Extracting Physiological Data for STARRRS fMRI Scans

12/7/2024

Ken Fishbein

Background

- Throughout brain MRI scanning, physiological data are acquired using SA Instruments and CWE hardware and recorded by PC-SAM and LabChart software.
- SA Instruments hardware monitors respiratory effort (pad sensor pressure), pulse oximeter signal (PulseOx) and rectal temperature (fiber optic sensor “FOT1”) and regulates warming air temperature with feedback from FOT1.
- PC-SAM software displays these signals, calculates respiration rate, pulse rate and SpO2 from the respiratory effort and pulse oximeter signals and generates trigger pulses to synchronize MRI acquisition with respiration, reducing blurring artifacts in the images.
- PC-SAM logs “slow” data (rates, SpO2 and temperature) but does not store signals. PC-SAM log data is not available until after scanning.
- To circumvent these limitations, we added SA Instruments “breakout boxes”, which convert the PC-SAM signals and slow data to analog voltages, which are digitized by a AD Instruments PowerLab 16/35 data acquisition system and recorded and displayed in real time by ADI LabChart software.
- In addition to these data, PowerLab digitizes and LabChart records and displays :
  - Logic pulses output by the scanner marking the beginning of each fMRI dynamic (or other event programmed in the MRI code)
  - Logic pulses corresponding to the radio-frequency (RF) pulses transmitted to excite the nuclear spins in the sample (rat brain). For 2D fMRI, for each dynamic, one pulse is generated just prior to scanning each slice.
  - Analog signals from a CWE GEMINI O2/CO2 analyzer, which monitors the gas exhaled by the anesthetized rat. The CO2 concentration (recorded in percent by volume) can be used to calculate end-tidal CO2 (EtCO2).
  - Analog signal from a potentiometer (variable resistor) attached to the dose adjustment knob of the isoflurane vaporizer supplying anesthesia gas to the rat in the magnet. This signal is calibrated to the isoflurane dose setting using a point-by-point interpolation in LabChart.
- All of these data are recorded and displayed ***synchronously*** by LabChart, so that physiological data can be matched to each MRI scan by identifying the block of logic pulses corresponding to that scan and selecting the physiological data acquired during that block.

Post-processing in LabChart

- During scanning, LabChart records both the signal waveforms and “slow” data output from PC-SAM but does not process these data.
- Sometimes, if the quality of the respiratory effort or pulse oximeter signal is poor, PC-SAM will output erroneous data for respiratory rate or pulse rate, respectively.
- Most often, this occurs when the respiratory effort signal is too small, e.g. due to improper placement of the pad pressure sensor.
- LabChart may be able to recover the missing respiration or pulse rate data by analyzing the digitized signal after scanning.
- This is possible because LabChart allows the user to adjust many parameters of its “Cyclic Measurements” function to achieve the best fit. PC-SAM has no such user-adjustable fit parameters.
- The user may also insert comments in the LabChart record, either during or after scanning. For example, after identifying the beginning and ending of a particular fMRI scan, the user can add comments marking these times.

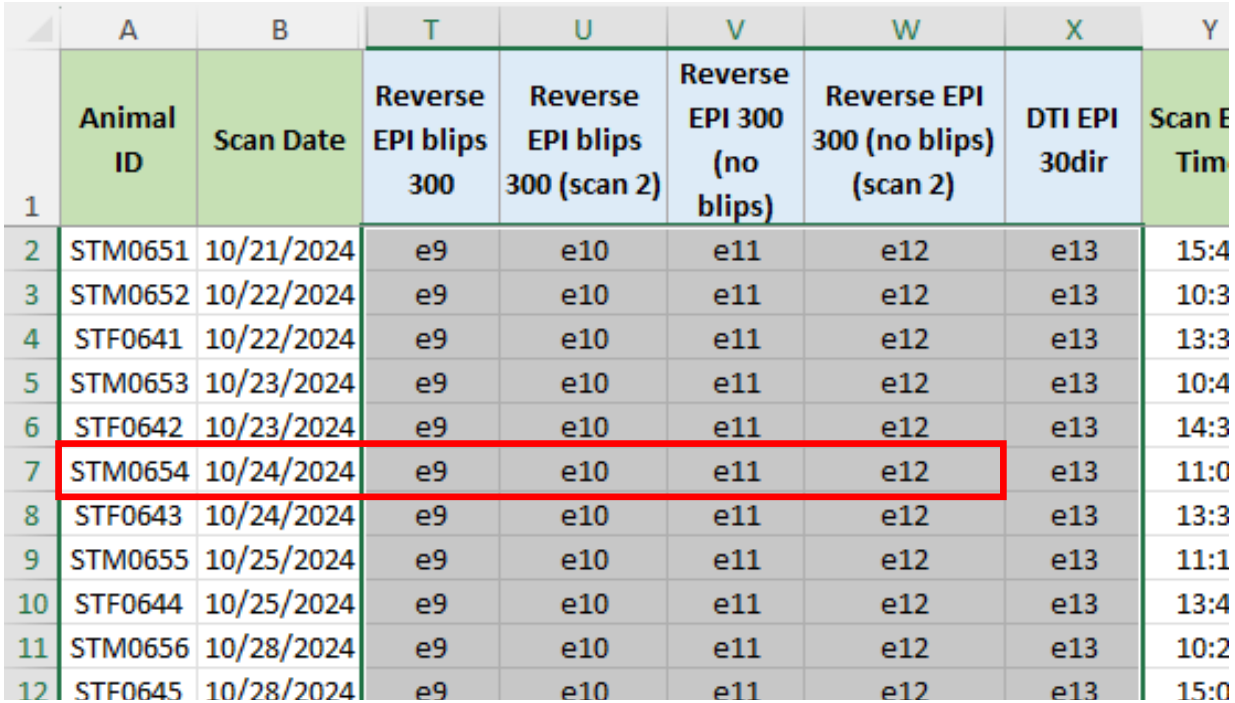
Challenges to Matching Physiological to MRI Data

- Unless the operator inserted comments into LabChart each time a scan started or ended, locating the time interval to extract must be achieved indirectly.
- Even though we know the MRI scan numbers for the data to be extracted, we can't assume that the scans were acquired in numerical order, e.g. E9, E10, E11,…
  - Although ParaVision starts each study with a template of empty, consecutively-numbered scans, the operator can skip, duplicate, or delete these scans during data acquisition.
  - Duplicated scans are assigned new scan numbers that succeed those loaded from the template.
- Fortunately, the approximate time at which each scan was completed is stored in that scan's `method` file.
- Subtracting the known duration of each scan from its end time, we can identify its approximate starting time.
- With the approximate start and end times for each scan, we can find the appropriate block of logic pulses in the LabChart record.
- We can then use the timing of those pulses to precisely determine the beginning and end of each scan and therefore which physiological data should be extracted for that scan.

Locating the Beginning and End of a Scan

Step 1: Look up the scan numbers in the Scan Record spreadsheet for the desired cohort and time point.

Example: Z:\STARRRS\STARRRS_inhouse\TempTransfer_01192023\C28_E_fMRI files & data\C28_E_fMRI Scan Record.xlsx



	A	B	T	U	V	W	X	Y
1	Animal ID	Scan Date	Reverse EPI blips 300	Reverse EPI blips 300 (scan 2)	Reverse EPI 300 (no blips)	Reverse EPI 300 (no blips) (scan 2)	DTI EPI 30dir	Scan E Tim
2	STM0651	10/21/2024	e9	e10	e11	e12	e13	15:4
3	STM0652	10/22/2024	e9	e10	e11	e12	e13	10:3
4	STF0641	10/22/2024	e9	e10	e11	e12	e13	13:3
5	STM0653	10/23/2024	e9	e10	e11	e12	e13	10:4
6	STF0642	10/23/2024	e9	e10	e11	e12	e13	14:3
7	STM0654	10/24/2024	e9	e10	e11	e12	e13	11:0
8	STF0643	10/24/2024	e9	e10	e11	e12	e13	13:3
9	STM0655	10/25/2024	e9	e10	e11	e12	e13	11:1
10	STF0644	10/25/2024	e9	e10	e11	e12	e13	13:4
11	STM0656	10/28/2024	e9	e10	e11	e12	e13	10:2
12	STF0645	10/28/2024	e9	e10	e11	e12	e13	15:0

The fMRI scan numbers for Cohort 28 rat STM0654 at its early time point are E9, E10, E11, E20. These scans were acquired on 10/24/2024.

The data for these scans will be in a folder named:

`20241024_HHMMSS_STM0654_STM0654_C28_E*`

Where **`HHMMSS`** is the time the study was created and * reflects the fact that a study may be repeated at the same time point. The first study for this rat will be C28_E_1_1 and a repeat study would be C28_E_1_2. The later time points will be C28_M_1_2 and C28_O_1_3.

Step 2: Locate the **method** parameter file for the scan of interest.

- Go to the folder containing the study (rat-timepoint) data:

`20241024_090446_STM0654_STM0654_C28_E_1_1`

- Go to the subfolder for the scan of interest and open the **method** file for that scan, e.g. for scan 9:

`20241024_090446_STM0654_STM0654_C28_E_1_1\9\method`

- Near the top, find the end time for this scan:

```
##TITLE=Parameter List, ParaVision 360 V3.3
##JCAMPDX=4.24
##DATATYPE=Parameter Values
##ORIGIN=Bruker BioSpin MRI GmbH
##OWNER=starrrs
$$ Write Options: Symbolic Enums, RLE encoded arrays, symbol visibility
$$ 2024-10-24 10:36:56.920 -0400  starrrs@starrrs_mri
$$ /opt/nmrdata/PV-360.3.3/data/starrrs/20241024_090446_STM0654_STM0654_C28_E_1_1/9/method
$$ process /opt/PV-360.3.3/prog/bin/parxserver
##$Method=<User:reversed_EPI>
```

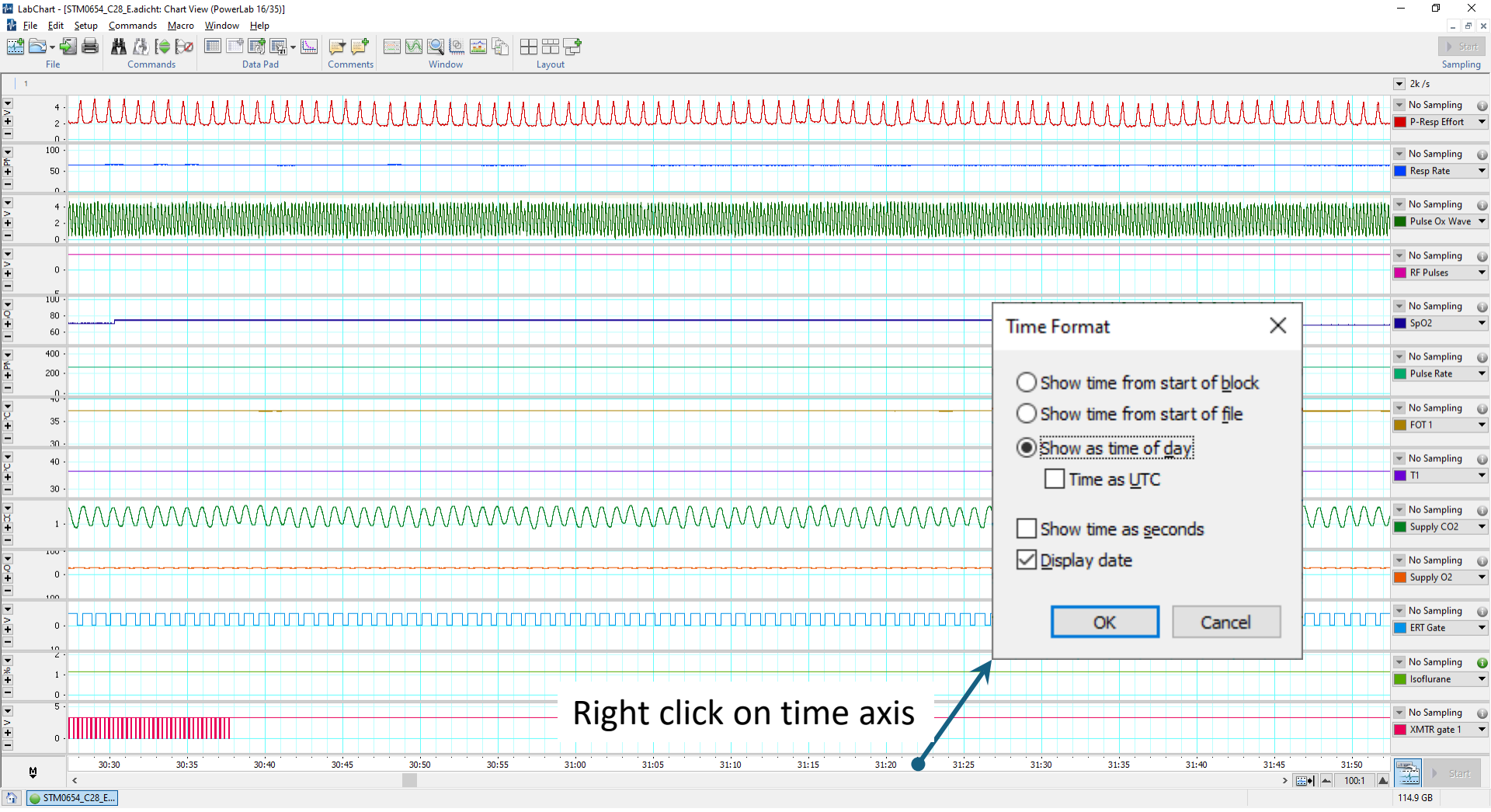
Step 3: In the LabChart record, locate the end of the scan of interest.

- Open the LabChart *.adicht file for the study of interest, e.g.:

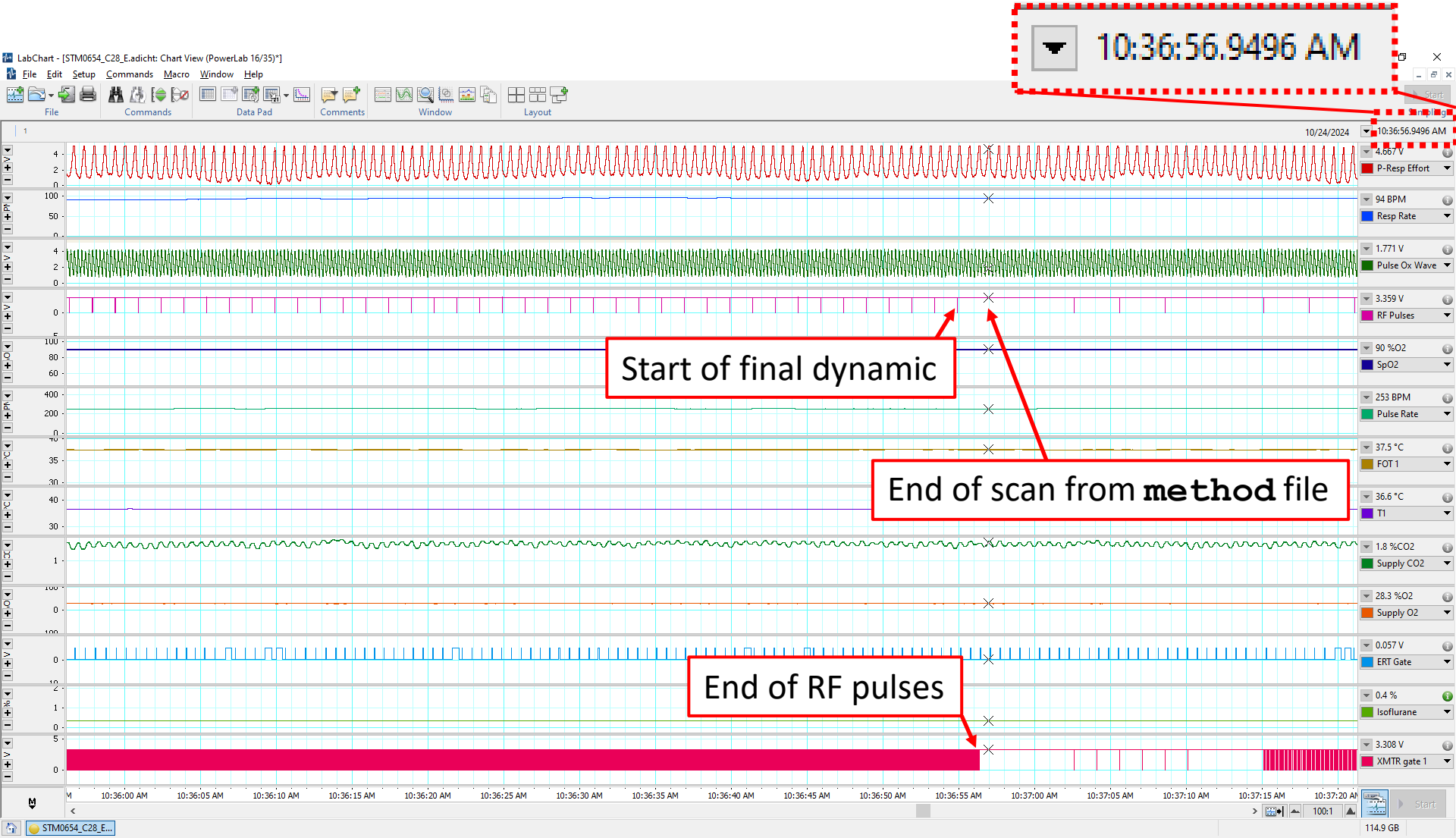
C28_E_fMRI files & data\STM0654_C28_E\STM0654_C28_E.adicht

- At the bottom of the LabChart window, right click on the X axis (time line) and select “Time Mode…”. Select “Show as time of day”
- Scroll the timeline to locate the approximate end of the scan. In this example, it’s 10:36:56.920.
- Place the mouse on the “RF Pulses” trace (Channel 4) and observe the exact cursor time in the top right corner of the LabChart window.
- Move the mouse left and right until the exact cursor time matches the end-of-scan time from the method file as closely as possible. Right-click and choose “Set Marker”.

