 the >50MHz S21 delay + 16.696ps entered as Length and Z0 corrected to flat response above 200MHz

Summary for the Rosenberger male-male adaptor:

The delay to use in calibration setting for Rosenberger male-mal thru adaptor:
Use 78.7ps + - 0.1ps at 1MHz
Use 78.8ps + - 0.1ps >50MHz
Please note !! Only two adaptors available for the test.

REMEMBER IN THE CALIBRATION SETTING THE OPEN AND SHORT IS TWICE THE VALUES IN THIS REPORT

Kurt Poulsen 20/10/2014