Reference Manual ──────────────

DanioVision™
Temperature Control Unit

for DanioVision DVOC-0041

May 3, 2021
For DanioVision DVOC-0041

The DanioVision Temperature Control Unit

INTRODUCTION

The combination of the DanioVision Observation Chamber and the Temperature Control Unit allows you to set up a temperature-controlled water flow underneath the well plate in the DanioVision Observation Chamber. The result is a constant temperature in the well-plate throughout an experiment.

If you are a new DanioVision user, you get a new DanioVision Observation Chamber, the Temperature Control Unit and all accessories necessary to work with the DanioVision system.

DanioVision users with a DanioVision Observation Chamber purchased before **25 January 2013** must upgrade their DanioVision Observation Chamber in order to be able to work with the Temperature Control Unit. Please contact your Noldus sales representative for more information.

WORKFLOW

Working with the DanioVision Temperature Control Unit involves the following steps:

Set up connections

Connect the DanioVision Temperature Control Unit and the Observation Chamber. See page 5.

Set up EthoVision XT

Set up the DanioVision Temperature Control Unit. See page 9.

OPTIONAL Configure the temperature alarms in EthoVision XT. See page 15.

Carry out an experiment

Acquire data with the DanioVision Observation Chamber and the DanioVision Temperature Control Unit. See page 15.

IMPORTANT After the experiment, drain the DanioVision Observation Chamber and the DanioVision Temperature Control Unit. Also keep the tubing far from sunlight to prevent algae growth inside the tubing. See **Drain the system** on page 10.

OTHER DOCUMENTATION

- Reference Manual - DanioVision Observation Chamber DVOC-0041. To open this manual, in the **Apps** screen choose **Noldus** > **EthoVision XT Other Documentation**.

- EthoVision XT Help. To open the Help, press **F1** in EthoVision XT.

You can download all documentation from www.noldus.com/downloads. Note that you must register and log in to access this page.

Connect the DanioVision Temperature Control Unit and the DanioVision Observation Chamber

IMPORTANT If you are a user of a DanioVision system with version number DVOC-0020/-0021, you need to upgrade your DanioVision Observation Chamber to be able to connect the Temperature Control Unit. Contact your nearest Noldus office for more information.

ACCESSORIES

The DanioVision Temperature Control Unit comes with the following parts:

- A 1.5 m color-coded drain tube.

   NOTE For connecting the DanioVision Temperature Control Unit, you also need the color-coded tubes that come with the DanioVision Observation Chamber DVOC-0041.

- A cable for the temperature sensor with a cinch-plug on both ends.
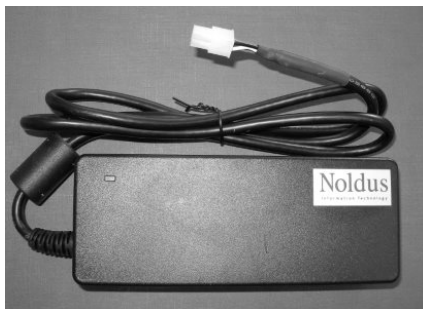

- A 3-m network (UTP) cable to connect the TTL ports on the Temperature Control Unit and the DanioVision Observation Chamber.

- Liquid coolant and a funnel to fill up the coolant.
- The Basin Refill Tool, for filling the DanioVision basin with liquid without opening the DanioVision Observation Chamber (see page 21).

- A power adapter **GS120A24** and a power cord.
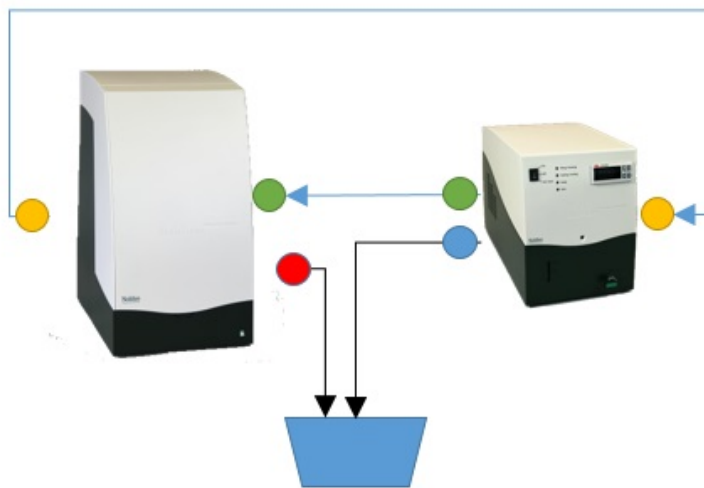
BASIC CONNECTION SCHEME

Figure 1 *Basic connections between the DanioVision Observation Chamber and the Temperature Control Unit.*
Arrows indicate the direction of water flow. Colored circles indicate the color of connectors.

IMPORTANT Make sure you place the DanioVision Temperature Control Unit at the same level as the DanioVision Observation Chamber. If that is not possible, place the DanioVision Temperature Control Unit at no more than 1.3 m below the DanioVision Observation Chamber.

PROCEDURE

1. Connect the tube with the green color code to the connectors with the green ring on (see Figure 2 how to connect a tube) both the DanioVision Temperature Control Unit and the Observation Chamber (indicated by '**2**' in Figure 3). This is the tube through which water flows into the DanioVision Observation Chamber.

2. Connect the tube with the yellow color code to the connectors with the yellow ring on both the DanioVision Temperature Control Unit and the Observation Chamber (indicated by '**1**' in Figure 3). This is the tube through which water flows out of the DanioVision Observation Chamber.
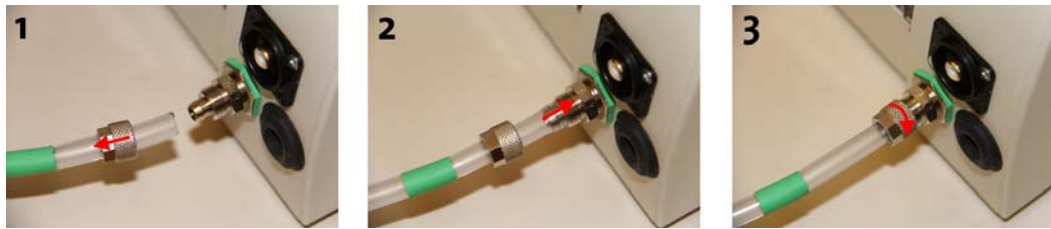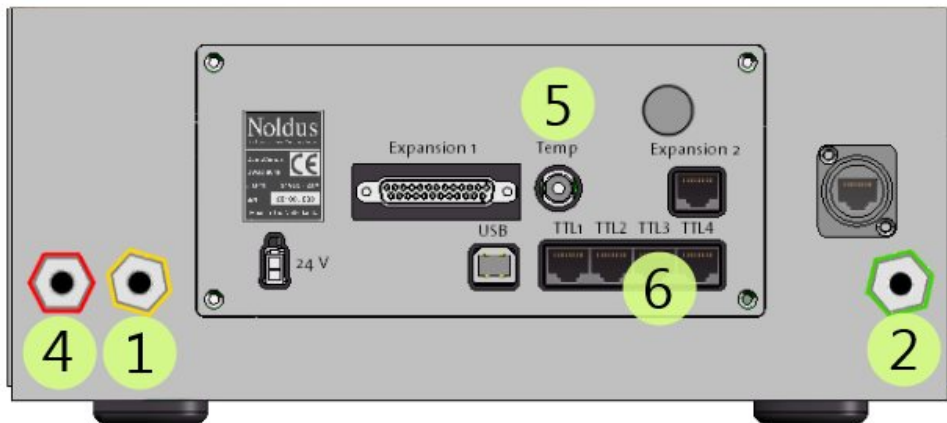
Figure 2 How to connect a tube to a connector. 1 - Slide the nut of the connector onto the tube, 2 - Connect the tube to the connector, 3 - Screw the nut onto the connector.

