

# USER MANUAL

## Cap CTRL

Version 1.3.0

Monitor and regulate water pH or  $p\mbox{CO}_2$  in sea and fresh water





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## 2.Getting started

Please follow these few steps below to get started. For more details go to the page numbers listed under each step.

- 1. Uninstall any previous versions of CapCTRL software (page 8).
- 2. Install the new CapCTRL software on a PC with Windows 8 or Windows 7 (page 9).

| Minimum PC requirements: |                             |  |  |
|--------------------------|-----------------------------|--|--|
| CPU                      | Duo core 2,4 GHz or similar |  |  |
| RAM                      | 2 GB                        |  |  |
| USB ports                | 2-6 (system dependent)      |  |  |
| Monitor                  | 1024 x 768                  |  |  |

- 3. Connect the DAQ-M instrument to the PC (page 17). Make sure to use grounded outlets only for all instruments and the PC.
- 4. Then connect your WTW pH-3310 instruments and activate the data communication (page 18).
- 5. For monitoring and controlling water temperature or pCO2 while measuring pH, please see page 23.
- 6. Insert the green hardkey protection dongle (page 19).
- 7. Start the CapCTRL software (page 19).



## 3. List of parts

- DAQ-M instrument
  - Power cord
  - Converter piece (230 V/110 V)
- User manual

#### Optional

-

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- WTW pH 3310 SET
- WTW pH 3310 instrument
- SenTix 41-3 probe
- Buffer fluids
- Suitcase
- USB cable

#### TMP-SET

- Coil
- Pump
- Tubing

#### DO-SET

- Air stone
- Solenoid valve
- Push-in fittings
- PU tubing



## 4. Examples of systems

















## 5.Installation procedure for CapCTRL

#### 5.1 CapCTRL software for Windows

The following steps will explain how to install CapCTRL and instrument drivers on your PC.

Minimum PC requirements:CPUDuo core 2,4 GHz or similarRAM2 GBUSB ports2-6 (system dependent)Monitor1024 x 768

It is important to remove any previous versions of CapCTRL before starting to install new CapCTRL software:

- 1. Click Start→Control Panel
- 2. Open Programs and Features
- 3. Double click on National Instruments software
- 4. Select all packages, and then click on Remove.

| 🚽 National Instruments Software   |  |
|---|--|
| Products       Patches         NI 985x Software 1.3.5 <ul> <li>NI CompactRIO 3.5.0</li> <li>NI CompactRIO Module Support 3.5.0</li> <li>NI FlexRIO 1.5.0</li> <li>NI FlexRIO Adapter Module Support 1.8.0</li> <li>NI FlexRIO Adapter Module Support 1.8.0</li> <li>NI Hierarchical Waveform Storage 1.4.8</li> <li>NI IVI Compliance Package 4.2</li> <li>NI Instrument I/O Assistant</li> <li>NI LabVIEW 2009</li> <li>NI LabVIEW 2010</li> </ul> | Modify Change which application features are installed. Displays the Select Features dialog, which lets you configure individual features.  Repair Reinstall missing or corrupt files, registry keys, and shortcuts. Preferences stored in the registry may be reset to default values.  Remove Remove Remove product from this computer.  Close |

- 5. You will then be notified that CapCTRL also will be removed. Click Yes
- 6. Now wait until all packages are uninstalled. This might take some time.
- 7. Windows will now ask for a restart.
- 8. When the computer is restarted, please proceed and install the new CapCTRL software.



Insert the CD labelled CapCTRL and wait until you see the following screen. If you do NOT see the screen, browse to the root of your CD and double click on the icon labelled CapCTRL\_Installer.exe.

| WinZip Self-Extractor - CapCTRL_DEMO_Installer.exe |        |  |
|--|--------|--|
| Unzipping CapCTRL DEMO by Loligo Systems           | Setup  |  |
|  | Cancel |  |
| Unzipping data.cab                                 | About  |  |

Click Next to start installation of CapCTRL.

| CapCTRL DEMO  |                |
|---|----------------|
| Welcome to the CapCTRL DEMO Installer   |                |
| Please follow the instructions on screen. Do not turn off the computer until the installation is complete.<br>After the installation of CapCTRL DEMO the Loligo Service Pack 1 will be installed. |                |
|   |                |
| << <u>B</u> ack <u>Next &gt;&gt;</u>  | <u>C</u> ancel |



Select destination directory for CapCTRL and for the National Instruments driver and then press Next.

