20.02.19

FP-62-NMR

We test the different operations on the p20 Control unit and adjust the 90° and 180° pulse with the help of an oscilloscope whiche we use to diplay the change of the Magnitization.

After adjusting the Pulses we start with measuring T_2 with Spin-Echo methode for Ga 500 and 600.
Then we proceed withe measuring T_2 with the Carr Purcell methode.
And at last we measure T_1 with the Spin-Echo-Methode again.

Table 1: Diffrent Relaxation Times

	$T_{2,SE}$ [ms]	$T_{2,CP}$ [ms]	$T_{1,SE}$ [ms]
Ga 500	62,4	66,1	68,1
Ga 600	78,6	~~86,4~~ 84,0	99,2

We continue with the chemical ~~shift~~ identification. After takeing all the Frequency profiles, we ~~try~~ match the peaks with the different parts of the ~~chem~~ molecules. First identify that for each "+"-probe the most left peak is from TMS and use the relatis distance of the other peaks to identify the responsible part of the molecule. ~~We identified~~

$\Delta T = 1.29\,\mu s$

$f_{HF} \sim 20\,MHz \sim f_2$

$B_0 = \frac{f_2 \cdot 2\pi}{\gamma}$

$B_1 = \frac{\alpha}{\gamma \cdot \Delta T}$

$\Delta E_{Res} = \sigma_{Halbwidth} \cdot h$

$\Delta E_{Dip} = \Delta f_{Peak\,3,4} \cdot h$

Table 2: Identifying the probes with relative distance

	A+	B+	C+	D+	E+
Δ(TMS)-(1st)	2.2	2.1	2.0	3.9	2.6
Δ(TMS)-(3rd)	3.9	6.9	11.6	6.3	7.5
Δ(TMS)-(4th)	6.3				
→ Molecule	FCH_2-CO-CH_3	H_3C-⌬-CH_3	CH_3COOH	FCH_2-CN	⌬-CH_3

The difference is here calculated via δ

$$\delta = \frac{\omega_{res} - \omega_i(\text{ith-peak})}{\omega_L (\sim 19.8\ MHz \cdot 2\pi)} \quad (1)$$

It should be mentioned that we didn't expect to se 2 peaks for FCH_2-CN or 3 peaks for $FCH_2-CO-CH_3$ because the resonce frequency for Fluor is a lot higher than ~~we~~ the one we are using here.

But if you consider the Spin-Spin Interation from Fluor and ~~Hydro~~ ~~The~~ the ~~Pro~~ proton (hydrogen) we can have two different energy states of ↑↑ and ↑↓. Hence we can see two peaks ~~and~~ for FCH_2- around 4 and 6.5.

We can also calculate the strength of the B-Fields with

$$B_0 = \frac{\omega_L}{\gamma} \quad (2)$$

$$B_1 = \frac{\alpha}{\Delta T \cdot \gamma} \quad (3)$$

with B_0 as static magnetic field used and B_1 the induced magnetic Field in the coil. $\gamma = 2.6 \cdot 10^8 \frac{1}{s \cdot T}$ is the gyromagnetic ratio of the nucleus for protons in this case. $f_L \approx f_{HF} = 19.8\ MHz$ is taken from the LabView program and ΔT for a $90°$ Pulse is identified with an oscilo...

$\rightarrow \Delta T_{90°} = 1.29 \cdot 10^{-6}\ s$

$$\rightarrow \quad B_0 = \cancel{0,48T} \quad \frac{19.8 \cdot 2\pi \cdot 10^6}{2.6 \cdot 10^8} \cdot T = 0,48T$$

$$B_1 = \frac{\pi/2}{1.29 \cdot 10^{-6} \cdot 2.6 \cdot 10^8}\ T = 4.3\ mT$$

Lastly we can also deduce our Energy Resolution by looking at the width of a peak.

$$\Delta E_{res} = f_{\cancel{FHWW}\,FWHM} \cdot h \qquad (4)$$

and calculate the ~~d~~ Energy diffence for the different Fluor states.

$$\Delta E_{Dipol} = f_{\Delta F} \cdot h \qquad (5)$$

For $f_{\Delta F}$ we take from A+ the 3rd and 4th peak and calculate the Δf and we get $f_{\Delta F} = 48\,Hz$, $f_{FWHM} = 19.9\,Hz$ is taken from the 2nd Peak in A+ with the 2 ~~coursers~~ coursors, and $h = 4.136\,eVs$.

$\rightarrow$ $\Delta E_{res} \approx 8 \cdot 10^{-14}\,eV$

$\Delta E_{Dipol} \approx 2 \cdot 10^{-13}\,eV$

Next we start with the 1-d MRI and 2-d MRI. We use a Bruker minispec mq7.5 to take the images. We compare the way oil sinks through sand with the diffusion from a gas and we can conclude that it can be desribed with such model.

At last we take pictures with it from different objects.

