KH Director®

Instruction Manual

Valid from Firmware-Version 1.00

As of 2019-10-24

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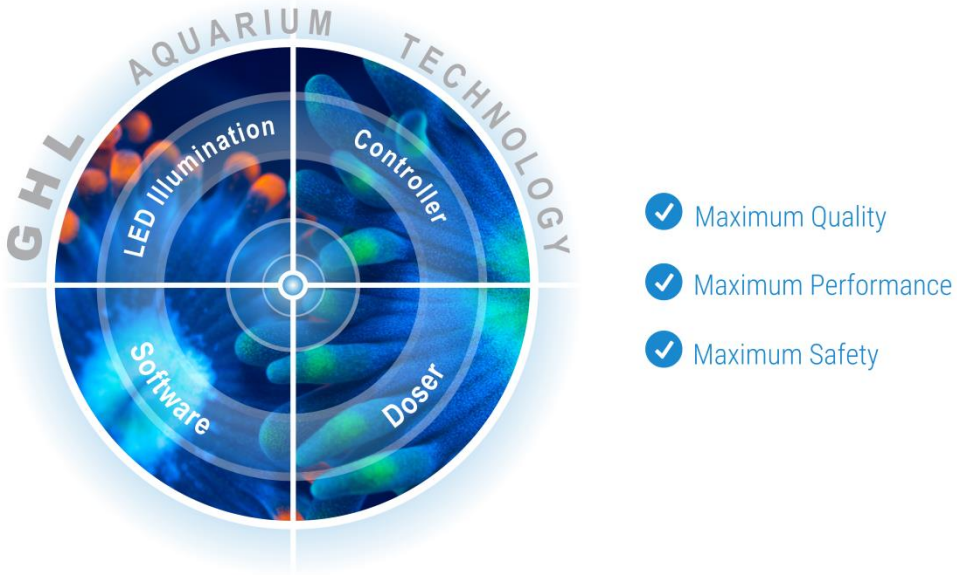


FOCUSSED ON SUCCESSFUL FISHKEEPING

Congratulations on your Purchase

Thank you for purchasing our product and allowing us to help support your path to successful fishkeeping! With a *KH Director* you now own a highly professional piece of equipment that is more than capable of assisting you in your daily monitoring and maintenance routines.

Please note that the *KH Director* does not have an internal controller and therefore requires for operation a *ProfiLux 3* Aquarium controller with latest firmware (6.32 or newer), a *ProfiLux 4* (7.10 or newer), a *GHL Doser 2 (2.1) Stand Alone* or *GHL Doser Maxi Stand Alone* both with firmware 1.27 or higher.

For transporting liquids to and from the *KH Director* a *GHL Doser 2/2.1* (Stand Alone or Slave) with at least 3 free pumps is required.

We are confident that our product will help make your hobby more efficient, safe, and ultimately help you spend more time enjoying your aquarium or terrarium.

Enjoy Your Passion!

GHL Takes Care of the Rest

Get the Most out of your GHL Product

GHL products are well-equipped with simple and intuitive features. In order to get the most out of our products, we recommend you read this Instruction Manual and the Instruction Manual of the respective Controller (*ProfiLux*, *GHL Doser 2/2.1 Stand Alone* or *GHL Doser Maxi Stand Alone*) together. Doing so will provide you with the most profound details for using our product. These and other helpful documents can be downloaded from our website's download area (*Support->Downloads*). Visit our homepage at www.aquariumcomputer.com, our Support Forum or meet us on Facebook to become a GHL-Product expert and fully utilize the full range of functions offered from your device!

1 Safety Instructions

Please read these instructions carefully before operating the *KH Director*.

GHL products are built with maximum security and safety in mind. However, product safety for this device can only be guaranteed if you follow these guidelines.

Anyone who uses this device must become familiar with the following safety instructions and the operation of the device.

Failure to follow these instructions will void any warranty claims.

Be sure to read over the safety instructions provided by this ProfiLux manual; including the respective manuals of other equipment manufacturers.

In this manual, the following symbols are used:

TIP

General note, tip or advice.

WARNING

Important note for operation, to avoid damage to the equipment, and for your safety.

DANGER

Warning that non-compliance can result in injury or damage to the device.

1.1 Safety of Children and Vulnerable Persons

WARNING

This equipment must not be used:

- By small children and vulnerable persons with limited physical, sensory or mental capabilities.
- By people who are unfamiliar with the functions of this product.

1.2 Intended Use

The *KH Director* is intended exclusively for use in the domestic area. *KH Director* may only be operated with GHL accessories.

The *KH Director* may only be used to determine the KH value of aquarium water or pond water.

Make sure to place the device away from splashing water, moisture or other liquids.

WARNING

Moisture indicators are placed inside the unit and will change color when exposed to excessive moisture.

Removing these indicators will void all warranty claims.

DANGER

- Make sure that the power cord is plugged into a grounded outlet; otherwise you could get an electric shock or cause a fire.
- Protect the power cable from damage (For example, twisting, kinking, clamping). Please also pay attention to the joints and connections to the device.
- Disconnect the power plug by pulling the plug, not the cable.

- Never attempt to disassemble, repair or alter the equipment by yourself.
- Do not insert sharp objects into the electrical contacts and ports.

DANGER

- If the unit falls into the aquarium or has been exposed to moisture or humidity, first turn off the power to the device via the fuse or circuit breaker, then pull the power cord.
- Never touch the power plug with wet hands.
- If the device has become wet or dirty, thoroughly clean and dry it with a dry cloth.

DANGER

- The device may not be operated if it has been damaged in any way (e.g. damaged power cord or plug, liquids or objects have gotten into the interior, device has been exposed to excessive moisture, the normal operation is disturbed, or the device has been dropped.)

For your own safety, please look at the hazard prevention and safety instructions in the chapters that follow.

2 General

2.1 About this Manual

These instructions apply to the *KH Director*.

2.2 Features

- 1 x *pH Electrode port*, BNC-socket
- 2 x *ProfiLux Aquatic Bus* (PAB Western sockets)
- 1 x AUX port
- 4 x Tube connectors (Water sample, Reagent, Waste water, Vent connector)
- 1 x Connection for power supply (24V DC hollow socket)

2.3 Scope of Delivery

Please check the contents of this box. The following items should be included:

- *KH Director*
- Power supply splitter-cable
- KHD pH-Electrode
- Calibration fluids pH 4 and pH 7
- KHD Reagent
- Flex PVC tube 0.7 m (0.28“) for reagent fluid
- Silicone tube 5.0 m (1.97“) for sample and waste water
- Inline water-filter
- Insert

PAB connection cables are not included with the *KH Director*-only. The *KHD-Sets* do however, include a *PAB-Cable* for connecting the KHD to the included Doser.

Please check to make sure all items are in perfect condition. In case of damage, immediately contact the dealer from whom you purchased the *KH Director*.

WARNING

A damaged *KH Director* or components may not be put into operation under any circumstances.

2.4 Important Operating Instructions

WARNING

To ensure safe operation, the following guidelines must be followed.

Disregarding these safety guidelines, will result in voiding your warranty. In which case, the manufacturer rejects any responsibility or liability for damage!

3 Connections of the KH Director

3.1 General

Applies to all connections:

WARNING

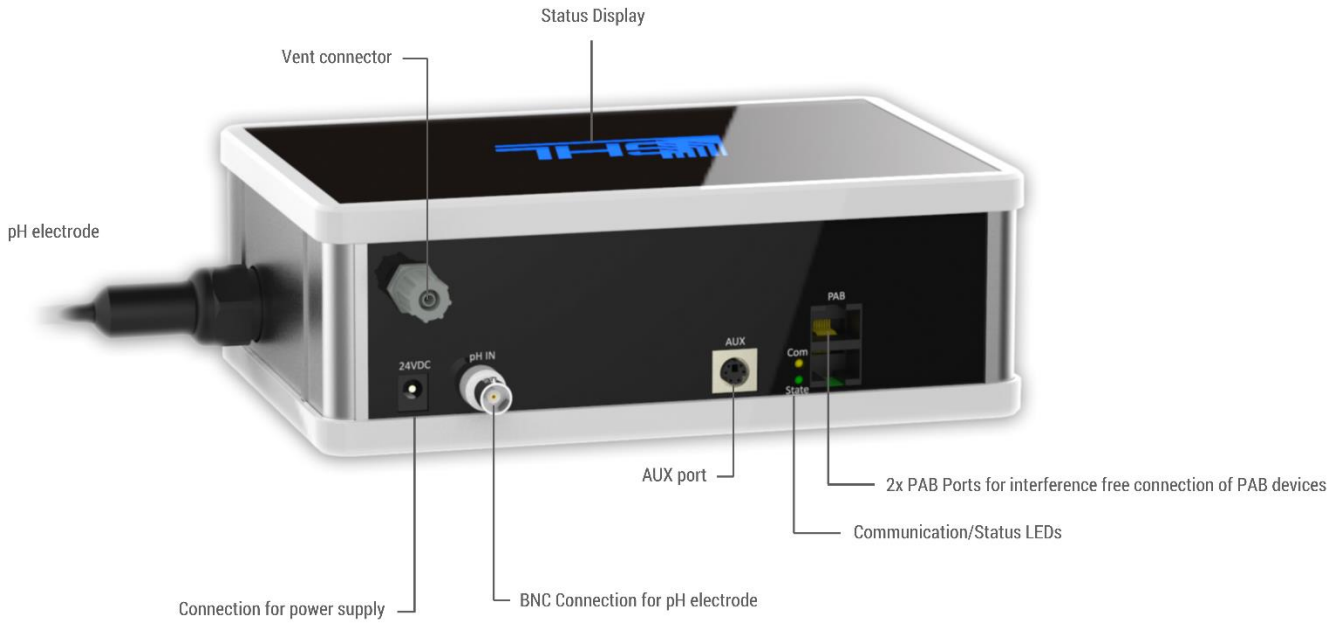
- Connect only original accessories from GHL.
- Do not use excessive force when plugging-in connectors. If a plug contact does not fit, it is imperative to check that you have chosen the correct socket.