Figure 3 The back panels of the DanioVision Observation Chamber (top) and the Temperature Control Unit (bottom). The numbers of the connectors / ports are also described in the text above.
Connectors with the same number are connected with the provided tubes with the same color-code.
1 - Yellow connectors for water flow into the Temperature Control Unit and out of the Observation Chamber. *2* - Green connectors for water flow out of the Temperature Control Unit and into the Observation Chamber. *3* - Drain connector. *4* - Water overflow connector. *5* - Connectors for the temperature sensor. *6* - TTL ports. *7* - Power connection.

3. Connect the tube with the blue color code to the connector with the blue ring on the DanioVision Temperature Control Unit (indicated by '**3**' in Figure 3). This is the tube to drain the DanioVision system. Make sure this tube ends in a sink or container.

4. Connect the tube with the red color code to the connector with the red ring on the DanioVision Observation Chamber (indicated by '**4**' in Figure 3). This is the tube for the water overflow of the Observation Chamber.

   IMPORTANT Make sure that the tubes with red and blue color codes end in a sink or container, and it is slanted downwards so that water flows spontaneously.

5. Connect the cable with the cinch-plugs to the temperature-sensor connectors on both the DanioVision Temperature Control Unit and Observation Chamber (indicated by '**5**' in Figure 3).

6. Optionally, connect the network cable to the TTL port on the DanioVision Temperature Control Unit and TTL port **1-4** on the Observation Chamber. This allows you to log temperature error messages and potentially use these in trial and hardware control in EthoVision XT.

   IMPORTANT If you have the DanioVision Observation Chamber version DVOC-0030 or older, you cannot use TTL2, because this port is used by the temperature sensor for the lens heater inside the observation chamber.

7. Connect the DanioVision Temperature Control Unit to the mains socket.

8. Connect the DanioVision Observation Chamber to the EthoVision XT computer. For details, see the Reference Manual - DanioVision Observation Chamber DVOC-0041.

Set up the DanioVision Temperature Control Unit

FILL AND DRAIN CYCLE

Before you start using the system, it is good to make sure that the whole water circuit is clean.

IMPORTANT Always drain the system at the end of the experiments.

What you need
Demineralized or distilled water, and a water container or sink.

1 - Fill the system

1. Turn on the DanioVision Observation Chamber.
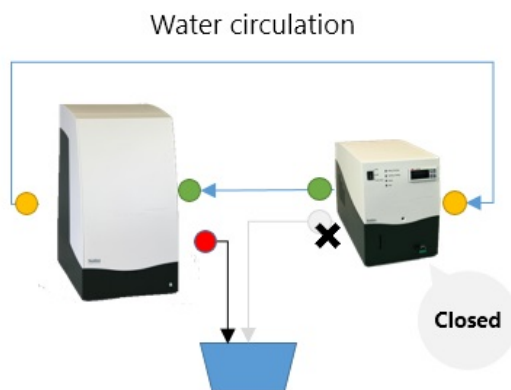
   On the DanioVision Temperature Control Unit, switch the Operation mode to **Fill/Drain**.

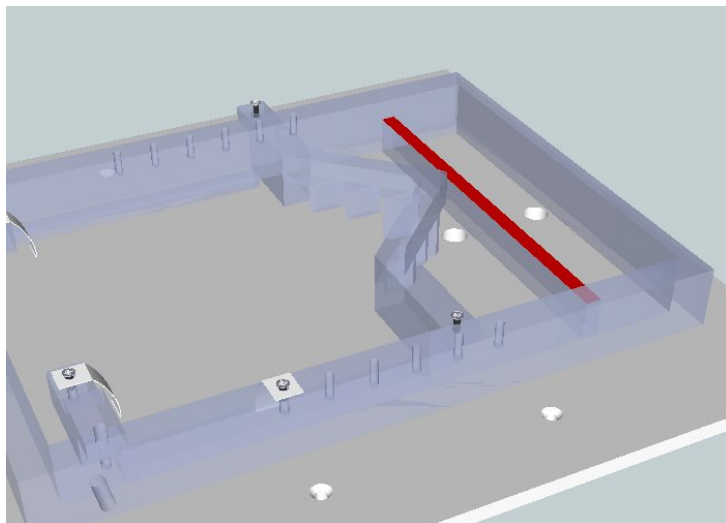2. Turn the Drain tap completely to **Closed**.

   Water will flow as depicted in this scheme:

3. Slowly start pouring water into the basin of the DanioVision Observation Chamber.

IMPORTANT Stop adding water when the water level reaches the edge of the basin indicated in red in the figure below).

As a result, the water starts flowing through the tubes. Pour more water a few times, until all bubbles in the tubes have gone and the basin is completely filled.

2 - Drain the system

1. Keep the Operation switch to **Fill/Drain** and turn the **Drain** tap to **Open**.

   Water will flow as depicted in this scheme:
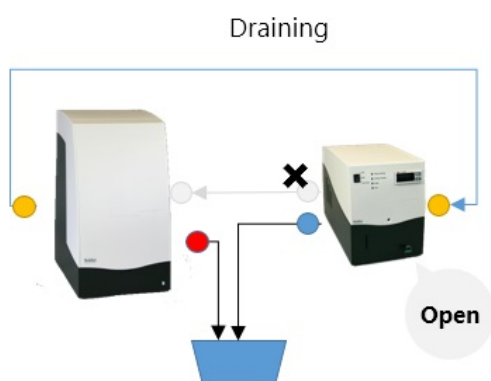
2. When the basin is empty, turn the **Drain** tap to **Closed** to remove all remaining water from the tubes and let it flow into the basin.

3. Turn the **Drain** tap to **Open** again, to completely drain the DanioVision Observation Chamber.

NORMAL USE WITH SET WATER TEMPERATURE

1. Turn on the DanioVision Observation Chamber.

   IMPORTANT After you turned on the Observation Chamber, wait at least 15 minutes before you start an experiment in EthoVision XT.

2. Open the DanioVision Observation Chamber, and locate the **Anti-Moisture** switch inside the chamber, at the right of the camera (see below).

   Set the switch in one of the two modes.

   On. Choose this when the room temperature is lower than the desired water temperature.