| CapCTRL DEMO  |
|---|
| <b>Destination Directory</b><br>Select the primary installation directory.  |
| All software will be installed in the following location(s). To install software into a<br>different location(s), click the Browse button and select another directory. |
| Directory for CapCTRL DEMO<br>C:\Program Files\CapCTRL DEMO\<br>Browse  |
| Directory for National Instruments products<br>C:\Program Files\National Instruments\<br>Browse   |
| << <u>B</u> ack <u>N</u> ext >> <u>C</u> ancel  |

If you accept the License Agreement, please select  ${\rm ``I}$  accept the License Agreement(s)" and then press Next.

| CapCTRL DEMO   |  |
|--|--|
| License Agreement<br>You must accept the license(s) displayed below to proceed.  |  |
| NATIONAL INSTRUMENTS SOFTWARE  |  |
| INSTALLATION NOTICE: THIS IS A CONTRACT. BEFORE YOU D<br>AND/OR COMPLETE THE INSTALLATION PROCESS, CAREFUL<br>DOWNLOADING THE SOFTWARE AND/OR CLICKING THE APP<br>COMPLETE THE INSTALLATION PROCESS, YOU CONSENT TO<br>AGREEMENT AND YOU AGREE TO BE BOUND BY THIS AGREE<br>BECOME A PARTY TO THIS AGREEMENT AND BE BOUND BY A<br>CONDITIONS, CLICK THE APPROPRIATE BUTTON TO CANCE!<br>DO NOT INSTALL OR USE THE SOFTWARE, AND RETURN THI<br>(30) DAYS OF RECEIPT OF THE SOFTWARE (WITH ALL ACCON<br>ALONG WITH THEIR CONTAINERS) TO THE PLACE YOU OBTA<br>SHALL BE SUBJECT TO NI'S THEN CURRENT RETURN POLIC | DOWNLOAD THE SOFTWARE<br>LLY READ THIS AGREEMENT. BY<br>PLICABLE BUTTON TO<br>D THE TERMS OF THIS<br>EMENT. IF YOU DO NOT WISH TO<br>ALL OF ITS TERMS AND<br>L THE INSTALLATION PROCESS,<br>E SOFTWARE WITHIN THIRTY<br>MPANYING WRITTEN MATERIALS,<br>INED THEM. ALL RETURNS<br>CY. |
| ● <u>il accept</u><br>○ I do not   | the License Agreement;<br>accept the License Agreement.  |
|  | <u>N</u> ext >> <u>C</u> ancel   |

Click Next.



| CapCTRL DEMO  |                |  |
|---|----------------|--|
| Start Installation<br>Review the following summary before continuing.                                   |                |  |
| Upgrading<br>• CapCTRL DEMO Files   |                |  |
| Adding or Changing     National Instruments system components   |                |  |
|   |                |  |
|   |                |  |
|   |                |  |
| Click the Next button to begin installation. Click the Back button to change the installation settings. |                |  |
| Save File) << Back Next >>  | <u>C</u> ancel |  |

| CapCTRL DEMO                   |   |
|--------------------------------|---|
|                                |   |
|                                |   |
|                                |   |
| 0verall Progress: 26% Complete |   |
|                                |   |
|                                |   |
|                                |   |
|                                |   |
|                                |   |
|                                |   |
|                                |   |
|                                |   |
|                                | << <u>B</u> ack <u>N</u> ext >> <u>Cancel</u> |



| CapCTRL DEMO                                     |                 |        |        |
|--|-----------------|--------|--------|
| Installation Complete                            |                 |        |        |
|  |                 |        |        |
| The installer has finished updating your system. |                 |        |        |
|  |                 |        |        |
|  |                 |        |        |
|  |                 |        |        |
|  |                 |        |        |
|  |                 |        |        |
|  |                 |        |        |
|  |                 |        |        |
|  |                 |        |        |
|  |                 |        |        |
|  | << <u>B</u> ack | Next>> | Einish |



Click Install





| 🛃 WibuKey Setup |  |
|-----------------|--|
|                 | Please select the languages that WibuKey should support:<br>English<br>Chinese [Simplified]<br>French<br>German<br>Italian<br>Hungarian<br>Japanese<br>Portuguese<br>Spanish |
|                 | < <u>B</u> ack <u>N</u> ext > Cancel   |

Click Next.





| 🛃 WibuKey Setup |  |
|-----------------|--|
|                 | If you press »Next« the following tasks will be performed:<br>Operating system: Windows Vista<br>Source path: C:\Users\LOLIGO~1\AppData\Local\Temp\WZSE<br>Selected languages:<br>English<br>The following components will be installed:<br>WibuKey driver files<br>WibuKey COM control<br>WIBU-SYSTEMS Shell Extension<br>WibuKey network server<br>WibuKey tools |
|                 | < <u>B</u> ack Cancel  |

Click Next.