DANGER

- Incorrect connection (For example inserting a USB connector into a *PAB* connector) can lead to damaging the *KH Director.*
- A repair caused by this, is not covered under warranty and will therefore incur repair charges**.**

3.2 Connection Overview

The *KH Director* includes the following connection ports and displays:



3.2.1 pH Sensor Connection

The white BNC socket is where the supplied pH-Electrode is connected.

TIP

- Many sensors are very susceptible to interference due to their low-level signals. To provide the most accurate measurements, please have enough distance between the sensors/cables and sources of interference. These can include: Electronic ballasts, power lines, pumps, consumer electronics, etc. False readings can be avoided by following these precautions.

3.2.2 PAB-Ports

The **black** RJ45 Western sockets are where *PAB* devices can be connected. For more information, please refer to the "*Connection to PAB*" section of the Instruction Manual for the *GHL Doser 2.1*.

3.2.3 AUX Port

This mini DIN socket can be used to connect devices with AUX plugs.

3.2.4 Vent Connector

Ventilation and emergency overflow.

3.2.5 Power Supply

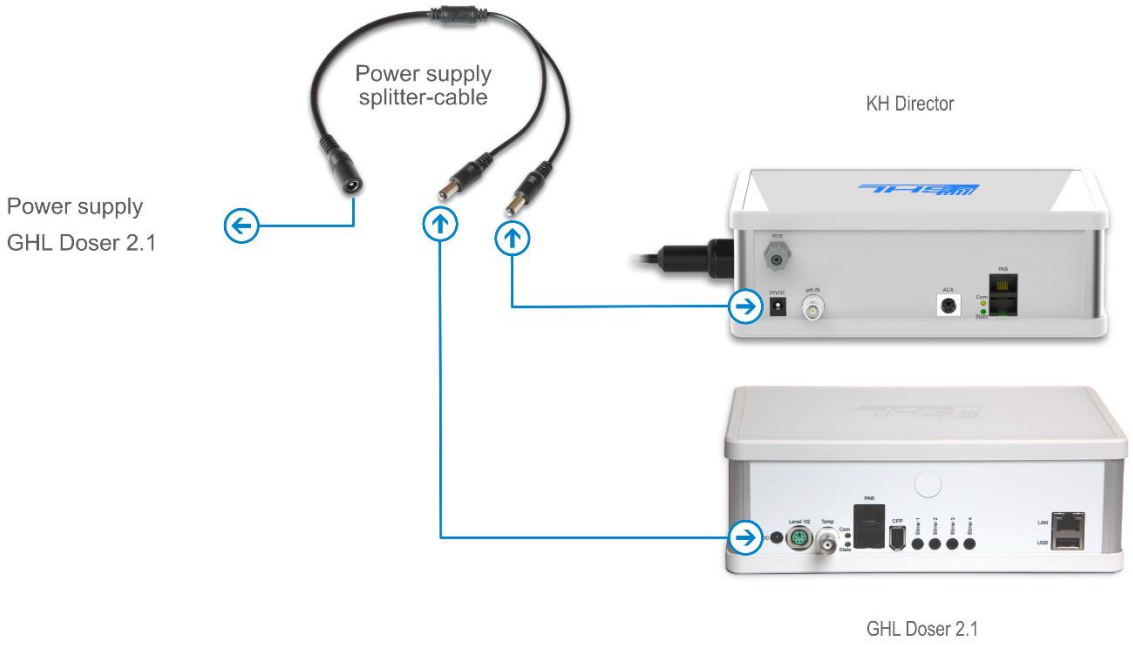
24 VDC hollow socket. The *KH Director* does not have its own power supply. The device needs to be connected to the power supply of the *GHL Doser 2.1* via the power supply splitter-cable.

To install, first connect each Y-ends of the splitter cable to the DC-connector of the *KH Director* (24 VDC, polarity: Inside +, outside -) and *GHL Doser 2.1*. Connect then the other end of the splitter to the main power supply of the Doser.

Please note that the *KH Director* and the *GHL Doser* are operated with **24 V**, *ProfiLux* on the other hand runs with **12 V**. It is therefore not possible to tap the supply voltage for the KH Director from the ProfiLux.

Never connect 12 V consumers to 24 V power supplies (or vice versa), this will inevitably lead to malfunction or destruction!

Use only the supplied original cables and power supplies for supplying power to the *KH Director* device.



DANGER

- To establish the power supply, the supplied *Power supply splitter-cable* may only be connected to the *KH Director* and to the *GHL Doser 2.1* (24 V consumer) and its power supply unit.
- Under no circumstances connect 12 V consumers (e.g. *ProfiLux*) to 24 V power supply units (or vice versa), this will inevitably lead to malfunction or destruction!
- A repair caused by this is not a guarantee and is therefore subject to a charge.

4 Activation

4.1 Configuration Options

DANGER

For conveying the liquids (sample water, reagent, waste water) to and from the *KH Director* only pumps of a *GHL Doser 2/2.1 Slave* or *Stand Alone* must be used!

Never use other pumps for this purpose (also don't use pumps of the *GHL Doser Maxi*) – this may cause destruction of the *KH Director*!

To operate the device, an additional control unit (*ProfiLux* from model 3, *GHL Doser Stand Alone* from model 2 or a *GHL Maxi Doser Stand Alone*) is required

4.1.1 Operation with GHL Doser 2.1 Stand Alone

The *KH Director®* is connected to the *GHL Doser 2.1 Stand Alone* via the ProfiLux Aquatic Bus (*PAB*).

With this option, the *GHL Doser* has full control over the measurement process and behavior of the *KH Director*. The *GHL Doser* will control both its dosing pumps and the valves in the *KH Director*. This will allow the Doser to evaluate the measurement results and calculate the KH value.

4.1.2 Operation with ProfiLux Aquarium Controller and GHL Doser Maxi Stand Alone

The KH Director® is connected to the ProfiLux 3 (3.1, 4) or a GHL Doser Maxi Stand Alone and a GHL Doser 2 (2.1) Slave via the ProfiLux Aquatic Bus (*PAB*).

With this option, the *ProfiLux* or the *GHL Doser Maxi Stand Alone* has full control over the measuring process and behavior of both the GHL Doser and KH Director. The *ProfiLux* or the *GHL Doser Maxi Stand Alone* will control the dosing pumps in the *Slave Doser* and the valves in the *KH Director*. This will allow the controller to evaluate the measurement results and calculate the KH value.

4.2 Connection of PAB-Devices

As a *PAB* device, the *KH Director* is connected via the *PAB* connection to the controller (*ProfiLux*, *GHL Doser 2.1 Stand-Alone* or *GHL Doser Maxi Stand Alone*).

4.2.1 What is the PAB

PAB is an interference free CAN-Bus-System which allows for extremely secure data transfer between all PAB devices such as for example *KH Director* and *GHL Doser 2.1*. The range can be up to 100 m (300 FT).

The required *PAB* cables are available in different lengths and are not included and must be purchased. The *KHD-Sets* do include a *PAB cable* for connecting the KHD to the included Doser.

TIP

- Be sure to obtain suitable PAB cables in the appropriate lengths to meet your needs.
- *PAB*-cables are available online at *GHL Store (EU) and GHL USA Shop (US)* in different lengths from 0.5 m up to 50 m.

To enable the operation of the *KH Director*, the device needs to be assigned to the respective controller. For thorough information on how to assign PAB devices please refer to the corresponding *Instruction manuals*. They can be downloaded here: https://www.aquariumcomputer.com/downloads/

4.3 Installing GHL Control Center

Full device settings and functions are accessible via the software *GHL Control Center (GCC)*, which is available for download free of charge in the download area (support-> downloads) of our homepage www.aquariumcomputer.com.

4.3.1 Requirements

You must use the appropriate *GHL Control Center* software version which supports the firmware of the respective controller, *GHL Doser 2.1* and *KH Director*.

GCC supports the following operating systems: Microsoft Windows Vista® and Windows 7®, Windows 8®, Windows 10®.

A connection to the used controller can be established via the following PC interfaces:

- USB
- WLAN/LAN

4.3.2 General

Please follow the instructions given in the Instruction Manual of your chosen controller (*ProfiLux* or *GHL Doser)* under the items *Operating the device via the software GCC* and *Assign further PAB Devices*.

Assign the *KH Director* to the respective controller.

4.4 Status Indicators of the KH Director

The *KH Director* includes two status indicator lights which are located on the housing cover and the back of the device. These lights provide system status information at a glance.

4.4.1 System-Status- LED on the housing cover

The various colors can show you at a glance, the condition of your aquarium.

The color and blink codes shown depend on the particular Firmware.

For the meaning of the blink codes, please refer to the Support-> FAQ section of our homepage www.aquariumcomputer.com.

DANGER

- Never leave your aquarium or terrarium unsupervised for an extended amount of time.
- The maximum amount of time without personal view depends on how long your aquarium, terrarium, or pond can survive without significant damage, even when errors occur.
- Always remember that technology can fail and therefore malfunctions can never be ruled out!
  Power failures, incorrect settings, damage (For example, by water or overvoltage) or simply an unexpected operating situation can lead to fatal damage.
- The manufacturer declines any liability for (consequential) damage or loss arising in connection with the use of the *GHL Doser 2.1*, as far as permitted by law

4.4.2 PAB Status LEDs on the Back Panel

Located on the back panel of the *KH Director* are another two LEDs that provide information about PAB connection status and PAB communication status..

The upper yellow LED indicates proper communication within the *PAB* connection. The lower green LED provides information about the status of the *PAB* communication.

Status	Meaning
Yellow LED flashes	*KH Director* receives *PAB* commands
Green LED is ON	*KH Director* is ready for operation

Green LED flashes quickly	*KH Director* is started, firmware update
Green LED flashes every second, yellow LED is OFF	*KH Director* has not received PAB commands from *ProfiLux, GHL Doser SA* or *GHL Doser Maxi SA* for more than 30 seconds
Both LEDs are OFF	*KH Director* has no supply voltage

4.5 Installing the KH Director

The device must be protected from water at all times!