   Off. Choose this when the room temperature is higher than the desired water temperature.
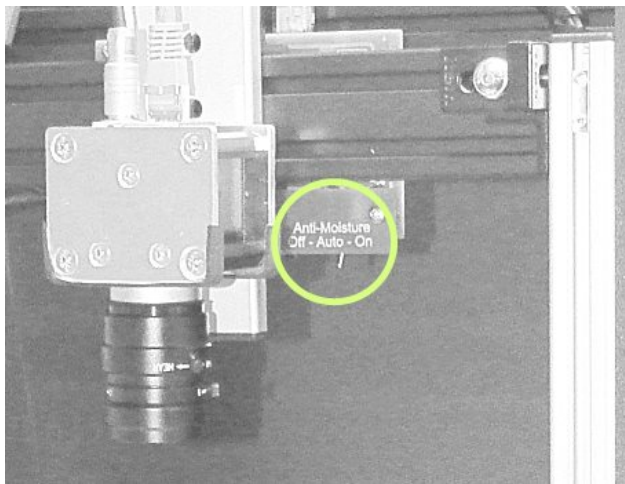
3. On the DanioVision Temperature Control Unit, switch the Operation mode to **Fill/Drain**.

4. Turn the Drain tap completely to **Closed**.

Water will flow as depicted in this scheme:
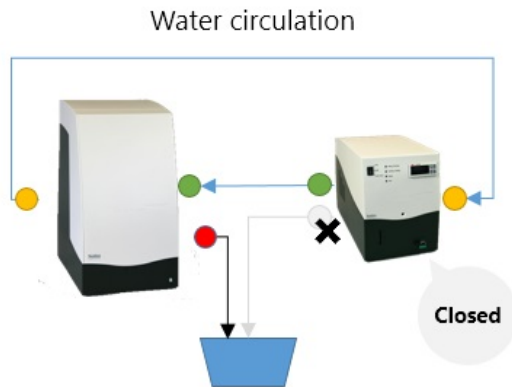
5. Slowly start pouring water into the basin of the DanioVision Observation Chamber.

   **IMPORTANT** Stop adding water when the water level reaches the edge of the basin indicated in red in the figure below).
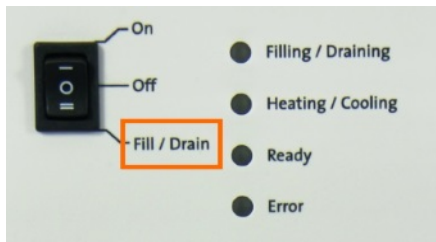
   IMPORTANT We strongly recommend to use demineralized or distilled water to minimize contamination of the system and the accumulation of calcium and salt.

   As a result, the water starts flowing through the tubes. Pour more water a few times, until all bubbles in the tubes have gone and the basin is completely filled.
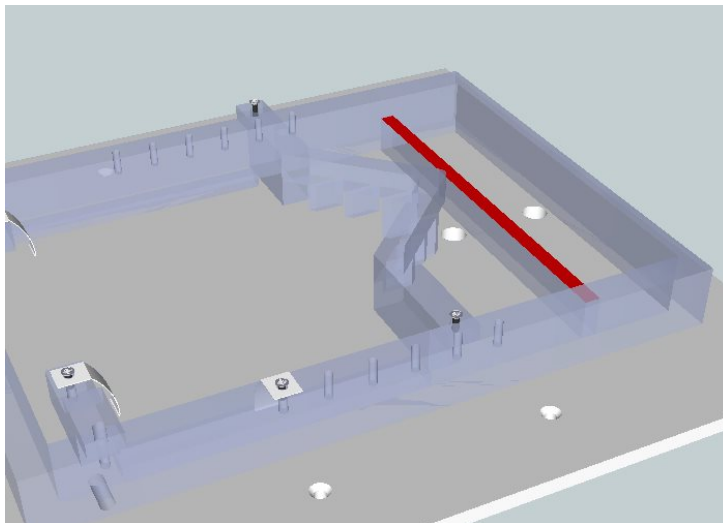
6. Close the DanioVision Observation Chamber before you set the desired temperature in the next steps.

7. Set the Operation switch to **On**.
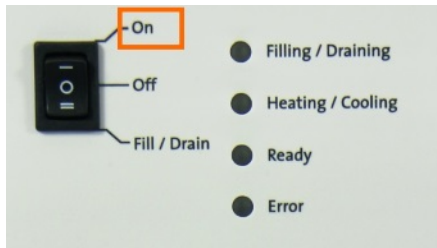
8. Next to the temperature display, hold the **Set** button for about 1 second; the display flashes displaying the currently set temperature.

9. Use the arrow keys to set the desired temperature.

10. Confirm by pressing the **Set** button once.

   IMPORTANT If the difference between the actual and set water temperature is more than 0.5 °Celsius / 0.9 °Fahrenheit, an error code appears (see **Feedback and error messages** on page 29 for more information). This error message disappears as soon as the water temperature is within a 0.5 °C / 0.9 °F range of the set value again.

11. Wait until the set temperature has been reached. This takes on average 10 minutes, depending on the set temperature and the temperature in the room. During this process, the status indicated by the LED lights at the front is on **Heating / Cooling**. Once the temperature is stable at the set value, the status changes to **Ready**.

The DanioVision Temperature Control unit is now ready to start an experiment. Make sure that the DanioVision Observation Chamber has been on for at least 15 minutes.

DISPLAYING CELSIUS OR FAHRENHEIT

You can choose to display the temperature in °Celsius or Fahrenheit. To set the display to Celsius or Fahrenheit, do the following:

1. Set the Operation switch to **On**.
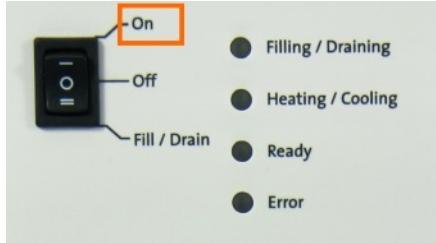
2. Keep the **Prg** and **Set** button both pressed until the entry code **0** appears on the temperature display.

3. Use the arrow keys to change the entry code to **77** and press **Set**.

   Result: **Program c0** appears on the display.

4. Use the arrow keys to go to program **c18** and press **Set**.

5. Use the arrow keys to set the temperature unit to Celsius = **0** or Fahrenheit = **1** and press **Set** to confirm.

6. Keep the **Prg** button pressed until you exit the program mode.

Additional options

CONFIGURE THE TEMPERATURE ALARMS IN ETHOVISION XT

Aim

To log the high and low temperature alarm in EthoVision XT. You can use the temperature alarm:

- in the Trial Control Settings, for example to stop the trial if the temperature alarm lasts for more than a certain time. See page 17.

- In the Analysis profiles, to visualize when an alarm occurred together with the data. See an example on page 18.

- As a hardware log that you can export. See page 19.

NOTE A temperature alarm should not happen if the TCU is in status "Ready". An alarm is therefore an unusual event in normal conditions. If the TCU is still in "Heating" or "Cooling" status, it is normal that a couple of temperature alarm occur.