Click Next.

| 🛃 WibuKey Setup |   |
|-----------------|---|
|                 | WibuKey Software Setup is complete.<br>Setup can launch the Readme help file with the latest product<br>informations. |
|                 | Yes, I want to view the Readme text now.  |
|                 | Click »Finish« to complete Setup.   |
|                 | Einish  |

Click Finish.





When installation is complete, please restart your computer



Click Finish, and let the PC restart.



#### 5.2 DAQ-M instrument



The DAQ-M instrument for USB is used with CapCTRL software for regulating water temperature and pH or pCO2 levels.

#### SETUP

To power up the instrument connect the power cord to a <u>grounded</u> wall outlet and the socket labeled *100-240 VAC 50-60Hz* on the back side of the instrument. Remember to switch the instrument ON/OFF using the main power switch. Connect the USB cable to the front input (marked *PC*) and to a free USB port on your PC.

First time the DAQ-M instrument is connected to the PC, the drivers will be installed. This might take some time.

The digital relays are used to control pumps or valves for water quality control. See page 23.

#### SPECIFICATIONS

| 100-240 VAC, 50-60 Hz                      |
|--|
| USB 2.0 (1.1 compatible)                   |
| 8  |
| 0-10 V                                     |
| 14 bit (single-ended)                      |
| 62 dB                                      |
| 1000 Hz                                    |
| 4  |
| 100-240VAC, 50-60 Hz                       |
| 2 A per channel (max 6.3 A for all relays) |
|  |



#### 5.3 WTW pH-3310 instrument



The WTW pH-3310 instrument for USB is used with CapCTRL software for monitoring pH and temperature.

#### SETUP

Connect the USB cable to the front input XXX (marked *PC*) and to a free USB port on your PC. First time the WTW pH-3310 instrument is connected to the PC, the drivers will be installed. This might take some time. If Windows cannot find the drivers, please insert the WTW disc.

The WTW 3310 pH needs to be calibrated before starting an experiment. Please follow the instructions in the WTW user manual of the instrument. The user manual can be found on the CD delivered together with the instrument.

Before starting CapCTRL the WTW instrument serial interface has to be set, to secure export of data.

- 1. Press ENTER in 2 seconds and choose **System**. Then press **Reset** and choose **Yes**.
- 2. Then press F1 and choose Reset. Press Yes.
- 3. Press ENTER in 2 seconds and choose **System**. Then press **Interface** and then **Output format**. Choose **CSV** and press ENTER. Leave the menu.
- 4. Press the F2 button in 2 seconds. Choose **Interval** and set it to 1 s.
- 5. Set **SEND ID** to **Yes**.
- 6. Now choose **Continue** and press ENTER.

The WTW instrument will now start sending data out every second via the serial interface (RS232).

## DO NOT CHANGE ANY SETTINGS, LIKE LANGUAGE, ETC. ELSE THE COMMUNICATION BETWEEN THE INSTRUMENT AND CAPCTRL WILL FAIL.



## 6.Using CapCTRL

**NB!** To enjoy all functions in CapCTRL it is necessary that the PC user has administrator status.

Start CapCTRL from the start menu in Windows. It might take a few seconds to load the program initially. Watch the Windows task bar.

CapCTRL is protected with an USB hardkey dongle (WiBu), and will only run if a valid dongle is connected to an USB port on the computer. If not, the error message below will appear.



Plug in the WiBu hardkey dongle and wait to let it be recognized by Windows. Only then can CapCTRL be used.

CapCTRL will start in the screen mode shown below. Here you can connect the different instruments that you have, calibrate the input channels and set up the relays. Here you also choose pCO2 unit and sample interval for the file writing.

| CapCTRL DEMO     |  |                |          |                               |  |
|------------------|--|----------------|----------|-------------------------------|--|
| File Log Setpoir | nts <b>Help</b>                        |                |          |                               |  |
| General I        | t                                      |                |          |                               |  |
| DAQ-M/S relay    | setting                                | pH instruments |          | Settings                      |  |
| DAQ-M/S          | Device number<br><sup>I</sup> ∕₀Dev1 ▼ | ✓ WTW ph3310   | COM port | pCO2 unit Sample interval [s] |  |
| 🗆 RE 1           | рН, І 💌                                | WTW ph3310     | COM port |                               |  |
| 🗆 RE 2           | рН, II 🔻                               | WTW ph3310     | COM port |                               |  |
| 🗆 RE 3           | рН, Ш 🔫                                | WTW ph3310     | COM port |                               |  |
| 🗆 RE 4           | pH, IV 💌                               |                |          |                               |  |
|                  |  |                |          |                               |  |
|                  |  |                |          |                               |  |
|                  |  |                |          |                               |  |



Example of configuration for a two channel system with pH and temperature regulation.