Mount the *KH Director* in a water-protected area. When selecting the mounting material, make sure that you have adequate sizing and stability. Make sure that the unit cannot fall into the water during assembly or normal use.

If the device is placed inside an aquarium cabinet, make sure that it is placed in an area free from splashing water; moisture or liquids that can penetrate.

The *KH Director* as well as its accessories are destroyed by excess moisture or excess atmospheric humidity - Please observe the technical data and notes below!

To ensure maximum safety and operation, the following regulations must be followed! Failure to follow the safety guidelines will result in VOIDING your warranty. The manufacturer rejects any responsibility or liability for damages resulting from misuse!

Powered equipment and water can become a dangerous combination if precautions are not taken. It is therefore essential to supply power to all mains-operated devices which are operated in the aquarium or in the vicinity of the device via a residual current circuit breaker!

In order to avoid any danger, all mains-operated devices must be disconnected from the mains; all plugs must be disconnected! When working in the basin, it can never be ruled out that a heating element, a pump, or a luminaire is defective.

Please also note the following notes:

TIP

- Please ensure good access to the connections of the device
- Please consider the maximum cable lengths of the connected *PAB* cables, sensors etc. when selecting the installation site
- Additional sensor cable extensions (*BNC2 cables*) and PAB cables are available in different lengths to fit your needs. They are available online in our *GHL Store (For US customers, GHL USA Store)*.

WARNING

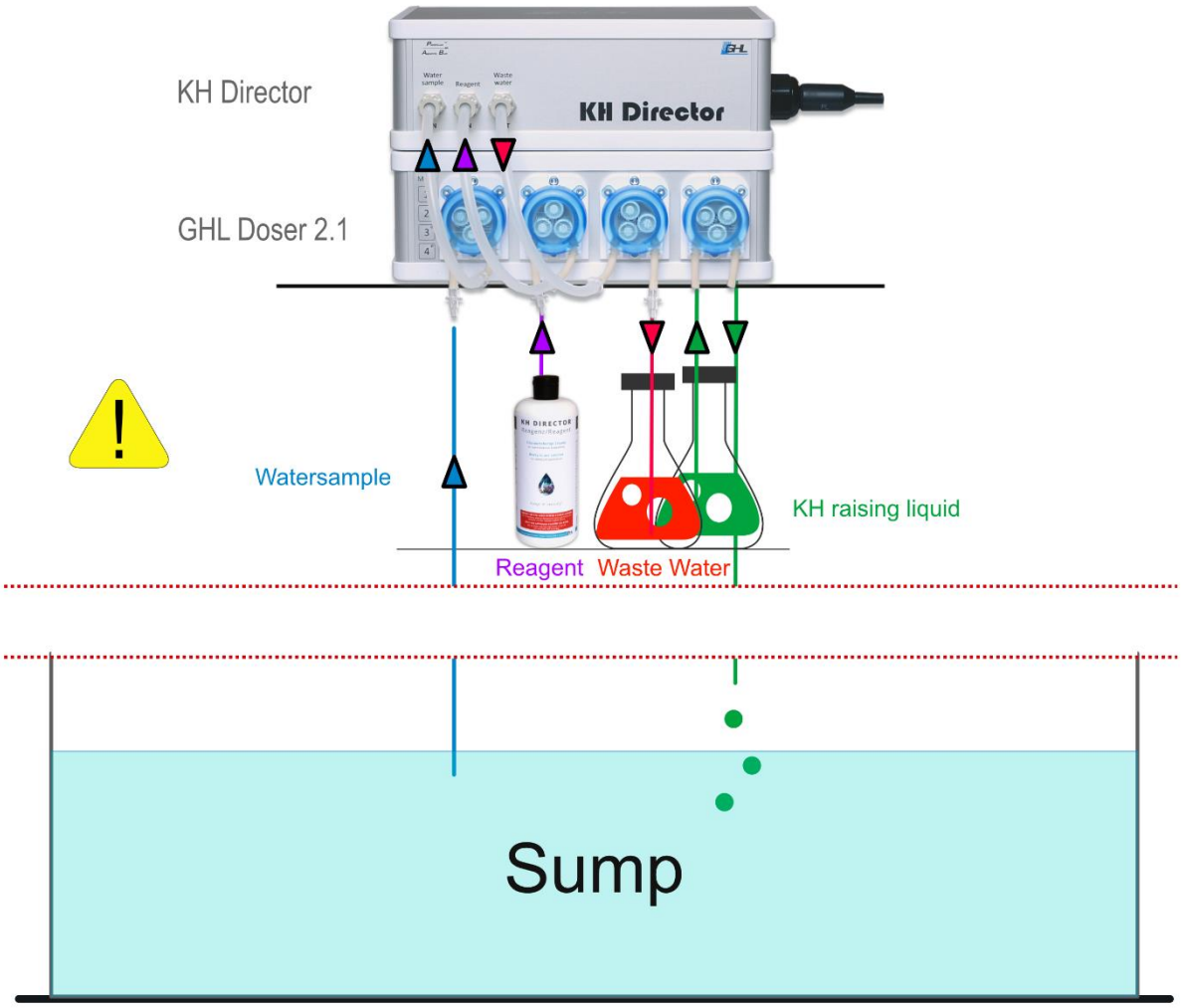
- To ensure proper operation, the connection cables should never be kinked, crimped, or positioned in an unsuitable way.

DANGER

- The *KH Director* **must** be installed horizontally.
- The maximum deviation from the horizontal must not exceed +/- 3 °.
- **Only when installed correctly** an adequate measurement can be carried out.
- **The KH Director may NEVER be used without a built-in pH electrode!**

4.6 How it works

The 2 inlets and 1 outlet of the KH Director connect to 3 dosing pumps on the Doser 2 (2.1). These 3 pumps are then responsible for accurately transferring fluid to and from the KH Director.



The KH Director is first supplied with a sample of the aquarium water, the sample tube is automatically deaerated.

Subsequently, with the slow addition of a reagent liquid and measurement of the pH value, the KH value is precisely determined.

After the KHD has calculated the KH value, the sample water is pumped out once again and then dispensed into a separate container for later disposal.

Finally, the content of the sample tube is pumped back into the aquarium, thus ensuring that always "fresh" aquarium water is measured and the reading is up to date.

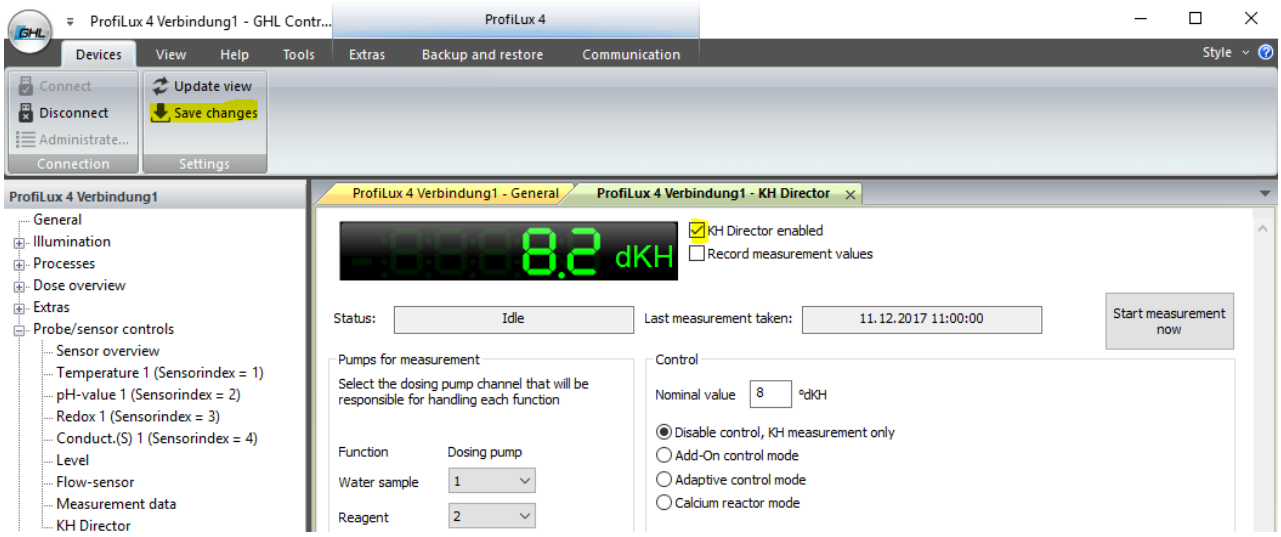
The illustration above shows a schematic representation of the principle of operation. Please note the following when installing the devices:

WARNING

- *KH Director* and *Doser* must be positioned away and protected from splashing water and excess humidity!
- Splashing water/saltwater and or condensing humidity (e.g. occurring nearby the sump) will *destroy the devices – this voids all warranty claims!*
- **The waste water must not be discharged into the aquarium.**