Cable connections

DanioVision Observation Chamber   Temperature Control Unit
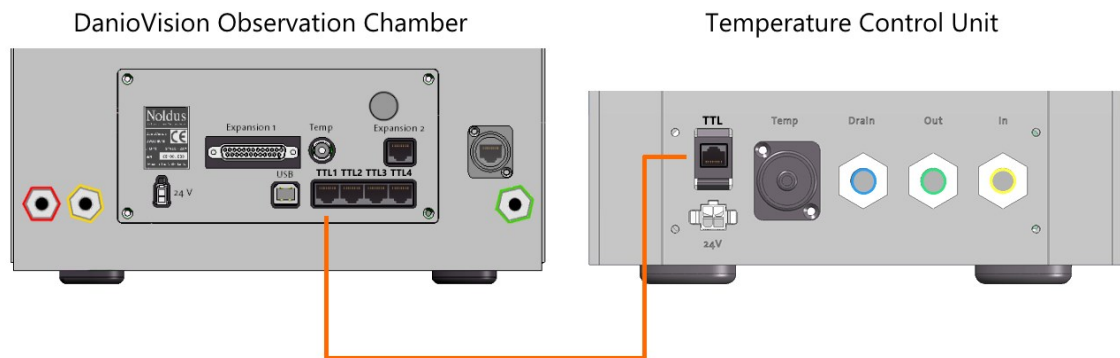
Connect the network cable to the TTL port in the DanioVision Temperature Control Unit and one of the TTL ports **1-4** in the Observation Chamber.

IMPORTANT If you have the DanioVision Observation Chamber DVOC-0030 or older, connect the TTL port of the Temperature Control Unit to TTL ports 3 or 4 on the Observation Chamber. **Do not use TTL port 2!**

To define the temperature alarm in EthoVision XT

1. In EthoVision XT, create a DanioVision experiment. For details, see the Reference Manual - DanioVision Observation Chamber DVOC-0041 or the EthoVision XT Help.

2. In the Experiment Settings, under **Trial Control Hardware**, click the **Settings** button. Select the version number of your DanioVision Observation Chamber (usually DVOC-004x or DVOC-004x/T if you have the DanioVision Tapping Device) and click **OK**.

3. In the Device Configuration window, under **Plug-in** devices, choose the TTL port that you used to connect the Temperature Control Unit (see above).

   Under **Device type** select **DanioVision TCU (DVTCU-001x)**. Under **Device ID** type in a name or accept the default name **DanioVision TCU (DVTCU-001x) 1**. Next, click **OK**.
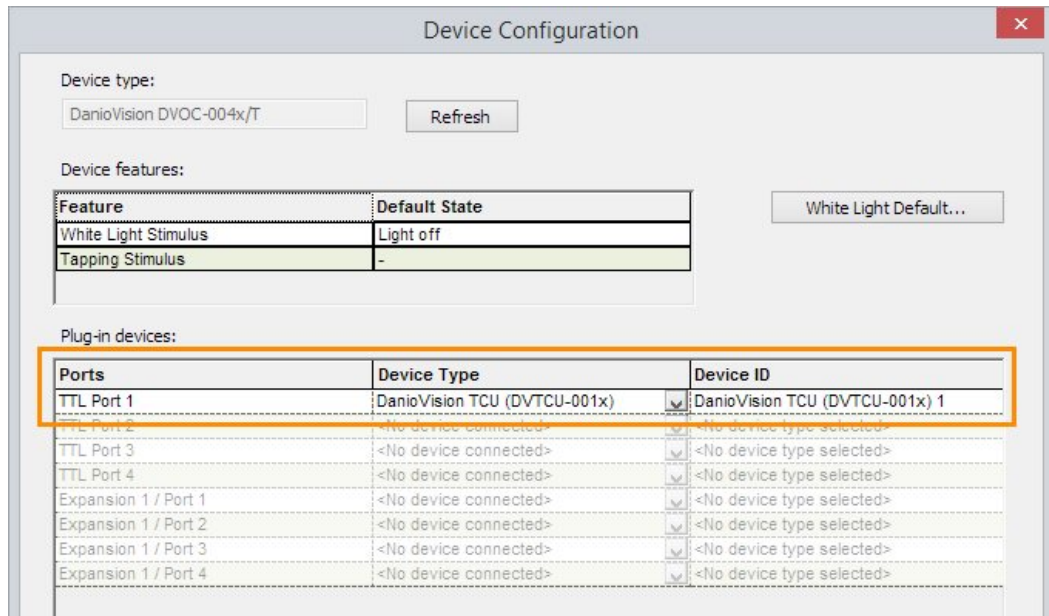
4. Choose **Setup** > **Arena Settings** > **Open** and choose the Arena Settings you use in the experiment. In the **Arena Settings** window, click the **Arena - Hardware mapping** button.

5. In the **Arena - Hardware Mapping** window, click the **Add device** button. Under **Device type** select **DanioVision TCU (DVTCU-001x)**. Under **Device name** enter a name, for example "TCU Temp alarm". In the column **A1** select the **Device ID** that you defined above.
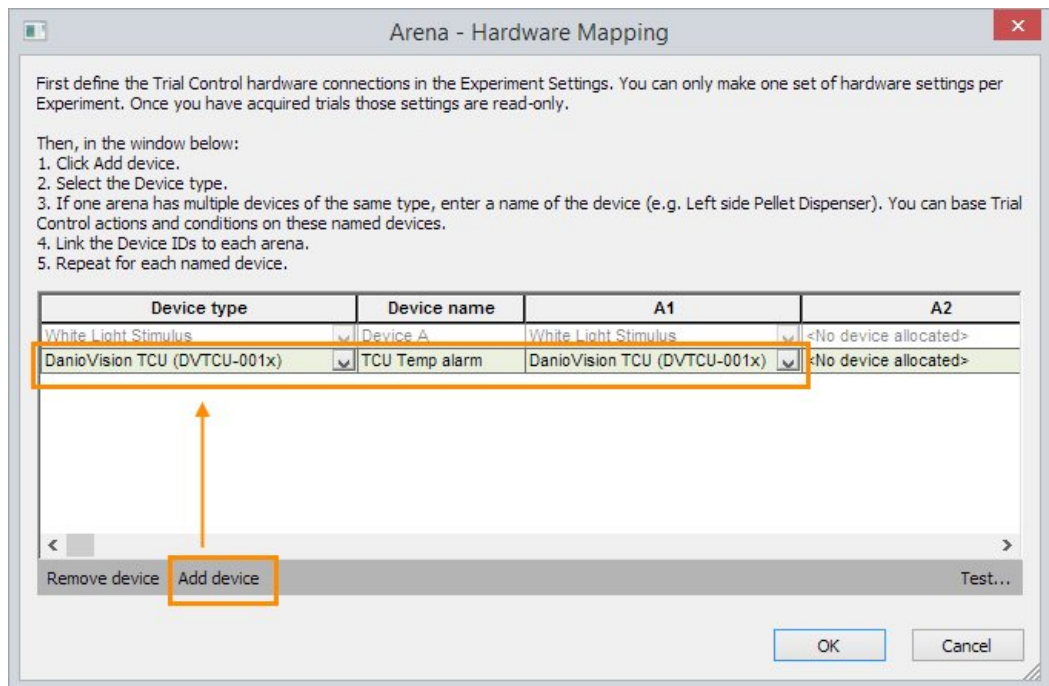
6. Click **OK**. EthoVision XT is now ready to log the alarm signals from the TCU.

