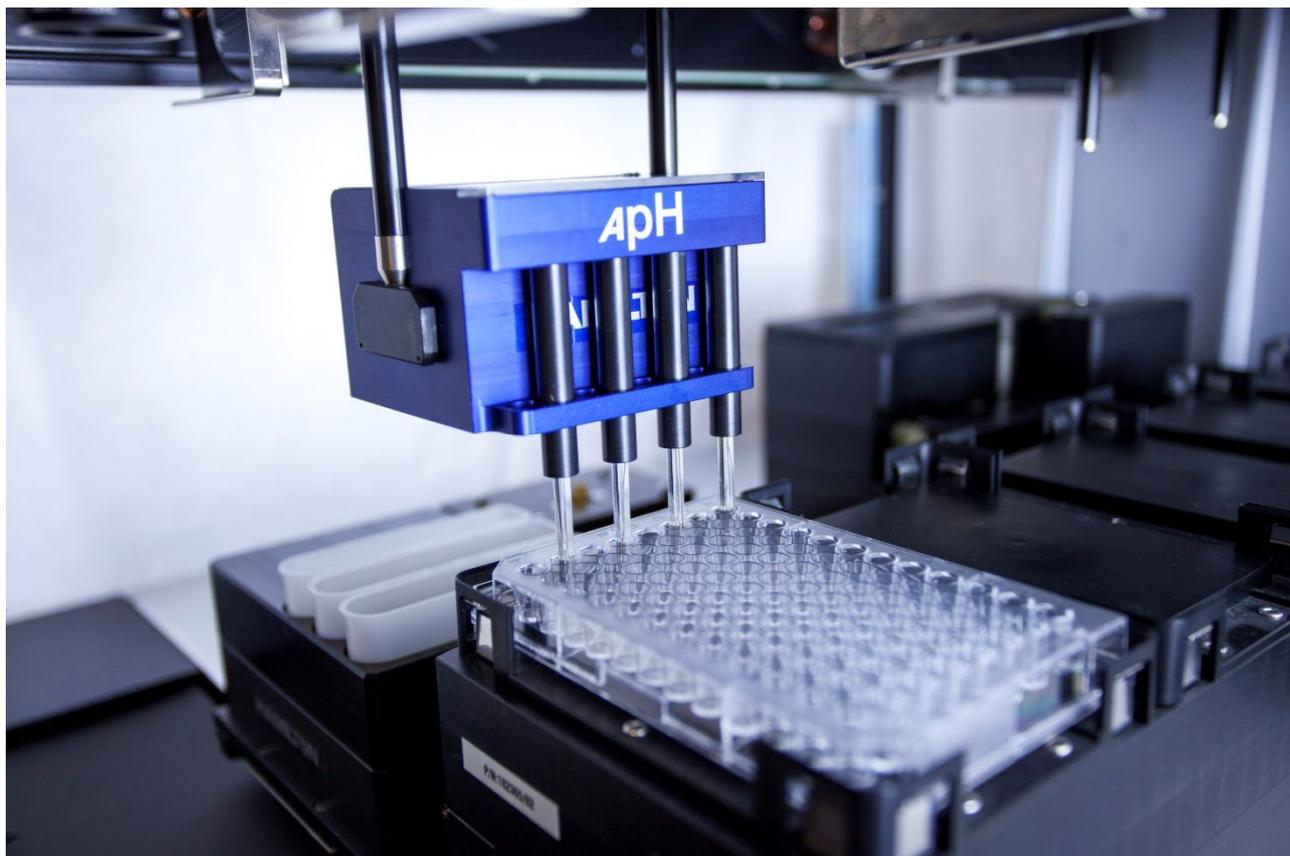


ApH

Automated pH Measurement

Operator's Manual



Important notice

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Table of Contents

1	Safety and General Information	1
1.1	About this Manual	1
1.2	Additional ML STAR Manuals	1
1.3	Intended Use	1
1.4	Training.....	2
1.5	Operation.....	2
1.6	Responsibilities.....	2
1.7	Legal Regulations	3
1.8	Safety Precautions and Hazards	3
1.8.1	General Precautions.....	3
1.8.2	ApH Module Installation and Relocation	3
1.8.3	Maintenance, Service and Repair.....	3
1.8.4	Method Programming.....	4
1.8.5	Work Routine	4
1.9	Electrical Safety Precautions.....	4
1.10	Chemical, Biohazard and Radioactive Hazards	4
1.10.1	Safety Measures	5
2	ApH Module Description	7
2.1	ApH Module Overview.....	7
2.2	Multiflex Carrier Interface	8
2.3	Trough Module	8
2.4	ApH Measurement Module.....	8
2.4.1	Loading and Unloading	9
2.4.2	Transport on the Liquid Handler	9
2.4.3	Interface, Power and Batteries.....	9
2.4.4	External Micro USB Charger	11
2.4.5	Dimension and Weight	11
2.4.6	Labware	12
2.5	Washer Module.....	15
2.5.1	Liquid Dispenser	15
2.6	Dryer Module	16
3	ApH Module Driver Library and Methods	17
3.1	General Information	17
3.2	Installing the ApH Module Driver Library and Methods	17
3.3	Configuration Method	20
3.4	Calibration Method.....	21
3.4.1	Preparing the Module	21
3.4.2	Calibration and Reference Measurement.....	22
3.4.3	Settings/Dialogues	22