4.7 Selection and Assignment of the Pumps

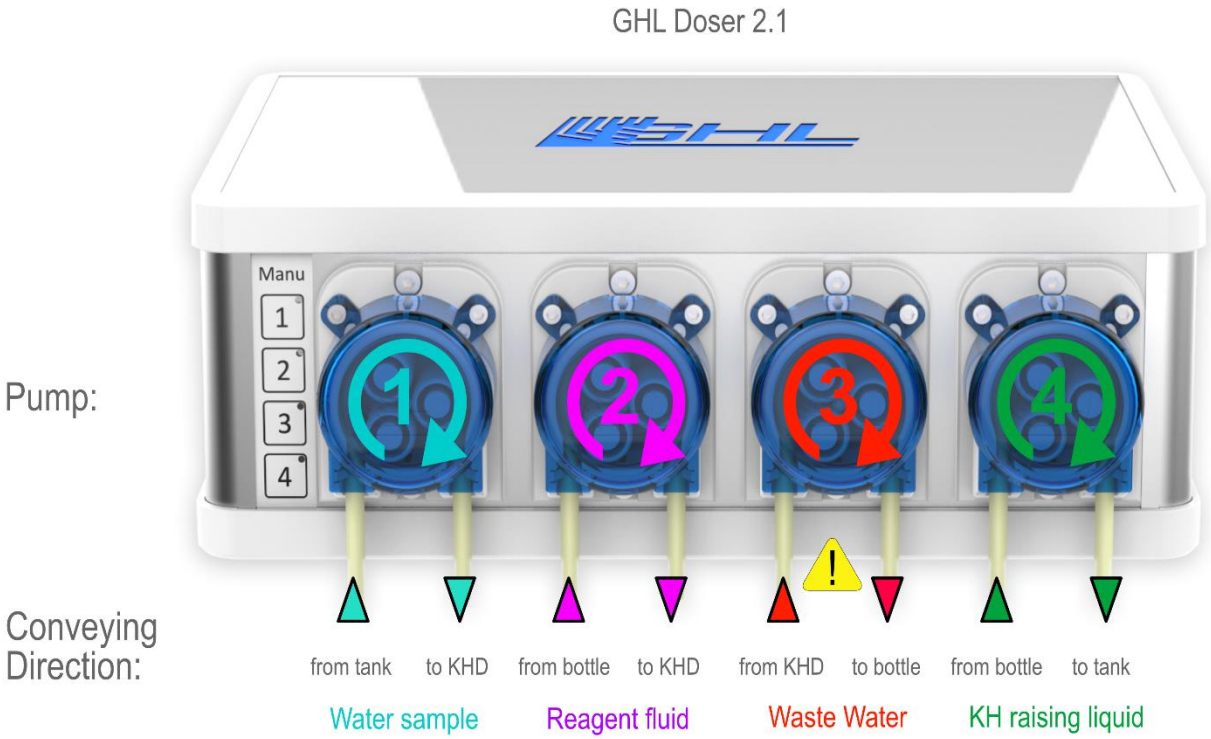
In the *GCC* under Regulation, select the category KH Director, activate the KH measurement. Save the changes.



DANGER

- If you have made or changed settings for your device via the *GCC*, you must **always** save them using the "*Save changes*" button.

For the measurement, three pumps of the GHL Doser 2.1 are required. As default, pumps 1-3 are preselected for the functions *Water sample*, *Reagent* and *Waste water*.



The pump assignment can be changed. If you already have several Dosers in your system, then care must be taken when numbering the pumps that one number is not assigned more than once.

WARNING

Note the conveying direction:
Pump 1 and 2 convey **to** *KH Director*. Pump 3 conveys **from** *KH Director*.

4.8 Activation of the Pumps

1. Set the pump speeds required for the KH measurement:
   Dose overview -> Dosing pump 1 (or the pump that is designated in your system for the KH measurement) -> Pump settings -> Maximum Speed.

   Pumps *Water Sample* and *Waste water* here numbers 1 + 3:-> Speed = 3 (fast).

   Pump *Reagent* here number 2: -> Speed = 0 (slow)

2. Calibrate the selected pumps

DANGER

- Please carry out the calibration carefully.
- The pump calibration has a direct influence on the precision of the measurement and control.
- The more precisely you perform the calibration, the more accurate the KH measurement can be.

3. Activate the fill level

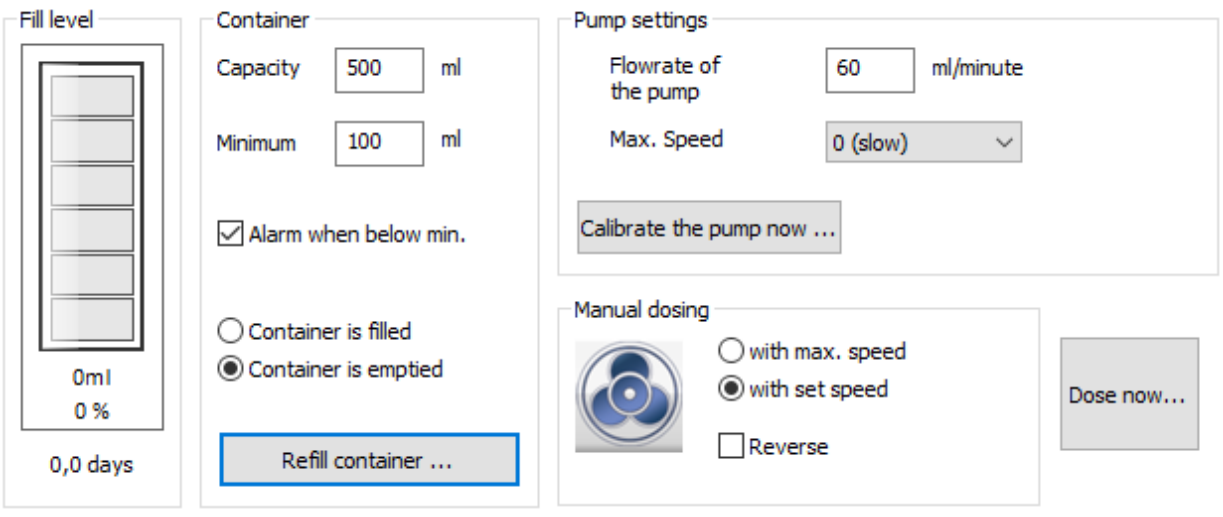
For safety reasons, KH measurements are only started if it is ensured that there is at least 50 ml of reagent liquid for the measurement in the dosing container.

Enter the container capacity. For the pump that delivers the reagent fluid (here 2), the example shown here is 500 ml. You can also enter a minimum below which an alarm should be triggered.

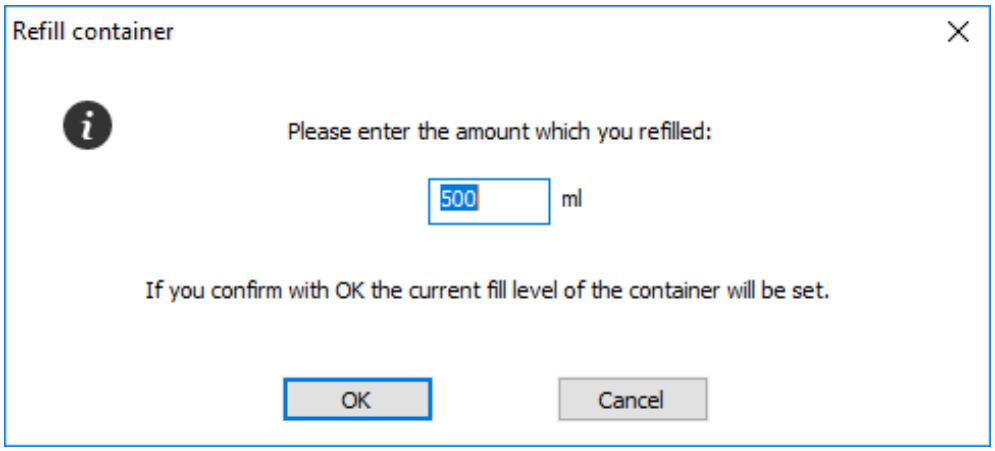
-> Save the changes.

The Doser calculates the fill level indicator according to the specified capacity of 500 ml and the filling level. If you choose a larger fluid container (for example, 1000 ml) at a later time, then you need to save that again, so that this capacity change can be taken into account in the level indicator.

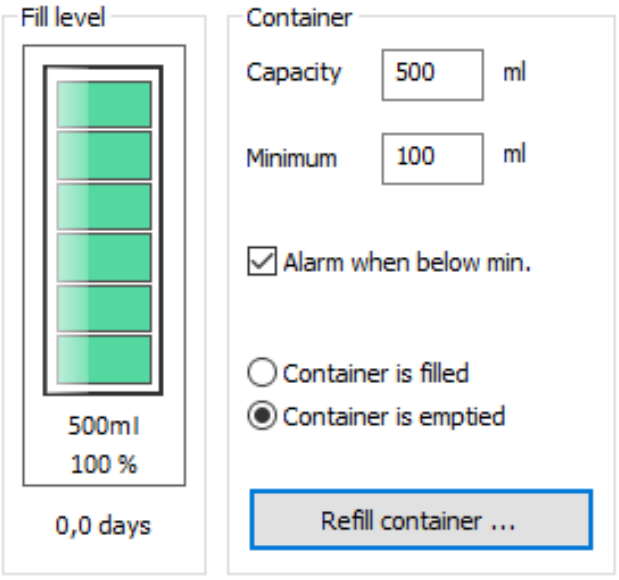
The container is emptied by dosing, therefore choose *Container is emptied*. For the pump Waste water (here 3) choose accordingly *Container is filled*.



To activate the level indicator, press the Refill container button and confirm with ***OK***.



The *Fill level* is now displayed.



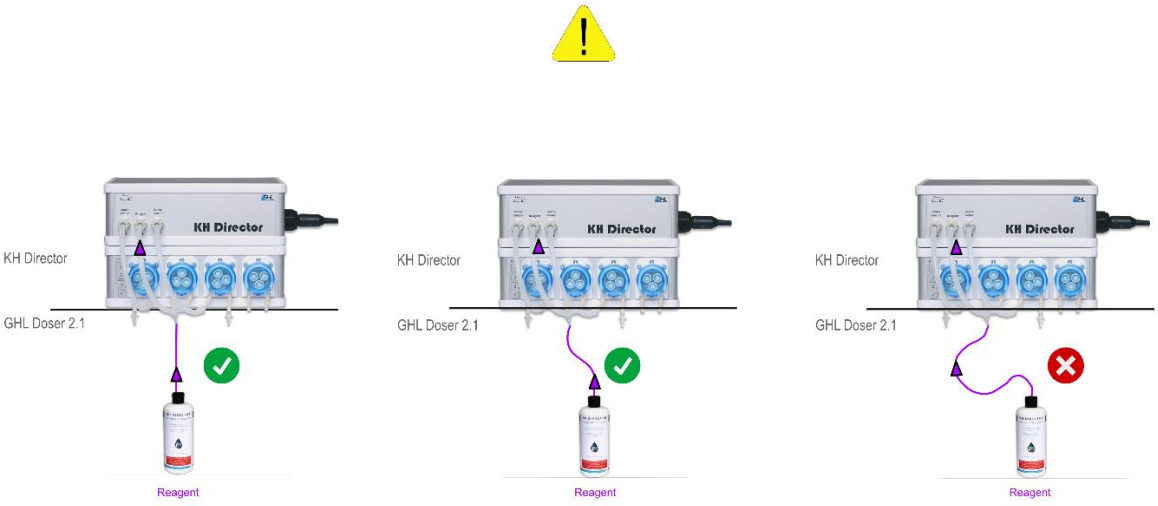
4.9 Mounting the Tubes

You can place the KH Director and the GHL Doser 2.1 side by side or stack the devices. Please note that depending on the chosen mounting method you need different tube lengths between *KHD* and *Doser*. For orientation, you will find below a tabular overview of the required tube lengths.

