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# 1. Chart Recording

The Online Analysis of PATCHMASTER can be used as chart recorder. Therefore, a fixed set of parameters should be displayed in ONE Online Window during the whole experiment. The display parameters of this window should be kept constant in all analysis methods used during the experiment. The set of analysis functions must be contained in each Analysis Method used during the experiment. If an analysis function can not be calculated due to e.g. missing data, no entry to the online display is added.

We recommend to record one experiment per data file only.

## 1.1 Setting Up for Chart Recording

### 1.1.1 Configuring the Online Analysis

In the Online Analysis the following settings should be made:

- **Wipe behavior** In order to prevent a "wipe" (clear of display in the the online window), you should check the option "Overlay". A wipe can be performed manually by clicking on the Wipe button in the Oscilloscope Window or automatically via a command implemented in the Protocol of the Protocol Editor.
  - **Wrap behavior**
    - In case you want to have a display of the whole experiment chart in the Online Window at all times, deselect the "Wrap" option and use Autoscale-X axis.
    - A more typical display method during chart recording is the wrapping at specified time intervals. Select the "Wrap" option and set the X-axis scaling to fixed and specify the time interval
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(e.g. 30 s). In this case the "Wipe" should be elicited automatically from within the protocol (see below). By use of an "IF (Analysis Function MOD 30 s) THEN Wipe" statement in the main experimental loop, the display of the online window can be cleared at each wrap.

- (Analysis Functions) A standard set of analysis functions should be listed at the beginning of the function selector at constant index numbers. E.g. the TimerTime should be assigned to analysis function number 1, current to 2, voltage to 3 etc. So that all function that are common to all analysis methods and a subject to be used for the chart display are listed in the beginning.

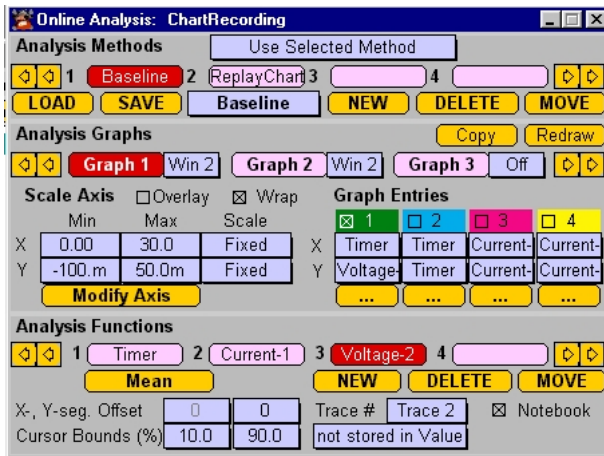


Figure 1.1: Sequence of the Testpulse used during Chart Recording. Please note that the order of AD channels recorded should be identical for all stimulation sequences used during Chart Recording.

### 1.1.2 Pulse Sequences

When setting up the Pulse sequences the following issues should be followed:

- You should use the identical order of acquired traces in all pulse sequences that are used during one experiment in order to allow replay of data with one online analysis method.
- Specify the Analysis Method, if different methods are used for different pulse sequences.

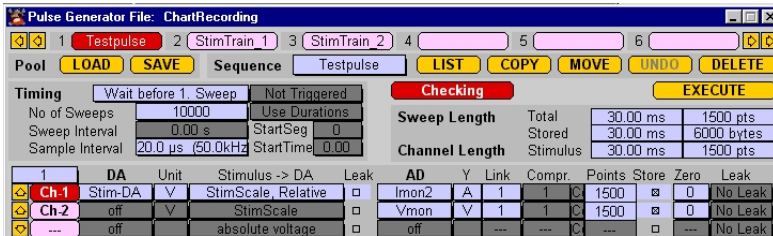


Figure 1.2: OnlineAnalysis Method used during Chart Recording. When the Wrap mode is used, fixed scaling for the X and Y-axis are required. The X-Max defines the page size.