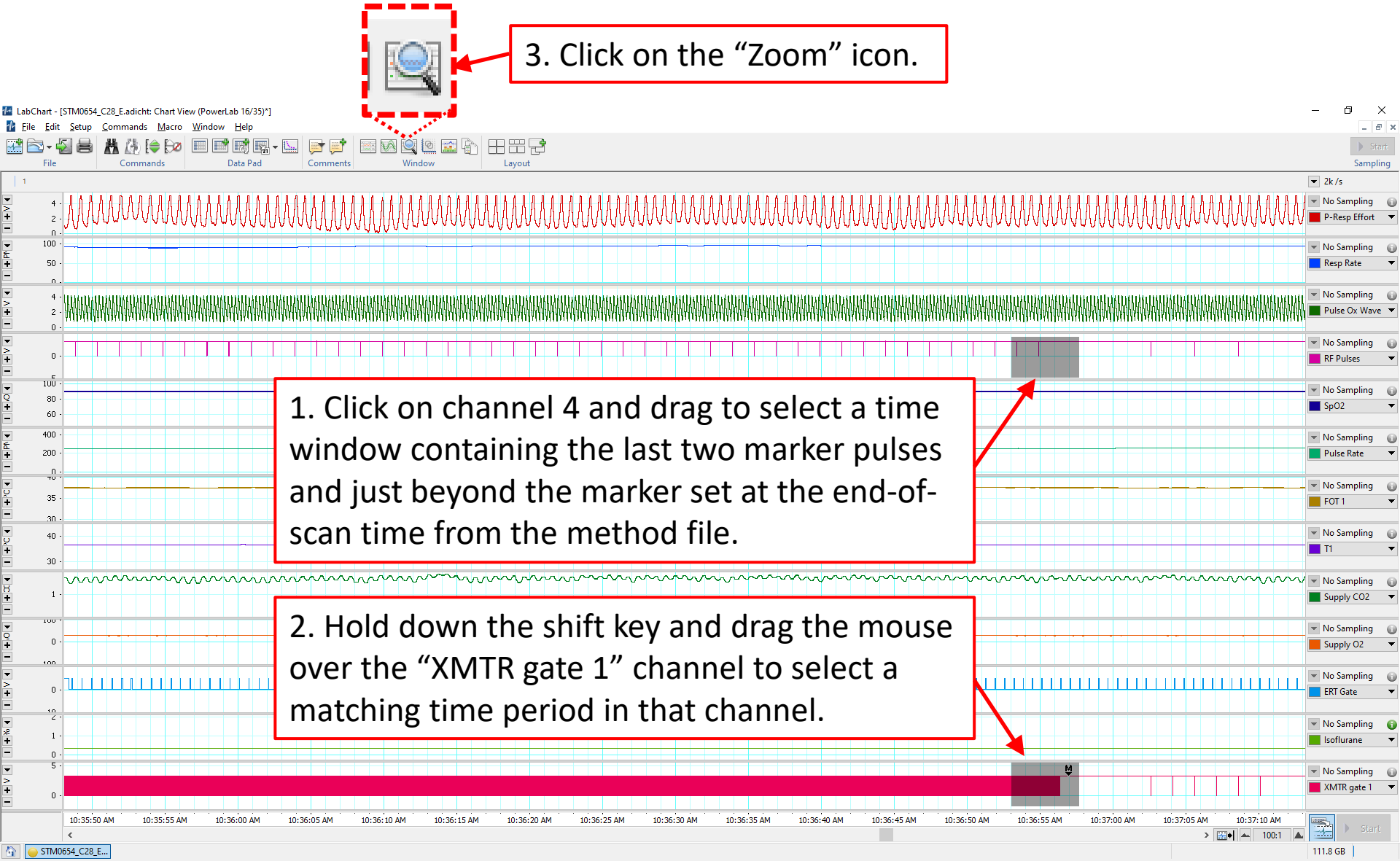
In LabChart, set X axis to time of day



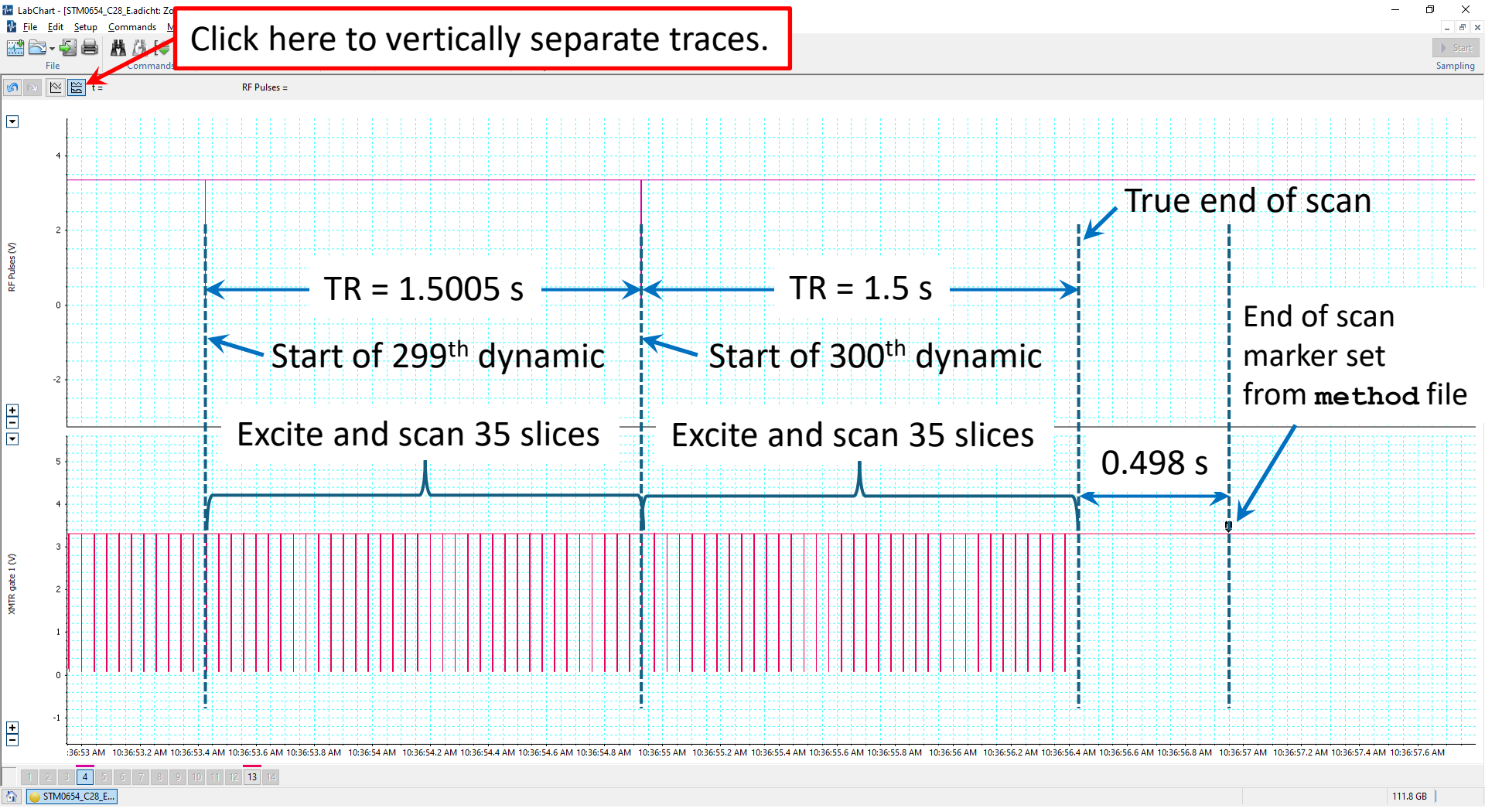
Scroll to approximate end-of-scan time from `method` file, then move mouse in data window to display exact time at top left. Right click and select “Set Marker”.



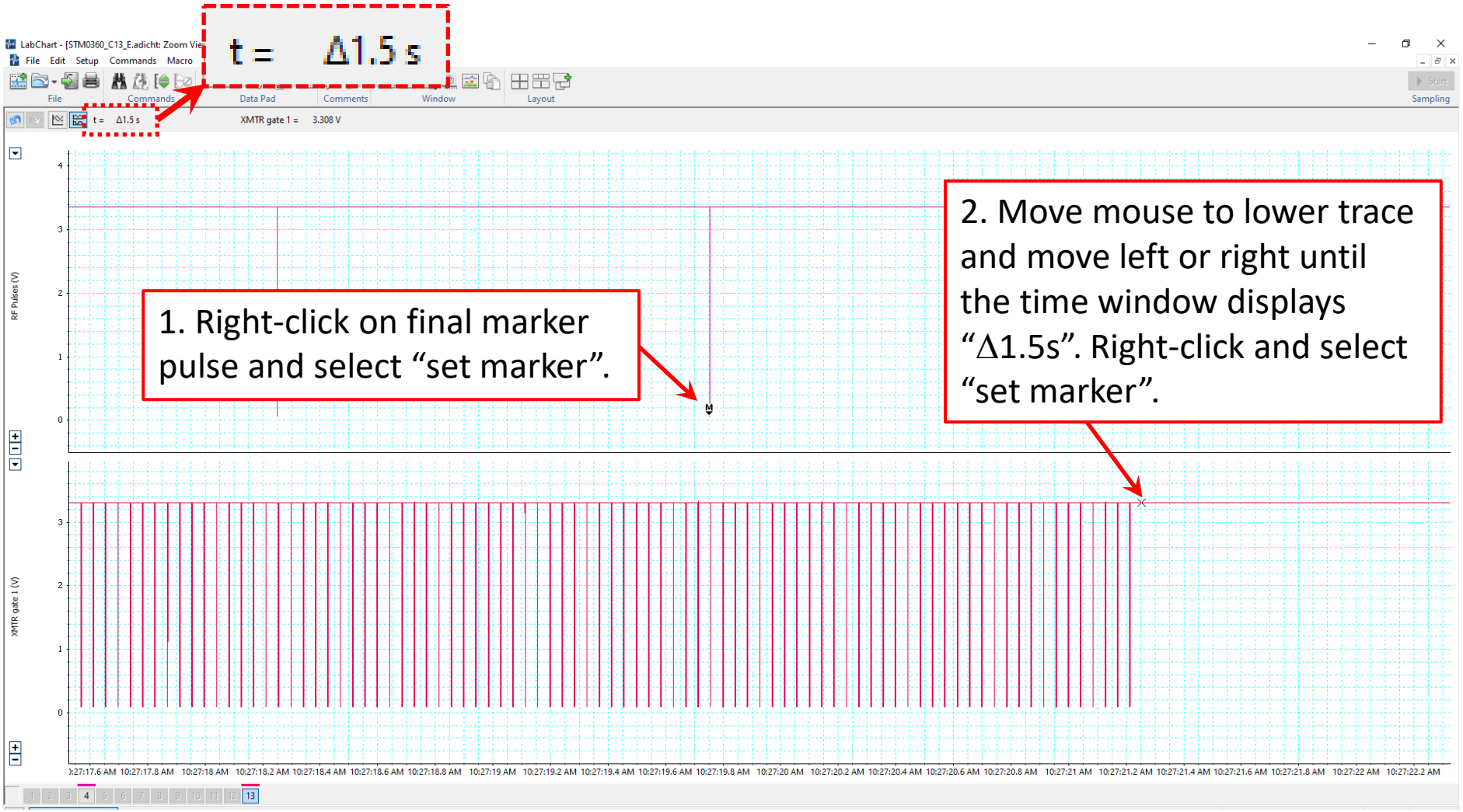
Let’s zoom in around the end of scan 9.



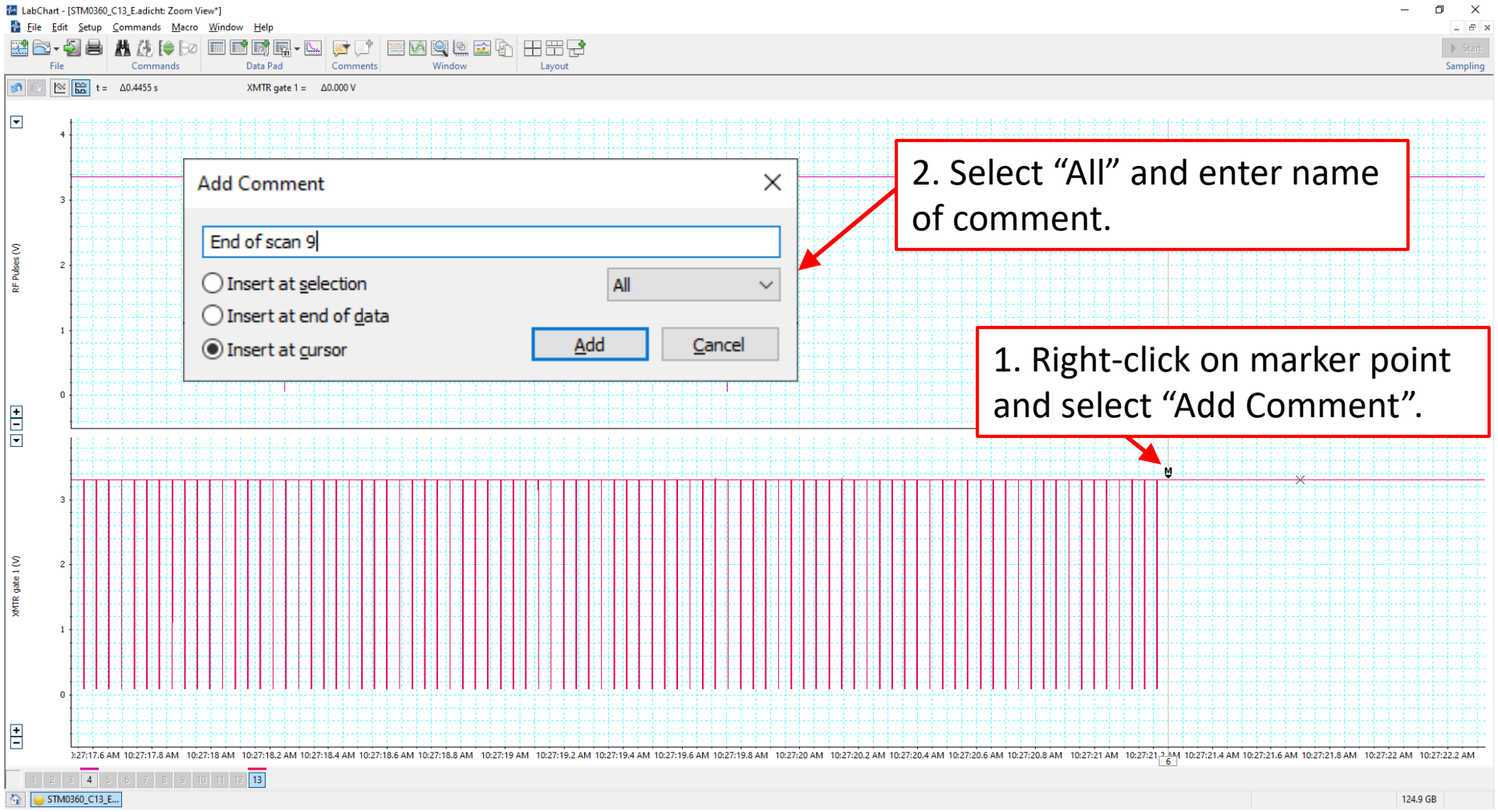
Now we can see the logic pulses for each slice. The end-of-scan time from the **`method`** file is 0.524 s after true end-of-scan. **Unfortunately, this is not an exactly reproducible delay (0.498, 0.5185, 0.586, 0.595 s…).** This variability may arise from variable latency in writing data to disk.



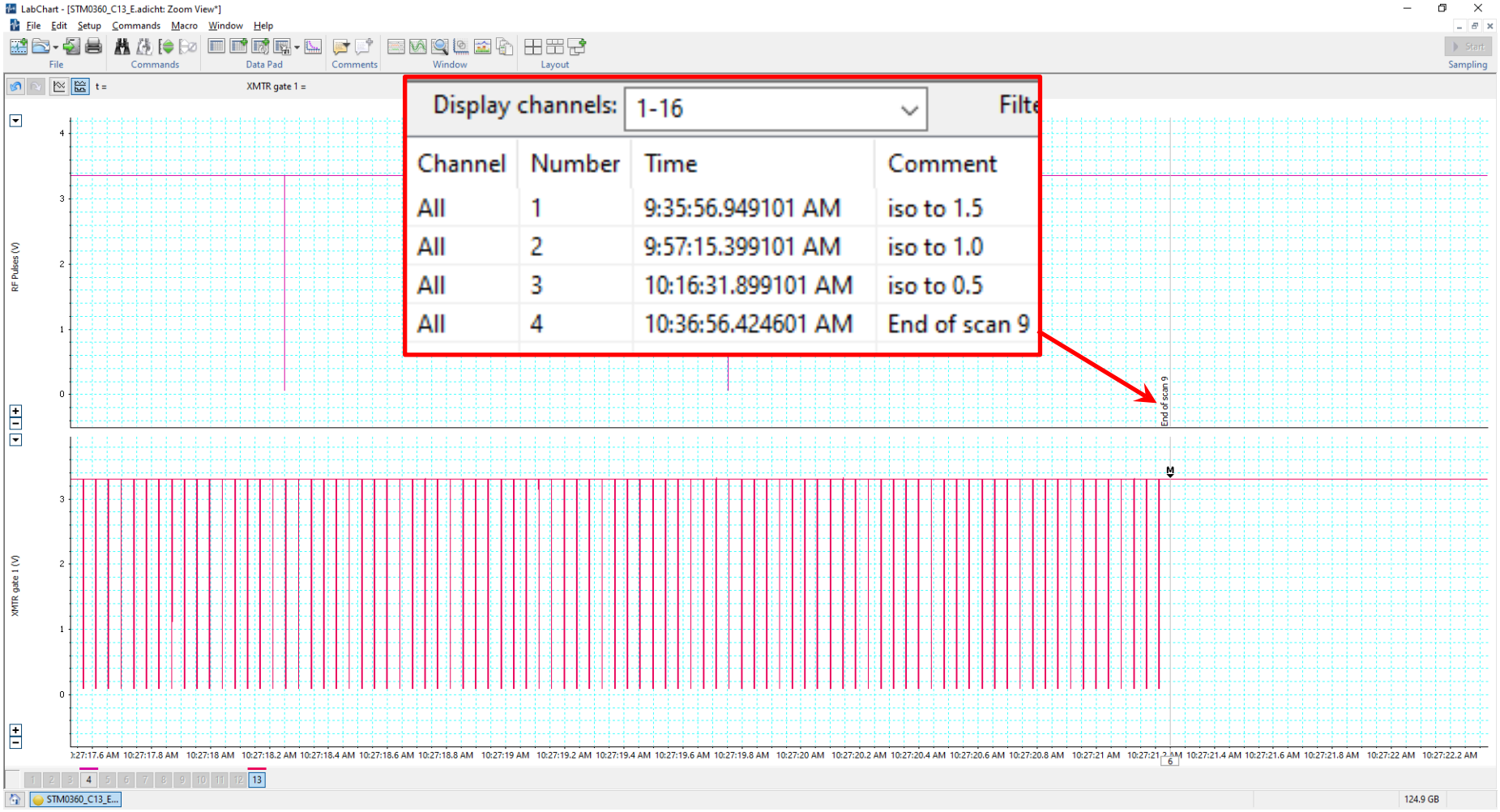
So the end-of-scan time from method is just approximate, but good for identifying the correct block. In the zoomed view, mark the actual end-of-scan.