T2_meas_freq.vi

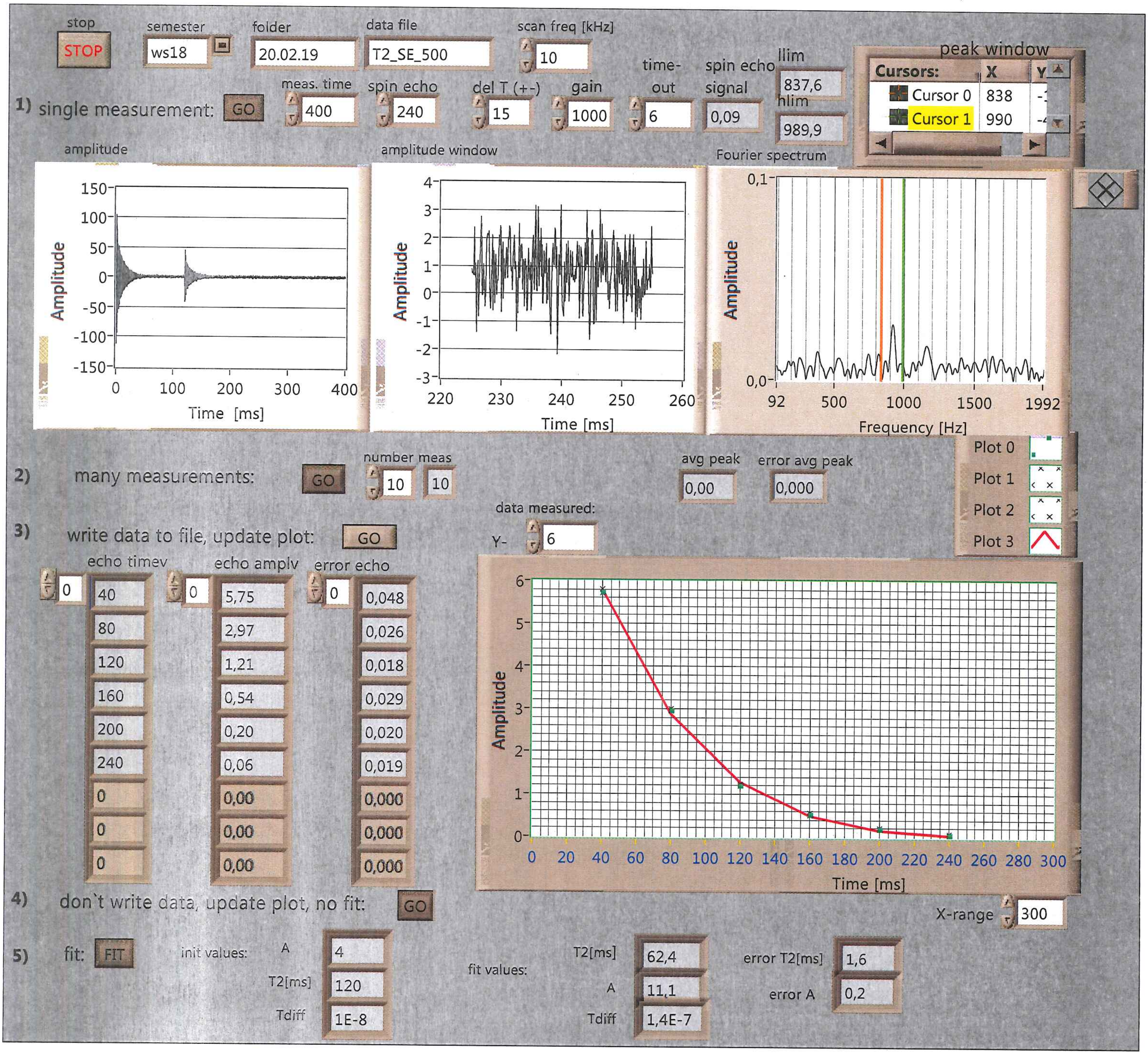
C:\F61\sw\T2_meas_freq.vi

Last modified on 26.11.2018 at 15:49

Printed on 20.02.2019 at 10:28

Measurement of $T_{2,SE}$, Ga 500

Front Panel



T2_meas_freq.vi

C:\F61\sw\T2_meas_freq.vi

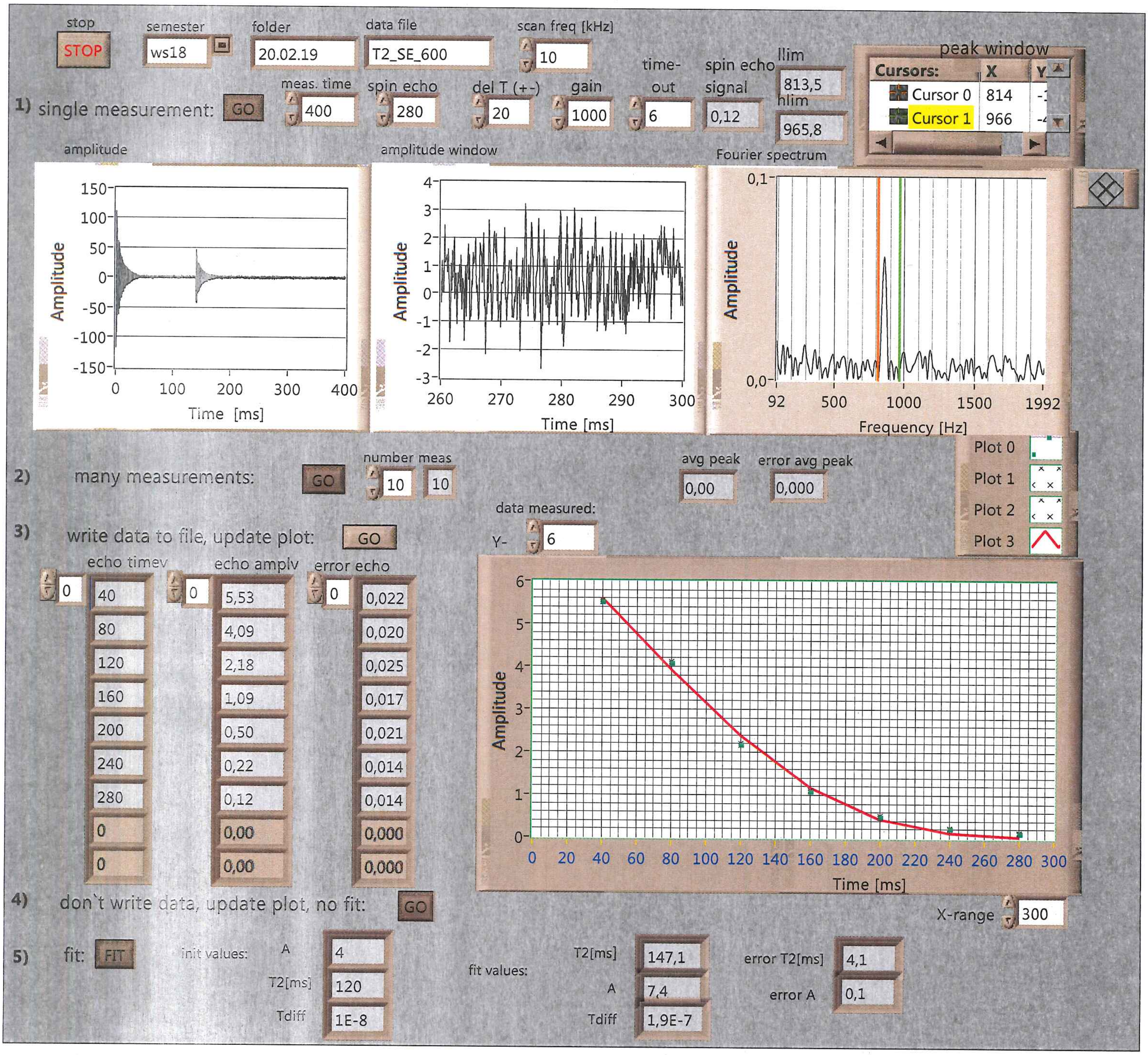
Last modified on 26.11.2018 at 15:49

Printed on 20.02.2019 at 10:44

Retaken -> check next one

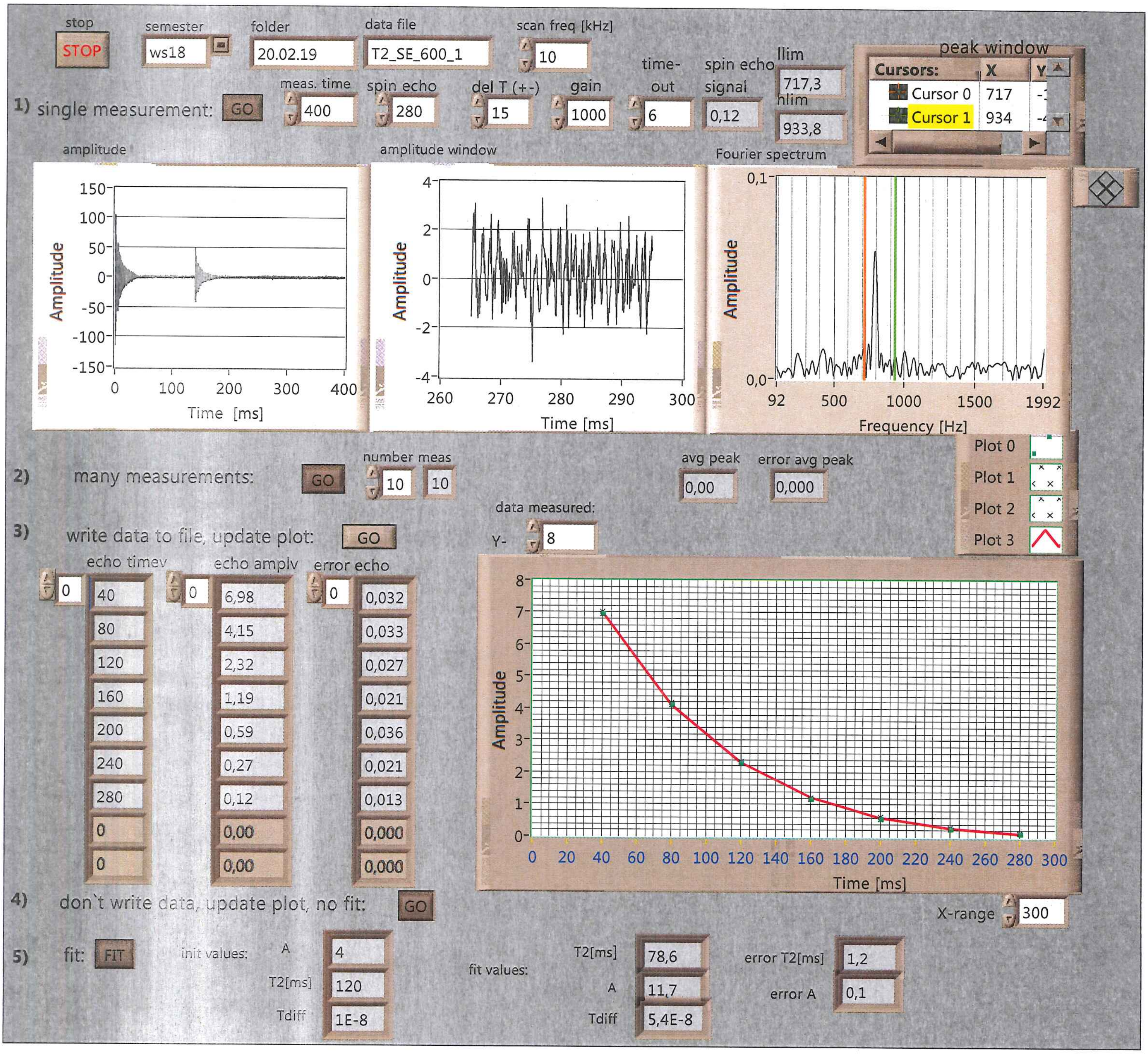
($T_{2,SE}$ Ga 600)

Front Panel



T2_meas_freq.vi
C:\F61\sw\T2_meas_freq.vi
Last modified on 26.11.2018 at 15:49
Printed on 20.02.2019 at 10:57 Measurment of $T_{2,SE}$, Ga 600

Front Panel



CP_meas_freq.vi
C:\F61\sw\CP_meas_freq.vi
Last modified on 16.10.2018 at 15:12
Printed on 20.02.2019 at 11:38

Measurment of $T_{2,cp}$ [illegible], Ga500

stop: STOP
semester: ws18
folder: 20.02.19
data file: T2_CP_500
scan freq [kHz]: 10

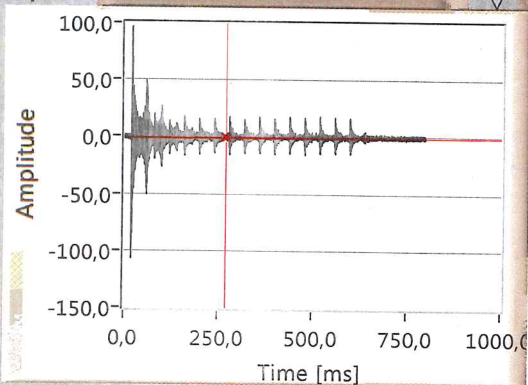
1) single measurement: GO
meas. time: 800
gain: 1000
time-out: 6
spin echo signal: 0
llim: 802,5
hlim: 1264,6

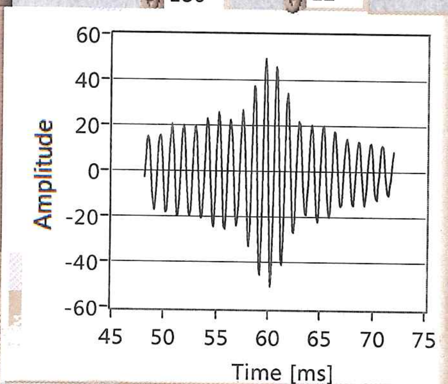
Cursors:	X	Y
Cursor	270,8	-0,8

Cursors:	X	Y
Cursor 1	1265	6,3

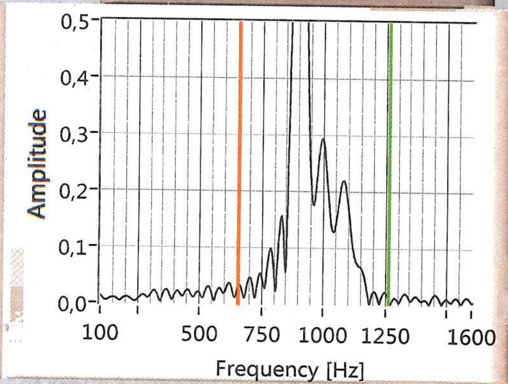
spin echo zoom: 180
del T (+-): 12

Amplitude





Fourier spectrum

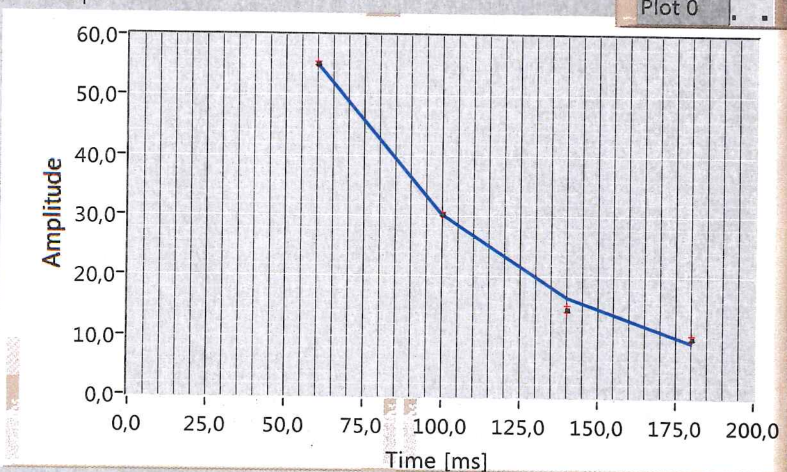


nr of SE: 4

SE time	mean	error
60	55,26	0,31
100	30,30	0,29
140	14,60	0,56
180	9,86	0,38
0	0,00	0,00
0	0,00	0,00
0	0,00	0,00
0	0,00	0,00
0	0,00	0,00
0	0,00	0,00

XY Graph

Plot 0



2) many measurements: GO
number meas: 10
meas done: 10

3) fit: FIT
init values T2_i[ms]: 50,0
A_i: 20,0
fit T2[ms]: 66,1
error T2: 0,9
fit A: 136,9
error A: 2,2

CP_meas_freq.vi
C:\F61\sw\CP_meas_freq.vi
Last modified on 16.10.2018 at 15:12
Printed on 20.02.2019 at 11:21

Retaken because of low workingfrequency
Measurment of $T_{2,cp}$, G= 600

stop: STOP | semester: ws18 | folder: 20.02.19 | data file: T2_CP_600 | scan freq [kHz]: 10

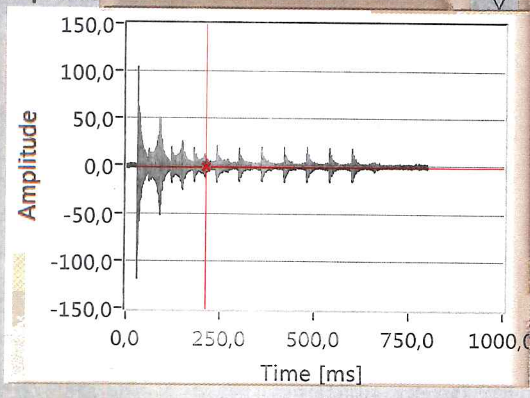
1) single measurement: GO | meas. time: 800 | gain: 1000 | time-out: 6 | spin echo signal: 0 | llim 568,4 | hlim 1030,4

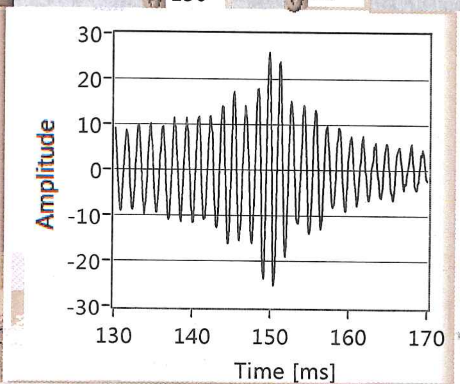
Cursors:	X	Y
Cursor	212,5	-0,5

spin echo zoom: 150 | del T (+-): 20

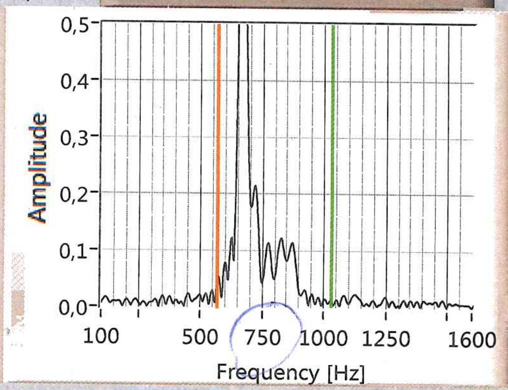
Cursors:	X	Y
Cursor 1	1030	6,3

Amplitude





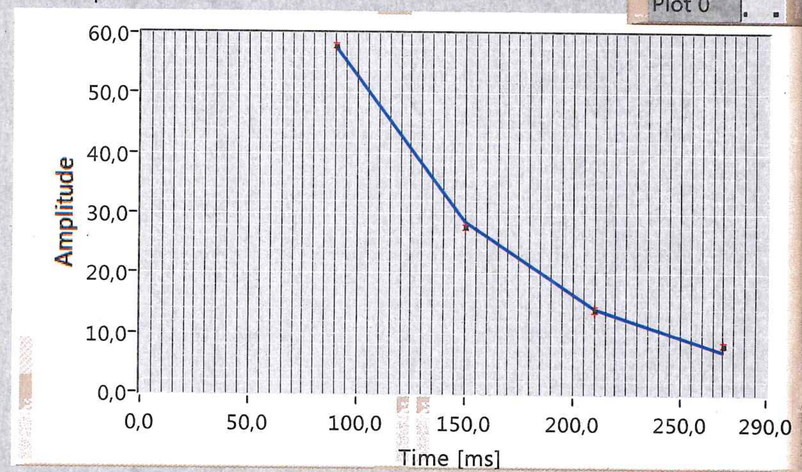
Fourier spectrum



nr of SE: 4

SE time	mean	error
90	57,95	0,40
150	27,76	0,44
210	14,01	0,53
270	8,14	0,42
0	0,00	0,00
0	0,00	0,00
0	0,00	0,00
0	0,00	0,00
0	0,00	0,00
0	0,00	0,00