## 1.2 Replay of Whole Experiment

When replaying the whole experiment you have to address the following points:

- You should define an additional online method, e.g. "ReplayChart" that contains the identical set of analysis functions as the methods used during the experiment, but with different display parameters:
  1. Use the copy function to create an new analysis function.
  2. Disable the "Wrap" option.
  3. Disable the "Overlay" option.
  4. Set the X-axis scaling to "autoscale after a series".
- In order to disable the "Automatic stimulus control" for the online Analysis you must select "Use Selected Online Method" as Online

Mode. (This can be done automatically at the end of the experiment from within the Protocol, see below)

- Replay the whole experiment. (Automatic replay at the end of the protocol can be implemented, see below.)

## 1.3 Experiment Control via a Protocol

The whole experimental control can be implemented in a protocol. The protocol can be used e.g.

- to configure the program for the individual display and analysis needs,
- to react to user input during the experiment,
- to react on analysis results or signals coming from peripheral devices,
- to automate tasks at the end of the experiment such as updating the file or replaying the whole experiment.

*Note: Another advantage of the protocol control is that you can switch between different pulse sequences during the experiment without wiping the display of online data which have been recorded before applied pulse sequence.*

A typical protocol consists of the following parts:

### 1.3.1 Prefix

In the Prefix section of the protocol we e.g.

**Configure Online behavior:** Since we do not want to wipe all the display of the online analysis when a new pulse sequence is started, we set "Wipe=OFF" in the Acquire event. Then, we set the Online Analysis behavior to "Auto" (=Automatic Stimulus Control).

```
Acquire          ( 0.000s) : Wipe=OFF
Online           ( 0.000s) : Auto
```

### 1.3.2 Main Loop

**Goto\_Mark:** At the beginning of the main loop we define a Goto\_Mark as reference point for returning back into the main loop.

```
GOTO_MARK      ( 0.000s) : "Baseline"
```

**Repeat Each Sweep:** With the "Repeat Each Sweep" event the main loop is defined. In a defined interval (e.g. every 1 second) one sweep of a test series is executed. In our example we execute a test pulse together with a command pulse for excitation of a fluorescence dye.

```
REPEAT        ( 0.000s) : sweeps 1.000s
  Sweep       ( 0.000s) : "Baseline", "", ""
  ...
END_REPEAT
```

**Conditional Statement:** With in the "Repeat Each Sweep" event we place a conditional statement. In our example the "If" statement is used to start a special action upon a key stroke and automatically wipes the online display every 30 seconds (in our example the same time interval the "Wrap" command is defined in the Online Analysis dialog).

If key "1" is hit, we jump to the Goto\_Mark "Stimulus\_1" which is located in the special actions section. Key "2" jumps to "Stimulus\_2". Key "F12" jumps to the mark "End" to enter the postfix section of the protocol to terminate the experiment. The online function number 1 analysis the TimerTime in our example. So, every 30 seconds a "WipeOnline" event is executed.

```
IF            ( 0.000s): Key = "1"
  ClearKey    ( 0.000s)
  GOTO        ( 0.000s): "Stimulus_1"
ELSIF        ( 0.000s): Key = "2"
  ClearKey    ( 0.000s)
  GOTO        ( 0.000s): "Stimulus_2"
ELSIF        ( 0.000s): Key = F12
  ClearKey    ( 0.000s)
  GOTO        ( 0.000s): "End"
ELSIF        ( 0.000s): Online-1 MOD 30.000
```

```
SetOsci          ( 0.000s): WipeOnline, Tr(N)= 1111111111111111
END_IF
```

**Special Actions:** Upon jumping to one of the Goto Marks the acquisition of a Series is executed. In our example when jumping to "Stimulus\_1" the Series "StimTrain\_1" is executed and then we return to the mark "Baseline" to reenter the experimental main loop.

```
;special actions GOTO\_MARK ( 0.000s): "Stimulus_1"
Series              ( 0.000s): "StimTrain_1", "", ""
GOTO                ( 0.000s): "Baseline"
GOTO\_MARK          ( 0.000s): "Stimulus_2"
Series              ( 0.000s): "StimTrain_2", "", ""
GOTO                ( 0.000s): "Baseline" ...
```