Mark the true end-of-scan with a comment. The exact time is saved by LabChart.



Press Ctrl-L or choose “Window -> Comments” to display comments.



Step 4: Locate the beginning of the block of data to export.

- Close the “Zoom” window and return to the main Chart window: “Window -> 1 STM0654_C28_E.adicht: Chart View”.
- From the marker you placed at the end of the scan, scroll to the left until the top right window shows “-Δ7:30”. This should correspond to the beginning of the first dynamic: 300 dynamics × 1.5 s

Note: The data were acquired at a very high speed (0.5 ms/point), so there a very large number of points and scrolling can be slow and jumpy!

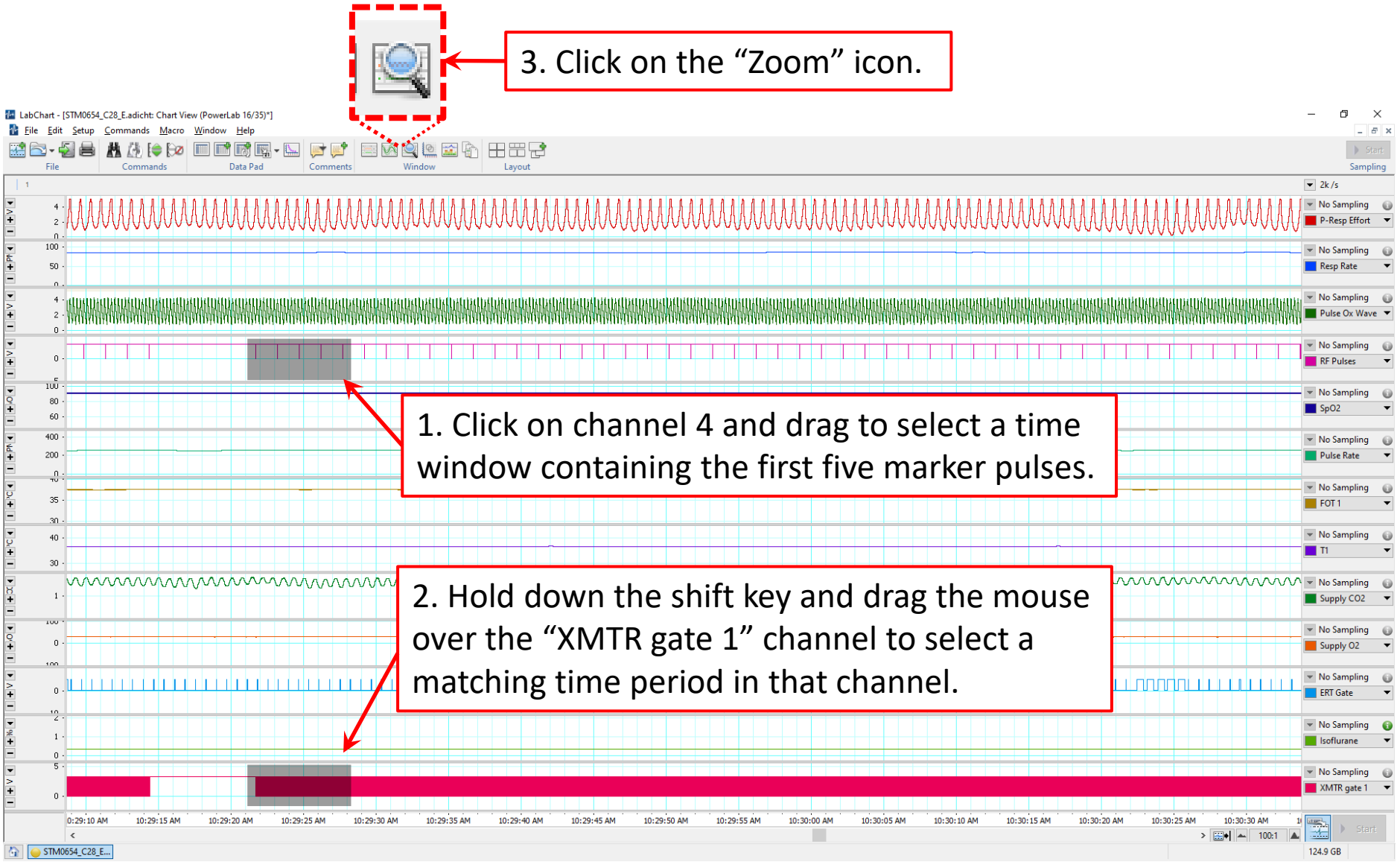
If you get lost, you can always go to the Comments window, select “End scan 9” and “Go To” (bottom right corner of window).

Rather than concentrating on the time display, you can just scroll to the beginning of the red bar (“XMTR gate 1”), but it’s easy to get lost and up in a different scan!

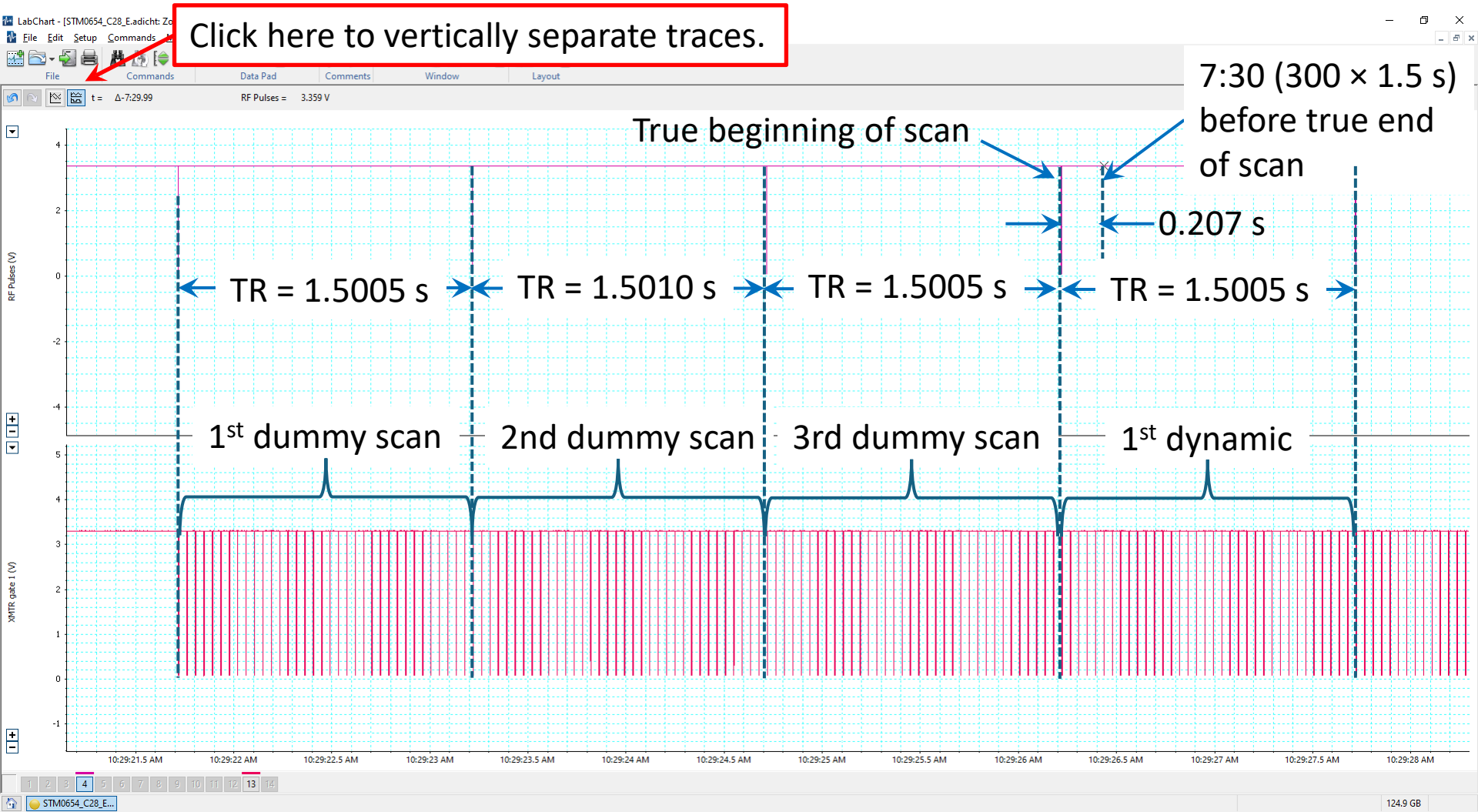
Step 4: Locate the beginning of the block of data to export.

- At the beginning of a fMRI EPI scan, there are three “dummy” dynamics. These are used to reach steady-state magnetization and should not be exported.
- From the marker you placed at the end of the scan, scroll to the left until the top right window shows “-Δ7:30”. This is the expected beginning of dynamic 1, since 300 dynamics × 1.5 s = 450 s = 7 min 30 s.

Zoom in on the first five marker pulses in channel 4.



Again, we can see the logic pulses for each slice. The actual time between marker pulses is not 1.5 s but longer by 0.5-1.0 ms (digitization rate of 0.5 ms/point). This difference accumulates so that the true beginning of scan is more than 450 s before true end of scan. **This difference of 207 ms seems to be consistent.**



Conclusions: Locating ends of data block

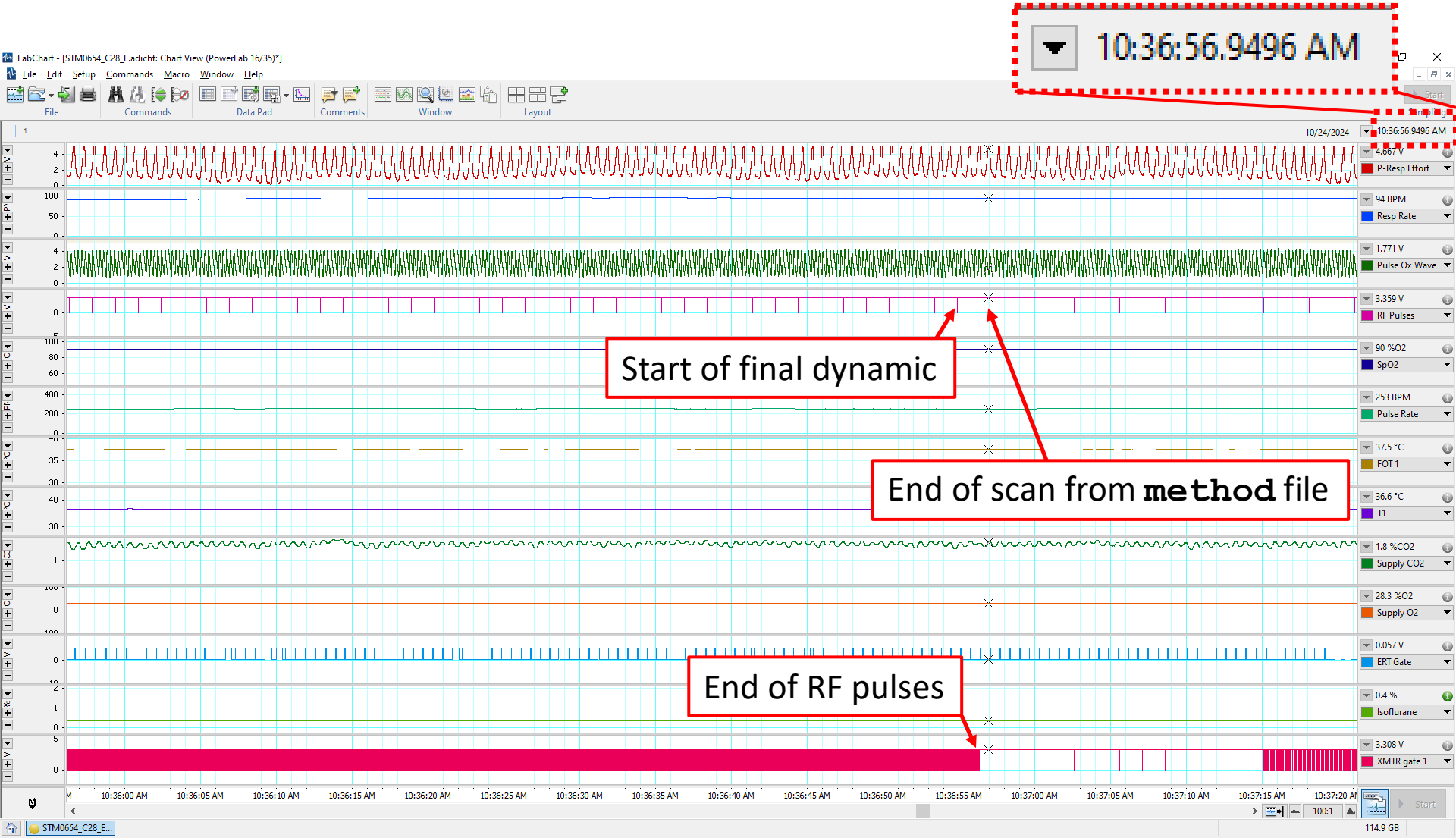
- 1. The header time from a scan's ParaVision **`method`** file is later than the actual end-of-scan by a variable amount. The **`method`** time can be used to find the correct block of data to analyze, distinguishing it from other scans.
- 2. The true end-of-scan can be marked by counting 1.5 s after the beginning of the final marker pulse.
- 3. The true beginning-of-scan is actually 450.207 s before the true end-of-scan. The beginning of the scan can easily be marked by skipping the first 3 (dummy) pulses and zooming in on the beginning of the 4^{th} marker pulse.

Recommended Procedure for Marking Beginning and End of Scan

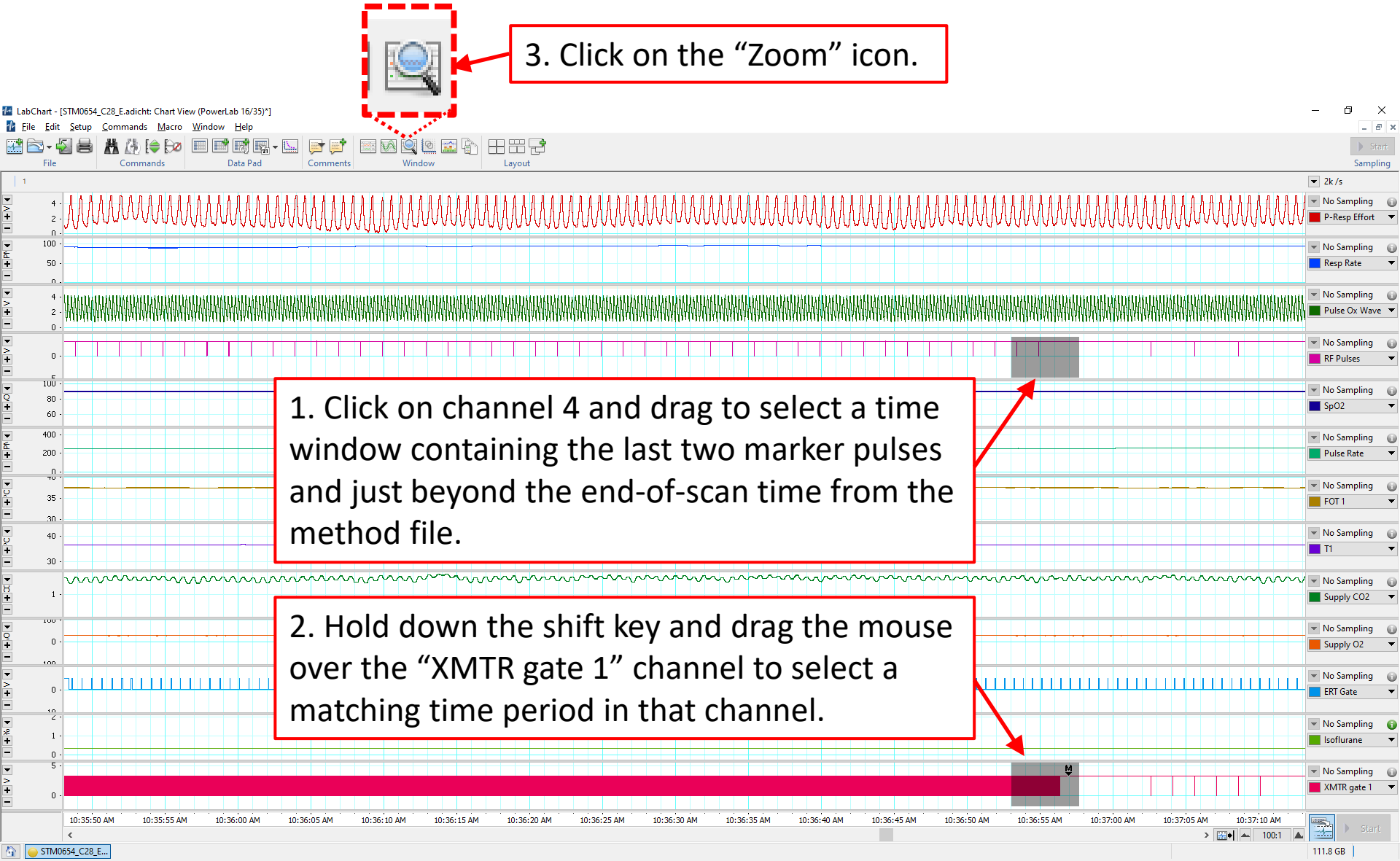
Recommended procedure to find true end-of-scan

- 1. Use the time in the header of the scan's method file to approximately locate the end of the scan in LabChart.
- 2. Zoom in from just before the last marker pulse (marking the beginning of the final dynamic) to a time well beyond the end of the XMTR gate 1 pulses.
- 3. Zoom in closely around the last marker pulse and set a marker.
- 4. Zoom out, then zoom in around the end of the XMTR gate 1 pulses and set the marker to 1.5 s after the previous marker. Enter a comment "End of scan" at this point. This should be one more "slice interval" after the last XMTR pulse.