XY Graph | Plot 0



2) many measurements: GO | number meas: 10 | meas done: 10

3) fit: FIT | init values T2_i[ms]: 50,0 | A_i: 20,0 | fit T2[ms]: 85,4 | error T2: 1,4 | fit A: 165,6 | error A: 3,4

CP_meas_freq.vi
C:\F61\sw\CP_meas_freq.vi
Last modified on 16.10.2018 at 15:12
Printed on 20.02.2019 at 11:26

Measurement of $T_{2,cp}$, Ga 600

stop: STOP | semester: ws18 | folder: 20.02.19 | data file: T2_CP_600 | scan freq [kHz]: 10

1) single measurement: GO | meas. time: 800 | gain: 1000 | time-out: 6 | spin echo signal: 0

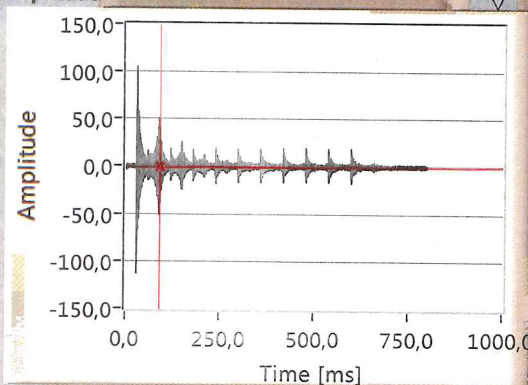
llim: 884,8 | hlim: 1308,9

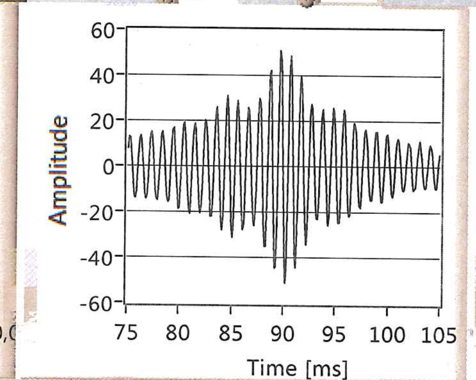
Cursors:	X	Y
Cursor	91,7	-0,5

spin echo zoom: 90 | del T (+-): 15

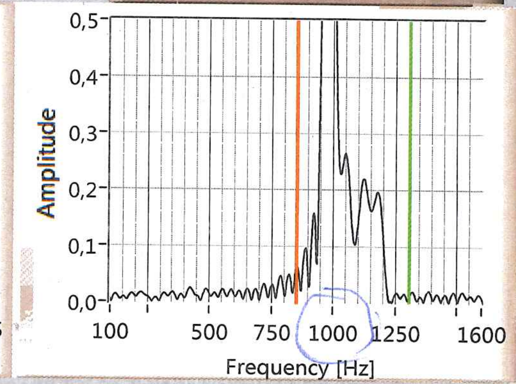
Cursors:	X	Y
Cursor 1	1309	6,3

Amplitude





Fourier spectrum

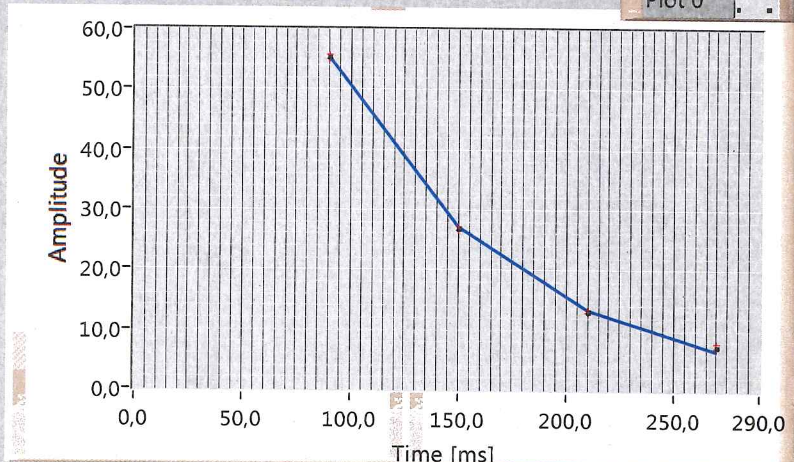


nr of SE: 4

SE time (0)	mean (0)	error (0)
90	55,41	0,32
150	26,93	0,29
210	13,15	0,21
270	7,39	0,38
0	0,00	0,00
0	0,00	0,00
0	0,00	0,00
0	0,00	0,00
0	0,00	0,00
0	0,00	0,00

XY Graph

Plot 0



2) many measurements: GO | number meas: 10 | meas done: 10

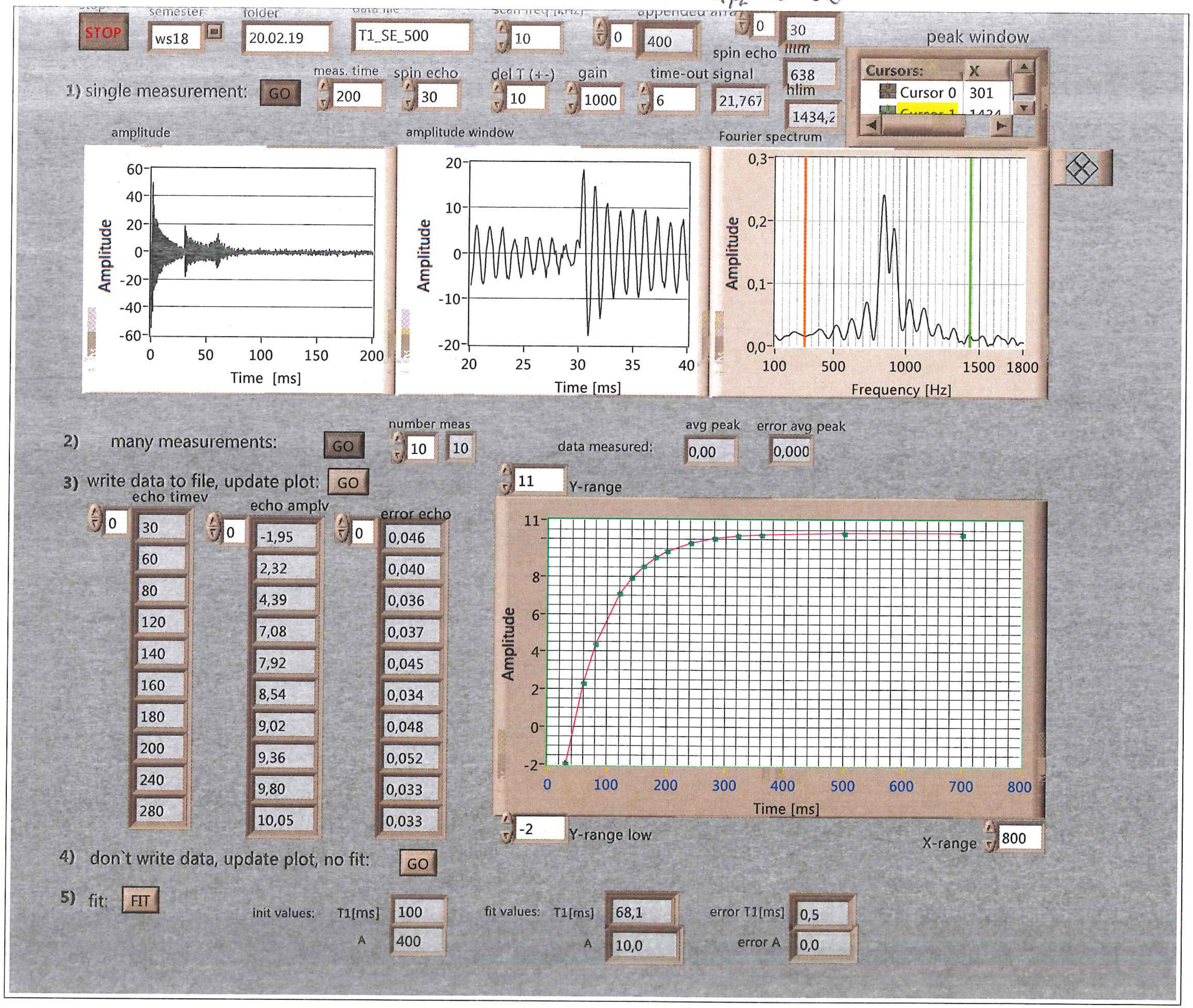
3) fit: FIT | init values T2_i[ms]: 50,0 | A_i: 20,0

fit T2[ms]: 84,0 | error T2: 0,8
fit A: 161,5 | error A: 2,3

working frequency → 1000 Hz

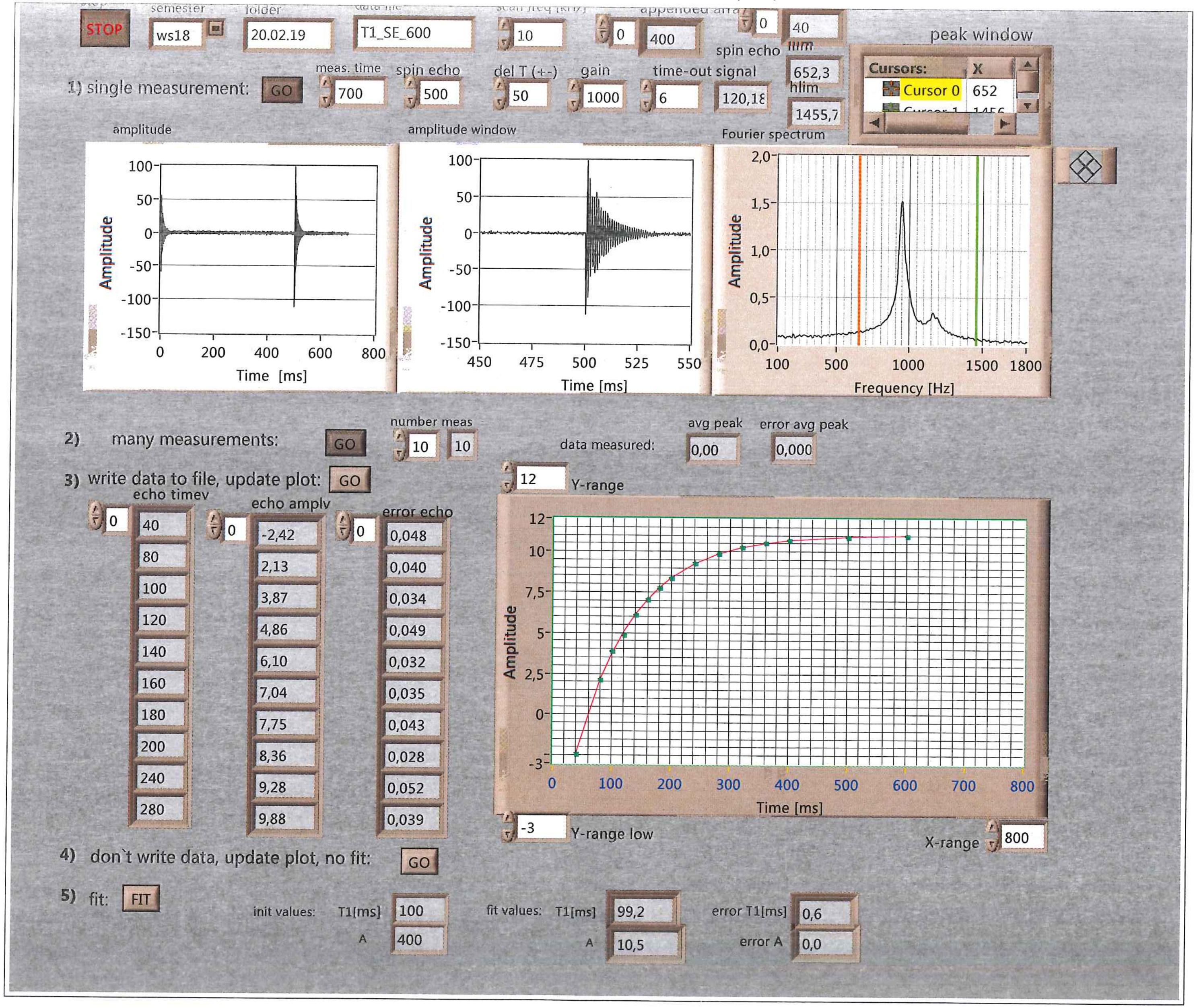
T1_meas_freq.vi
C:\F61\sw\T1_meas_freq.vi
Last modified on 26.11.2018 at 16:30
Printed on 20.02.2019 at 12:10

Measurement of $T_{1,SE}$ Ga 500



We changed the amplitude from positive to negative for $\tau = 30$ ms

T1_meas_freq.vi
C:\F61\sw\T1_meas_freq.vi
Last modified on 26.11.2018 at 16:30
Printed on 20.02.2019 at 12:43 *Measurement of $T_{1,SE}$, Ga 600*