Possible alarm signals

The following TTL signals are sent to EthoVision XT and can be used as usual in the Trial Control Settings and Analysis Profiles:

- When the current water temperature is within the normal temperature range, that is, a temperature that deviates by less than 0.5 °C from the set temperature: [T_{set} -0.5°C $\leq T_{current} \leq T_{set}$+0.5°C), no alarm is given. Both **Low temp error state** and **High temp error state** are **false**.

- When the current water temperature is more than 0.5 °C lower than the set temperature ($T_{current} < T_{set}$ -0.5°C), a 'low-temperature alarm' is given and **Low temp error state** becomes **true**.

- When the actual water temperature is more than 0.5 °C higher than the set temperature ($T_{current} > T_{set}$ +0.5°C), a 'high-temperature alarm' is given and **High temp error state** becomes **true**.

- When you turn off the Temperature Control Unit or unplug the network cable from the TTL port, both **Low temp error state** and **High temp error state** become **true**.

Note

During a temperature alarm, the TCU tries to bring the temperature back to the normal range, so you do not need to take any particular action.

USE THE TEMPERATURE ALARMS IN ETHOVISION XT

In Trial Control Settings

Use a temperature alarm in the Trial Control Settings for example to stop tracking or start an external program when a temperature alarm occurs. Here it is described how to make conditions based on the temperature.

NOTE During a temperature alarm, the TCU tries to bring the temperature back to the normal range, so you do not need to take any particular action with Trial Control.

PREREQUISITE You have defined the temperature alarm in EthoVision XT (page 15).

1. Choose **Setup** > **Trial Control Settings** > **Open** (an existing profile) or **New** to create a new profile.

2. In the Trial Control Settings, under **Conditions** click the button next to **DanioVision TCU (DVTCU-001x)**.
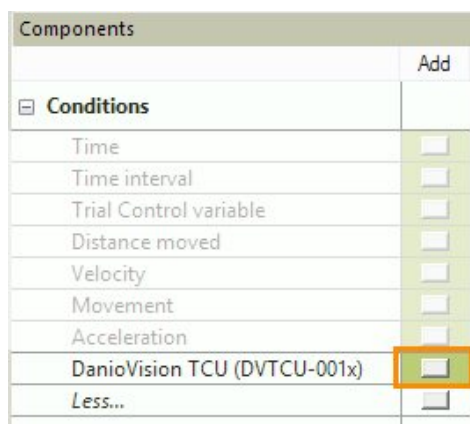
3. The Hardware Condition window appears. In the **Condition name** field, enter a name for the condition (for example, "TCU Low Temp alarm").

4. From the **DanioVision TCU** list select the device name that you defined in the **Arena - Hardware Mapping** window ("TCU Temp alarm", in the example above).

5. Choose the following, depending on when an action should be taken:
   - To take an action when an alarm occurs, next to **Signal to check** choose either **Low temp error state?** or **High temp error state?** depending on the alarm you want to use. Then next to **Signal value** select **true**.
   - To take an action when the number of temperature alarms reaches a certain value, next to **Signal to check** choose either **Low temp errors** or **High temp errors** and select the threshold of alarm errors.

6. Insert the condition box in the Trial Control rule.

For more information, see the EthoVision XT Help and the Reference Manual - Trial and Hardware Control in EthoVision XT.

In the Analysis Profile

In an Analysis Profile, you can define a temperature alarm variable, for example to visualize alarm events in the Integrated Visualization. This way you can review your trials and see if something has changed in the behavior of the larvae during those alarm.

1. In an **Analysis Profile**, under **Hardware**, click the button next to **Hardware state**.

2. Next to **Device type** choose **DanioVision TCU (DVTCU-001x)**.

3. Next to **Device** choose the name given in the Arena - Hardware Mapping window ("TCU Temp alarm" in the example above).

4. Next to **Signal**:
   - To visualize or calculate the duration of the time that the system was in temperature error state during the trial, select **Low temp error state** for a low-temperature alarm, or **High temp error state** for a high-temperature alarm. Next to **Value** select **true**. Select **false** if you want to visualize or calculate the time that there was no temperature alarm.
   - To visualize or calculate the duration of the time when the system had more (or less) a certain number of temperature error alarms, choose **Low temp errors** or **High temp errors**. Choose whether the number of errors was higher/lower or equal to a threshold value. Keep the option **Cumulative** selected.

5. In the **Trial Statistics** tab, select the statistic you want and click **OK**.

6. **OPTIONAL** Right-click the row **Hardware state** and select **Rename**. Enter a custom name (for example "Hardware state Low Temp alarm").

The figure below shows part of the Integrated Visualization windows of a trial in which first a low-temperature alarm occurred, and after that a high-temperature alarm.
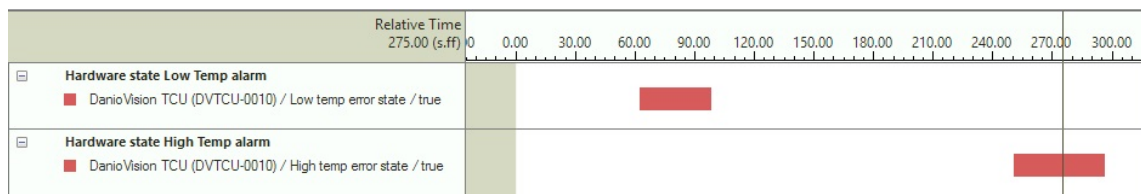
In a Hardware log

Do the following to export the Hardware log containing the TCU alarm events.

1. Choose **Analysis** > **Export** > **Raw Data**.

2. In the Raw Data Export window, make sure to select the **Hardware log** check box.

3. Click **Start export** to export the data.

Carry out an experiment

NOTE If you want to log temperature errors, configure EthoVision XT beforehand. See **CONFIGURE THE TEMPERATURE ALARMS IN ETHOVISION XT** on page 15.

PROCEDURE

1. Follow the procedure **NORMAL USE WITH SET WATER TEMPERATURE** on page 11.

2. Wait that the temperature has reached the set value and no error codes appear on the LCD screen of the TCU.

3. Insert a well plate with the larvae into the basin. To prevent air getting trapped underneath the well-plate, put the back of the well plate against the wall with the shape of "∧" and place it on the basin floor, then tilt the front of the well plate down to the basin floor.
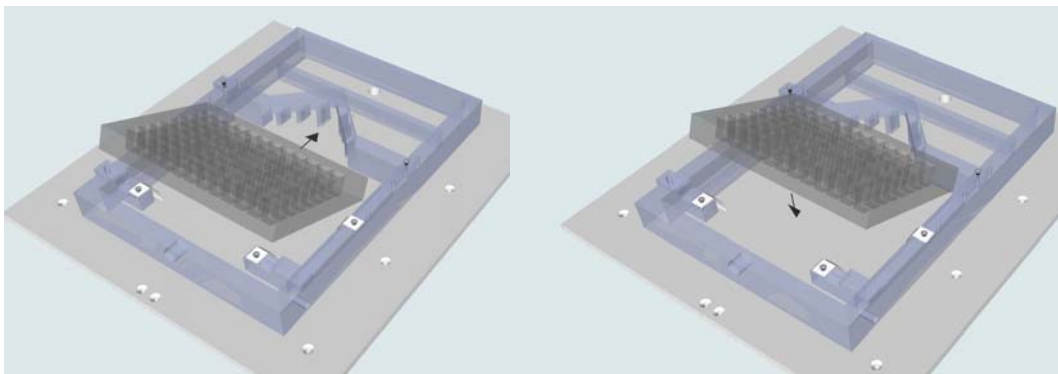
As you do this, water flows into the over-flow part of the basin.