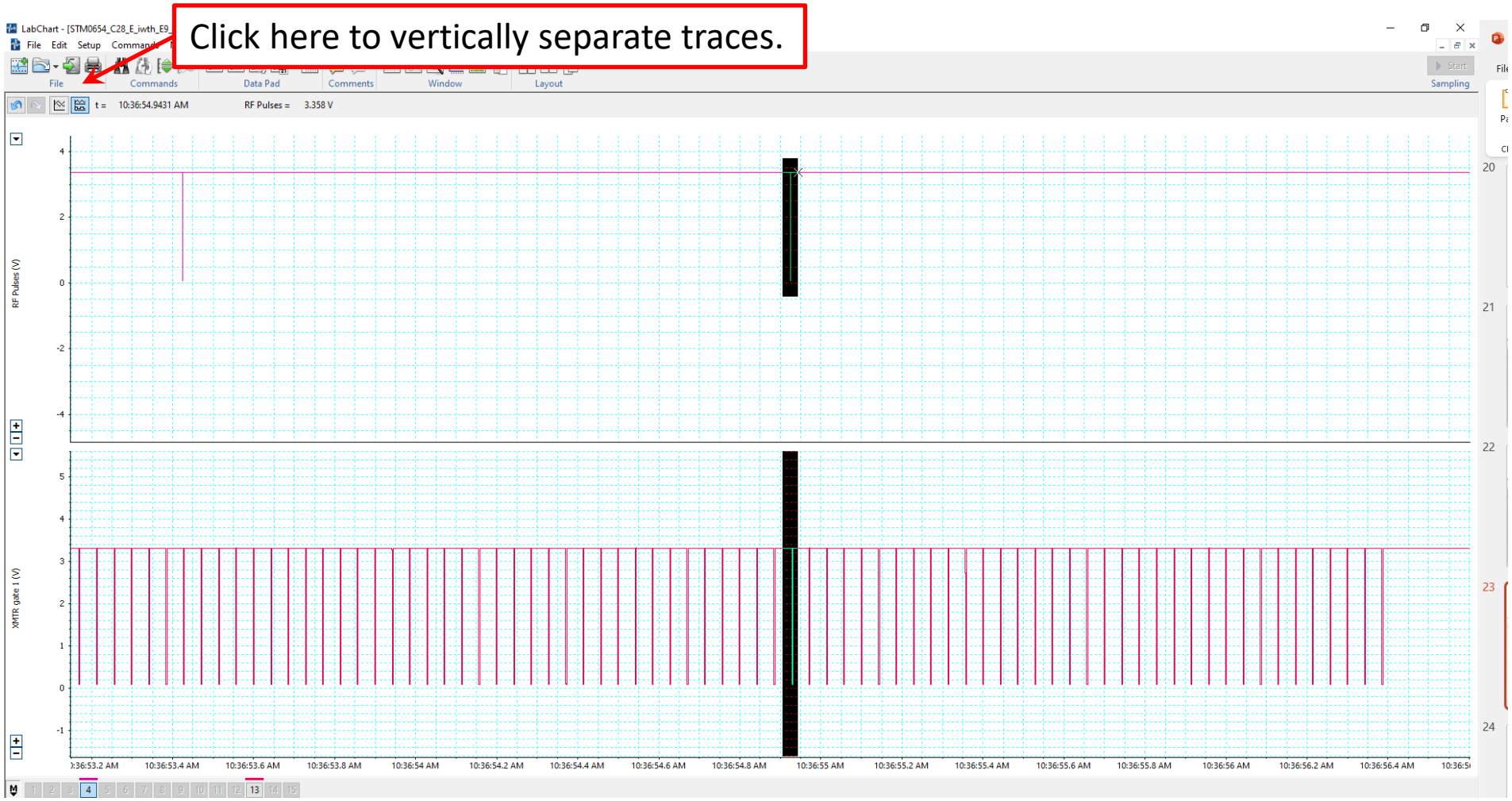
Scroll to approximate end-of-scan time from **`method`** file. This will be just after the block of physiological data for that scan.



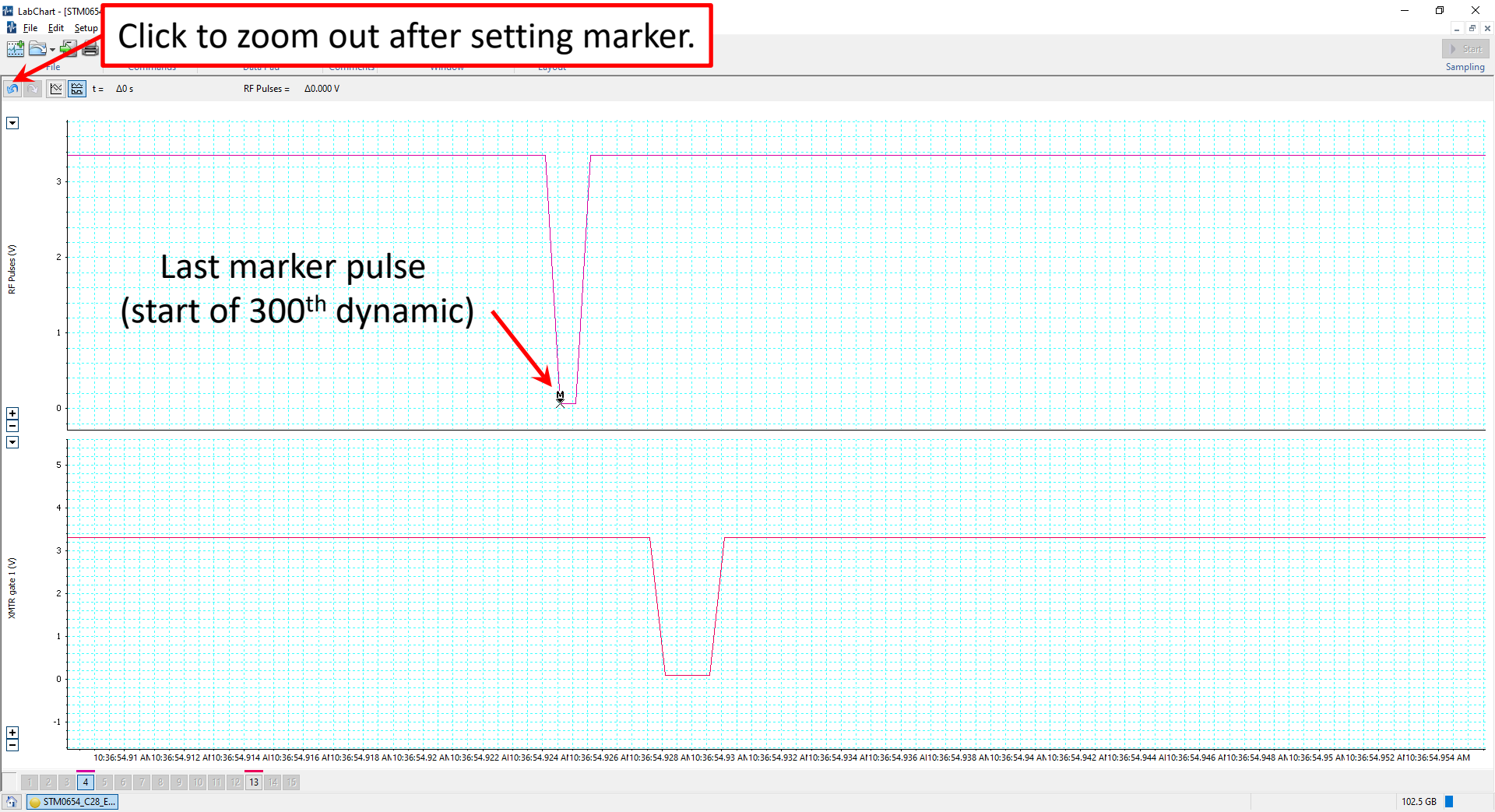
Zoom in around the end of the scan.



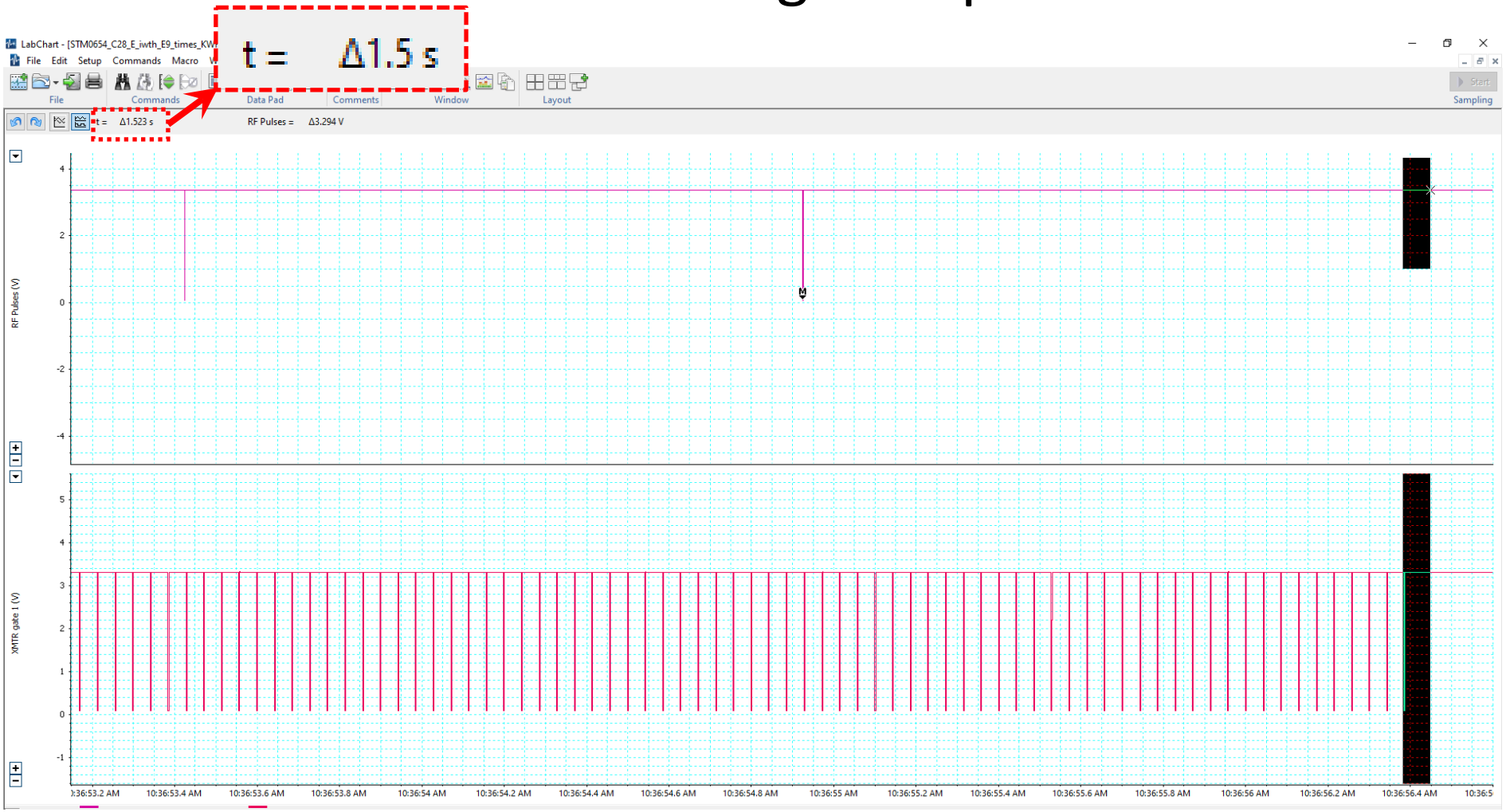
Zoom in closely around the last marker pulse.



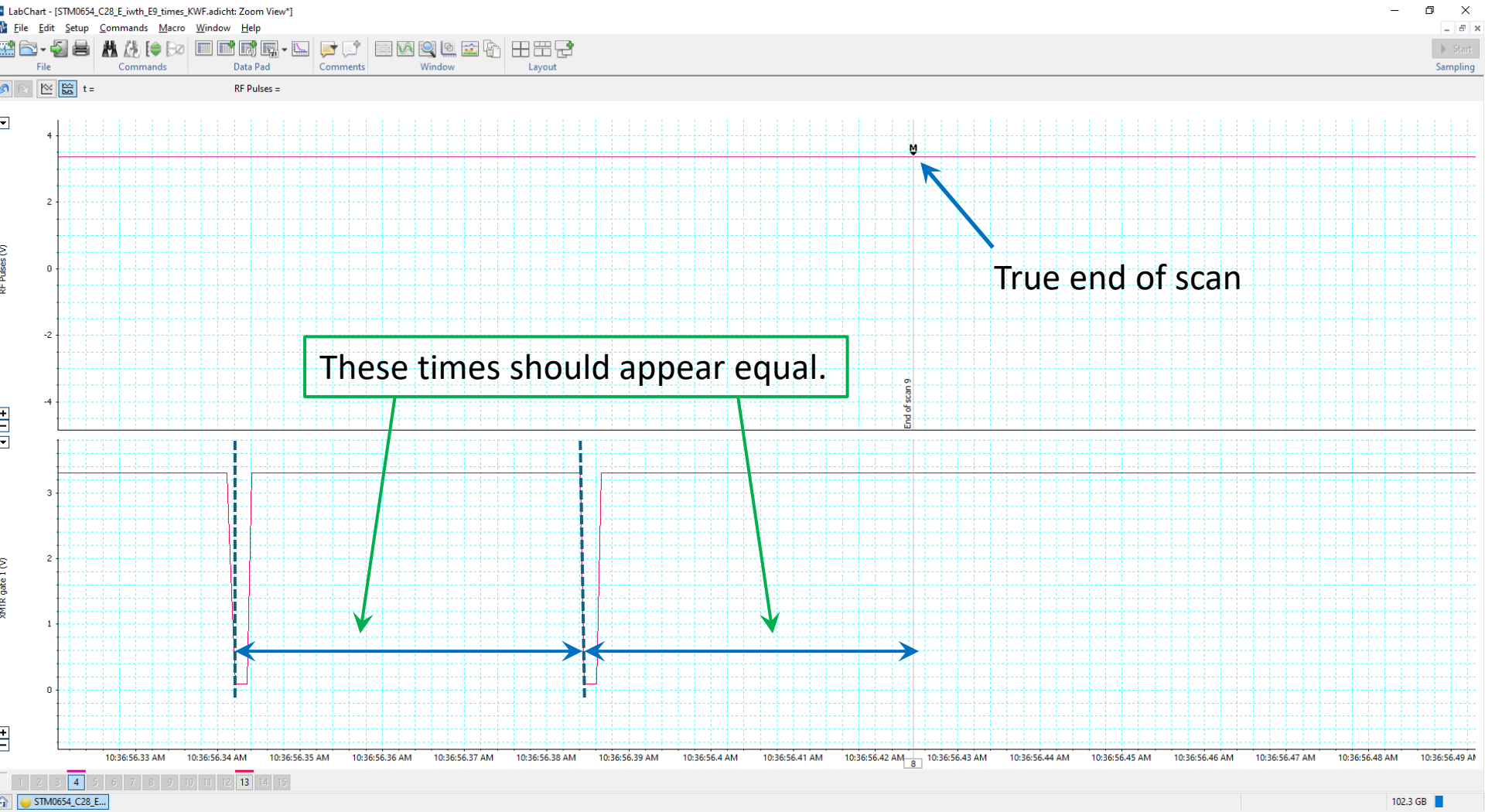
Now, we can see each data point. Move the cursor to the first data point of the marker pulse, right-click and choose “Set Marker”.