Changed sign for $\tau =$ ~~20~~ 40 ms

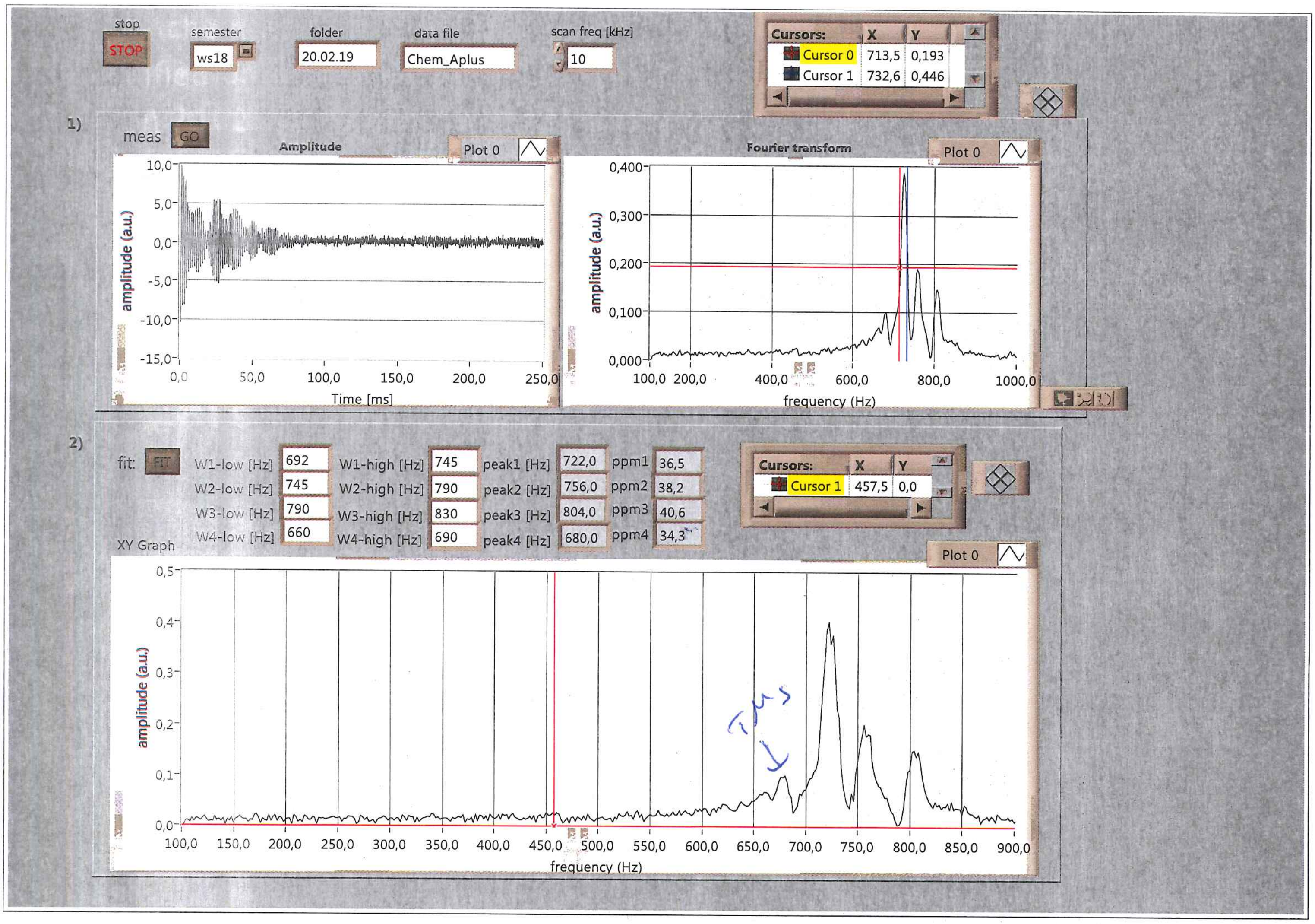
chem_shift.vi

C:\F61\sw\chem_shift.vi

Last modified on 10.01.2019 at 14:36

Printed on 20.02.2019 at 15:36

A+ . 2



2: ~~1.8~~ 2.2

3: 3.9

4: 6.3

$FCH_2 - CO - CH_3$

Dipole interaction with F-Atom:

$\Delta E = 48\ Hz \cdot h = 1.99 \cdot 10^{-13}\ eV$

↑

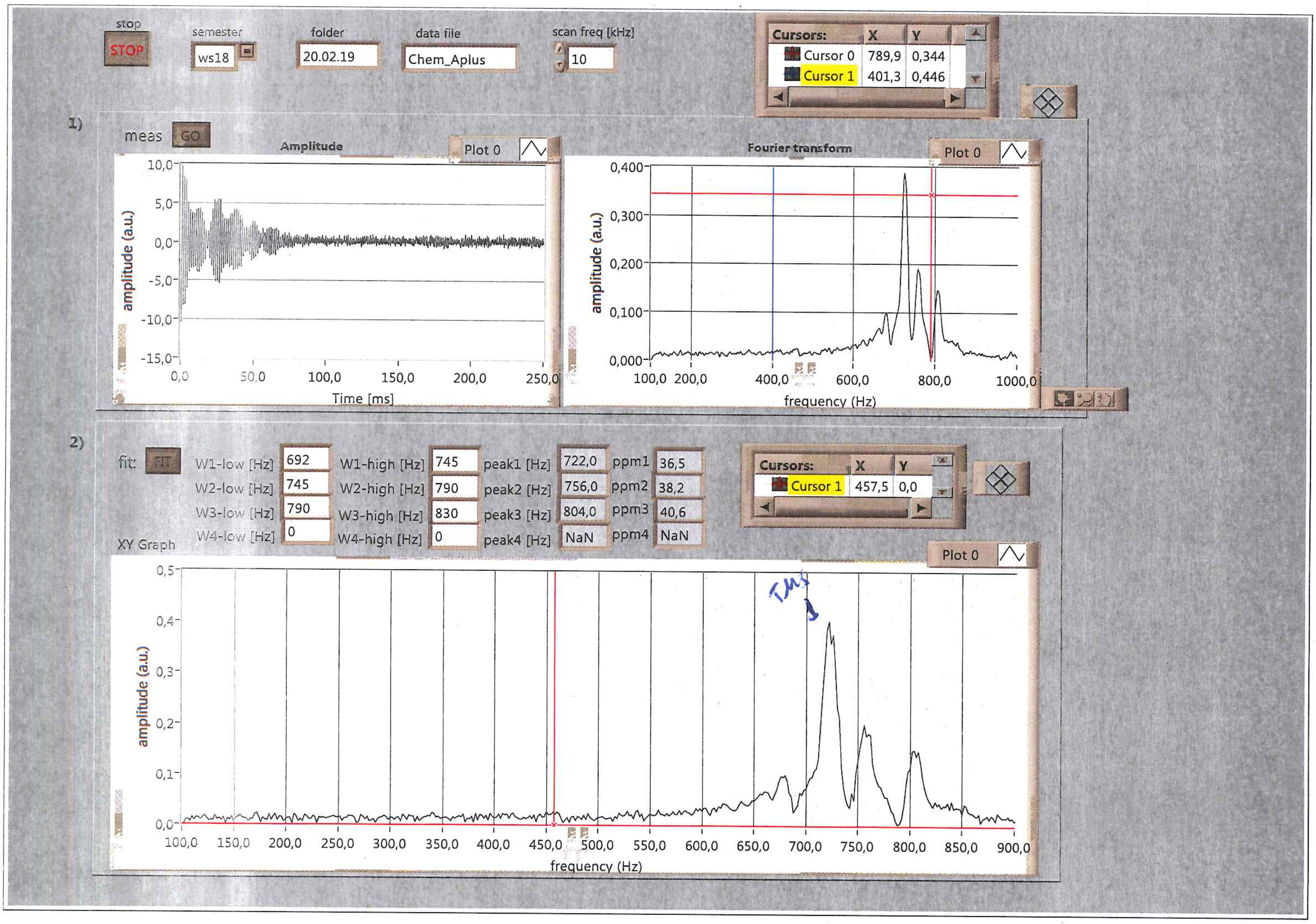
peak 4 - peak 3

Energy resolution:

we read the WDFH of a peak → $\Delta E \approx 8 \cdot 10^{-14}\ eV$

chem_shift.vi
C:\F61\sw\chem_shift.vi
Last modified on 10.01.2019 at 14:36
Printed on 20.02.2019 at 14:18

A+ Retaken
→ One Peak not fitted see A+.2

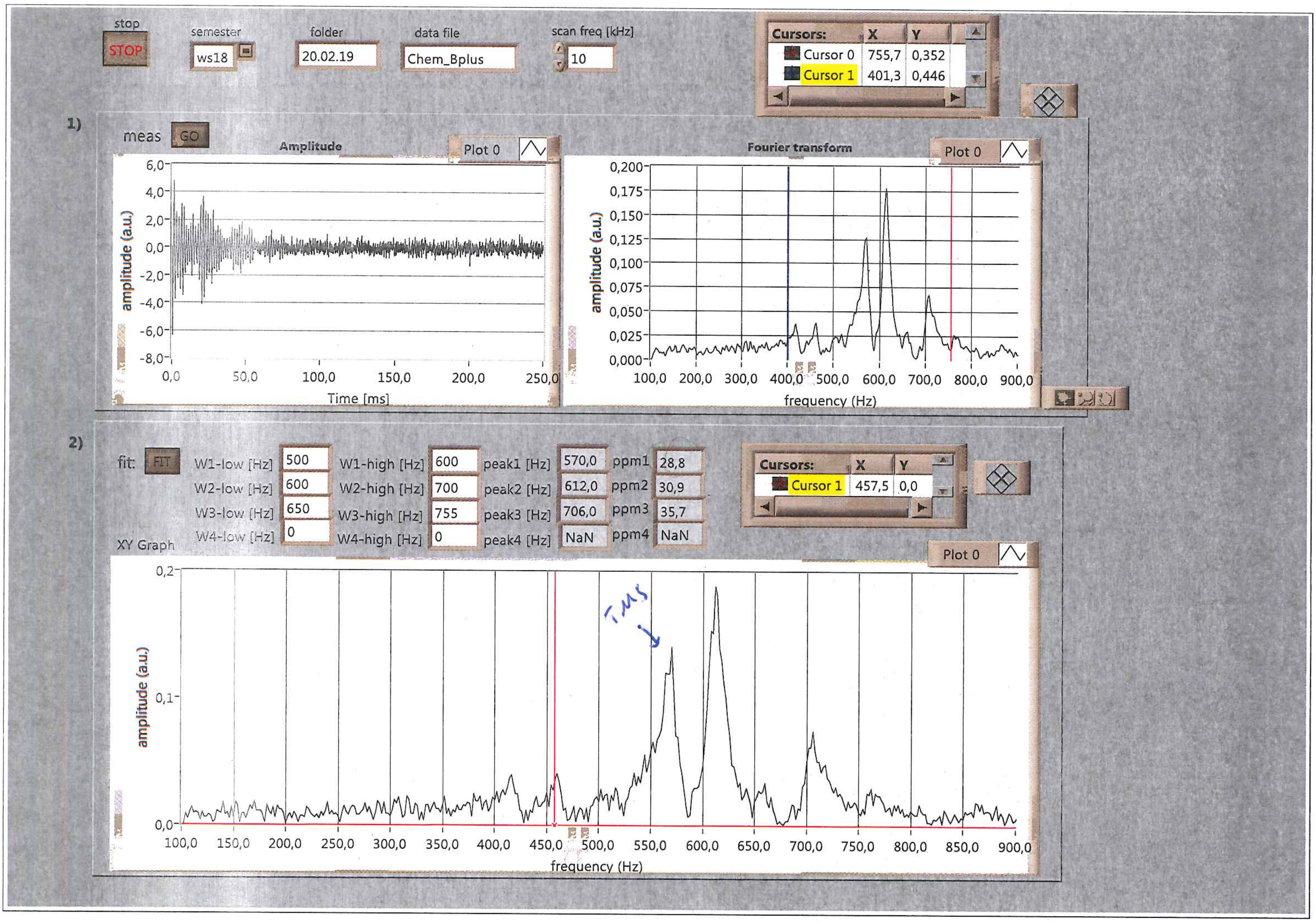


2 : ~~1.7~~ 1.7
3 : 4.1

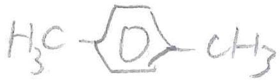
$FCH_2-CO-CH_3$

chem_shift.vi
C:\F61\sw\chem_shift.vi
Last modified on 10.01.2019 at 14:36
Printed on 20.02.2019 at 14:04