4. Lower the Fresnel lens over the well plate and close the DanioVision Observation Chamber. You can now carry out an DanioVision experiment as usual.

5. If necessary, grab a background image and define the arenas. Next, if necessary, define the Detection Settings. For more information, see the Reference Manual - DanioVision DVOC-0041 and the EthoVision XT Help.

6. Choose **Acquisition** > **Open Acquisition**. Start the trial.

7. At the end of the experiment, follow the procedure *2 - Drain the system* on page 10.

   IMPORTANT Draining prevents contamination from building up inside the system. Before you drain the system, make sure the drain tube with blue connector ends in a sink or container.

VISUALIZE THE TEMPERATURE ALARMS DURING THE TRIAL

On the Temperature Control Unit

If an error occurs in the Temperature Control Unit, an error message appears on the display. See **Feedback and error messages** on page 29 for an explanation.

On the EthoVision XT screen

1. Choose **Show/Hide** > **Show Dependent Variable**.

2. From the **Select hardware** list, choose **Hardware state**. Click **OK**.

3. Next to **Device type** choose **DanioVision TCT (DVTCU-001x)**. Choose the signal you want to display. Click the Statistics tab and choose the statistics of that signal that you want to display.

   TIP Choose **Current** to display whether a temperature alarm is occurring.

4. During acquisition, in the **Analysis Results and Scoring** pane click the Dependent Variables tab. There you can view the alarm state (under the arena A1). Here, **true** means error state.

Analysis Results and Scoring						
Trial Status	Dependent Variables					
		Velocity		Movement		Hardware state
Trial	Arena	center-point	Moving / center-point	Not Moving / center-point	DanioVision TCU (DVTCU-00
		Mean	Cumulative Duration	Cumulative Duration	Current
		mm/s	s	s	
	A1	11.633391	0.383318	7.983014	true
	A2	5.243906	0.116662	8.249670	-
	A3	6.540901	0.516646	7.849686	-

REFILL THE BASIN DURING LONG EXPERIMENTS

The Basin Refill Tool

During long-lasting DanioVision experiments, evaporation of water out of the basin could be an issue. You can compensate for evaporation by refilling the basin without opening the DanioVision Observation Chamber (DVOC-0040).

The **Basin Refill Tool** (DVBR-0010) allows you to refill the basin without opening the DanioVision Chamber during an experiment. It is provided standard with the DanioVision Temperature Control Unit (DVTCU).


IMPORTANT It is possible to fill/refill the basin directly (see Chapters 3 and 4 in this Manual). However this is not practical when an experiment is running.

Only use the Basin Refill tool in combination with the DanioVision Temperature Control Unit (DVTCU).

To set up the Basin Refill Tool

You must install the Basin Refill Tool before starting the experiment.

1. Make sure your DanioVision basin is empty. To do so, follow the instructions in the Section *2 - Drain the system* on page 10.

2. Disconnect the tube marked in green between the DanioVision Chamber and the TCU (when applicable).

3. Connect the ends of the tubes of the Basin Refill Tool to the corresponding green-marked inlets at the back of the DanioVision Observation Chamber and the Temperature Control Unit:

DanioVision Observation Chamber   Temperature Control Unit
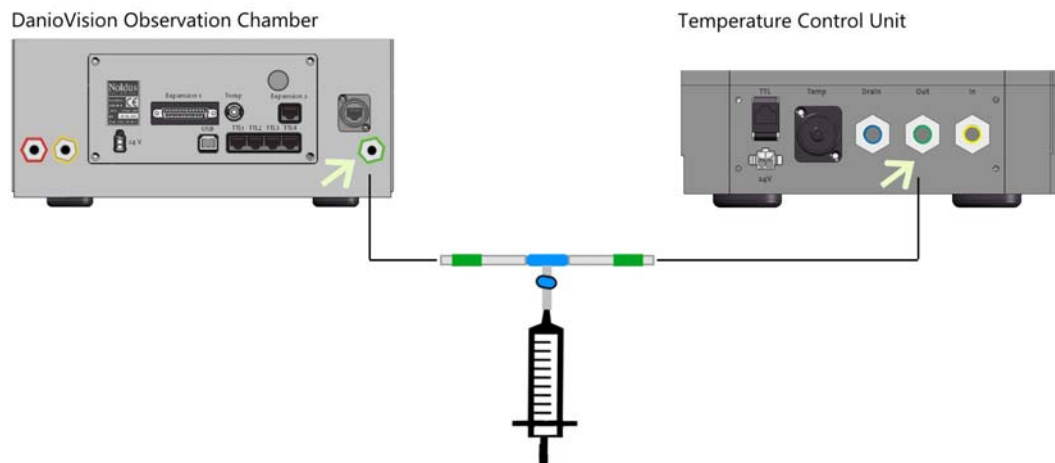
4. Make sure the faucet is closed (**Off** position).

5. Fill the syringe with basin liquid, and connect it to the short faucet tube.

6. Fill the basin circuit (see page 11).

   TIP While the basin circuit is being filled, insert a few ml liquid out of the syringe in order to prevent air bubbles from getting into the circuit.

7. Start the experiment as usual.

To use the Basin Refill

How much liquid to insert via the syringe depends on the level of evaporation and the duration of the experiment. Add liquid into the basin circuit whenever needed.

During refill, do not switch off the Temperature Control Unit!

1. Open the faucet (**On** position).

2. Make sure you can see the overflow outlet of the DanioVision Chamber (red marked tube).

3. Gently push the syringe to insert liquid.

4. Carefully watch the overflow tube. Whenever the liquid comes, stop pushing the syringe.

Notes

- Overflow is a good indication for a 100% filled basin, however it may lag on filling.

- The DVTCU will, whenever occur, compensate any temperature fluctuation due the refill. However, make sure that the liquid temperature in the syringe is not too far from the desired basin temperature.

To refill the syringe

1. Make sure the faucet is closed (**Off** position).

2. Disconnect the syringe.

3. Fill the syringe with basin liquid.

4. Make sure no air is present in the syringe.

5. Connect the syringe back to the faucet tube.

Maintenance and Support

REPLACE THE FILTER

The filter inside the DanioVision Temperature Control Unit is a particle filter with a pore size of 20 µm. The filter does not remove bacteria and/or yeast.


TIP The filter can get blocked after you have used the system for a longer period of time. When this happens, you will get an 'insufficient-flow' error message. Please first check the error table (page 29). Contact Noldus IT to order a new filter.

IMPORTANT Before replacing the filter, drain the system (see page 10 for how to do this).

Make sure to use demineralized or distilled water to prevent small particles (> 20 µm) from blocking the filter.