In order to achieve maximum measuring accuracy, it is necessary to keep the tube to the reagent liquid as short as possible (in total max. 70 cm / 27,5”).
Use for the reagent fluid the Flex-PVC-tube only!

Please make sure that bubbles cannot collect anywhere in the tube, for example because the tube sags.

The tube must therefore be routed steadily from the reagent bottle to the corresponding metering pump.



After connecting the tubes, the tube of the pump (here pump 2), which supplies the reagent liquid, must be vented.

This can either be done manually using the buttons on the GHL Doser 2.1 or via the *GCC* under *Manual dosing*.

TIP

Make a note of the assembled tube length for taking the water sample (here Pump 1) and the tube length to the Water Sample input of the KH Directors and add the two lengths. You will need this total tube length later when determining the *Sample tube volume*.

Assembly	Water sample (Silicone tube)	Reagent (Flex-PVC tube)	Waste water (Silicone tube)
stacked	16 cm (6.3“)	17 cm (6.7“)	17 cm (6.7“)
side by side	26 cm (10.2“)	23,5 cm (9.3“)	21 cm (8.3“)

Assembly stacked and next to each other:

Impurities in the sample water can damage the pump and the KH-Director. We therefore recommend the use of our inline water filter (Art. No. PL-1610, 1x included) in the sample tube between the aquarium and the sample water pump. Please note the marking of the flow direction, this must point to the pump. If the filter begins to clog it must be replaced, it is available as a spare part.

DANGER

- Before activation, the connected reagent tube (pump 2) must be completely deaerated.
- Carefully perform the deaeration, as otherwise accurate measurement results cannot be achieved.
- Guide the reagent tube in a way that no air bubbles can form during operation.
- The venting of the internal reagent tube takes place shortly before the measurement is carried out (see point 5).

DANGER

- During operation, it must be ensured that no air bubbles can form in the reagent tube, as these can falsify the measurement result.
- **The total length (= length before pump + length between pump and KHD) of the reagent tube must not exceed 70 cm (27.5”)**.
- If you detect air in the tubes, deaerate them again and then vent the internal reagent tubing using KH Director -> Maintenance -> *Vent internal reagent tube*.

4.9.1 How to install the ventilation tube

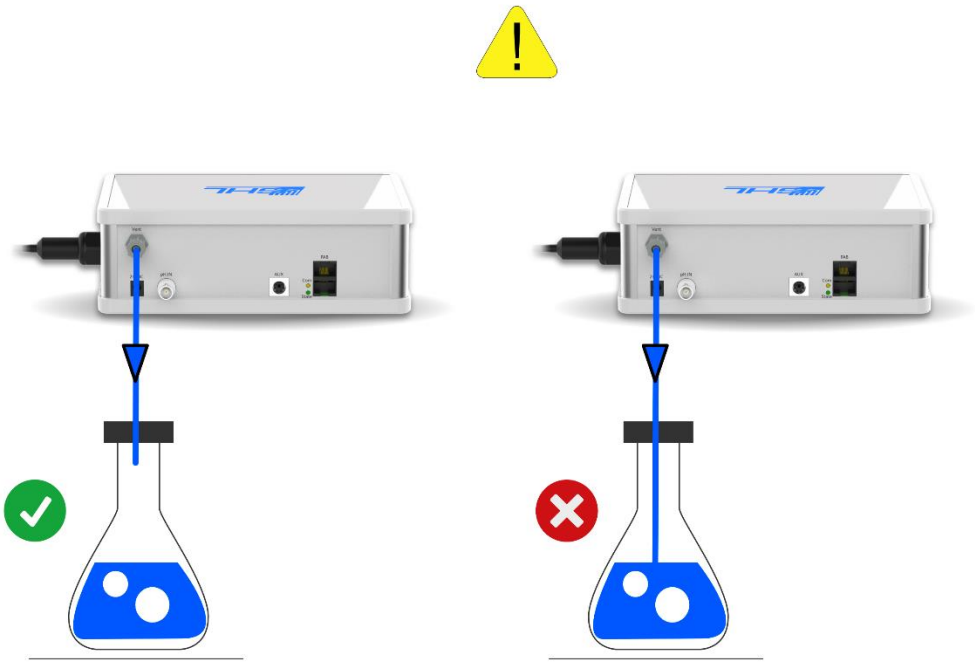
The vent port on the back of the KH Director must also be tubed and connected to the Waste water container.

WARNING

The vent tube must never be positioned in a way that will allow it to suck-in water.

Therefore, please make sure the vent tube is placed above the water surface at all times!

An incorrectly installed vent tube will result in incorrect measurement results!



4.10 Connecting the pH-Electrode

Connect the sensor connection cable into the corresponding BNC connector socket.

Before using for KH measurement, the pH electrode must **first** be calibrated. Please note the following instructions in this manual.

DANGER

- Sensor plugs must not be wet or damp when connecting to the socket.
- Do not use force.
- Products that are already powered should never be pulled by the cable. This may cause malfunction or damage the connected products and the *KH Director*.
- **The KH Director may NEVER be used without a built-in pH electrode!**
- A repair caused by this is not a guarantee and is therefore subject to a repair charge.

4.11 Calibrating the pH-Electrode

Calibration is always necessary with new sensors. Also, the calibration should be repeated from time to time (approximately every 2-4 weeks) due to the aging process of the sensor. Please also observe the information enclosed with the sensor.

DANGER

- Please allow some time for the calibration
- Please follow the instructions of the *GHL Control Center* carefully
- Before immersing the sensor in a calibration solution, the sensor must be carefully dried with a dry, lint-free paper towel.

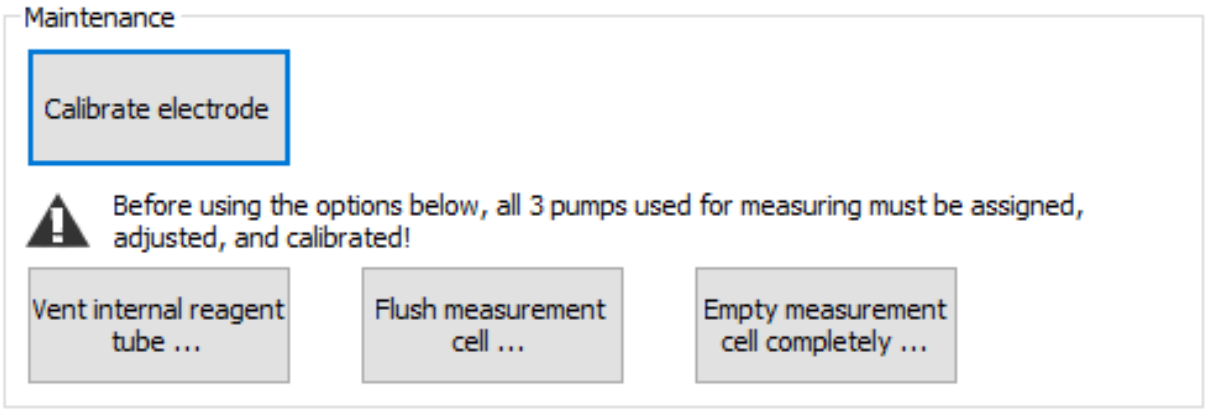
Connect the pH-Sensor.

If you have not already done so, check the check box for *KH Director enabled* and save the changes.

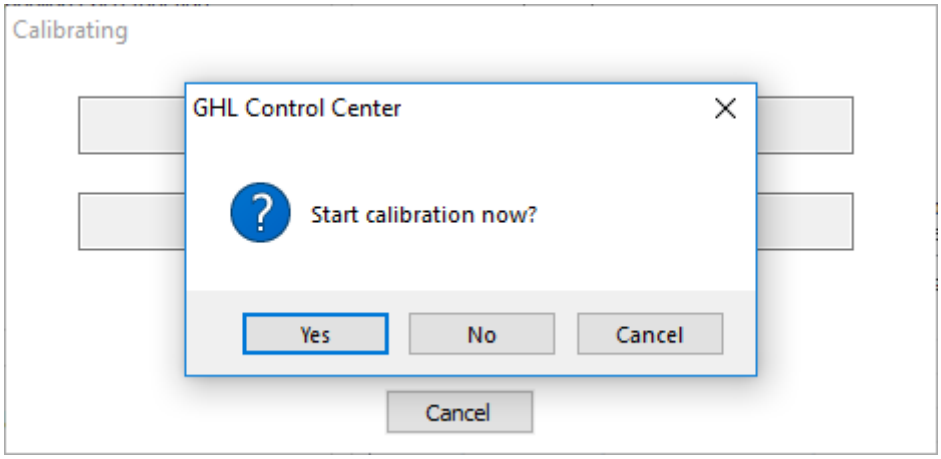
Before removing the pH electrode (e.g. for replacement or calibration), stop the automatic measurement (set measurements per day to 0) and skip the automatic measurement while the pH electrode is removed.

Switch the automatic measurement back on (measurements per day larger 0) only after the pH electrode has been fitted correctly and watertight.