B+

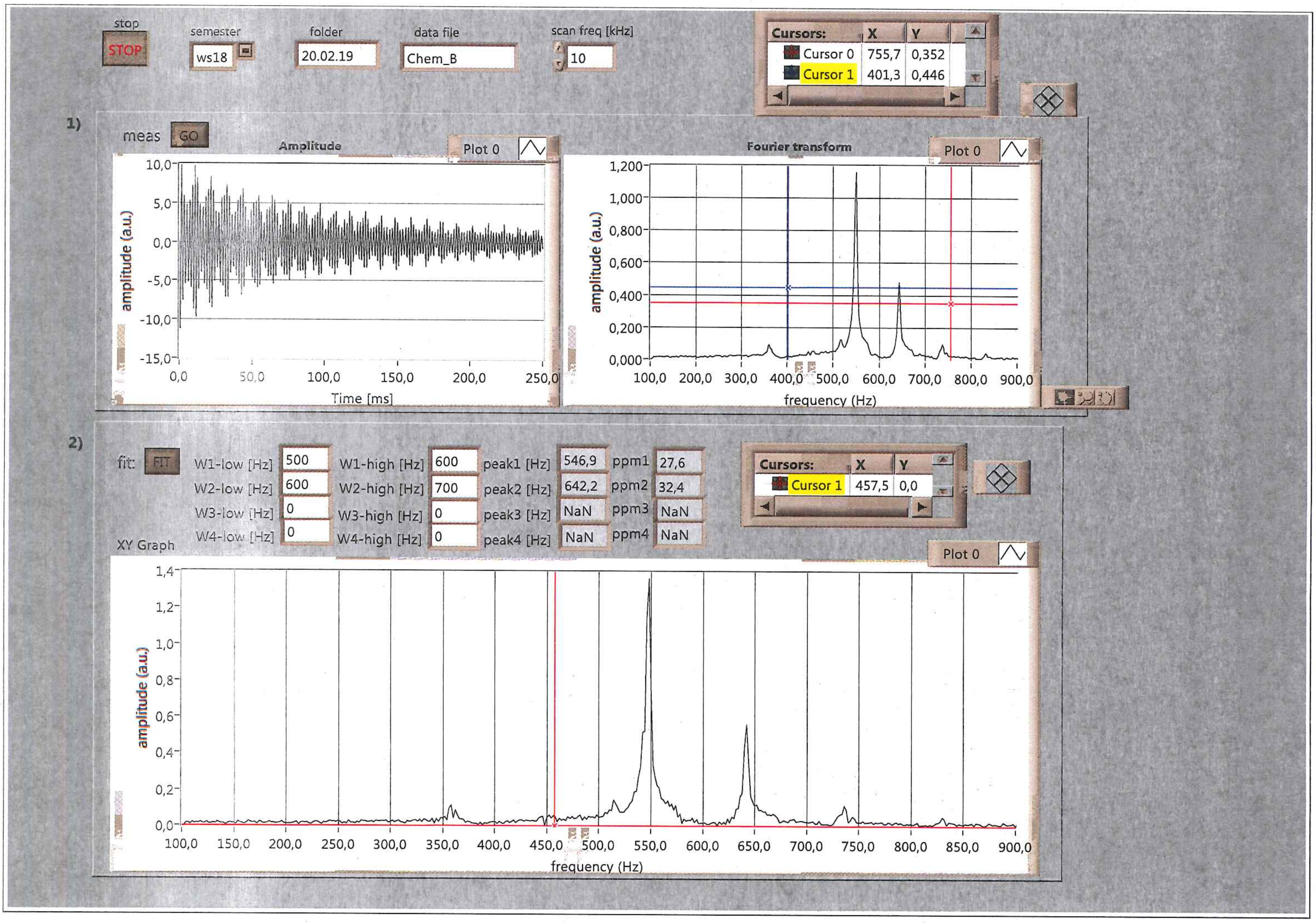


2: 2.1
3: 6.9



chem_shift.vi
C:\F61\sw\chem_shift.vi
Last modified on 10.01.2019 at 14:36
Printed on 20.02.2019 at 14:01