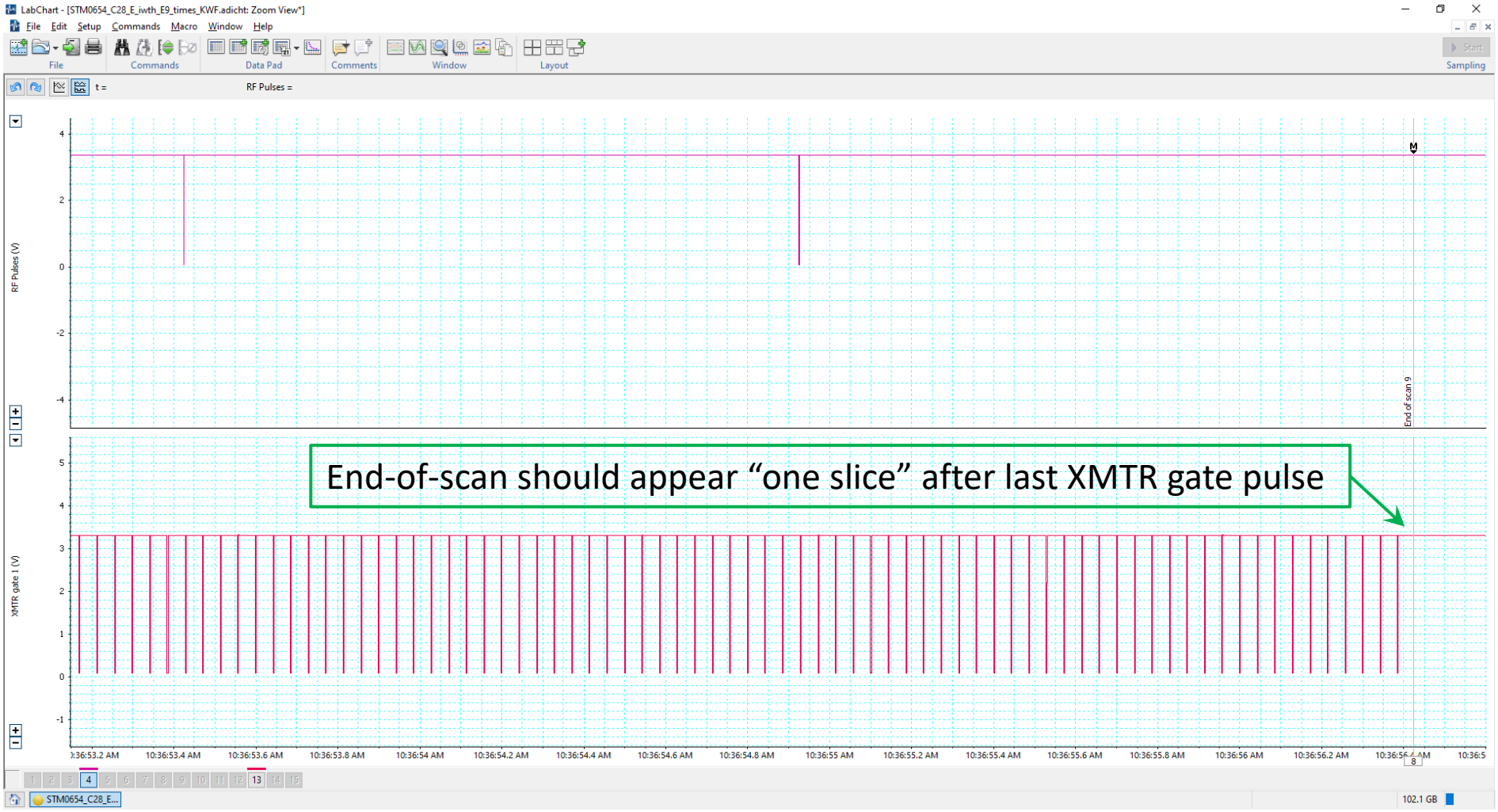
Zoom out, then move the cursor until the time display (top left) reads Δ1.5s. Draw a box just a little to the left and right of this point to zoom in. Include the last two or more XMTR gate 1 pulses .



Now move the cursor to exactly Δ1.5s, right click and set a marker and a comment: “End of scan”.



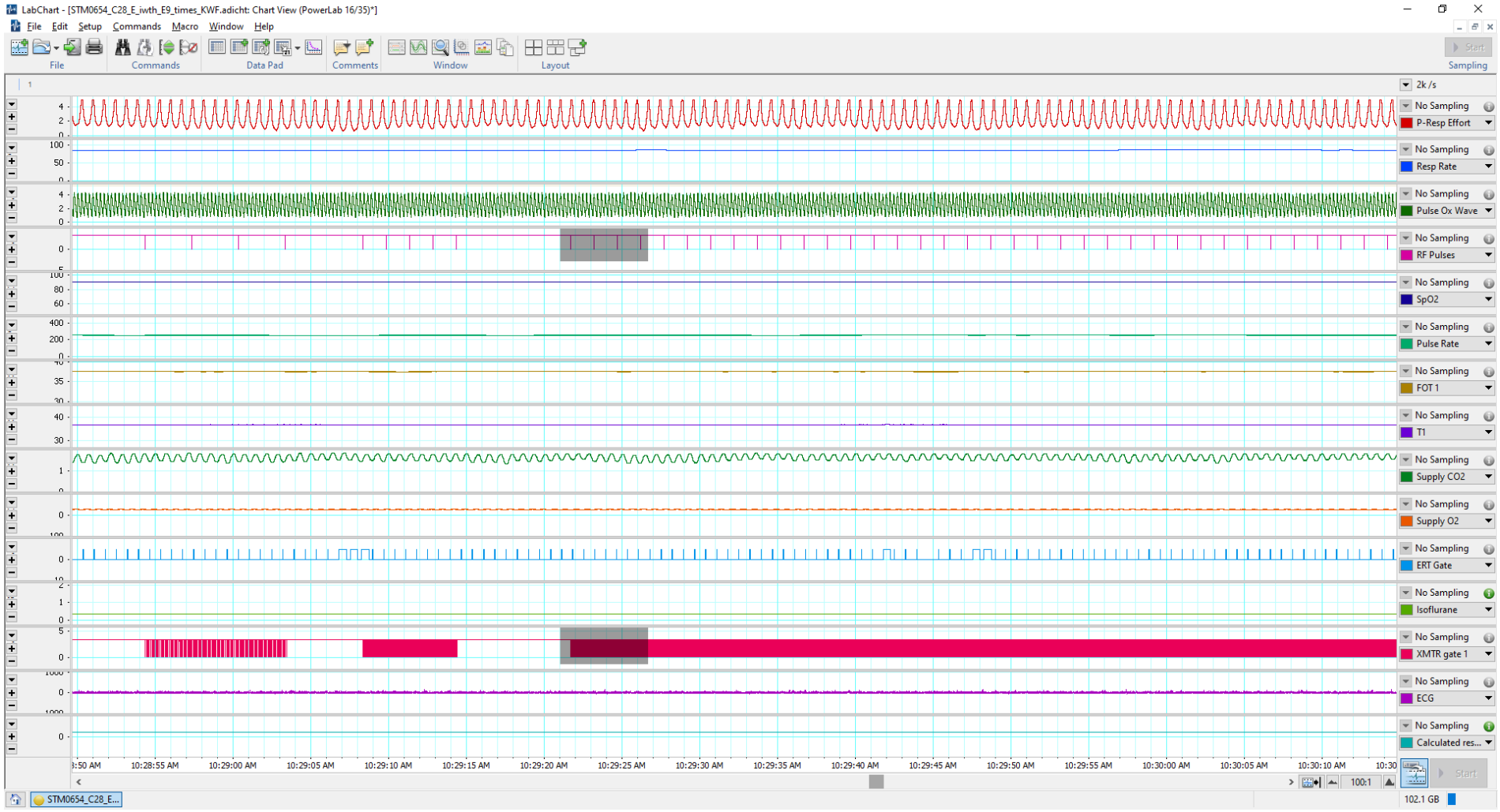
Zoom out and you should see something like this:



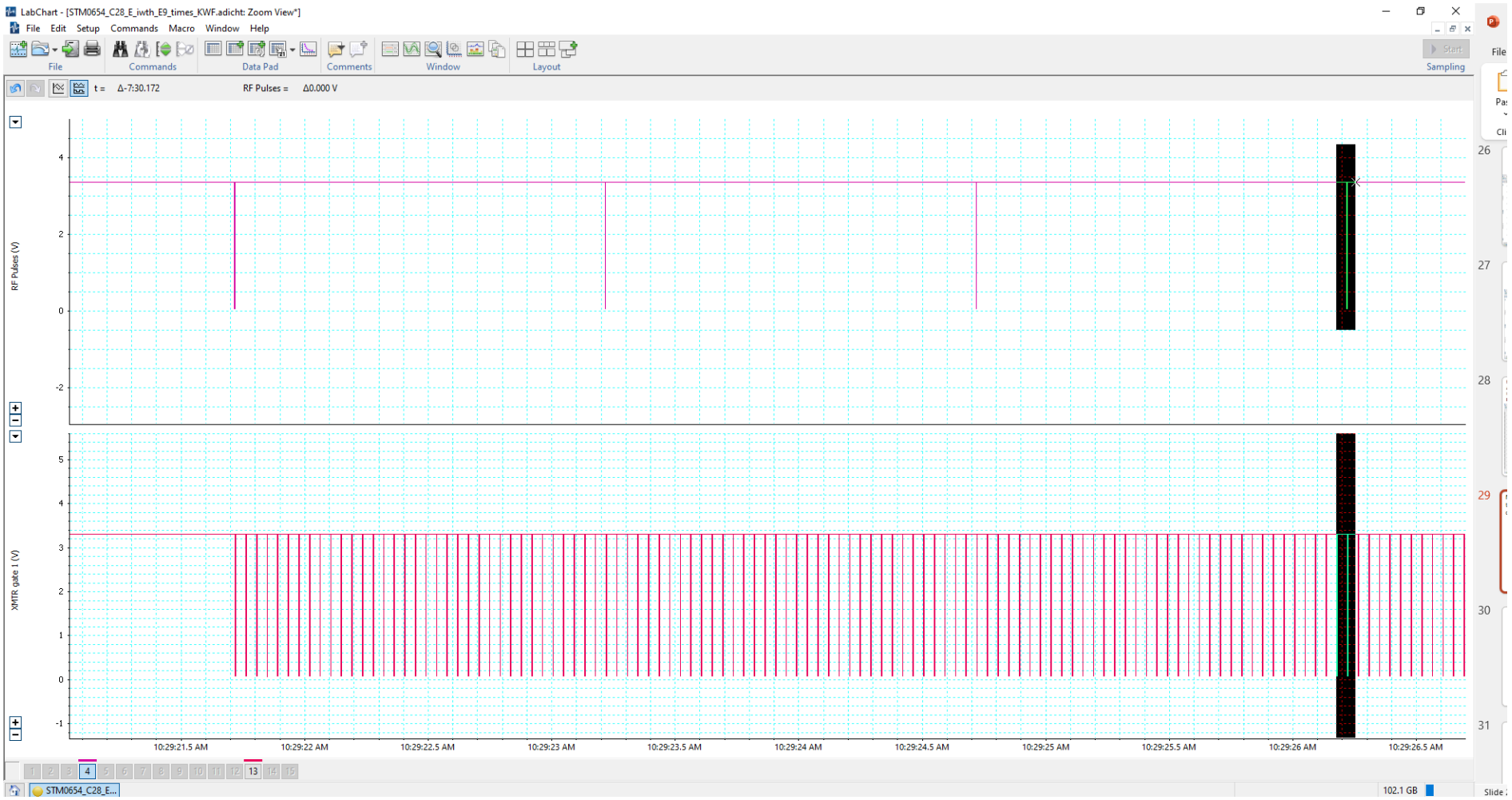
Recommended procedure to find true beginning-of-scan

- 1. Close Zoom window and return to Chart view.
- 2. Scroll to beginning of scan (block of continuous pulses in XMTR gate 1 trace), then zoom in around first four marker pulses.
- 3. Zoom in around the fourth marker pulse and enter comment “Beginning of scan” at the beginning of that pulse. The time counter should read Δ = -7:30.207.

Return to Chart View and scroll until the time display reads approximately Δ7:30. This is close to the beginning of the scan. Zoom in on an interval a little before the first marker pulse to a little after the fourth pulse.



Now zoom in closely around the fourth marker pulse, which marks the beginning of the first fMRI dynamic (after three dummy dynamics).



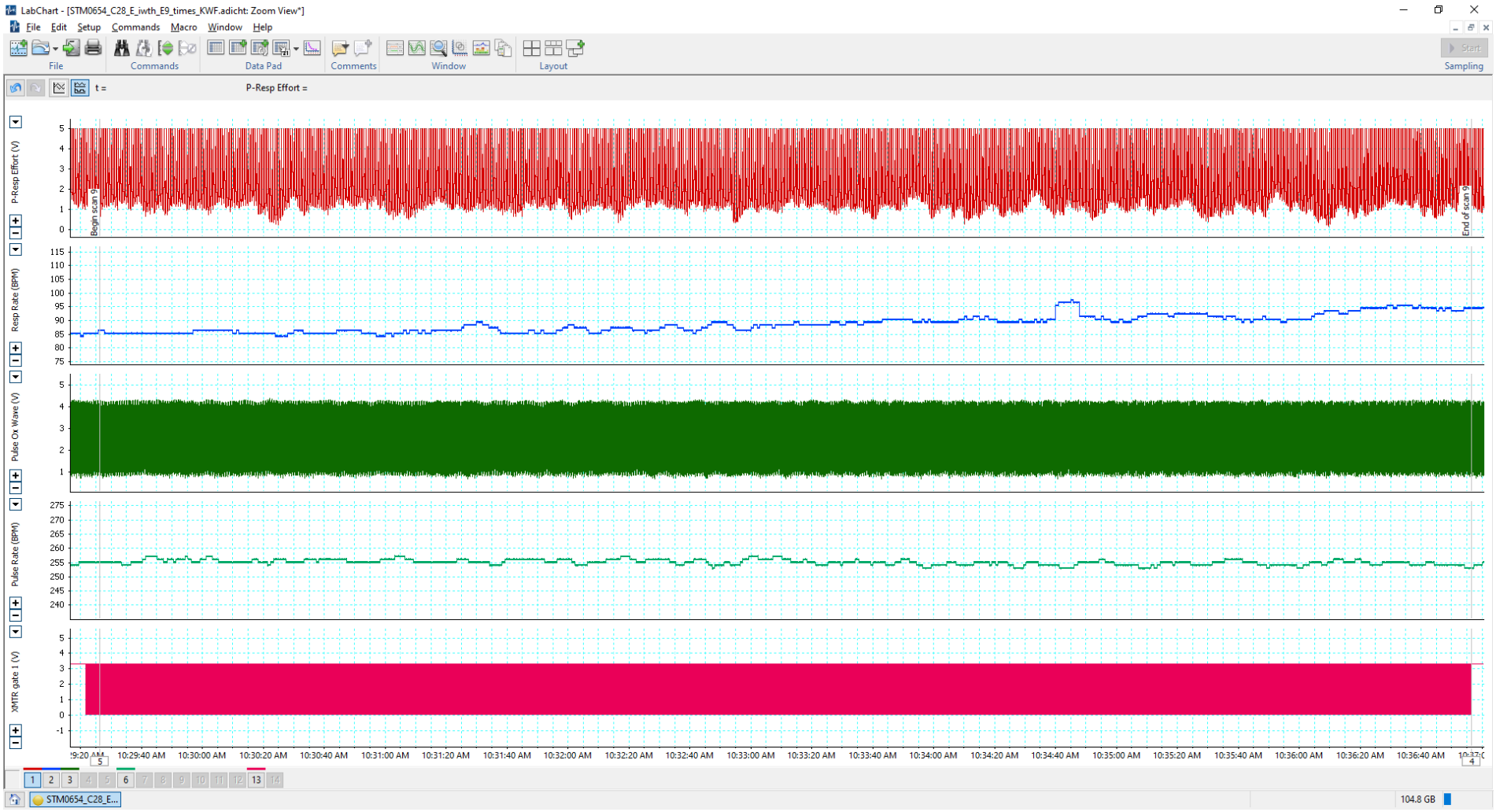
Move the cursor to the beginning of the fourth marker pulse, right click and add comment: “Beginning of scan”. Time display should read Δ-7:30.207 at this point.

Quality Control Procedures

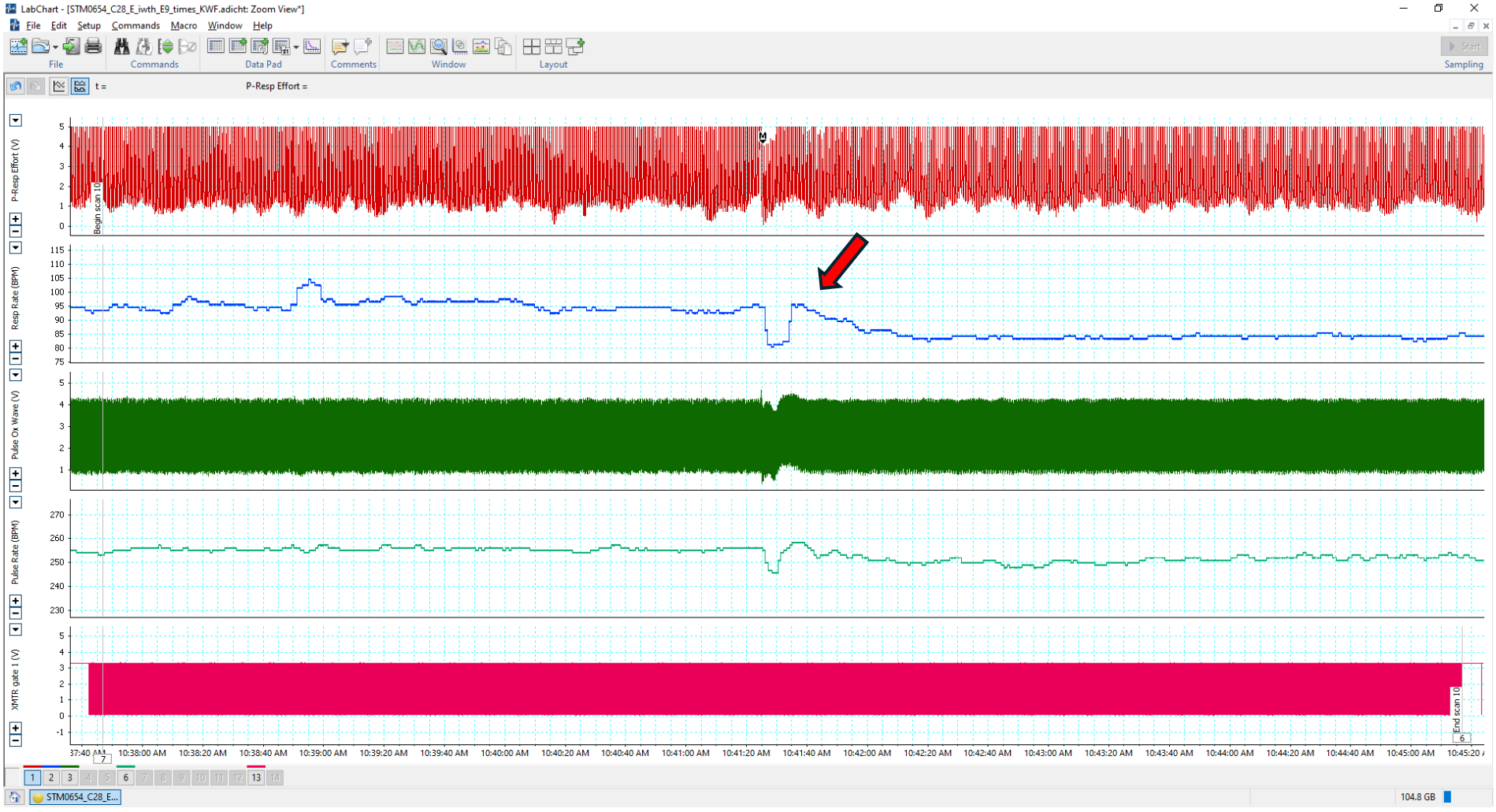
Checking data quality before exporting

- The “Resp Rate” and “Pulse Rate” (as well as SpO2 and FOT) data are calculated by PC-SAM, converted to analog signals, and digitized by PowerLab.
- Sometimes, especially if the respiratory effort or pulse signal becomes weak or changes suddenly in baseline, amplitude or phase, PC-SAM may make an error in calculating the rate.
- PC-SAM reports the running average respiration or pulse rate over several cycles, so an error in calculating the instantaneous rate may persist for several seconds.
- **Scroll through the data from beginning to end, checking for continuous, smoothly varying respiration and pulse rate within a sensible physiological range (respiration 30-100 BPM and pulse 250-400 BPM for rats).**