Available products: DAQ-M instrument WTW ph-3310 (2x) DO-SET (2x) TMP-SET (2x)

Follow the step-by-step procedure below to configure CapCTRL:

- 1. Activate WTW pH-3310 number I and II and select the right COM port. (Refresh?)
- 2. Click device number, browse and choose the right device number. The device number is assigned by the Measurement and Automation Explorer, usually it is set to *dev1*.
- 3. Enable RE1-RE4 and choose pH for RE1 and RE2 and temperature for RE3 and RE4.
- 4. Connect the DO-SETs to RE1 and RE2 and connect the TMP-SETs to RE3 and RE4.

| CapCTRL DEMO      | Help  |                |                   |                               |  |
|-------------------|---|----------------|-------------------|-------------------------------|--|
| General I         | II  |                |                   |                               |  |
| DAQ-M/S relay set | ting  | pH instruments |                   | Settings                      |  |
| DAQ-M/S           | Device number<br><sup>I</sup> / <sub>0</sub> Dev1 | ✓ WTW ph3310   | COM port<br>KCOM1 | pCO2 unit Sample interval [s] |  |
| <b>▼</b> RE 1     | рН, І 💌   | ✓ WTW ph3310   | COM port<br>COM3  |                               |  |
| <b>I</b> RE 2     | рН, II 🔻  | WTW ph3310     | COM port          |                               |  |
| <b>▼</b> RE 3     | Temperature, I 💌                                  | WTW ph3310     | COM port          |                               |  |
| <b>☑</b> RE 4     | Temperature, II 💌                                 |                |                   |                               |  |
|                   |   |                |                   |                               |  |
|                   |   |                |                   |                               |  |

5. Now click on the tab named I to go to pCO2 calibration for WTW pH-3310 instrument number I.





- 6. Make sure that the WTW pH-3310 instrument is correctly configured and calibrated, before calibrating pH vs. pCO2, see page 18.
- 7. Prepare at least two water samples of the same quality/source, since it is important to use water with the same buffer capacity as the water used for experiments.
- 8. Make sure that samples have the same temperature and keep it constant during the calibration procedure.
- 9. Bubble samples with different known pCO2 pressures This can be done using a gas mixture pump (e.g. Wösthof) or calibrated gas mixtures from a supplier of lab gasses. Preferently, choose calibration. We recommend using at least 3 different pCO2 values for calibration, preferently within the range of min and max pCO2 values you want to measure or control.
- 10. Make sure to measure pH several times at each pCO2 level to ensure that readings stabilized.
- 11. The calibration is now done.

E.g this is a calibration for fresh water at 20°C with three different pCO2 values and three pH values measured.



- 12. Repeat Step 4 10 for calibrating WTW ph-3310 instrument number II in the tab II.
- 13. The calibration and configuration is saved to a binary file when closing CapCTRL.

This means that whenever CapCTRL is closed and re-started, all settings and calibration will be remembered.

- 14. Now choose  $Log \rightarrow Start$  to start logging and regulating.
- 15. Now a file dialog pops up, where the user is asked a file path for the data file.





- 16. Move the mouse over the relay indicator diodes in the upper right corner. A Help text will pop up and help the user which relay is used and show the current setpoint.
- 17. Three different time graphs are available, e.g. pH, temperature and pCO2. Use the tab to toggle between the graphs. Right clicking on the graph will show a submenu. It is here possible to hide/show plots, scale axes, view set points graphs etc.
- 18. The data file will look like this:

| Date & time of file |                    |                    |            |      |                 |                   |
|---------------------|--------------------|--------------------|------------|------|-----------------|-------------------|
| creation            | 30-11-2010 12:12   |                    |            |      |                 |                   |
| Data file path      | C:\ 30-11-2010.txt |                    |            |      |                 |                   |
|                     |                    |                    |            |      |                 |                   |
|                     |                    |                    |            |      |                 |                   |
| CALIBRATION DATA I  |                    |                    |            |      |                 |                   |
| рН                  | 7,83               | 7,86               | 7,87       | 6,42 | 6,44            | 6,48              |
| pCO2 [%]            | 0,04               | 0,04               | 0,04       | 0,97 | 0,97            | 0,971             |
| Moving average      | 1                  |                    |            |      |                 |                   |
|                     |                    |                    |            |      |                 |                   |
|                     |                    |                    |            |      |                 |                   |
|                     |                    |                    |            |      |                 |                   |
| Date & Time         |                    |                    |            |      |                 |                   |
| [HH:MM:SS]          | рНI                | Temperature I [°C] | pCO2 I [%] | RE 1 | Setpoint, pH, I | Hysteresis, pH, I |
| 12:12:14            | 4,8                | 26,28              | 40,02      | ON   | 7               | 0,1               |
| 12:12:15            | 4,15               | 28,15              | 175,8      | ON   | 7               | 0,1               |
| 12:12:16            | 3,53               | 29,93              | 723,89     | ON   | 7               | 0,1               |
| 12:12:17            | 2,94               | 31,61              | 2754,97    | ON   | 7               | 0,1               |
| 12:12:18            | 2,39               | 33,18              | 9562,31    | ON   | 7               | 0,1               |
| 12:12:24            | 0,22               | 39,37              | 1303815    | ON   | 7               | 0,1               |



## 7. Regulating water quality

To control the pH or pCO2 in the water a DO-SET is needed. This DO-SET must be connected to the DAQ-M instrument. The DO-SET includes:

- Solenoid valve
- Air stone
- Tubing



To use the DO-SET assemble the system shown in the figure below. The power cord is connected to the DAQ-M.



For using a DO-SET with CapCTRL, connect the solenoid directly to one of the DAQ-M relays. Now activate the relay. After the calibration is finished, the relay settings can be found in Setpoints $\rightarrow$ RE1-RE4.

|         | ~~~~    |
|---------|---------|
| Loligo® | Systems |

|  | 23                |
|--|-------------------|
|  |                   |
| AUTO ON  | ○ OFF             |
| pH setpoint  | pH hysteresis     |
| <ul> <li>Decreasing</li> <li>Increasing</li> </ul> |                   |
| Ramp setpoint                                      |                   |
| Interval [min]                                     | pH interval<br>∎0 |
| Min. pH<br>≹0                                      | Max. pH<br>∯0     |
| <ul> <li>+ feedback</li> <li>- feedback</li> </ul> |                   |
| ОК   | Cancel            |

Enable the control by choosing AUTO. Set the setpoint and hysteresis and if you want the relay to act on values below or above the setpoint. (Decreasing or Increasing)



#### Graphic depiction of the relay function setpoint:



A ramp function allow users to let the software change set points up or down (use negative step value) in a step-wise way. When activating the ramp function CapCTRL will automatically increase/decrease the setpoint by a given interval and after a given time interval. The duration of the time interval can be set in minutes. The user can choose between ramping setpoints with or without feedback. Feedback means that setpoints are not ramped (changed) until the measured value has reached the setpoint value. This to avoid problems with large volumes of water and/or large steps of increment/decrement in values, in which case it can take considerable time to change water temperature or oxygen saturation.

Finally, the user can set minimum and maximum setpoint values to avoid severe changes or harmfull conditions when using the automated ramp functions.

To control the temperature a TMP-SET is needed. This TMP-SET must be connected to the DAQ-M instrument. The TMP-SET includes:

- Stainless coil
- Pump
- Tubing



To use the TMP-SET, assemble the system as shown in the figure below. The power cord for the pump is connected to a DAQ-M relay using a power strip or adapter cable supplied with the system.



After the calibration is finished, the relay settings can be found in Setpoints $\rightarrow$ RE1-RE4.



#### 8.References

The following papers used the same technique to control pCO2.

D.J. McKenzie, A.Z. Dalla Valle, M. Piccolella, E.W. Taylor and J.F. Steffensen 2003. Tolerance of chronic hypercapnia by the European eel (Anguilla anguilla). J. exp. Biol. 206: 1717-1726.

D.J. McKenzie, E.W. Taylor, A.Z. Dalla Valle and J.F. Steffensen 2002. Tolerance of acute hypercapnic acidosis by the European eel (Anguilla anguilla). J. Comp. Physiol. B 172: 347-354.

Cruz-Neto, A. & Steffensen, J. F. (1997). The effects of acute hypoxia and hypercapnia oxygen consumption of freshwater European eel, Anguilla anguilla L. J. Fish Biol. 50; 759-769.