B



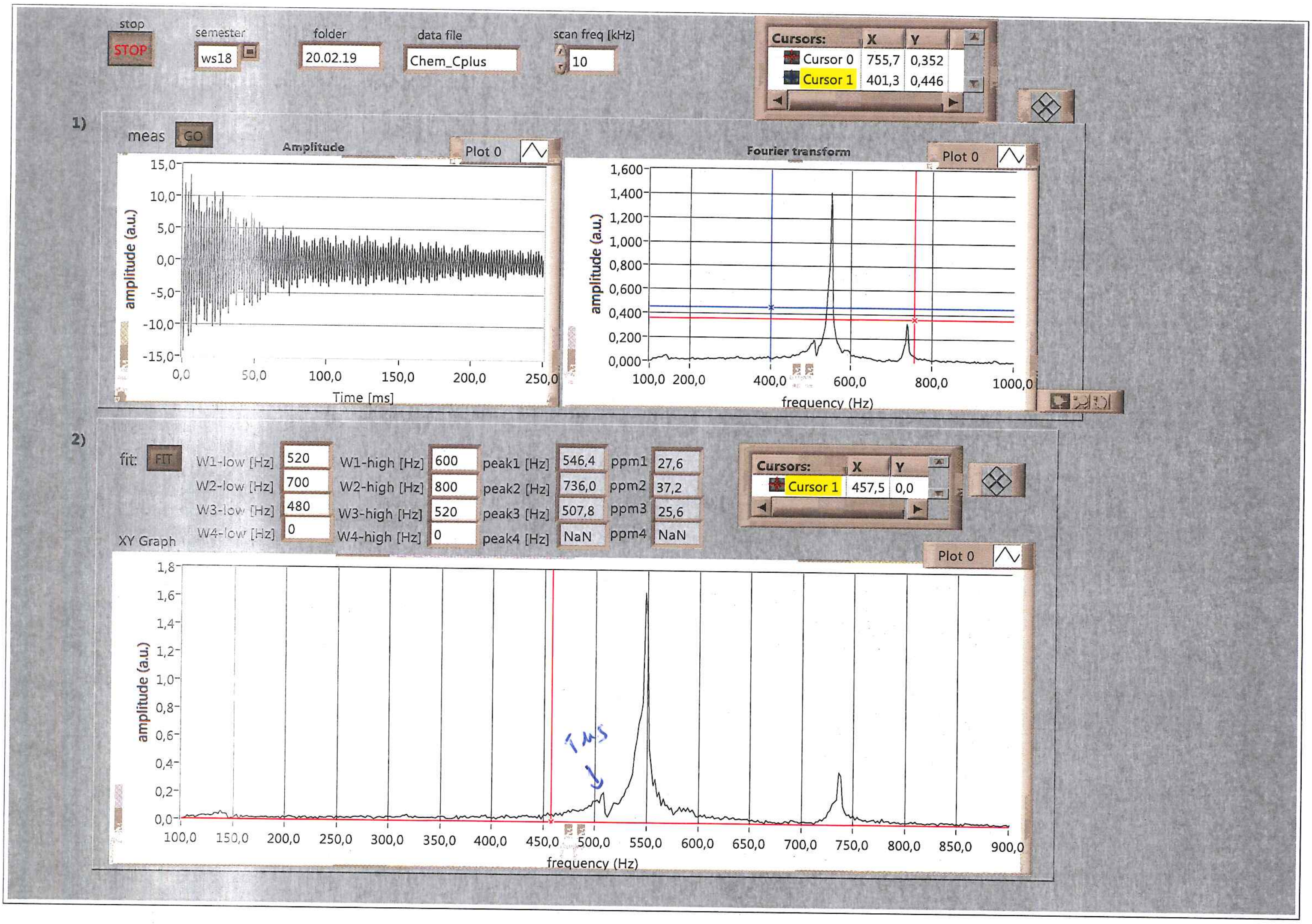
chem_shift.vi

C:\F61\sw\chem_shift.vi

Last modified on 10.01.2019 at 14:36

Printed on 20.02.2019 at 14:11

C+



2: 2.0

3: 11,6

CH_3COOH

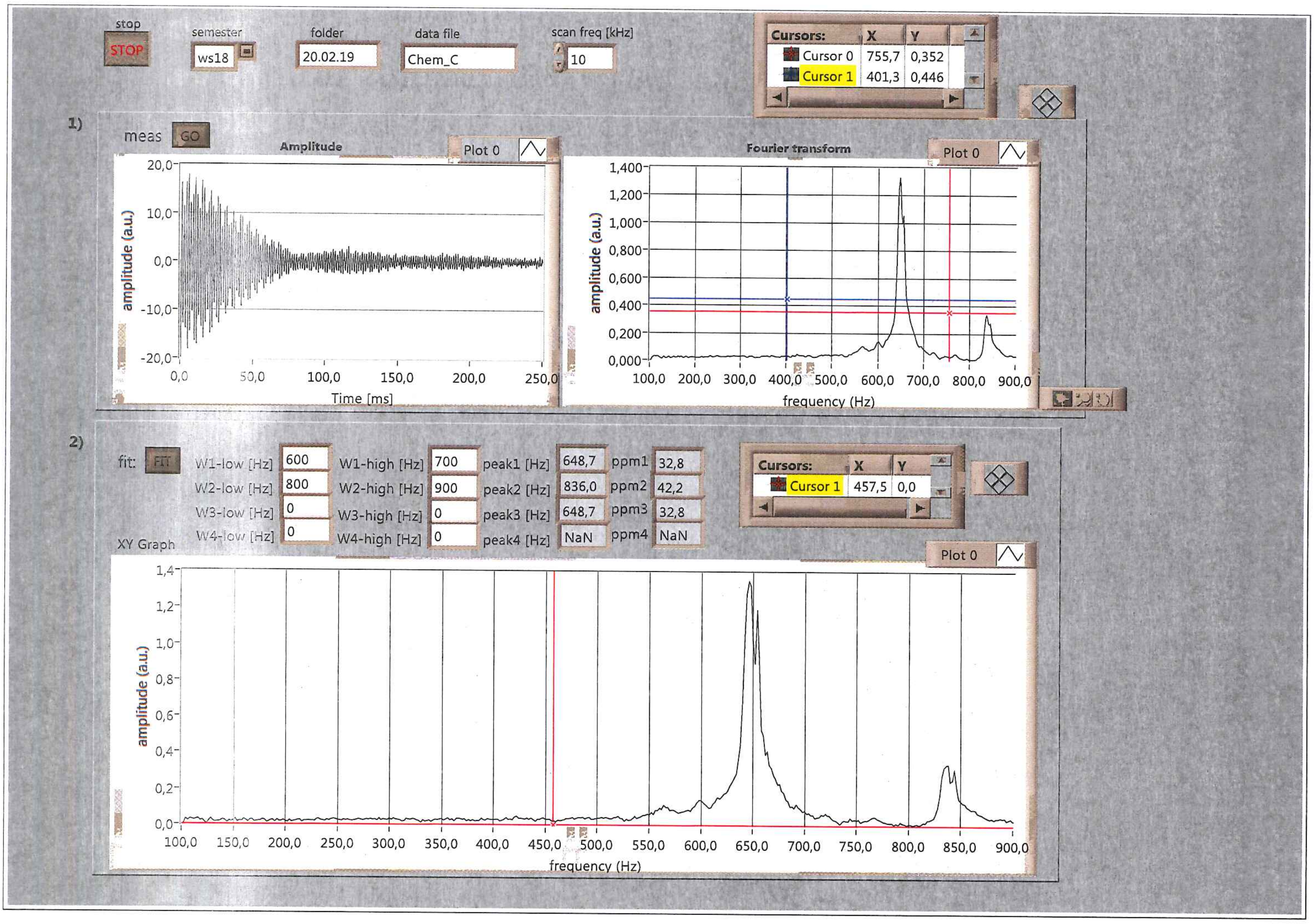
Page 1

chem_shift.vi

C:\F61\sw\chem_shift.vi

Last modified on 10.01.2019 at 14:36

Printed on 20.02.2019 at 14:05



chem_shift.vi
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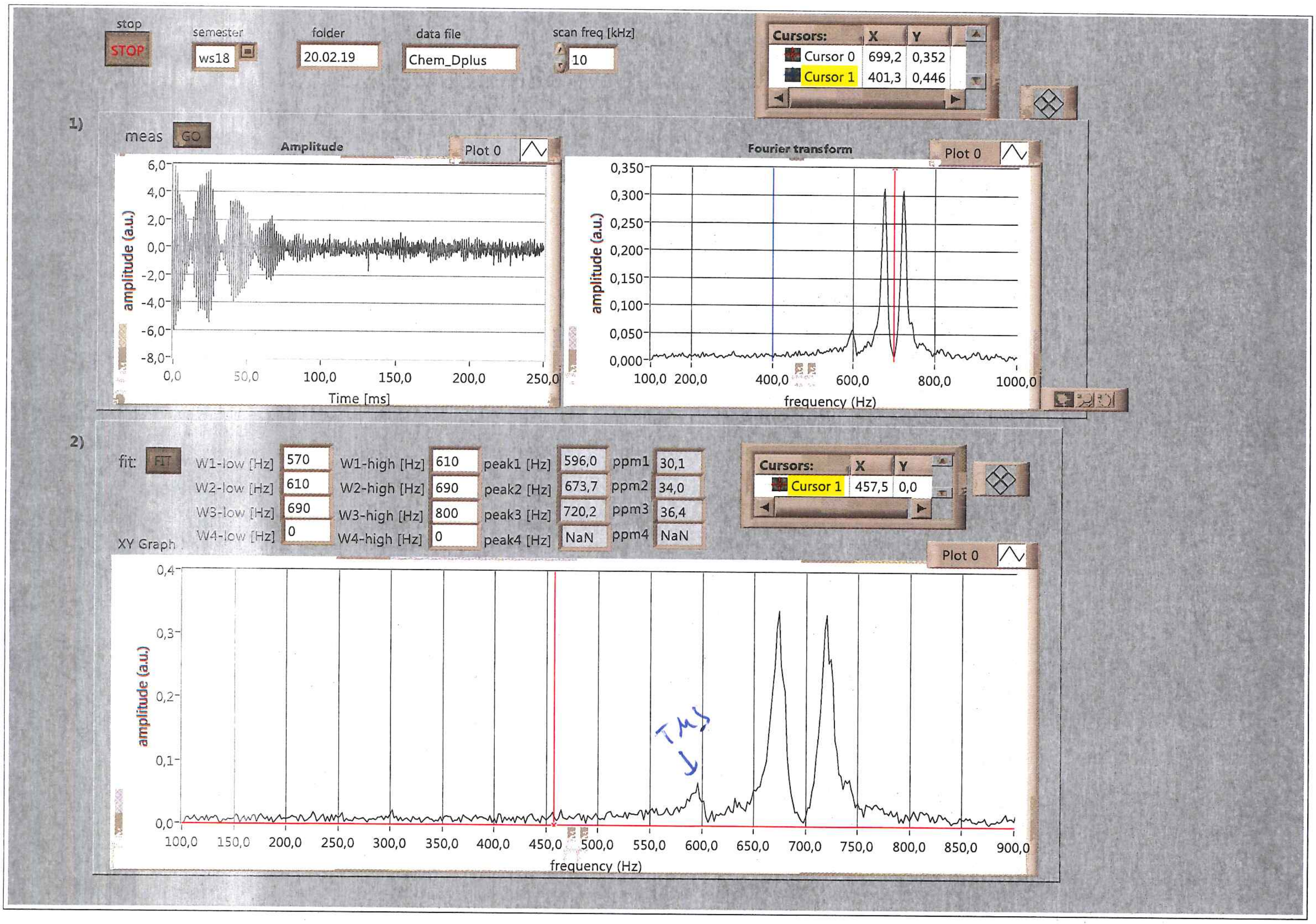
Last modified on 10.01.2019 at 14:36
Printed on 20.02.2019 at 14:13

D+



2: 3.9

3: 6.3

FCH_2-CN

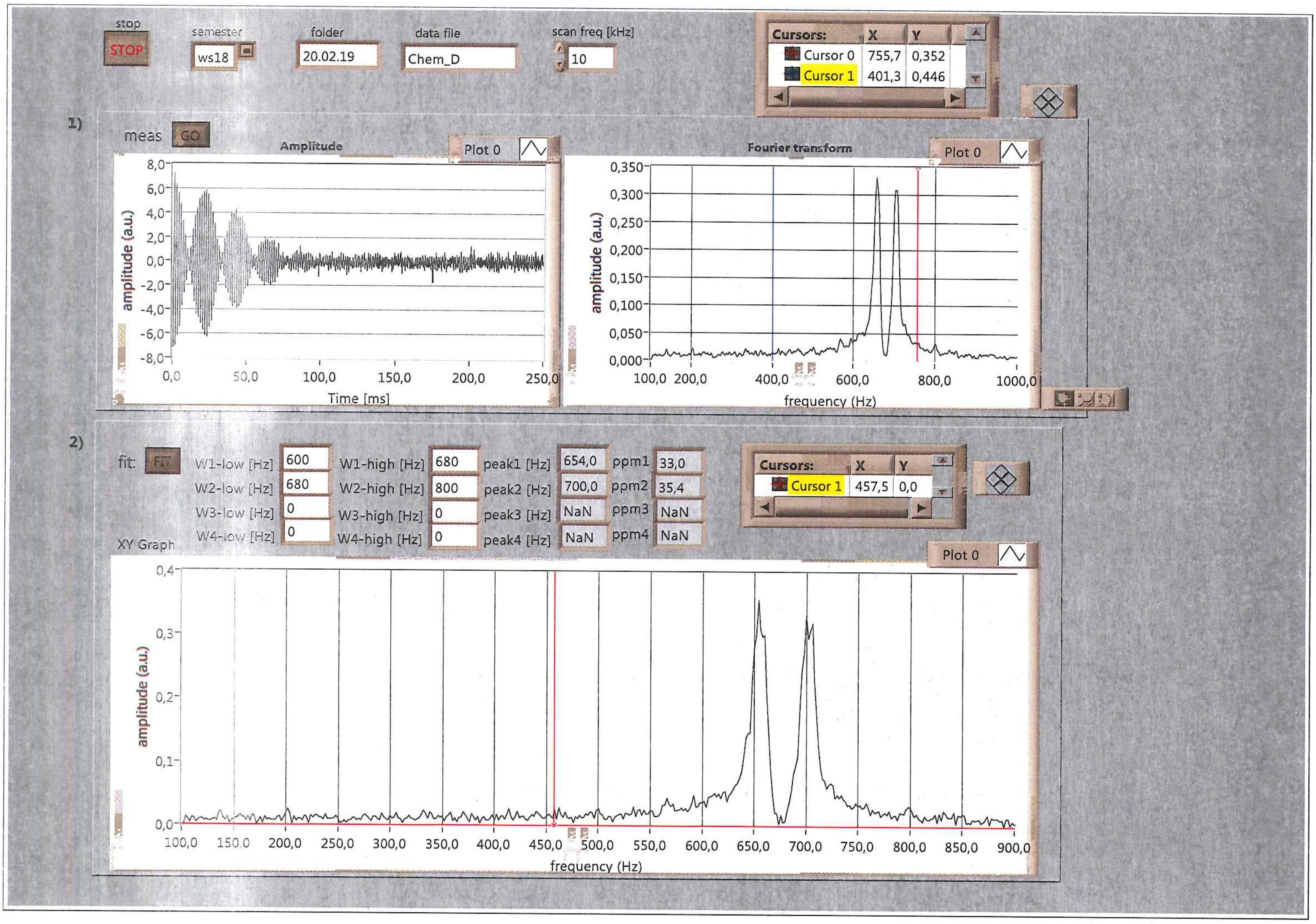
chem_shift.vi

C:\F61\sw\chem_shift.vi

Last modified on 10.01.2019 at 14:36

Printed on 20.02.2019 at 14:12

D



chem_shift.vi

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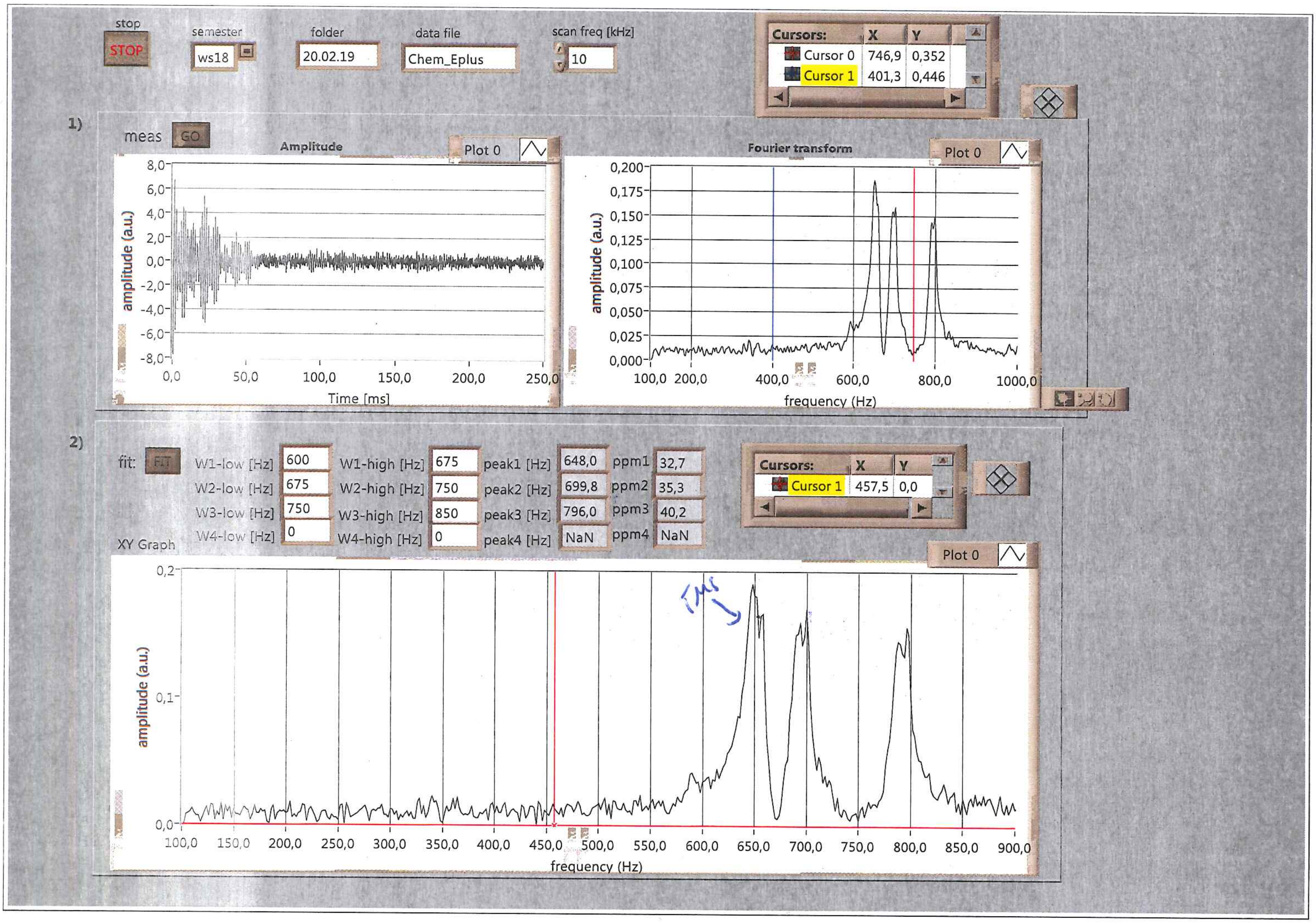
Last modified on 10.01.2019 at 14:36