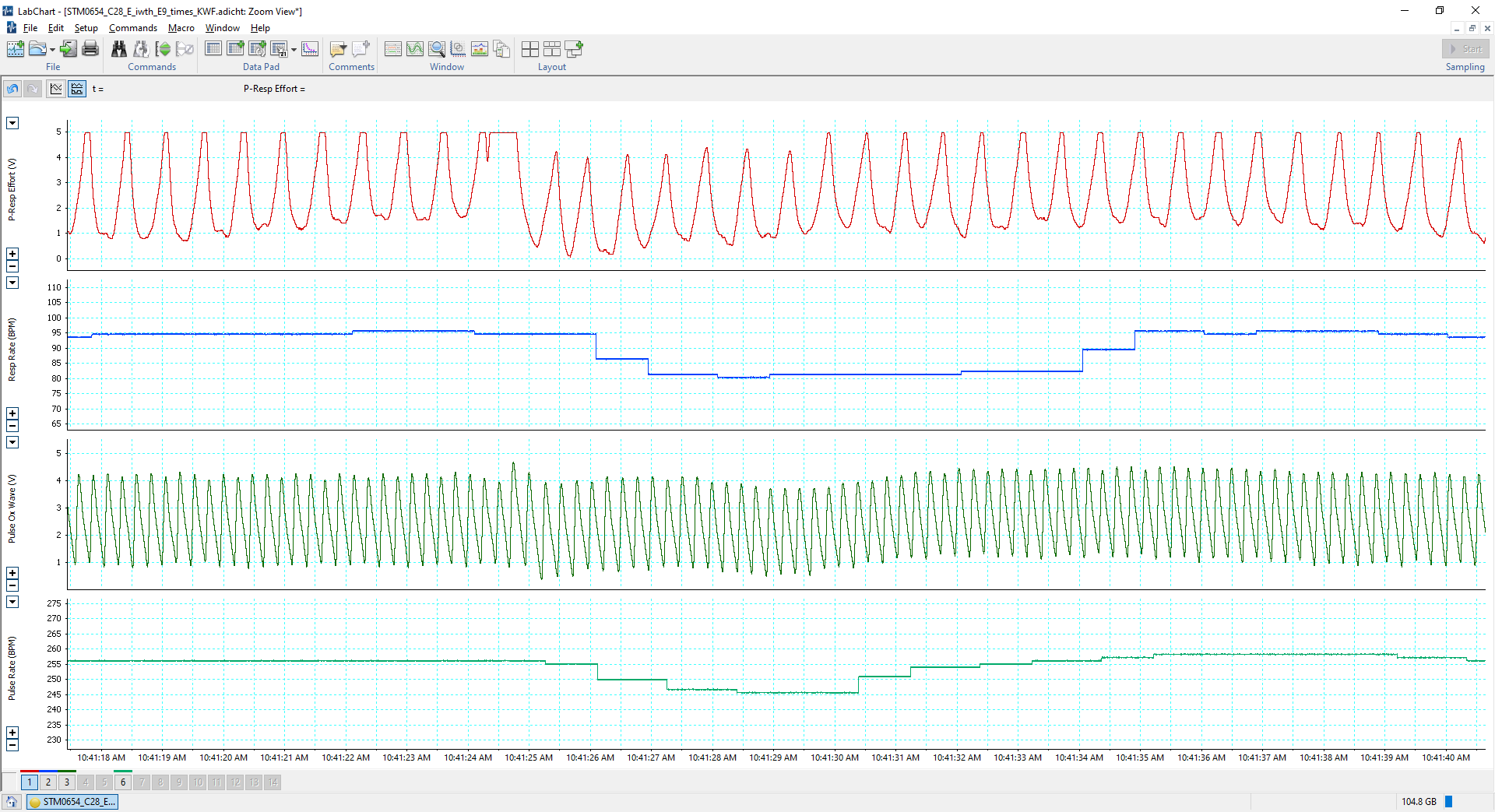
Looking at the entire duration of scan 9, all seems OK!



In scan 10, there were some anomalies worth checking out.



Here, there was a single irregular breath, which caused the calculated respiration rate to dip for about 10 s. The pulse signal and pulse rate also dipped, so this looks like a real physiological event. No recalculation needed.



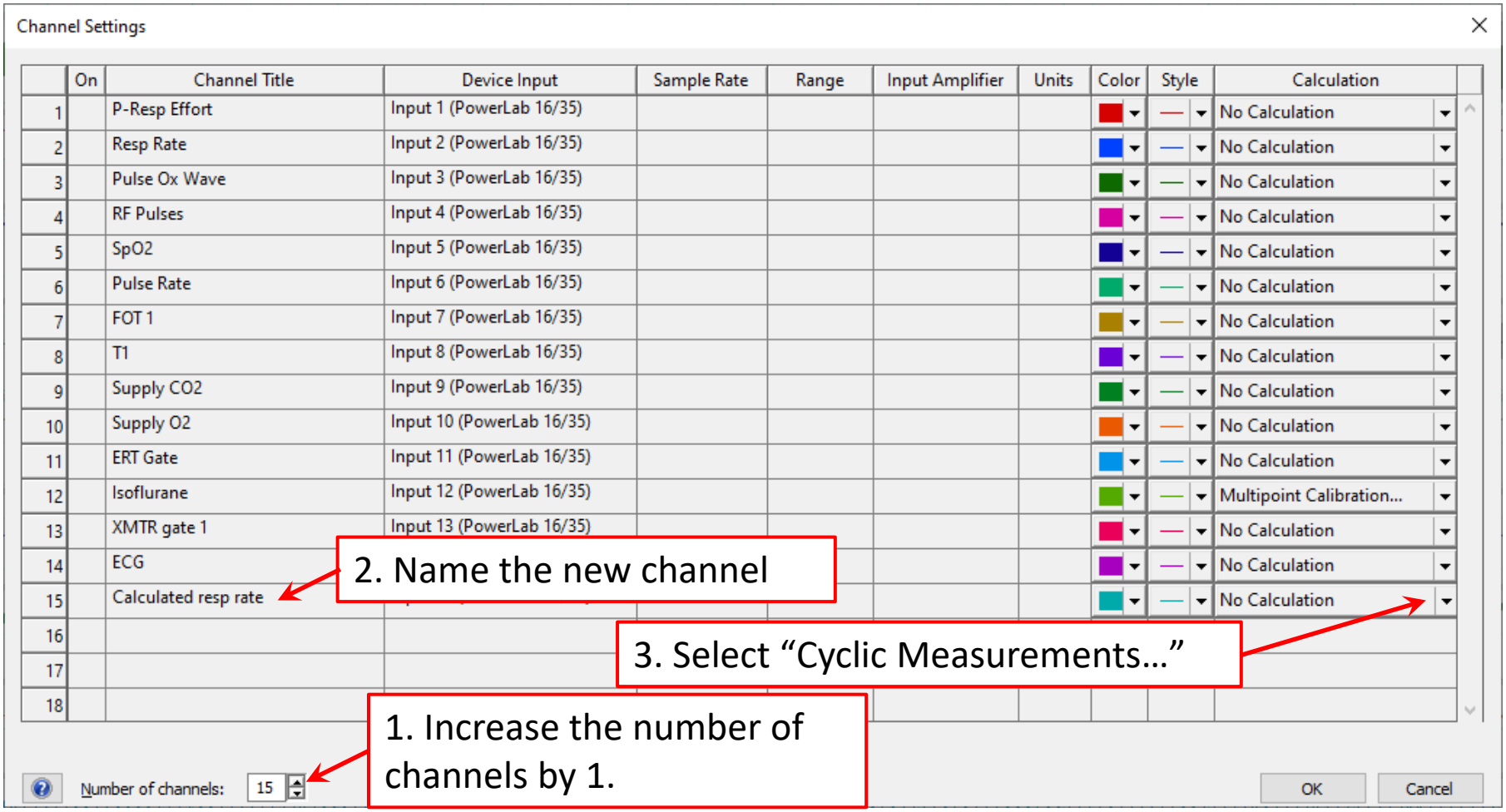
Here, there was a brief acceleration in breathing, but due to the moving time average, it isn't evident in the respiratory rate trace until several seconds later.

This is a similar example, but here, the pulse oximeter signal decreased briefly. This is due to automatic gain adjustment of the pulse signal by PC-SAM and is not a physiological anomaly.

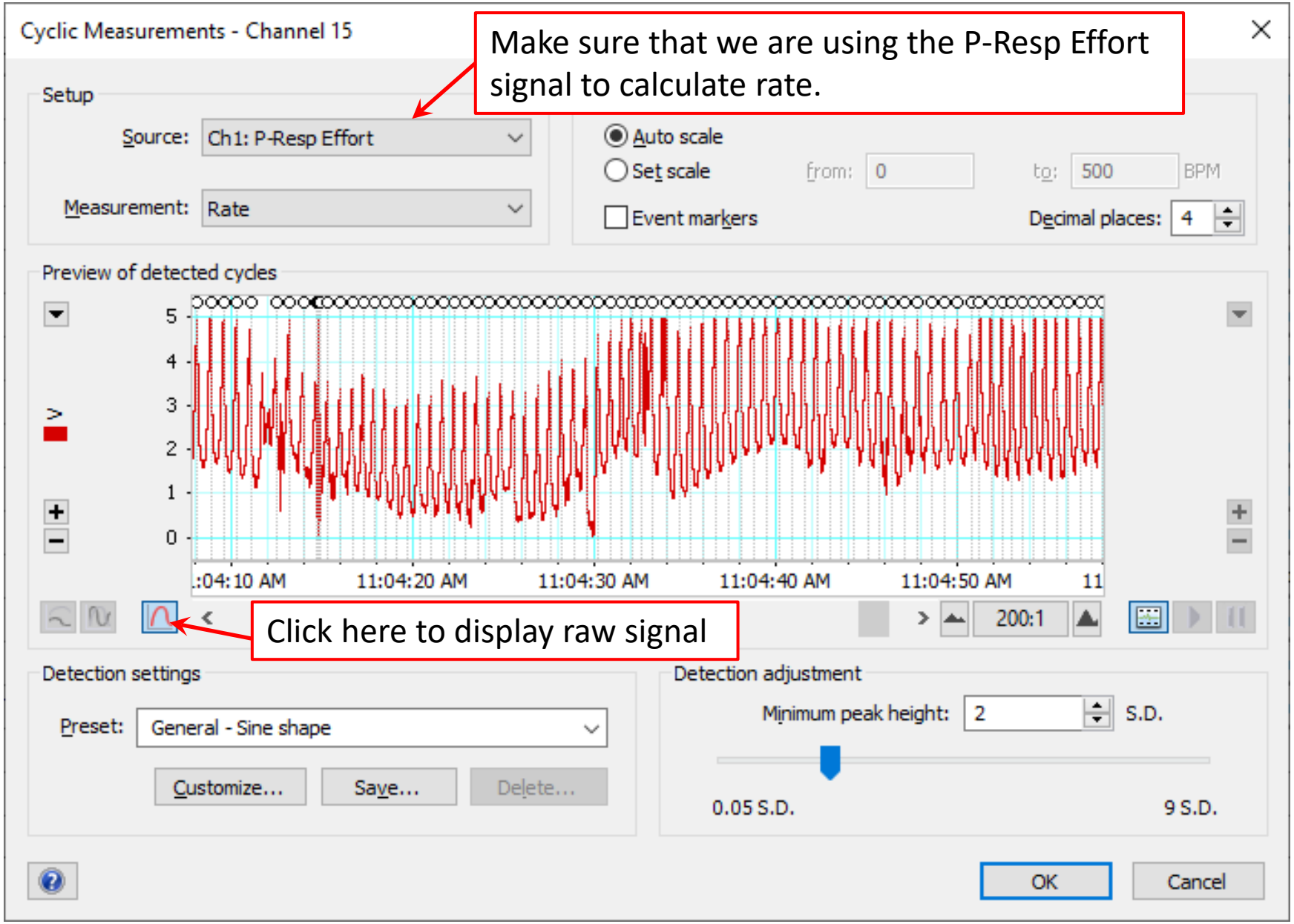
Here, as the respiratory effort signal gets smaller and its baseline drifts, PC-SAM underestimates the respiration rate. LabChart may be able to calculate the correct rates here, after the fact.

Calculating rate data in LabChart

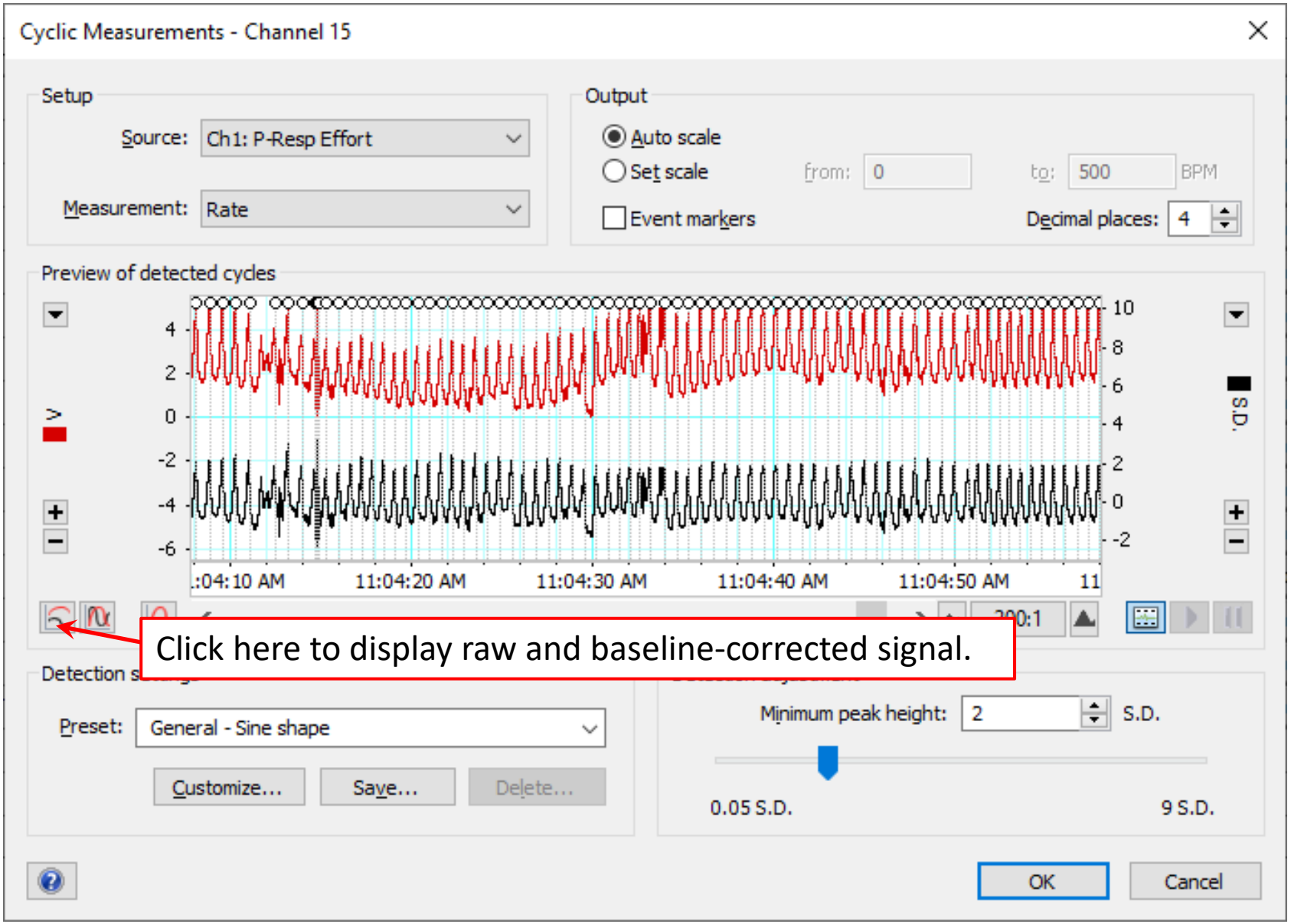
- First, create a new channel to store the calculated rate data: Setup -> Channel Settings