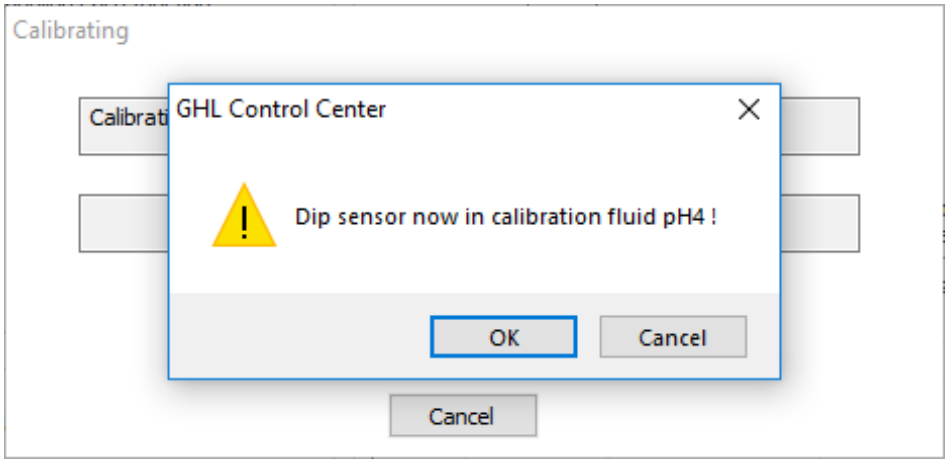
Go to Probe/ sensor controls -> KH Director -> Maintenance -> and click the button *Calibrate electrode*.



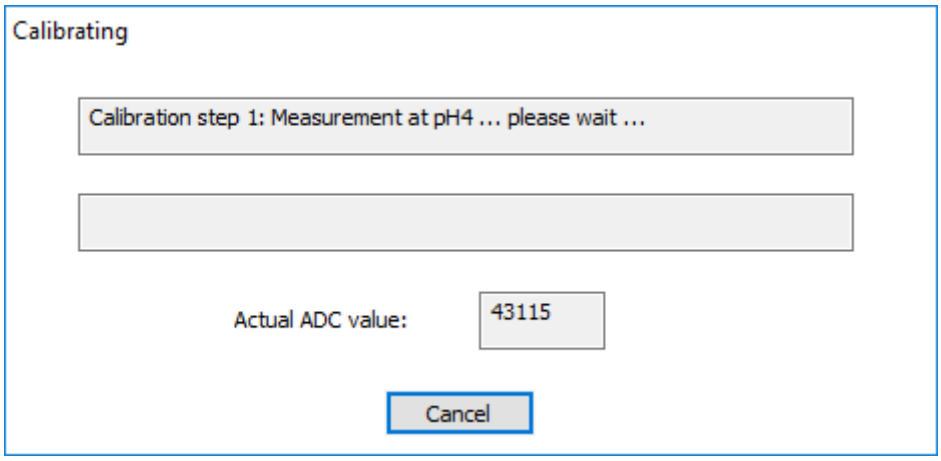
Start the calibration.



Prepare the **red** calibration fluid **pH 4**, immerse the electrode and start the calibration.

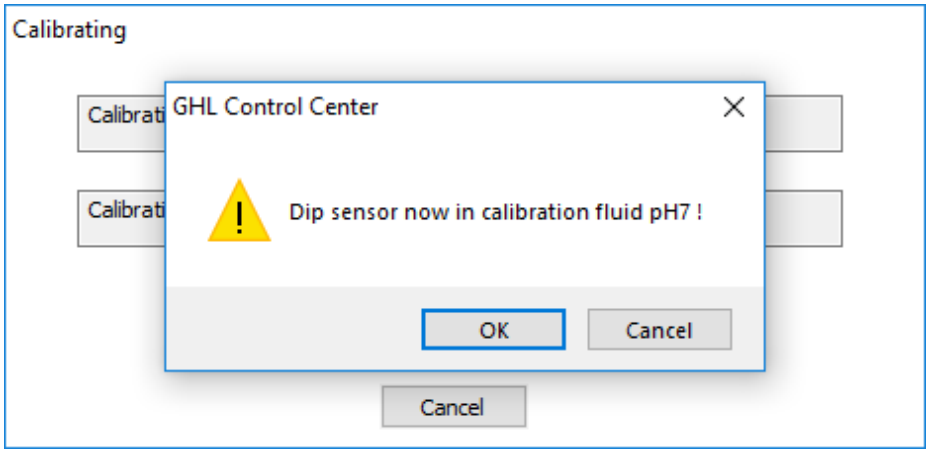


Wait until the measurement is done. this can take up to 5 minutes.

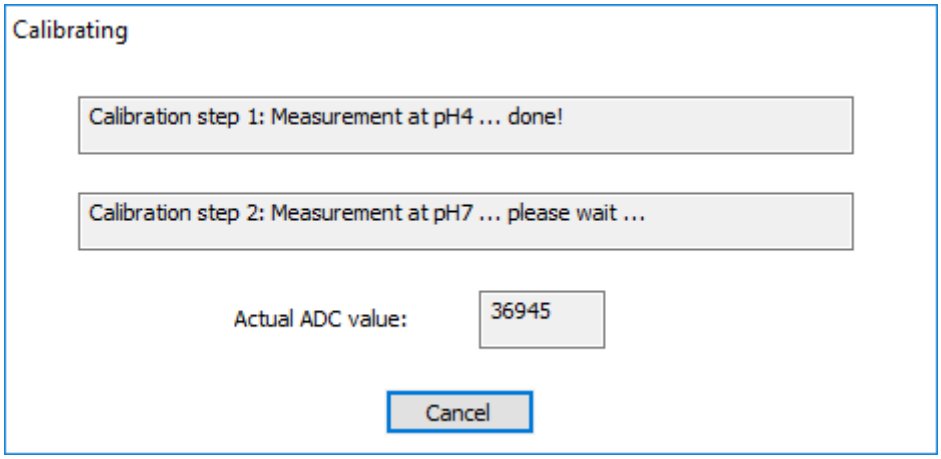


As soon as the calibration of the electrode to pH 4 has been completed, you will be asked to immerse the sensor in the **green** calibration liquid **pH 7**.

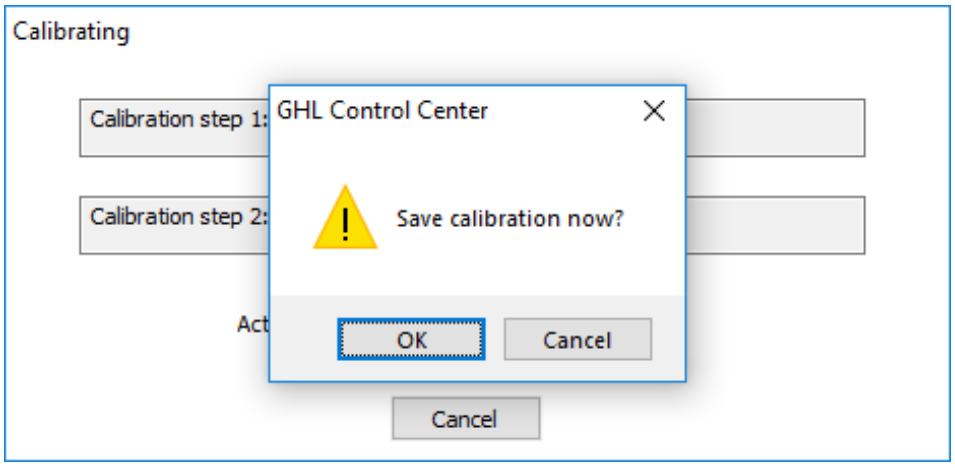
Shake the electrode well and wipe it dry with a lint-free cloth. Then immerse the sensor in the calibration liquid and continue the calibration with pH 7.



Wait for the completion of the calibration.



Save the calibration values.



4.12 Mounting the pH-Electrode

After successful calibration, the *pH-Electrode* can be installed. To do this loosen the locking nut on the side of the KH Director and push the electrode into the device or rather into the measurement cell until it stops. Then turn the locking nut tight again.

Make sure that the rubber seal is seated correctly and that the screw connection cannot be loosened, and ensure that no water can escape.

Tighten the screw connection as tightly as possible to prevent water from leaking out of the electrode, use an appropriate tool!

TIP

To keep the rubber seal smooth and dense, we recommend rubbing it with Vaseline thinly from time to time.

DANGER

- Incorrect installation of the *pH-Electrode* can destroy the *KH Director*!
- Any repair caused by this – e.g. through a water leakage – is not a warranty claim, a repair or replacement is therefore subject to a charge.

WARNING

Please note that the pH electrode must not dry out.

KH Director retains a small amount of water in the cell after each measurement to protect the pH electrode from drying out.

After 3 days without measurements, it is possible that the humidity in the measuring cell is insufficient and the electrode could dry out.

If the KH Director should not carry out any measurements for more than 3 days, please remove the electrode and attach the supplied electrode protection cap to the electrode with approx. 1 drop of liquid (ideally KCl 3 mol / l).

Only re-install the electrode when measuring again.
During prolonged inactivity, the electrode must be recalibrated.

5 Carrying out the KH Value Measurement

5.1 Select Sample volume

Select your desired sample volume to be used by *KH Director* for KH measurement. There are settings from 50 to 100 ml selectable. The default setting is 80 ml.

TIP

The larger the selected sample volume, the more accurate can be measured. However, this also increases the consumption of the reagent liquid.

Depending on your specific application and the desired measuring accuracy, the measurement with 50 ml sample volume may be sufficient.