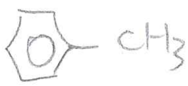
Printed on 20.02.2019 at 14:17

E+



2: 2.6

3: 7.5



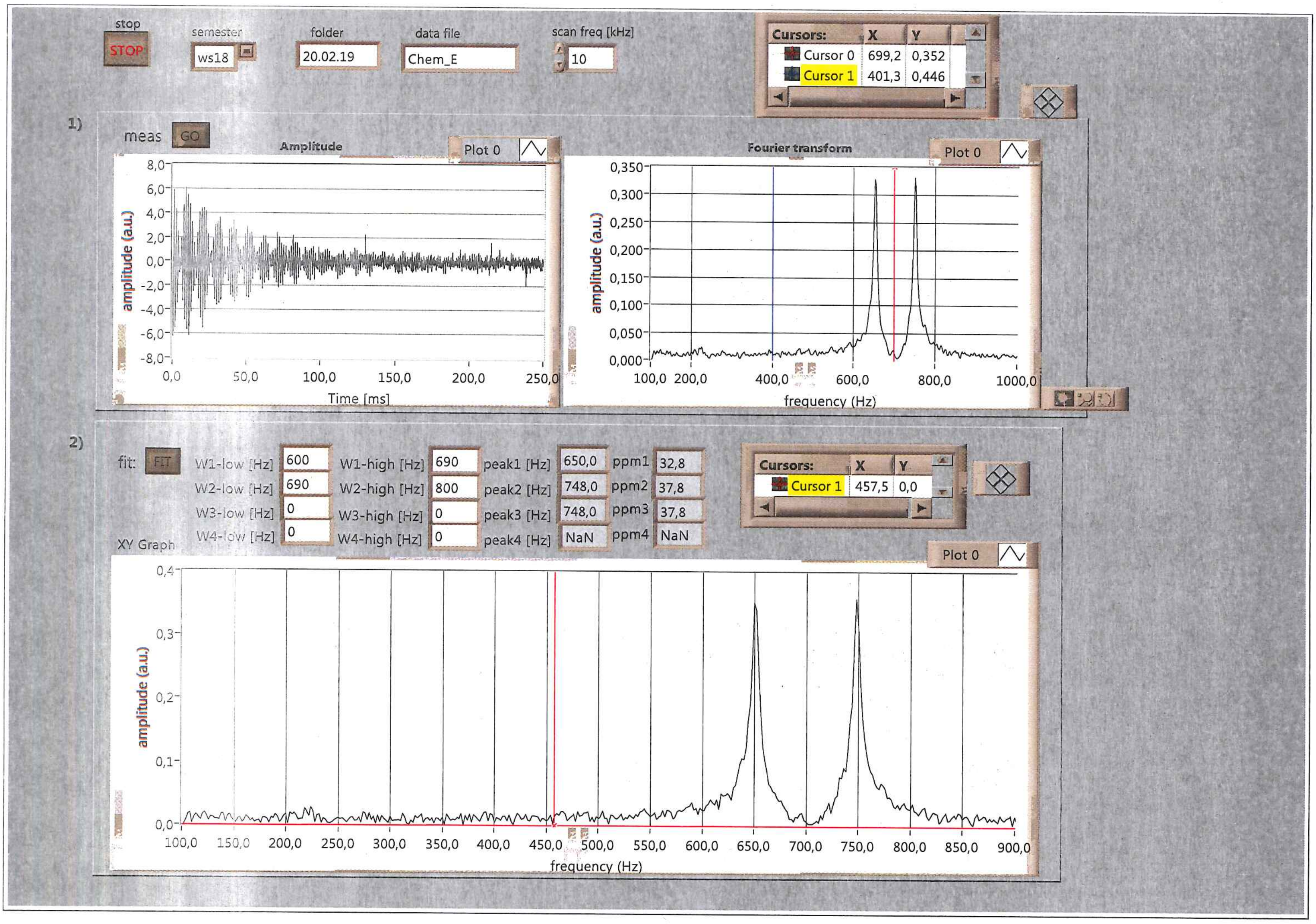
chem_shift.vi

C:\F61\sw\chem_shift.vi

Last modified on 10.01.2019 at 14:36

Printed on 20.02.2019 at 14:14

E



many_profiles.vi
C:\F62\sw\day3\many_profiles.vi
Last modified on 19.02.2019 at 10:50
Printed on 20.02.2019 at 16:15

Filtered
Filtered
Filtered
Filtered
Filtered
Filtered

# of files 2

semester ws18

folder 20.02.19

common prename testProfil

common postname .txt

file names

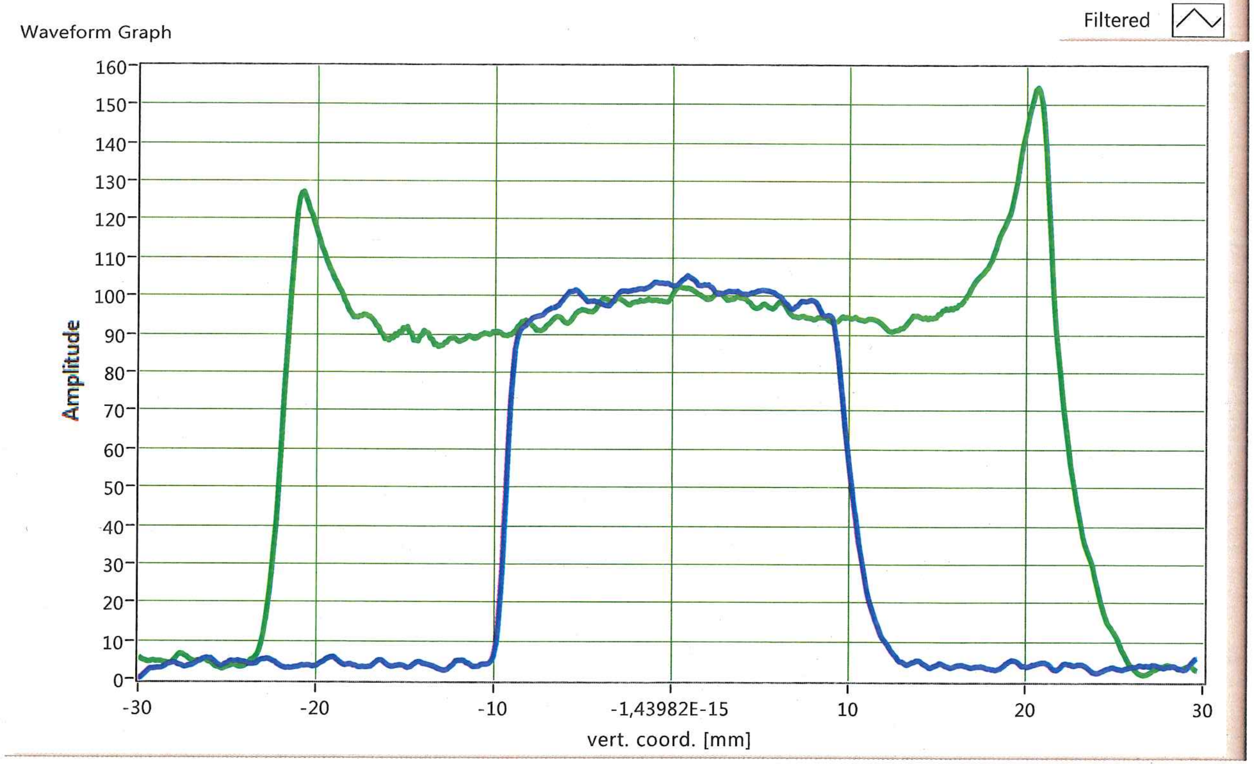
0

1
18

min xval -30,0

max xval 29,8

scaling x axis 0,116958



many_profiles.vi
C:\F62\sw\day3\many_profiles.vi
Last modified on 19.02.2019 at 10:50
Printed on 20.02.2019 at 16:20

# of files	semester	folder	common prename	common postname
3	ws18	20.02.19	testProfil	.txt

file names

0

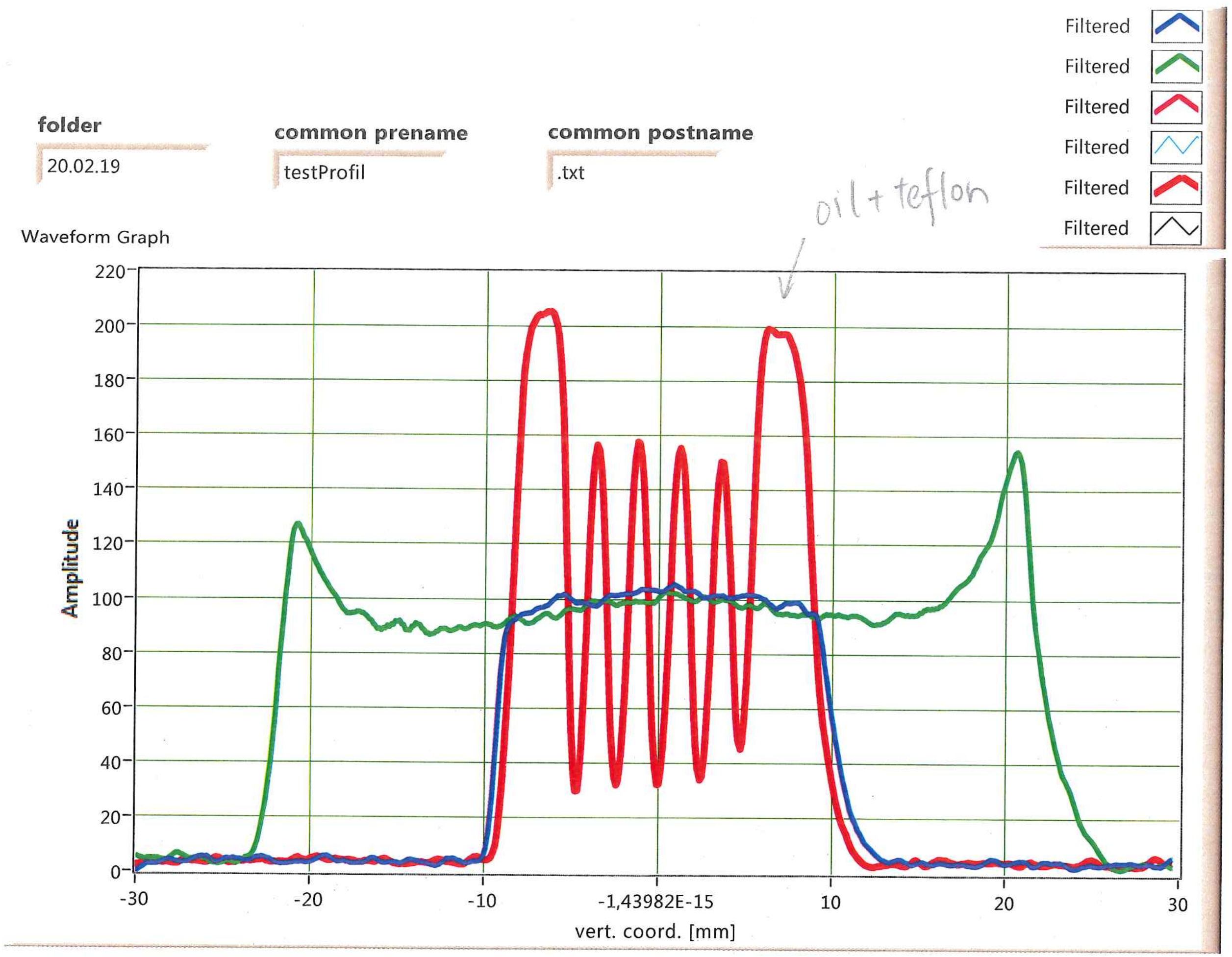
1
18
21

min xval -30,0

max xval 29,8

scaling x axis 0,116958

Waveform Graph



many_profiles.vi
C:\F62\sw\day3\many_profiles.vi
Last modified on 19.02.2019 at 10:50
Printed on 20.02.2019 at 16:57