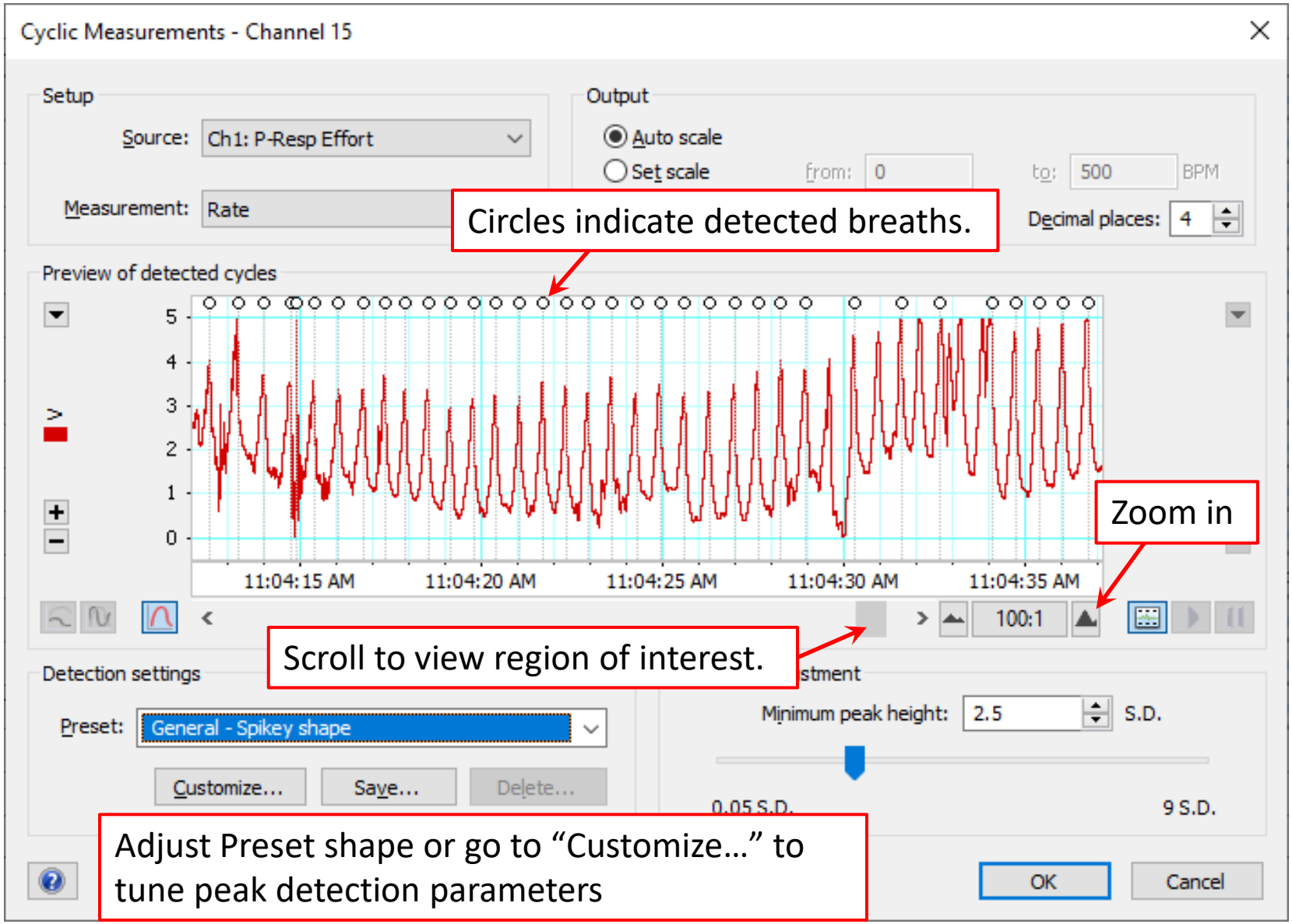
Cyclic Measurements Window



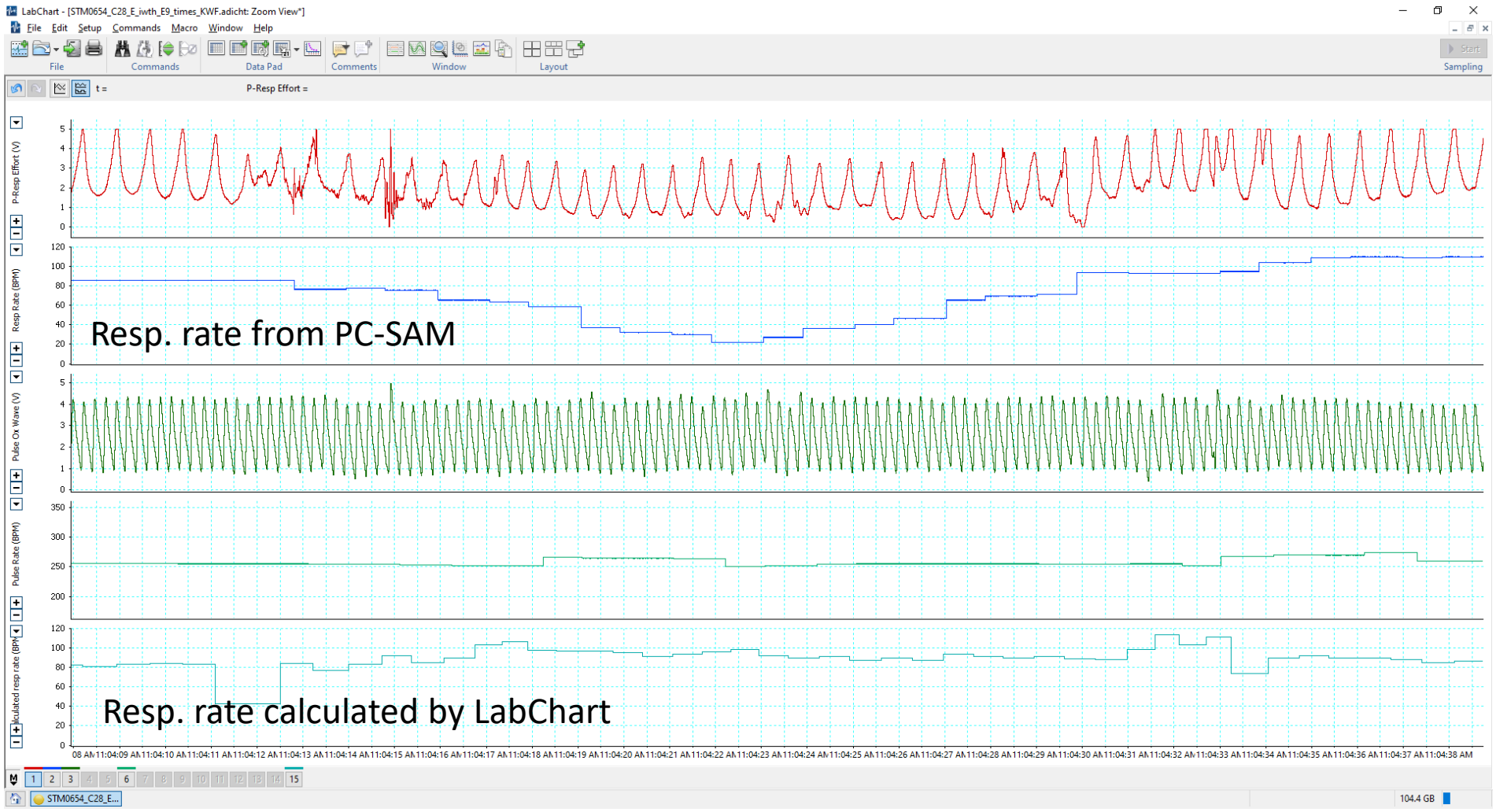
LabChart can correct baseline drift



Use the zoom control and slider to locate a region with bad rate data



On closing the “Cyclic Measurements” and “Chart Settings…” windows, the calculated respiration rate is shown in the new, bottom trace.

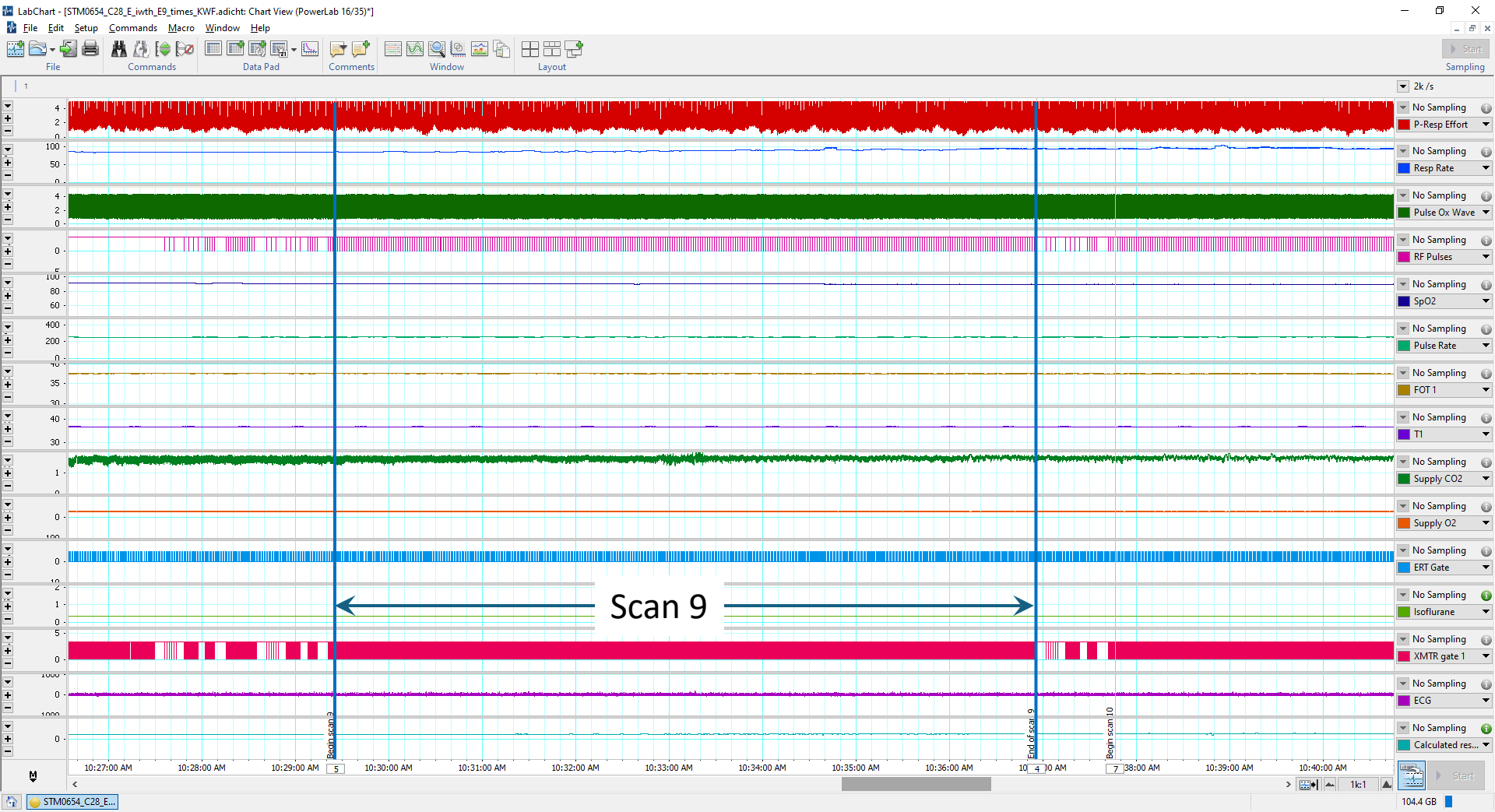


Exporting Data to a Text File

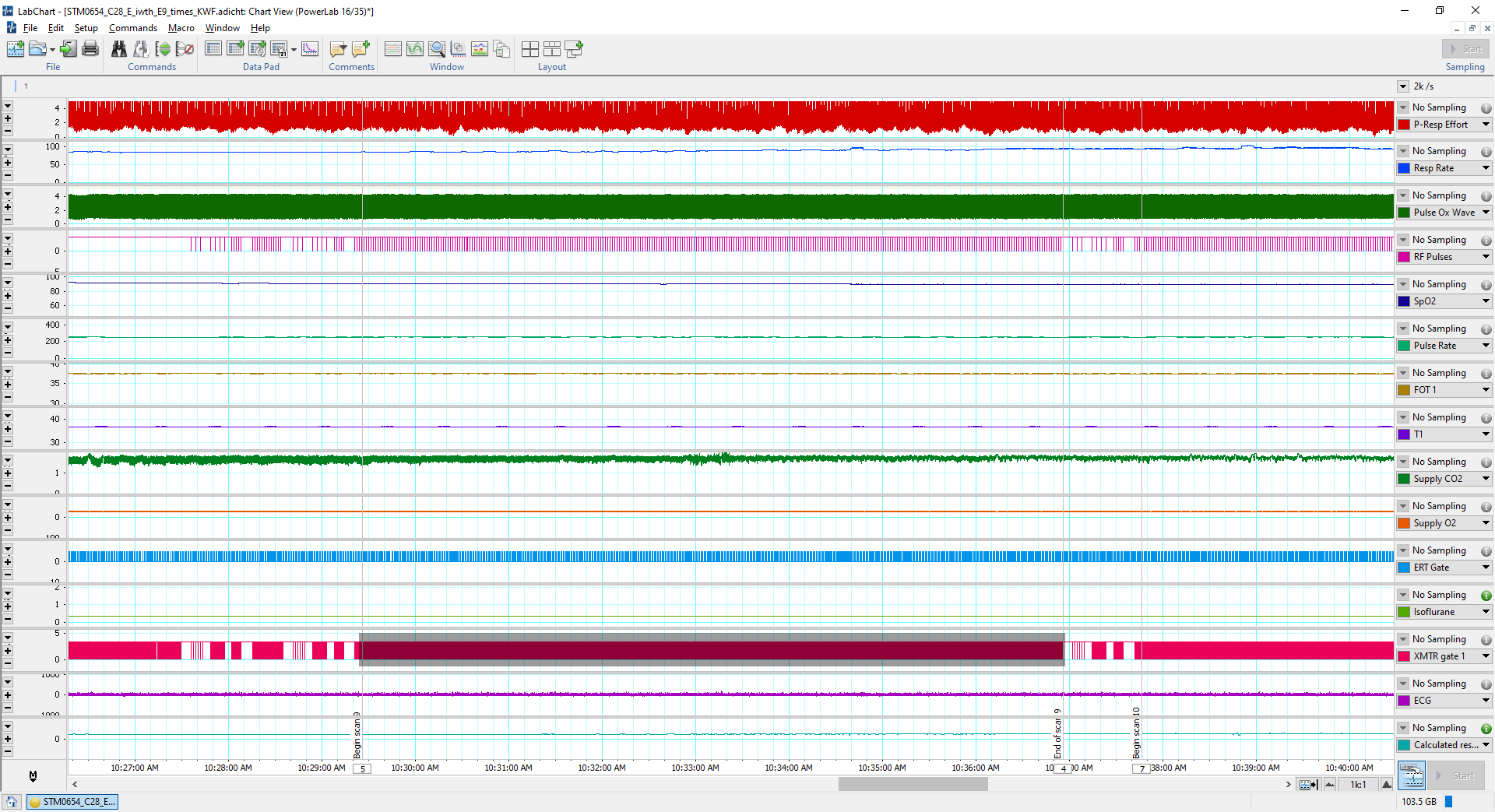
Challenges to exporting the physiological data that exactly correspond to each MRI scan

- When selecting data to export, you can't position the cursor with sufficient accuracy to exactly match the true beginning and end of the scan.
- There doesn't seem to be a way to zoom in and out without clearing the selection.
- LabChart doesn't seem to let you type in bounds for exporting data.
- **Since we do know the exact beginning and end time, we can export data from a little before to a little after the scan, then trim the data to the correct times.**

At a zoom factor of 1k:1 in LabChart, you can see the entire record for one fMRI EPI scan. At this zoom factor, the scan seems to contain a continuous block of XMTR gate 1 pulses.



On the XMTR gate 1 trace, select an interval from just before the beginning of scan 9 to just after end-of-scan, as determined earlier.

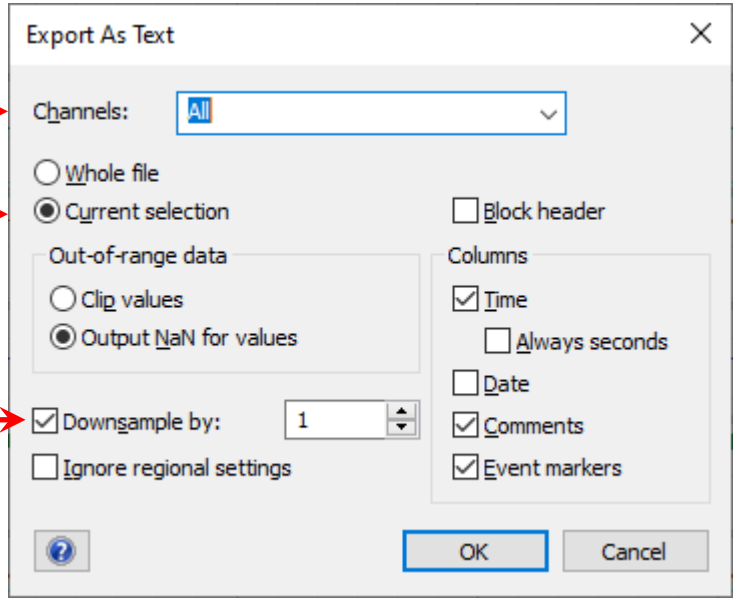


Choose “File->Export…” and name the exported text file. Next, adjust export settings as shown below.

Exporting all channels →

Very important! →

Downsample = 1 (or unchecked): 0.5 ms per point, ca. 3000 rows per dynamic, ca. 86 rows per slice, ca. 900,000 rows total →



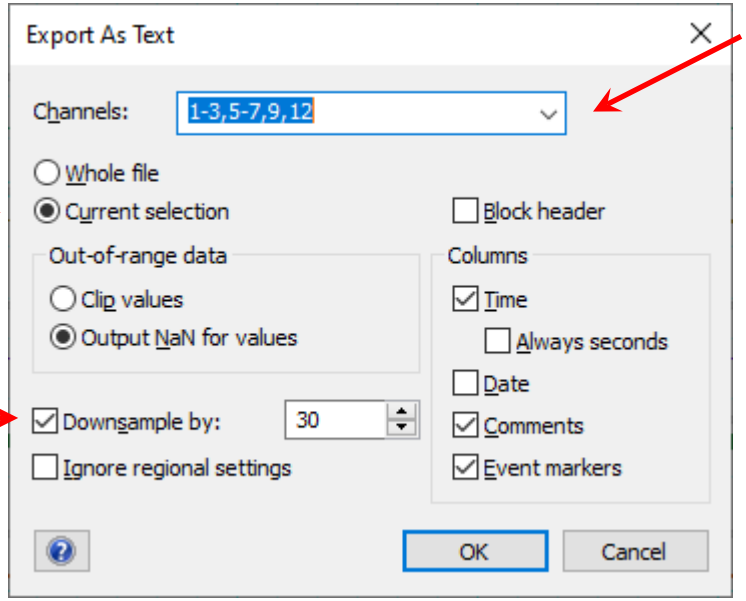
These settings export data from all channels at all sampled points in the selected interval.