5.2 Enter sample tube volume

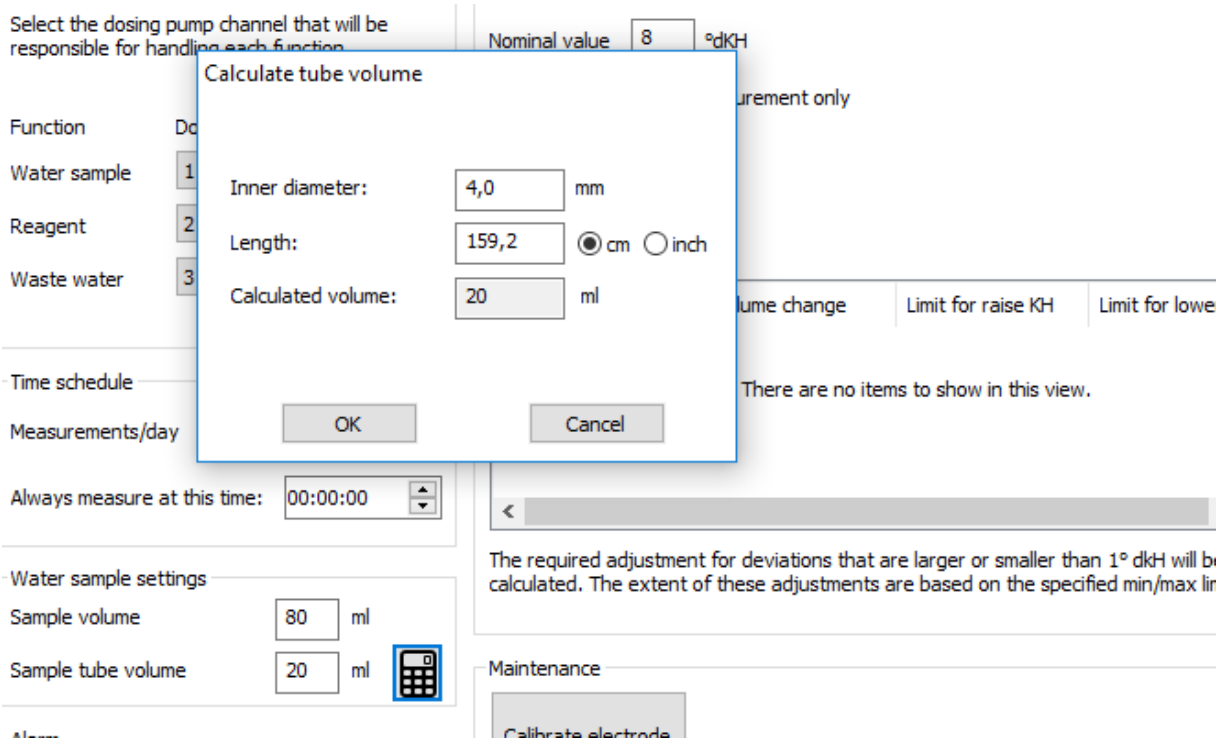
The sample tube is automatically deaerated before a measurement. After the measurement, the water in the tube is pumped back into the aquarium. This ensures that a current measured value is always determined.

For that the *KH Director* requires the exact specification of the *Sample tube volume*. When calculating the volume, you are supported by a built-in tool. Just click on the calculator next to the input field for the *Sample tube volume*. Enter the total tube length (including the sample tube between the *KH Director* and the dosing pump and including the tube length of

the dosing pump which is 12 cm / 4.2") that you have connected and confirm with ***OK***. The tube volume will automatically be taken over.

HINT

If you use an inline filter in the sample tube, its volume must be added.
The GHL inline filter has a volume of 7 ml.
Example: The tube had a volume of 10 ml - then a sample tube volume of 17 ml has to be entered.



5.3 KH value measurement

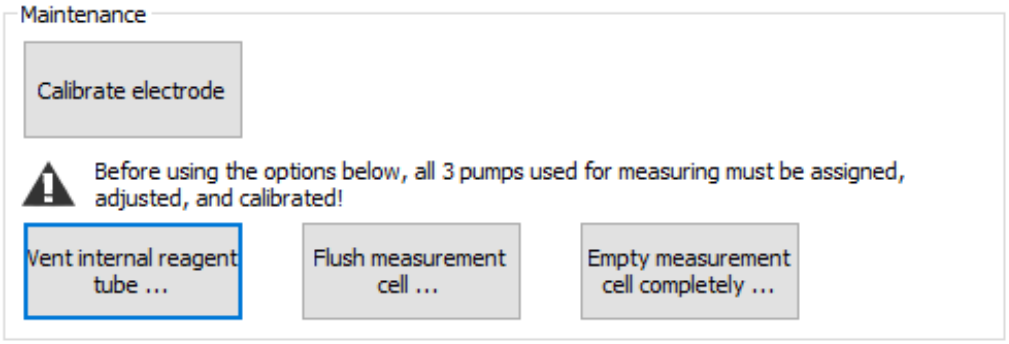
A measurement can be started manually or automatically every day at certain times.

Perform manual and automatic measurements only when the pH electrode is installed and the fitting is screwed tightly and watertight.

5.3.1 Preparation

Before the initial implementation, the following steps must first be carried out by pressing the corresponding buttons:

1. *Vent internal reagent tube ...*
2. *Flush measurement cell ...*



Please carry out both steps one after the other.

Only pump fluids into the KH Director when the pH electrode is installed and the fitting is screwed tightly and watertight.

In certain operating situations, it may happen that the measuring cell is not automatically emptied completely, as for example when canceling a measurement process.

The emptying of the measuring cell can be started completely empty by clicking on the button *Empty measurement cell completely*. The waste water pump will pump out the maximum possible filling volume.

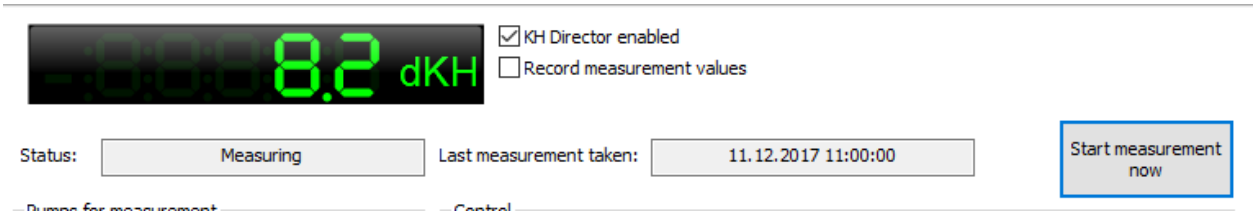
DANGER

- **The sample water tube must always take water from an area free of sediment and dirt! Dirt and/or sediment will damage BOTH the dosing pumps and internal circulation pump inside the KHD!** In these cases, the KHD will no longer provide a correct measurement. The water sample tube must be positioned carefully so that only clean water is pumped into the KHD.
- If dirty sample water cannot be prevented, a filter must be installed before the water sample pump!
- **Damages, caused by dirty sample water, are not covered by warranty.**
- It must always be ensured that there are no air bubbles in the sample tubes, as these falsify the measurement result.
- Make sure that the tubes cannot draw air during operation.
- If you detect air in the hoses, vent them and then perform steps 1-2 as described for the initial measurement.

5.3.2 Manual KH value measurement

Before starting a measurement, please make sure that the pH-Electrode has been calibrated and installed correctly and that all dosing pumps involved in the measurement have been correctly selected, adjusted and calibrated.

Then the measurement can be started via the button *Start measurement now*.



Depending on the KH value, a measuring process will take about 10-20 minutes.

Please note

The KH measurement is only started if at least 50 ml of reagent fluid is available!

5.3.3 Daily automated measurement

If you want to carry out automatic KH measurements daily, you can define a *Time schedule*.

Measurements/day
As often (1 to 24) is measured daily at equal intervals

Always measure at this time
This allows you to select a time to always be measured

Example

➢ ¬ You want to measure twice a day at 07:00 and 19:00.

1. Set for *Measurements per day* = 2
2. for *Always measure at this time*, set 07:00 (the second time is automatically: 07:00 + 24h / 2 = 19:00)

Note

- In most cases, it will not be necessary to measure more than once or twice a day. If the dosing pumps regulating the KH value are used correctly and the control procedure explained below is followed, a sufficiently stable KH value will be reached.
- The more often you measure, the more reagent fluid will be consumed.

5.4 Alarm

The *KH Director* can monitor the measured KH value and, if necessary, display an alarm. To do this, activate the alarm monitoring and specify the *Lower* and the *Upper limit* for the permissible KH value. If the measured value is outside these thresholds an alarm is displayed.

If, for safety reasons, you wish to switch off the KH regulation in the event of an alarm, then check *Deactivate control during alarm*.

6 KH Value Control

Depending on the difference between the desired KH *Nominal value* and the measured KH actual value (= control difference), measures can be taken that raise or lower the KH value. The control is either via the influence of one or more dosing pumps or via the pH setpoint control of a calcium reactor.
Set the desired setpoint and switch the desired control mode active.

6.1 Control via dosing pumps

Up to 5 dosing pumps can be influenced depending on the control difference in their dosing quantity.

First of all, set your dosing pumps, which are involved in the KH value of your aquarium, as usual (for example according to the Balling or Triton method). Here you already set times

and dosing quantities optimally. That means the desired water values should be achieved as well as possible and be stable.

The KH regulation intervenes in a corrective manner, which means that the set amounts of certain dosing pumps are varied. Two modes are available for the KH control by metering pumps:
You have the choice between *Add-On control mode* and *Adaptive control mode*.

6.1.1 Add-On control mode

In this mode, the single doses of the dosing pumps involved are influenced by addition or subtraction of quantities (volume change in ml).

First, select the dosing pumps that are to be influenced depending on the KH value (maximum 5). The following parameters can be set independently for each of the selected metering pumps:

- *Volume change* (in ml)

  If the setpoint is undershot by 1° dKH, the amount of *Volume change* is metered in addition to the quantities already set for this dosing pump (KH lifting). This amount is added at each dosage (*raise KH*)

  If the setpoint has been exceeded by 1° dKH, the set single doses are reduced by the amount of *Volume change* (*lower KH*).

  For other control differences than 1° dKH the quantity change will be calculated proportionally.

- *Limit for raise KH* (in ml)

  If KH is too low: This can be used to limit the maximum amount that can be added to the regular dosing amount.

- *Limit for lower KH* (in ml)

  If KH is too high: This can be used to limit the maximum amount that is subtracted from the regular dosing amount.

Example

Dosing pump #4 doses 4 x 100 ml daily

➢ You want to have a KH value of 8.0 ° dKH and if your KH drops below 1° dKH you want to dose 20 ml more with each single dosing (here: 4 a day).

For KH setpoint, 8.0 ° dKH must be set, for pump 4, a volume change of 20 ml.

➔ Don´t forget to press *Save changes* after each entry!

What happens after the KH measurement?