### 1.3.3 Postfix

At the end of the experiment we would like to display the online data of the whole experiment in the Online Window 2. Therefore, we first scroll back to the beginning of the experiment in the Replay window. Then, we set the Online Analysis to the method "ReplayChart" and finally replay the whole experiment.

```
;Show whole experiment at the end
GOTO\_MARK          ( 0.000s): "End"
Command            ( 0.000s): "R ScrollLeft"
Command            ( 0.000s): "R ScrollLeft"
Command            ( 0.000s): "R ScrollLeft"
Command            ( 0.000s): "R ScrollLeft"
Command            ( 0.000s): "R ScrollRight"
Online              ( 0.000s): "ReplayChart"
Command            ( 0.000s): "R ShowIt"
```

## 1.4 Chart Recording: An Example

The following example is configured for working with an EPC 10 Single patch clamp amplifier. In case you are using another amplifier (e.g. EPC 9 or EPC 10 Double or Triple) please double check the assignment of the acquisition channels in the example pgf file.

### 1.4.1 Getting Started

1. Please connect the model cell to your amplifier,
2. start the PATCHMASTER software and
3. load the following example files:
  - ChartRecording.pgf
  - ChartRecording.onl
  - ChartRecording.pro
4. Open (create) a new data file.
5. Bring the Model Cell into the whole-cell configuration. To do so,
  - first switch the model cell to the 10 MOhm position and press the "SET-UP" button in the amplifier window.
  - Then switch to the middle position and press "ON-CELL".
  - Finally, switch to the 0.5 GOhm position and press "WHOLE-CELL".
6. Now apply some typical holding potential. Let's say -70 mV.

Now we are ready to start the experiment.

### 1.4.2 The Chart Recording

During the example recording you should execute or note the following points:

- Just before you start your experiment set the Timer to zero. (Press the "Set" button in the Oscilloscope.)

***Note:** Typically you might zero the Time at the time you go whole-cell. If appropriate you can also implement the `ResetTimer` function in a protocol.*

- You will start the chart recording by executing the protocol "Baseline". To do so, select the protocol in the ProtocolEditor window and press the "Go" button.
- Now you will see the voltage and current displayed in the two graphs of OnlineWindow 2.
- You can execute the pgf sequence "StimTrain\_1" by pressing the key "1" on your keyboard. You will see increasing voltage and current steps in the chart display. After the "StimTrain\_1" sequence is finished the protocol will automatically return to the "Baseline" sequence.
- When the timer time crossed a multiple of 30 seconds the chart will be wrapped and wiped.
- You can play around with it and e.g. execute some other sequences. (in this example we have prepared the protocol and pgf for two different stimulation sequences.)
- If we would like to terminate the experiment we press "F12". Then, automatically the whole experiment chart will be replayed and displayed on the screen.

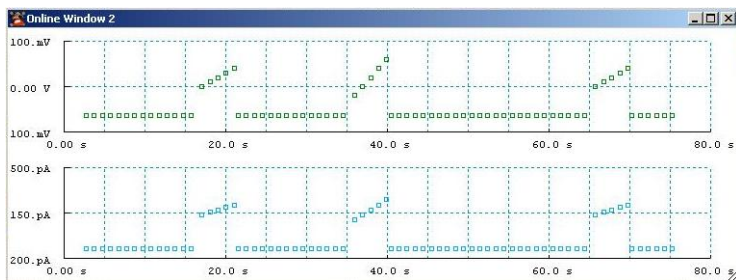


Figure 1.3: Display of the chart of the whole experiment. Three stimulation sequences have been elicited manually. For the display the Wrap mode has been disabled and the X-axis has been set to autoscale.

To start the next experiment (e.g. with another cell) we suggest to open a new file.

***Note:** You can also create another *Experiment* in the data tree of the current data file. If you do so, it is advisable not to reset the *TimerTime* while the file is opened and more data will be stored to the file.*