3.5	Demo Method	26
3.6	Charging Method.....	27
3.7	pH Probe Exchange Method	29
4	Running the ApH Measurement Module	32
4.1	Preparation.....	32
4.2	Programming, Testing and Running a Method.....	32
4.2.1	Programming	32
4.2.2	Testing.....	32
4.2.3	Running a Method.....	33
4.2.4	Results Files	33
5	Maintenance, Storage Safety Instructions and Life Time	34
5.1	pH Probe Storage.....	34
5.2	Cleaning.....	34
5.3	Regenerating	35
5.4	Maintenance	35
5.5	Environment Conditions.....	35
5.6	Storage and Transportation Conditions.....	35
5.7	Robustness and Life Span.....	35
6	ApH Module Decontamination	36
7	Appendices	37
7.1	Appendix A: Ordering Information	37
7.2	Appendix B: Technical Specifications	38
7.3	Appendix C: Regulatory Affairs.....	38
7.3.1	Applied Company Quality Management Systems.....	38
7.3.2	Recycling Process.....	38
7.4	Appendix D: Description of Driver Libraries.....	39
7.4.1	ApH Module Controller Library.....	39
7.5	Appendix E: Troubleshooting.....	40

1 Safety and General Information

You should carefully read through the entire manual before beginning to operate your workstation. This first section should be read with particular attention. It contains important information about the safe use of the ApH Module and this manual.

1.1 About this Manual

The purpose of this manual is to help the operator to understand all parts of the ApH Module.

The manual starts with a general description of the product and then guides the operator through each available method. The subsequent sections describe the loading process, data handling and troubleshooting.

Warnings and **Notes** emphasize important and critical instructions. They are printed in italics and appear as follows:



ATTENTION

Any special problems, warning or important information will be accompanied by this symbol. Read these items carefully.



NOTE

Information is given to the operator that is useful but not essential to the task at hand.

1.2 Additional ML STAR Manuals

For the programmer and/or operator of the system:

- The Microlab STAR Line Operator's Manual is a reference for operation of the Microlab STAR Instrument
- The VENUS Software Programmer's Manual describes all the features of the ML STAR Software and provides sample methods of typical applications to guide you through the programming
- A detailed software reference for the ML STAR can be found in the Help Function of the VENUS Software

1.3 Intended Use

The ApH Measurement Module is a dedicated module for measuring pH based on STAR Line Instruments and other Hamilton Liquid Handlers.

THE PRODUCT WILL ACCOMPLISH THE SAFETY ASPECTS AND THE REQUIREMENTS FOR THE BIOTECH MARKET.

1.4 Training

Training courses will be held by your HAMILTON representative. Please feel free to contact your Hamilton representative to arrange for an operator training.

The ApH Module should be operated by qualified and properly trained personnel. Hamilton recommends that the operator of the ApH Module should attend training by a Hamilton representative.

Please contact your local Hamilton representative or Hamilton to get more information on training programs.

1.5 Operation

The software and demo methods were developed by Hamilton. They are deemed to be fully operable.



ATTENTION

During instrument operation, stand clear of all moving parts and the working deck of the instrument. In general, never lean over or into the instrument while it is in operation.



ATTENTION

If the ApH Module is used in a manner not specified by Hamilton, the protection provided by the equipment may be impaired.

The ApH Module is operated by means of control software. The operator should not modify methods except in consultation with the persons responsible for the programming and/or the assay supplier. Improper method changes can lead to false results.

1.6 Responsibilities

Person	Responsibility
Technical Service (TS)	Installation of the instrument hardware and software (installation qualification [IQ]), preventative maintenance and repair if required
Application Specialist (APS)	Installation and setup of the application software. Implementation of customer-defined settings if required. Together with the customer, method testing and training (operational qualification [OQ]).
Customer	Together with the application specialist, method testing and training (operational qualification [OQ]) The performance qualification (PQ) is in the sole responsibility of the customer.
Operator	Loading, running and unloading the instrument, regular maintenance if required.