Filtered
Filtered
Filtered
Filtered
Filtered
Filtered

# of files 6

semester ws18

folder 20.02.19

common prename testProfil

common postname .txt

file names

0

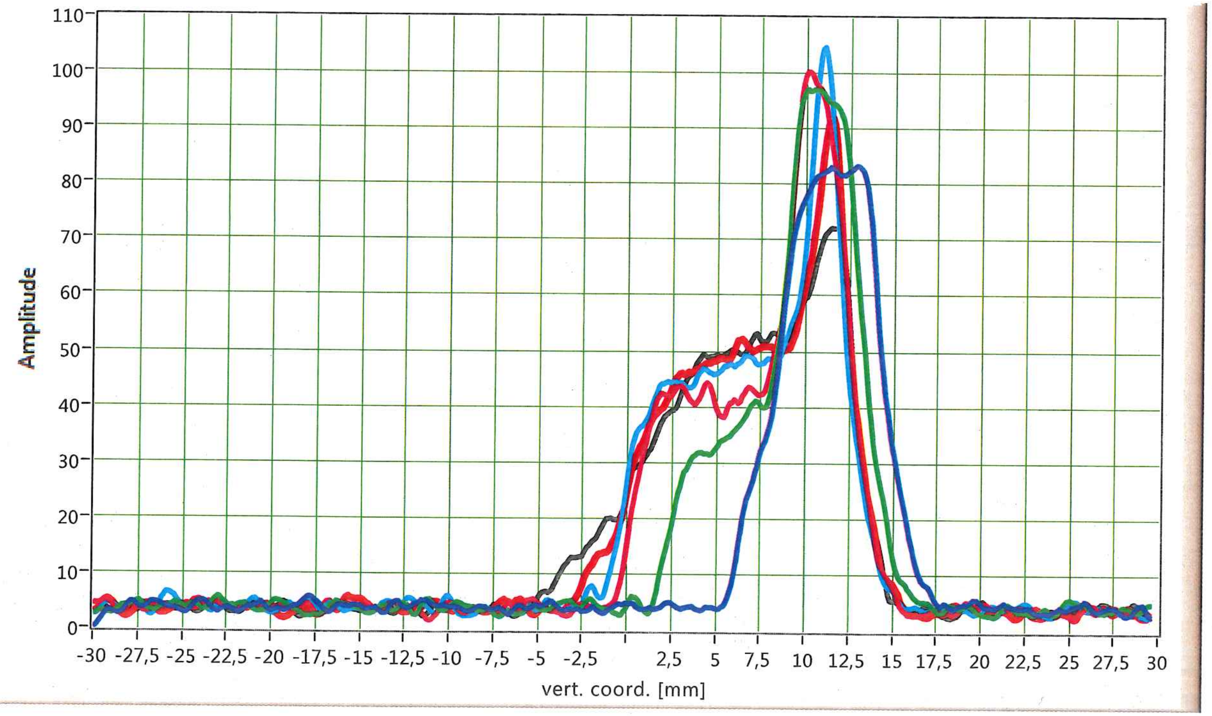
23
43
63
83
103
123

min xval -30,0

max xval 29,8

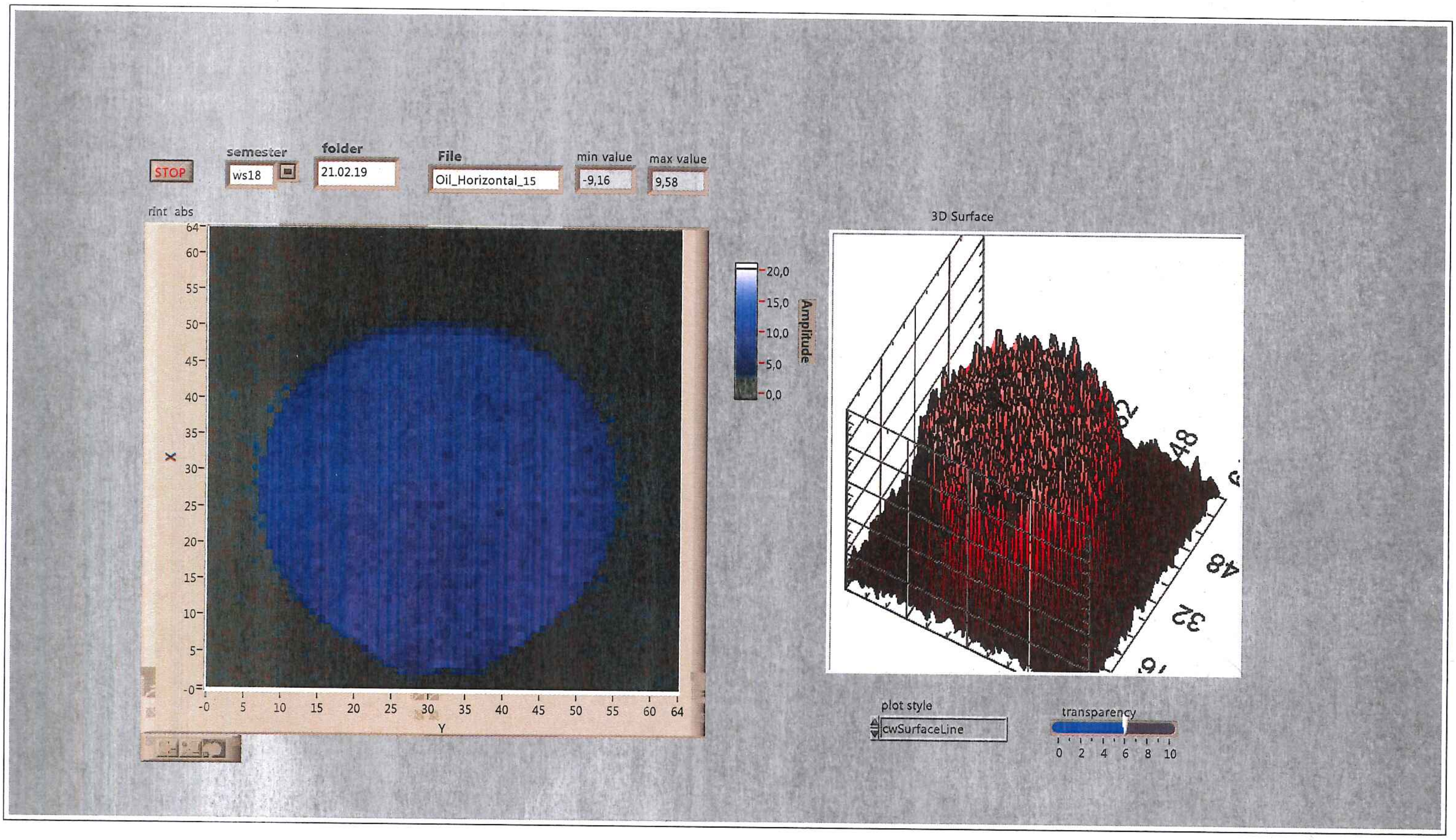
scaling x axis 0,116958

Waveform Graph



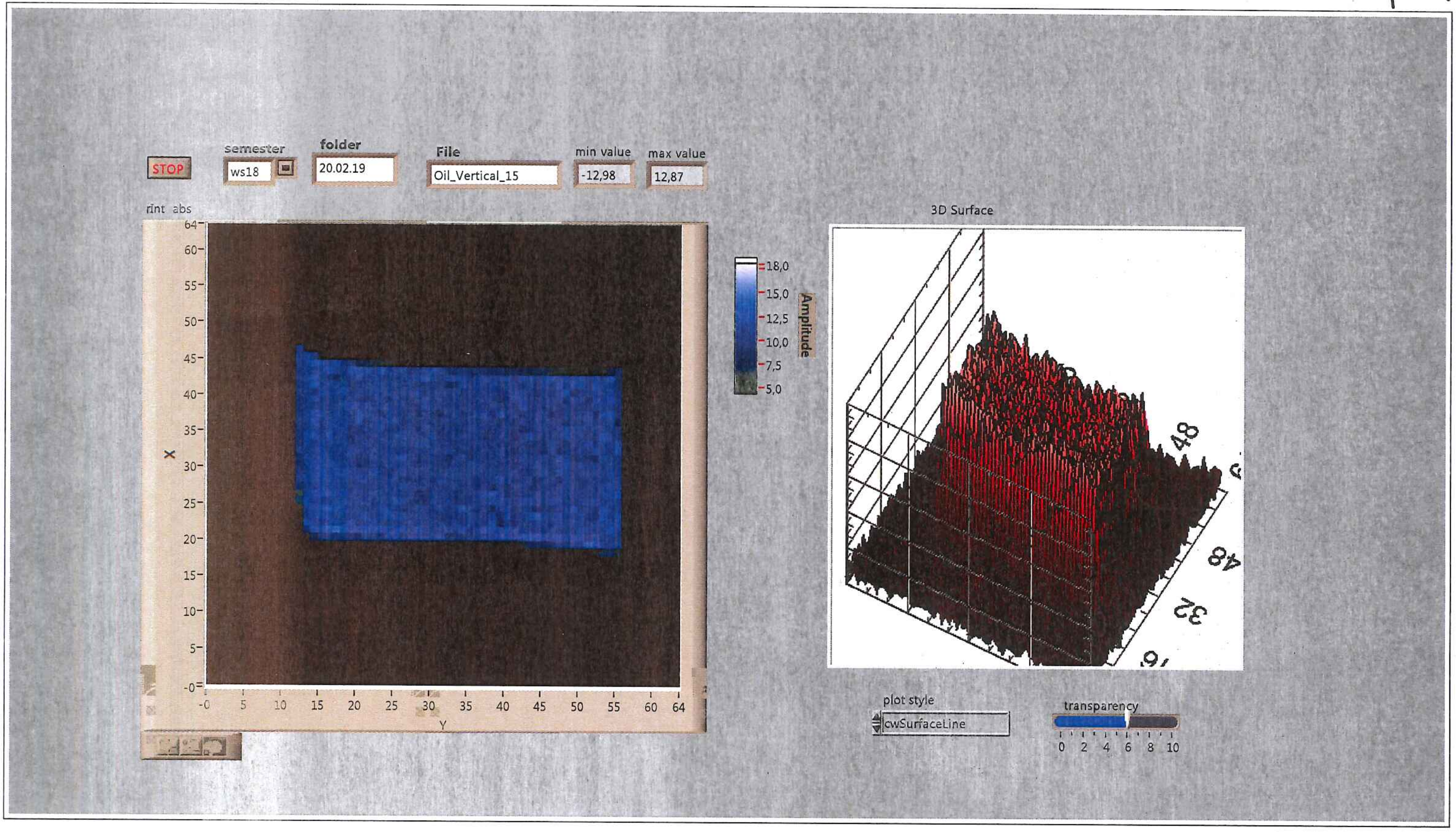
nmr_2d.vi
C:\F62\sw\day3\nmr_2d.vi
Last modified on 25.01.2019 at 13:47
Printed on 21.02.2019 at 09:37

Pic. 3.1 15mm oil horizontal



nmr_2d.vi
C:\F62\sw\day3\nmr_2d.vi
Last modified on 25.01.2019 at 13:47
Printed on 21.02.2019 at 09:43

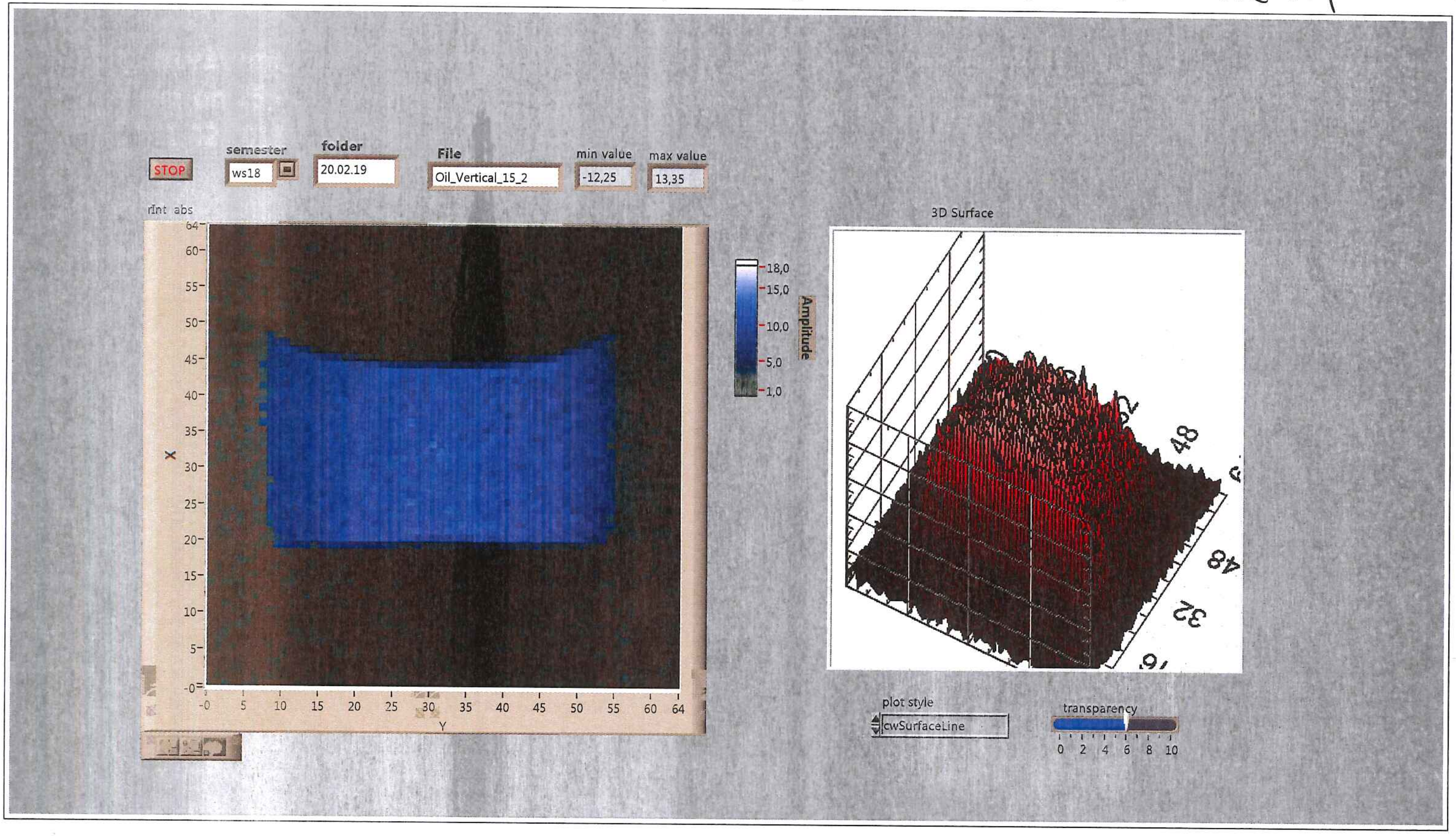
Pic 3.2 15 mm oil vertical back to front



capillar effect + distortion on the right side

nmr_2d.vi
C:\F62\sw\day3\nmr_2d.vi
Last modified on 25.01.2019 at 13:47
Printed on 21.02.2019 at 09:52

Pic 3.3 15 mm oil vertical left to right



nmr_2d.vi
C:\F62\sw\day3\nmr_2d.vi
Last modified on 25.01.2019 at 13:47
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Pic 3.4 Celery (field of view 22, 5 Avgs)