To replace the filter

1. Open the lid of Temperature Control Unit by unscrewing the white, plastic screw at the front of the unit. You can use a small screwdriver or a coin to do this.

2. Remove the left side panel by unscrewing the two screws at the top and three screws at the bottom of the side panel (indicated in the figure below).
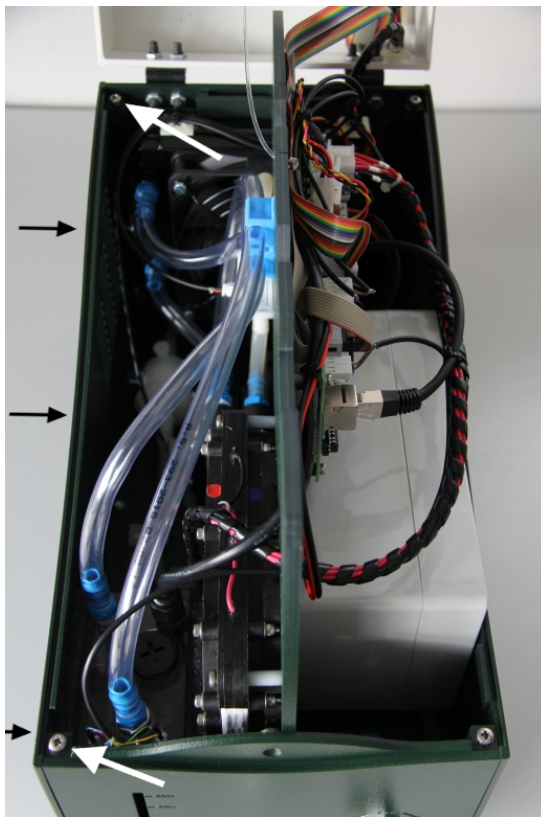
3. Lift the filter from the clamp and disconnect the tubes at both ends from the filter.
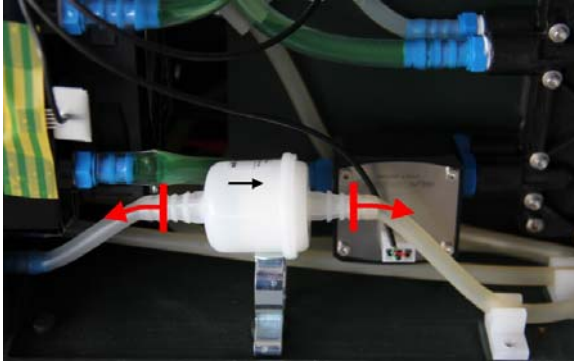
4. Insert the new filter, connect the tubes and push the filter back into the clamp. Make sure the small black arrow on the filter points in the direction as shown in the figure above.

5. Put the side panel back in place and close the lid of the Temperature Control Unit.

REPLACE THE LIQUID COOLANT

1. Open the lid of Temperature Control Unit by loosening the plastic screw at the front of the unit.

2. Remove the left side panel by unscrewing the screws at the top of the side panel (see the figure in step **2** on page 23).

3. Locate the cap on top of the reservoir for the liquid coolant. This differs slightly between TCU versions (see the figures below).
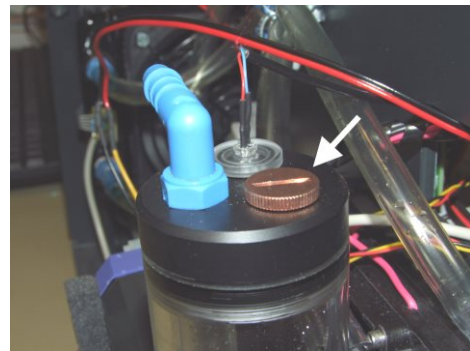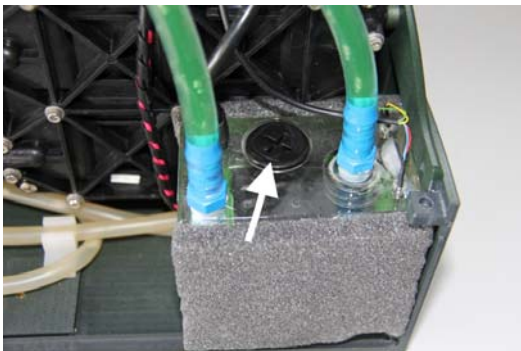
4. Unscrew the cap using for example a small coin.

5. Use the funnel to fill the reservoir with the liquid coolant.

We recommend to fill it to **maximum** level.
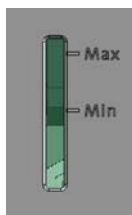
After refilling the liquid coolant, turn the Operation switch to **Fill/Drain** to make sure the tubes inside the Temperature Control Unit are also filled with liquid coolant. As a result, the level of coolant in the reservoir might drop a bit. Add more coolant so it reaches the **Max** level.

6. Screw the cap back on the reservoir.

7. Put the side panel back in place and close the lid of the Temperature Control Unit.

Make sure to regularly check that the level of coolant does not drop below the **Min** indication on the front of the Temperature Control Unit. If the level is too low, refill the coolant.

Please contact Noldus IT if you want to purchase a new bottle of liquid coolant.

WEAR AND TEAR

All Noldus hardware is sold with a two-year guarantee. That means that if it breaks within two years of the delivery date, it will be repaired or replaced at Noldus' expense. Please see the document 'Noldus guarantee' to see what is covered by the guarantee.

Wear and tear caused by regular, normal use of the DanioVision Temperature Control Unit is not covered by the guarantee. Below are some recommendations about environmental conditions and cleaning of the Temperature Control Unit.

Environmental conditions
See the Technical Specifications on the next page, under **Environmental conditions**.

Cleaning

To clean the DanioVision Temperature Control Unit, please use a damp cloth. Please do not use chemicals or soap to wash the Temperature Control Unit. Make sure that no liquid gets into the Temperature Control Unit.

Keeping the tubing clean

It is very important that the tubes are kept as dry as possible when not using the DanioVision and the TCU. To prevent the growth of algae in the tubing, do the following:

- Always fill the system with demineralized water, and drain it after the end of an experiment.

- Keep all units and the tubes far from sunlight.

TECHNICAL SUPPORT

Help desk
If after reading this manual you still have questions, please contact our help desk.

www.noldus.com/support-center

Event data logger

If you purchased a DanioVision Temperature Control Unit after November 2016, this is equipped with a board and a compact SD card that records performance data during functioning. If you encounter problems when using the Temperature Control Unit, the Noldus Help desk may ask you to send the files stored in the card. In that case, the Noldus help desk will send you the instructions for how to that.