KH actual value	Calculated volume change for pump 4 per single dosing
7,0° dKH	+20 ml = 120 ml
7,5° dKH	+10 ml = 110 ml
8,0° dKH	0 ml = 100 ml; no change, KH value fits
8,5° dKH	-10 ml = 90 ml
9,0° dKH	-20 ml = 80 ml

(the maximum *Volume change* can be limited with the limit settings)

The *Calculated adjustment* affects the dosages of this dosing pump until the next KH measurement.

6.1.2 Adaptive control mode

In this mode, the individual doses of the dosing pumps involved are influenced by the percentage variation of the dosing quantities (volume change in%).

First, select the dosing pumps that are to be influenced depending on the KH value (maximum 5). The following parameters can be set independently for each of the selected metering pumps:

- *Volume change* (in %)

  If the set point is undershot by 1° dKH, the quantities set with this dosing pump are increased by this percentage (*Volume change*) as a percentage (*KH raise*). This increase will be carried out with each single dosage.

  If the set point is exceeded by 1° dKH, the set individual doses will be reduced by this percentage (*Volume change*) as a percentage (*lower KH*).

  For control differences other than 1° dKH, the percentage change is calculated proportionally.

- *Limit for raise KH* (in %)

If KH is too low: This can be used to limit the percentage increase in the volume of regular dosing.

- *Limit for lower* KH (in %)
  If KH is too high: This can be used to limit the percentage reduction of the regular dosage amount.

Example

Dosing pump #6 doses regularly 5 x 200 ml per day

➢ You would like to have a KH value of 8.5° dKH and 10 % more dosage for each single dosing (here: 5 a day) if it falls below 1° dKH.

For KH setpoint you have to set 8.5 ° dKH, for pump 6 a volume change of 10%.

➔ Don´t forget to press *Save changes* after each entry!

What happens after the KH measurement?

KH actual value	Calculated volume change for pump 6 per single dosing
7,5° dKH	+10 % = 220 ml
8,0° dKH	+5 % = 210 ml
8,5° dKH	0 % = 200 ml – no change, KH value fits
9,0° dKH	-5 % = 190 ml
9,5° dKH	-10 % = 180 ml

(the maximum *Volume change* can be limited with the limit settings)

The *Calculated adjustment* affects the dosages of this dosing pump until the next KH measurement.

Please note the following when setting these and all other limits:

DANGER

- In any case, safe limits must be set.

- The limits must be chosen so, that the amounts varied by the KH regulation have any chance of correcting the KH value.
- On the other hand, in the case of a malfunction (for example, incorrect measurement because reagent is empty), the amounts should not become so high that they could endanger the aquarium.
- There is no plausibility check of the settings you have made.
- The manufacturer disclaims any responsibility or liability for damages!

6.2 Control via pH-value

These modes are only available if there is a pH control (via ProfiLux 3 or 4) in the system.

6.2.1 Control via reactor: Calcium reactor mode

Depending on the difference KH setpoint to KH actual value (= control difference), the pH setpoint of a reactor can be influenced (for example, by switching a CO2 solenoid valve).

First, the pH sensor is selected for its regulation, then the following parameters must be set:

- *Nominal value change* (in pH)

  If the KH actual value is too low by 1° dKH, then the pH setpoint is reduced by this value.

  If the KH actual value is too high by 1° dKH, then the pH setpoint is increased by this value.

- *Limit for raise KH* (in pH)

  If KH is too low: This can be used to set how much the pH value can be reduced at maximum.

- *Limit for lower KH (in pH)*

  This can be used to set how much the pH value can be raised at maximum.

Example

The pH control of the reactor has a setpoint of pH 6.5

➢ You want a KH value of 7.5° dKH and that the pH value is reduced by 1.5 if it falls below 1° dKH.

For KH setpoint, 7.5 ° dKH must be set, for the pH setpoint of the reactor control pH 6.5.

➔ Don´t forget to press *Save changes* after each entry!

What happens after the KH measurement?

KH actual value	Calculated pH setpoint change
6,5° dKH	-1,5 = pH 5,0
7,0° dKH	-0,75 = pH 5,75
7,5° dKH	0 = pH 6,5 – no change, KH value fits
8,0° dKH	+0,75 = pH 7,25
8,5° dKH	+1,5 = pH 8,0

(the maximum pH setpoint change can be limited with the limit settings)

The calculated pH setpoint change affects the pH control until the next KH measurement.

6.2.2 *Kalkwasser* mode

This mode works in principle like the calcium reactor mode, but the relationship between KH value and target pH value is exactly the opposite: If the KH value is too low, the target pH value is increased; if the KH value is too high, the target pH value is decreased.

For the Kalkwasser mode, the explanations on the setpoint, limits and examples apply as already explained under Calcium Reactor Mode, only with the opposite signs.

6.3 Simple control: Switching sockets

This option is only available if switchable sockets (controlled via ProfiLux 3 or 4) are present in the system.

As of firmware 6.43 (ProfiLux 3) or firmware 7.20 (ProfiLux 4), the following socket outlet functions are available:

- KH-value control downwards (decrease): socket is switched on if the current KH-value is too high

- KH-value control upwards (increase): socket is switched on if current KH-value is too low

7 Measurement accuracy

The KH Director gives you the best possible accuracy for a measuring device of this class.

In lengthy and time-consuming trials, the measurement process, the measurement electronics and the mechanical design have been optimized to such an extent that the KH Director can supply very precise measurement results. Nevertheless, small measuring tolerances, as they occur in all measuring devices, cannot be completely avoided.

You as a user can make a significant contribution to achieving the maximum measurement accuracy the KH Director can offer by ensuring the following optimal starting conditions:

- Max. *Water sample* volume (100ml)
- Careful calibration of the pH electrode at regular intervals (about every 4 weeks)
- Very accurate calibration of the dosing pumps involved in the measurement
- Shortest possible tubes between dosing pumps and KH Director as well as between reagent container and dosing pump
- Careful ventilation of reagent liquid tubes

Under these optimal conditions, a tolerance of approximately 0.1 ° dKH can be achieved per measurement.

If not all optimal conditions are met (for example because of smaller sample volume to consume less reagent), the tolerance becomes slightly higher, typically to about 0.3 ° dKH.

In any case, the measured value resolution is 0.1° dKH.

7.1 What does the measuring tolerance mean in practice?

On closer consideration, it can be concluded that the aforementioned tolerance for the application does not play a significant role. Why is that?

- Depending on the source, optimal KH ranges with a range of approx. 1.5 ° dKH are recommended.
- Daily KH fluctuations of 2 ° dKH or more are not uncommon and usually do not harm, whereas exceeding or falling below the optimal range may well be detrimental.
- Many other conventional measuring methods, e.g. Droplet tests, provide a reproducibility of 0.5 ° dKH at best under real conditions.

- When controlling the KH value, it is not important that a certain value of one tenth be maintained permanently; on the contrary, care should be taken to ensure that the KH value moves within an optimal range.

7.2 Comparison with other KH measurements

Our investigations have shown that different measuring methods (droplet tests or measuring instruments from various manufacturers) hardly yield any consistent results.

In most cases, several successive measurements with the same equipment show more or less deviant results. It is therefore difficult to judge which result is the "right one".

Here, the KH Director shows another strength: The results are calculated exactly according to scientific principles and are typically reproducible down to 0.1 ° dKH.

7.3 Conclusion

Every measurement is subject to tolerances, yet the KH Director delivers a high degree of precision when used carefully.

For effective measurement and control (if used) we recommend the following:

1. Make sure the measurement achieves reasonable accuracy with reasonable effort.
2. Adjust the control in a way, that the desired optimum KH range is maintained.
3. Do not choose this area too narrow (recommendation: range approx. 1.5° dKH, for example 7° dKH to 8.5° dKH).

8 Maintenance

The *KH Director®* is largely maintenance-free. It is recommended to clean the device from dust and other contaminants.

Tubes, pumps and motors are wearing parts, the service life depends on the frequency of use, the flow rates and the ambient conditions.

In the event of malfunction (for example, inadequate fluid delivery, loss of suction, leakage, increased operating noise) or mechanical failure, these must be replaced.

Due to the maintenance-friendly design, all wear parts can be easily replaced by yourself, all wearing parts are available as accessories.

9 Warranty/Liability

You have a 2-year warranty beginning from invoice date. This applies to material and manufacturing defects.

We guarantee that the supplied products correspond to the specifications and that the products do not have material resp. manufacturing defects. For the accuracy of the manuals, we do not guarantee damages of any kind which result from improper operation or from an unsuitable environment. Furthermore, we do not take over warranty for damages that are caused by a false connection or excessive humidity. We assume no liability for direct damages, indirect damages, consequential damages and third-party damages as far as it is legally permitted. We do not take over guarantee that our product package corresponds to the requirements of the buyer. Our warranty expires if the delivered original product is damaged or modified.

10 Additional Information

10.1 Help and Information

For help or further information, please visit our *Support Forum* at www.aquariumcomputer.com or contact your retailer.

10.2 Firmware-Update

The firmware of your *GHL Devices* is constantly being further developed. If you want to use new features that are not supported by your current firmware, you can update your device.

DANGER

- Be sure to back up your data **before** updating!

  You can use the menu item
  "*Backup and Restore*" -> "*Transmit all settings from GHL Device to file*"
  and load them again after the successful update via "*Transmit from file to GHL Device*".

For the update, you need the latest firmware and the PC program *GHL Control Center*, both of which can be downloaded free of charge from our homepage www.aquariumcomputer.com in the download area (*Support-> Downloads*), as well as our USB cable.

Instructions for updating firmware can be found from our homepage.

11 Technical Data

Input voltage	24 VDC
Environmental conditions	Operating temperature: 0°C - 40°C / 32°F – 104°F Humidity: Max 80% rel. Humidity non-condensing
Current consumption	200 mA max.
Dimensions	220 mm (8.66”) x 150 mm (5.9”) x 75 mm (2.95”) (without pH Electrode) 310 mm (12.20”) x 150 mm (5.9”) x 75 mm (2.95”) (with pH Electrode)

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