Pro: Users can see the logic pulses on channel (one per dynamic) and channel 13 (XMTR gate 1; one per slice) to precisely locate data.

Con: The resulting text file takes several minutes to export and is huge (128 MB!)

To save time and space, data may be downsampled and only useful channels exported.

Very important!



Export just essential channels:
1. Respiratory effort
2. Resp. rate (from PC-SAM),
3. Pulse ox signal
5. SpO2 (from PC-SAM)
6. Pulse rate (from PC-SAM)
7. Rectal temp. (FOT1)
9. Exhaled CO2 (from CWE)
12. Isoflurane dose

Downsample by 30:
15 ms per point
ca. 100 rows per dynamic
ca. 3 rows per slice
ca. 30,000 rows total

Pro: Export much faster and exported text file is much smaller (2.6 MB).
Con: The time per point is too long to reliably digitize the logic pulses, so they are not usable for locating individual dynamics or slices. However, these can be located by calculating time from the beginning or end of the scan.

Using the start and stop times from the Comments window in LabChart, trim the exported text file to exclude data before dynamic 1 or after end-of-scan.

10:29:26.0346 AM	4.745729	86.41066	2.754891	90.82231	255.104	37.52354	1.433104	0.3507409
10:29:26.0496 AM	4.076833	86.40427	3.756031	90.80211	255.1147	37.52243	1.414223	0.3506737
10:29:26.0646 AM	3.359292	86.39787	4.127583	90.80413	255.104	37.52077	1.382516	0.3507185
10:29:26.0796 AM	2.791656	86.39787	4.023927	90.792	255.1168	37.52243	1.382802	0.3506177
10:29:26.0946 AM	2.338062	86.37653	3.692177	90.81019	255.1125	37.52077	1.367673	0.3505953
10:29:26.1096 AM	2.001156	86.38507	3.302349	90.792	255.0933	37.5228	1.363289	0.3507074
10:29:26.1246 AM	1.759229	86.40853	2.949573	90.79604	255.1147	37.51985	1.342328	0.3507522
10:29:26.1396 AM	1.537427	86.38507	2.655411	90.81221	255.1189	37.52243	1.339331	0.3506737
10:29:26.1546 AM	1.360927	86.39787	2.377349	90.81019	255.1168	37.52188	1.3388	0.3506961
10:29:26.1696 AM	1.221708	86.39147	2.122615	90.81827	255.1083	37.52022	1.339086	0.3507074
10:29:26.1846 AM	1.140906	86.38934	1.854312	90.80817	255.1253	37.52169	1.339066	0.3506737
10:29:26.1996 AM	1.09474	86.38293	1.572677	90.81827	255.104	37.52243	1.339127	0.3506513
10:29:26.2146 AM	1.094729	86.39147	1.319984	90.81625	255.1168	37.52077	1.339066	0.3507857
10:29:26.2296 AM	1.087917	86.4064	1.036156	90.81019	255.1125	37.52188	1.33876	0.3507409
10:29:26.2446 AM	1.054948	86.4192	0.8267292	90.81423	255.0997	37.52022	1.339066	0.3507746
10:29:26.2596 AM	1.055042	86.40853	1.387203	90.83039	255.1211	37.52243	1.362718	0.3506177
10:29:26.2746 AM	1.027083	86.3872	2.783568	90.80413	255.1189	37.52372	1.382781	0.3505729
10:29:26.2896 AM	0.975375	86.38934	3.870443	90.81019	255.1232	37.52114	1.415772	0.3507409
10:29:26.3046 AM	0.9206563	86.37653	4.276146	90.81221	255.1168	37.51985	1.448457	0.350685
10:29:26.3196 AM	0.856	86.3744	4.163818	90.77584	255.0784	37.52169	1.48416	0.3506626
10:29:26.3346 AM	0.7924895	86.37866	3.769099	90.81625	255.1147	37.52077	1.50822	0.3507522
10:29:26.3496 AM	0.7595937	86.37653	3.331729	90.82029	255.1147	37.52151	1.533075	0.3507522

#* Begin scan 9

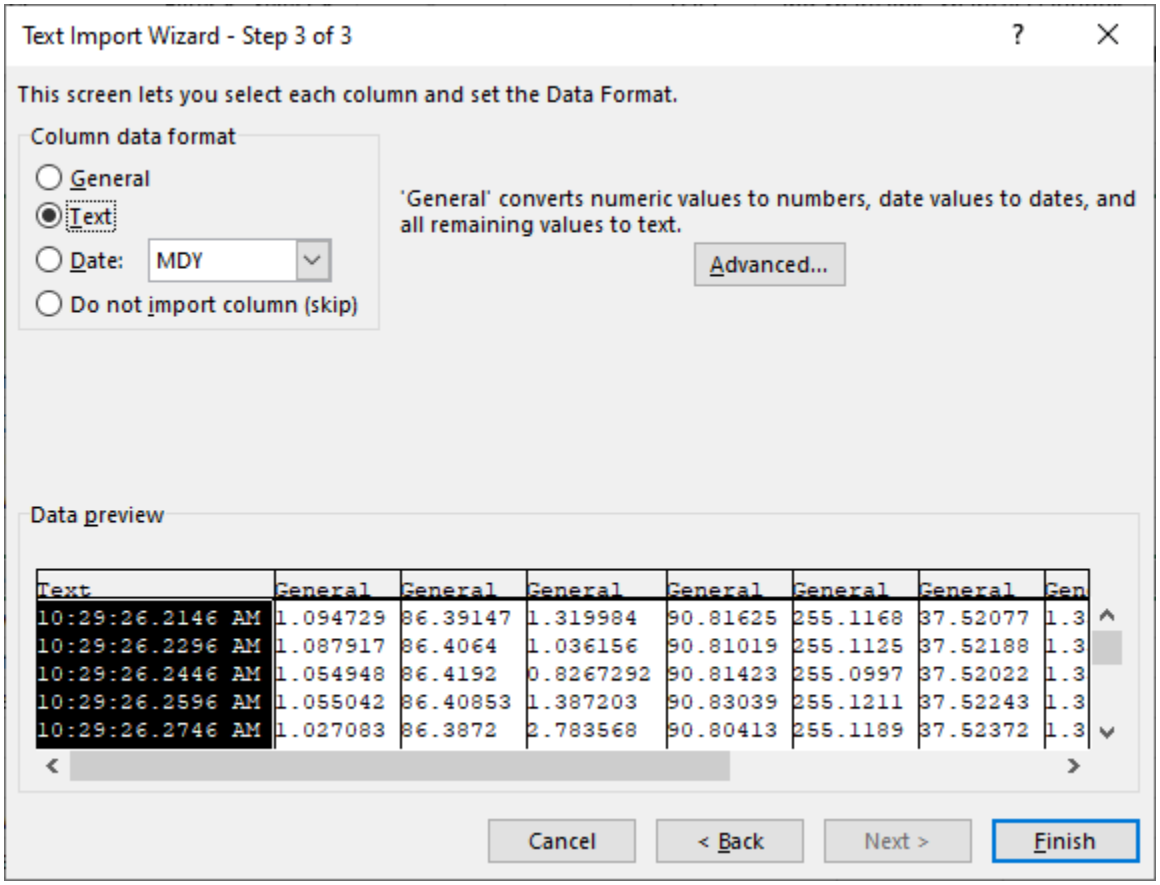
Delete rows before dynamic 1
(start time = 10:29:26.218601)

10:36:56.2596 AM	3.460573	94.54934	1.186984	89.86039	253.0304	37.49975	1.705023	0.3515703
10:36:56.2746 AM	3.800552	94.5664	0.9491146	89.86646	253.0389	37.49754	1.706104	0.3516151
10:36:56.2896 AM	4.161656	94.54507	1.268573	89.85837	253.0496	37.49754	1.714729	0.3517833
10:36:56.3046 AM	4.622021	94.56	2.477125	89.86039	253.0453	37.49938	1.715218	0.3516264
10:36:56.3196 AM	4.967844	94.55573	3.628	89.86039	253.0347	37.50067	1.722865	0.3516824
10:36:56.3346 AM	4.987386	94.54293	4.158734	89.85231	253.0325	37.49901	1.724577	0.3516824
10:36:56.3496 AM	4.987386	94.52587	4.146609	89.84221	253.0283	37.49772	1.724801	0.351604
10:36:56.3646 AM	4.98724	94.5408	3.836568	89.83008	253.0261	37.49809	1.724924	0.3516264
10:36:56.3796 AM	4.987344	94.5344	3.412854	89.85635	253.0304	37.49625	1.725128	0.3516151
10:36:56.3946 AM	4.970729	94.5472	2.967484	89.85837	253.0048	37.49717	1.725148	0.3515479
10:36:56.4096 AM	4.636521	94.54934	2.58588	89.84827	253.0368	37.49864	1.725128	0.35166
10:36:56.4246 AM	3.988979	94.56427	2.289448	89.85231	253.0283	37.50049	1.724985	0.3517385
10:36:56.4396 AM	3.389271	94.56	2.072219	89.8806	253.0261	37.4992	1.724924	0.3517272
10:36:56.4546 AM	2.869583	94.5408	1.846417	89.86039	253.0389	37.49717	1.724944	0.351772
10:36:56.4696 AM	2.457146	94.53013	1.621781	89.86242	253.0432	37.4992	1.725005	0.3517161
10:36:56.4846 AM	2.184333	94.5472	1.391734	89.86646	253.0517	37.49957	1.724129	0.3516713
10:36:56.4996 AM	1.942625	94.53866	1.150255	89.87454	253.0261	37.49846	1.715381	0.3516151
10:36:56.5146 AM	1.764958	94.53227	0.9317917	89.8806	253.0496	37.49735	1.701435	0.3515703
10:36:56.5296 AM	1.637823	94.528	1.436812	89.87252	253.024	37.49994	1.678496	0.3515703
10:36:56.5446 AM	1.552115	94.53866	2.778198	89.85433	253.0176	37.49957	1.670993	0.3515927

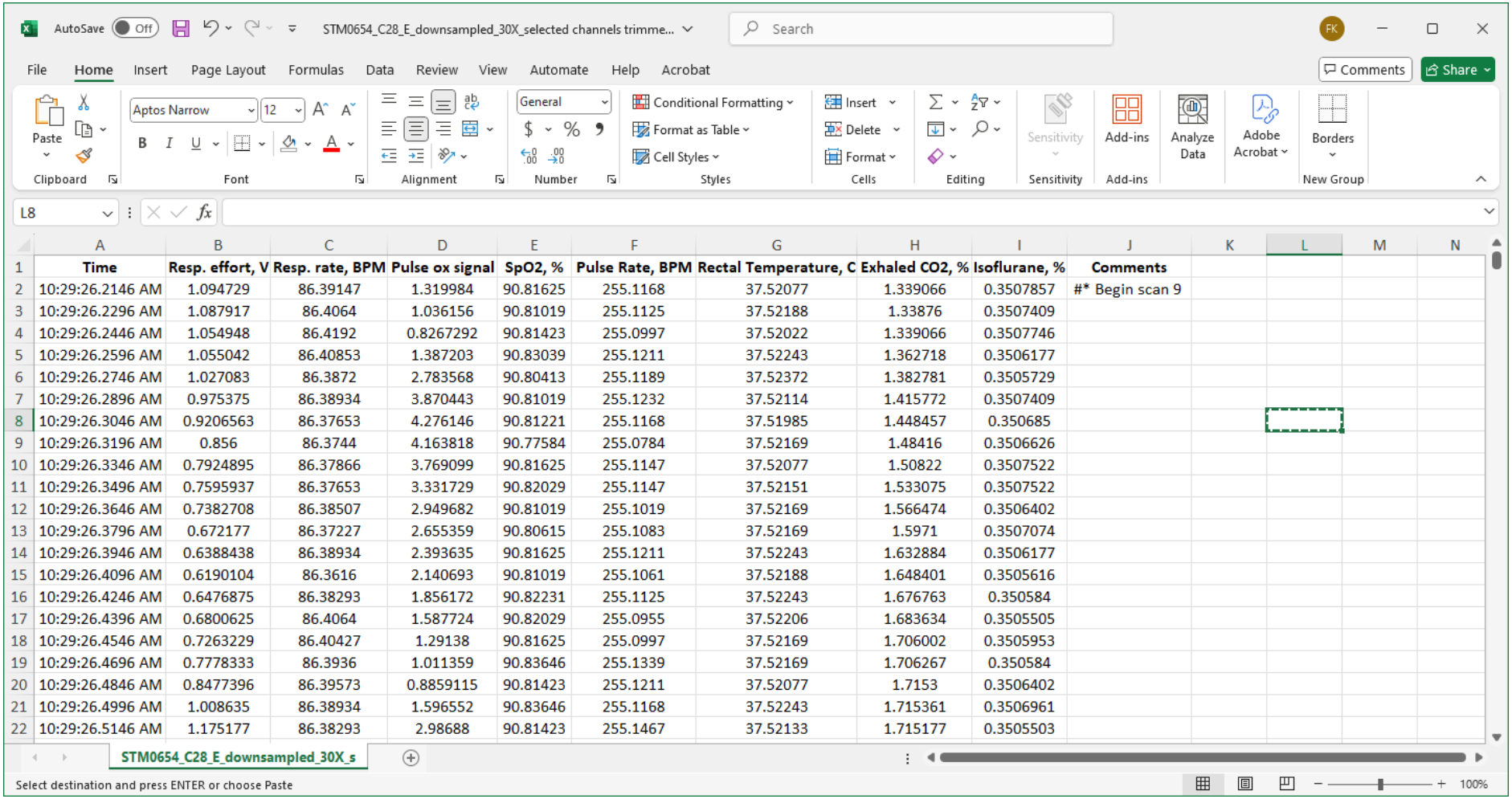
#* End of scan 9

Delete rows after dynamic 300
(end time = 10:36:56.424601)

When importing data into Excel, specify first (time) column as text since Excel times do not show fractional seconds.



Final result: Physiological data for E9!



AutoSave Off — STM0654_C28_E_downsampled_30X_selected channels trimme... — Search

File Home Insert Page Layout Formulas Data Review View Automate Help Acrobat — Comments — Share

Paste — Aptos Narrow — 12 — General — Conditional Formatting — Format as Table — Cell Styles — Insert — Delete — Format — Sensitivity — Add-ins — Analyze Data — Adobe Acrobat — Borders

Clipboard | Font | Alignment | Number | Styles | Cells | Editing | Sensitivity | Add-ins | New Group

L8

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Time	Resp. effort, V	Resp. rate, BPM	Pulse ox signal	SpO2, %	Pulse Rate, BPM	Rectal Temperature, C	Exhaled CO2, %	Isoflurane, %	Comments				
2	10:29:26.2146 AM	1.094729	86.39147	1.319984	90.81625	255.1168	37.52077	1.339066	0.3507857	#* Begin scan 9				
3	10:29:26.2296 AM	1.087917	86.4064	1.036156	90.81019	255.1125	37.52188	1.33876	0.3507409					
4	10:29:26.2446 AM	1.054948	86.4192	0.8267292	90.81423	255.0997	37.52022	1.339066	0.3507746					
5	10:29:26.2596 AM	1.055042	86.40853	1.387203	90.83039	255.1211	37.52243	1.362718	0.3506177					
6	10:29:26.2746 AM	1.027083	86.3872	2.783568	90.80413	255.1189	37.52372	1.382781	0.3505729					
7	10:29:26.2896 AM	0.975375	86.38934	3.870443	90.81019	255.1232	37.52114	1.415772	0.3507409					
8	10:29:26.3046 AM	0.9206563	86.37653	4.276146	90.81221	255.1168	37.51985	1.448457	0.350685					
9	10:29:26.3196 AM	0.856	86.3744	4.163818	90.77584	255.0784	37.52169	1.48416	0.3506626					
10	10:29:26.3346 AM	0.7924895	86.37866	3.769099	90.81625	255.1147	37.52077	1.50822	0.3507522					
11	10:29:26.3496 AM	0.7595937	86.37653	3.331729	90.82029	255.1147	37.52151	1.533075	0.3507522					
12	10:29:26.3646 AM	0.7382708	86.38507	2.949682	90.81019	255.1019	37.52169	1.566474	0.3506402					
13	10:29:26.3796 AM	0.672177	86.37227	2.655359	90.80615	255.1083	37.52169	1.5971	0.3507074					
14	10:29:26.3946 AM	0.6388438	86.38934	2.393635	90.81625	255.1211	37.52243	1.632884	0.3506177					
15	10:29:26.4096 AM	0.6190104	86.3616	2.140693	90.81019	255.1061	37.52188	1.648401	0.3505616					
16	10:29:26.4246 AM	0.6476875	86.38293	1.856172	90.82231	255.1125	37.52243	1.676763	0.350584					
17	10:29:26.4396 AM	0.6800625	86.4064	1.587724	90.82029	255.0955	37.52206	1.683634	0.3505505					
18	10:29:26.4546 AM	0.7263229	86.40427	1.29138	90.81625	255.0997	37.52169	1.706002	0.3505953					
19	10:29:26.4696 AM	0.7778333	86.3936	1.011359	90.83646	255.1339	37.52169	1.706267	0.350584					
20	10:29:26.4846 AM	0.8477396	86.39573	0.8859115	90.81423	255.1211	37.52077	1.7153	0.3506402					
21	10:29:26.4996 AM	1.008635	86.38934	1.596552	90.83646	255.1168	37.52243	1.715361	0.3506961					
22	10:29:26.5146 AM	1.175177	86.38293	2.98688	90.81423	255.1467	37.52133	1.715177	0.3505503					

STM0654_C28_E_downsampled_30X_s

Select destination and press ENTER or choose Paste — 100%