Technical Specifications

Mechanical	
Dimensions (mm / inch)	460 x 210 x 280 / 18'11 x 8'26 x 11'02 (L x W x H)
Weight (kg / pound)	7 / 15.43
Hose connectors	8 mm outer diameter tube

Electrical	
Operating voltage (volt-DC)	24
Power consumption (W): Average / Maximum	40 / 120
TTL port specs: 2 input / 2 output	Max. 5 Volt / Max. 5 Volt, open collector

Operational	
Temperature accuracy (°C / °F)	± 0.5 °C / ± 0.9 °F
Temperature set point range (°C / °F)	15 - 40 °C / 59 - 104 °F
Maximum heating capacity (°C / °F)	At least 10 °C / 18 °F above ambient temperature (within the temperature set point range 15-40 °C / 59-104 °F)
Maximum cooling capacity (°C / °F)	2.5 °C / 4.5 °F below ambient temperature (within the temperature set point range 15-40 °C / 59-104 °F)
Permissible water temperature range (°C / °F)	5 - 50 °C / 41 - 122 °F
Water capacity (ml / oz)	± 350 / ± 11.83
Pump flow rate – water (ml per min / oz per min)	± 310 / ± 10.48
Water filter type	20 µm pore size, 1 inch diameter
Cooling liquid capacity (ml / oz)	± 250 / ± 8.45
Cooling liquid type	Colored, anti-corrosive, anti-algae, PC-type cooling liquid
Pump flow rate – cooling liquid (ml per min / oz per min)	± 1650 / ± 55.79
Maximum height difference DanioVision Observation Chamber and Temperature Control Unit (m / ft)	1.3 / 4.26. Do not place the Temperature Control Unit higher than the Observation Chamber!
Noise level (dB)	Average over all frequencies <35dB. Max. peak of ±48 dB around 160Hz.

Environmental conditions

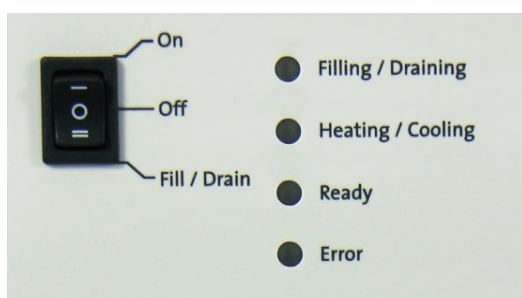| Permissible ambient temperature range:	
- Operating (°C / °F)	10 - 35 °C / 50 - 95 °F
- Storage (°C / °F)	5 - 65 °C / 41 - 149 °F
Permissible relative humidity (%)	20 - 80 (non-condensing)

Feedback and error messages

The DanioVision Temperature Control Unit gives feedback about its status with four LED lights and error codes on the temperature display.

For the LED lights on the front panel: see below.

LED INDICATORS

| Status	LED	Explanation	User action
Filling / Draining	Orange - blinking	System is pumping.	The system can be filled with water (see step **5** on page 12). Water can be drained from the basin (see page 10). Cooling liquid can be filled (see page 24).
Filling / Draining	Red - continuous	Time out. There has been no flow in the water circulation and/or the cooling liquid circulation for > 10 minutes.	Reset the system by turning the **Operation** switch to **Off** and then back to **Fill/Drain**.
Heating / Cooling	Green - blinking	The water is being heated/ cooled to the set temperature.	Wait. No action needed.
Ready	Green - continuous	The set temperature has been reached and the system is ready to be used.	The Temperature Control Unit is ready to be used and an experiment can be started.

Status	LED	Explanation	User action
Error	Red - 1 blink - repeatedly	Insufficient flow in the water circulation.	Look for the source of the problem. This may be: • Low water level in the basin (due to evaporation or leakage). In this case, fill the system (step **5** on page 12). • Flow blockage somewhere in the system or filter clogged. See page 23 or contact Noldus to replace the filter. • Pump failure. The Fill/Drain mode can be used to localize the problem. Reset the system by setting the **Operation** switch to **Off** and then to **Fill/Drain**.
Error	Red - 2 blinks - repeatedly	Insufficient flow in the cooling liquid circulation.	Look for the source of the problem. This may be: • Low cooling liquid level in the pump reservoir. Check if the liquid level is above the indication. If not, refill cooling liquid (see page 24 for instructions) and check for signs of leakage in the emergency liquid container. • Flow blockage somewhere in the system. • Pump failure. The Fill/Drain mode can be used to localize the problem. Reset the system by setting the **Operation** switch to **Off** and then to **Fill/Drain.**
Error	Red - 3 blinks - repeatedly	The fan is not spinning, or not spinning at sufficient speed.	Check if there is anything blocking the fan. If this is not the case, please contact Noldus support.
Error	Red - 4 blinks - repeatedly	System is overheated.	Turn off the system and end the experiment. Cooling liquid can be cooled down by switching the **Operation** switch to **Fill/Drain**. Search for the possible cause of the overheating: • Air vents of the Temperature Control Unit might be blocked so the radiator cannot get rid of its heat. Make sure air vents are free. • System is used in environmental conditions that have not been tested, for example, room temperature >35°C.

Status	LED	Explanation	User action
Error	Red - 5 blinks - repeatedly	Heating and cooling have been activated simultaneously. An electrical problem has occurred.	Please contact Noldus support.
Error	Red - 6 blinks - repeatedly	A problem with the data logger has occurred.	Open the TCU and take the SD-card out. • If it is locked, unlock it. • Check that it has a minimum capacity of 4 GB. Next, put the SD-card back in the TCU. If the error persists, take the card out, and format it (FAT32). Leave the card empty; do not copy the old files to the newly-formatted card. Next, put the SD-card back in the TCU and restart the TCU.
Error	Red - continuous	A temperature deviation larger than 0,5°C above or below the set temperature has been detected. Water conditioning will continue to try to resolve the situation. Once the situation is resolved the status of the system returns to 'Ready'.	Depending on your protocol you can choose to continue or to abort the experiment.

TEMPERATURE DISPLAY

Code	Explanation
1	The water is being heated to the set temperature.
2	The water is being cooled to the set temperature.

Code	Explanation
3	The current water temperature is at least 0.5°C below the set temperature. It is shown together with the temperature alarm code **E05**. In normal conditions, when code **3** is shown, code **1** is also shown and the red **Error** LED (re-continuous) is on.
4	The current water temperature is at least 0.5°C above the set temperature. It is shown together with the temperature alarm code **E04**. In normal conditions, when code **4** is shown, also code **2** is shown and the red **Error** LED (re-continuous) is on.
⚠	Error mode (see page 32)
↑R↓	This is a system setting indicator, which blinks when the TCU is in heating/cooling mode. No action need be taken.
LCD is off	A possible reason is that one of the flat cables coming from the LCD display is not properly connected. Open the DV-TCU, locate the multi-color flat cable (3rd to the right of the CD card), disconnect it and connect it again.

ERROR CODES

Error code	Explanation	User action
E01	The temperature sensor is not detected.	Please connect the temperature sensor cable (with cinch-plugs on both ends).
E04	'Too high' temperature alarm. The measured temperature is 0,5 °C higher than the set temperature. See 'Red – continuous' LED on page 29.	Depending on your protocol you can chose to continue or abort the experiment. Please note that this error also occurs while the system is Heating/Cooling before the start of the experiment; the system continues to heat/cool to try to resolve the error.
E05	'Too low' temperature alarm. The measured temperature is 0,5 °C lower than the set temperature. See Error with 'Red – continuous' LED on page 29.	Depending on your protocol you can chose to continue or abort the experiment. Please note that this error also occurs while the system is Heating/Cooling before the start of the experiment.
Ed1	System error. See Status = **Error** on page 29.	