1.7 Legal Regulations

All local, state and federal laws which prescribe the use, application, and/or the handling of dangerous materials in connection with the instrument must be strictly followed.

1.8 Safety Precautions and Hazards

The following sections describe the main safety considerations; electrical, biological, chemical and radioactive, in operating this product and the main hazards involved.



ATTENTION

Read the following safety notices carefully before using the ApH Module.

1.8.1 General Precautions



ATTENTION

All safety precautions according to the STAR Operator's Manual should be followed.

1.8.2 ApH Module Installation and Relocation

The ApH Module is installed or relocated by a Hamilton Trained Field Service Engineer. Installations of instrument options and accessories are also done by a Hamilton Trained Field Service Engineer.

1.8.3 Maintenance, Service and Repair

Only Hamilton Trained Field Service Engineers are authorized to perform mechanical maintenance on the ApH Module.

For repair or shipment, all mechanical parts must be put in their rest positions. The ApH Module or individual parts which are sent away for repair must also be decontaminated (see [Section 6 ApH Module Decontamination](#)) if it was in a laboratory environment with infectious or hazardous materials.

The Hamilton Trained Field Service Engineer and the laboratory share the responsibility for the Installation Qualification (IQ) and Operation Qualification (OQ). The Process Qualification (PQ) is the sole responsibility of the laboratory.

1.8.4 Method Programming

Programming and Validation of new methods is the responsibility of every customer.



ATTENTION

Never disable any safety measure.

1.8.5 Work Routine

Periodic maintenance (daily maintenance, weekly maintenance, six-monthly maintenance) is a mandatory part of the work routine.

1.9 Electrical Safety Precautions



ATTENTION

Before manually removing a mechanical or electrical component, the ApH Measurement Module and the ML STAR must be switched off and disconnected from the main electrical supply and from the PC.

1.10 Chemical, Biohazard and Radioactive Hazards

If the ApH Module becomes contaminated with chemical, bio-hazardous or radioactive materials, it should be cleaned according to the maintenance procedures (see the [Section 5 Maintenance and Storage Safety Instructions](#) and [Section 6 ApH Module Decontamination](#)). Observe and carry out the maintenance procedures given. Failure to do so may impair the reliability and correct functioning of the ApH Module.



ATTENTION

Chemical, biological and radioactive hazards can be associated with the substances used or the samples processed with the instrument. The same applies to waste disposal. The handling of substances and the disposal of waste may be subject to local, state or federal law or regulations with regard to health, environment or safety.

- Always be aware of possible hazards associated with these substances
- Use appropriate protective clothing, goggles and gloves
- Strictly observe the corresponding provisions



ATTENTION

Caustic substances can cause burns and eye injury.

- Always be aware of possible hazards associated with these substances
- Avoid exposure to caustic substances
- Use appropriate protective clothing, goggles and gloves



ATTENTION

Fire Hazard

- Use caution when using flammable materials. The instrument is not explosion protected nor for use in Ex zones.

1.10.1 Safety Measures



ATTENTION

Be careful when working on the deck of a robotic system! Working inside the deck of a robotic system might lead to an enhanced risk of injury.



ATTENTION

Also refer to the Microlab STAR Operator's Manual for additional Safety Precautions and Hazards information.

- **Access to Power Switch/Power Cord**

Ensure there is enough room to access the power switch and power cord.

- **Working Area**

The safety concept assumes that the doors are always closed and locked during normal operation.

- **Surrounding Area**

Make sure the ventilation outlets of the instrument are not impaired by obstacles placed in the surrounding area.

Use appropriate:

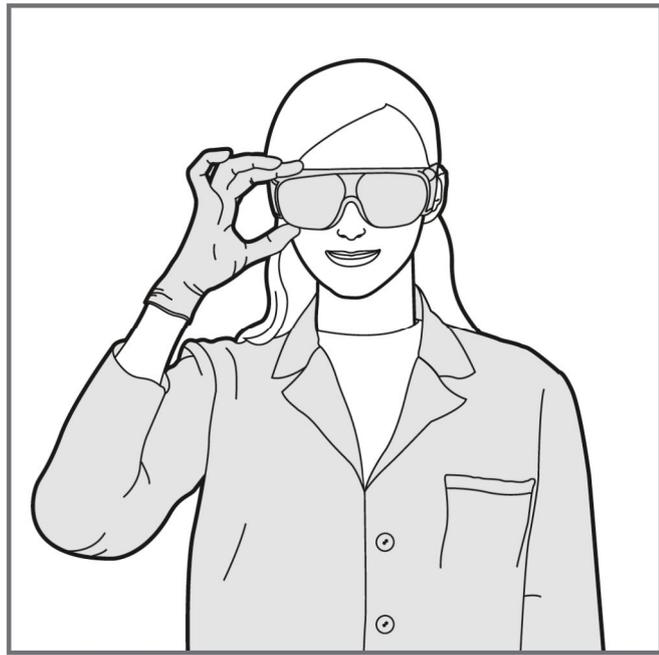
Protective clothing



Goggles



and Gloves



2 ApH Module Description

2.1 ApH Module Overview

The ApH Module is a dedicated module for measuring pH in well plates or other labware. It is compatible with the Hamilton STAR Line systems and requires the CO-RE Gripper. The probes are regular electrochemical probes suitable to measure in a range from pH 2 to 12. Measuring lower or higher pH is also possible, as long as the calibration is performed in the right range, but will impair the lifetime of the pH Probe. As standard, the ApH Measurement Module is equipped with 4 pH probes but can be used with less.



NOTE

The iSWAP cannot be used with the ApH Measurement Module.

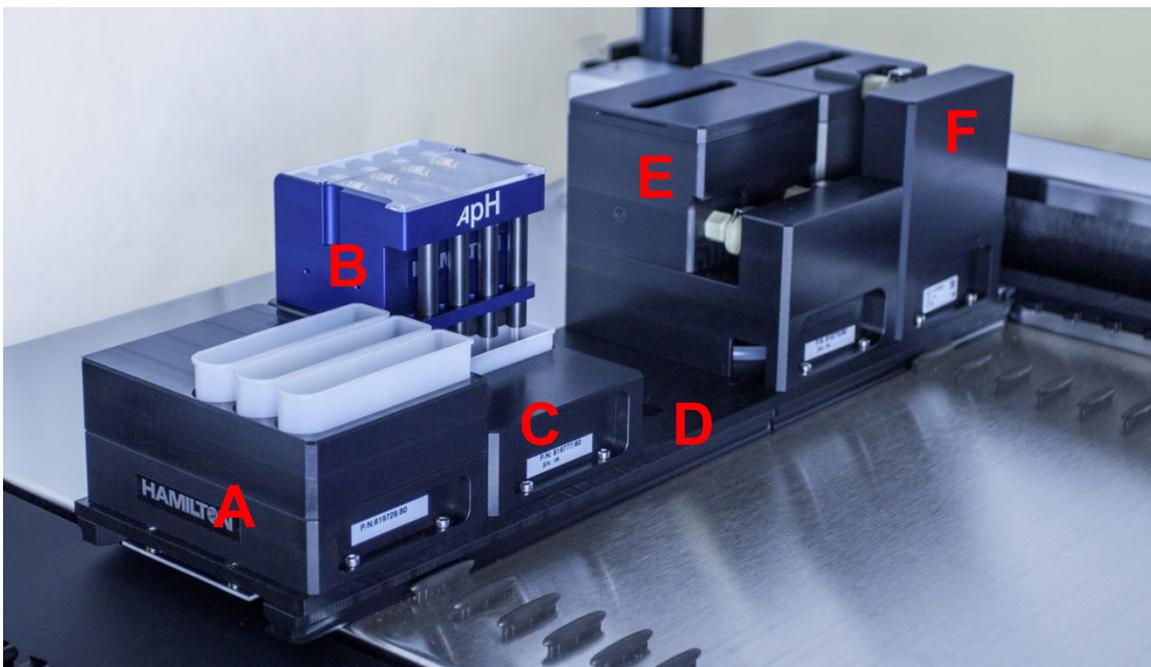


ATTENTION

When handling the ApH Measurement Module manually from and to the Charging Module, the Microlab STAR Instrument must be switched off.

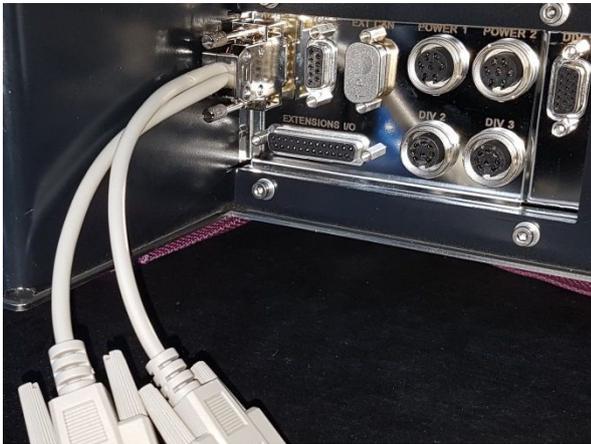
The ApH Module consists of a 6T Multiflex 2.0 Carrier (PN 188539) which holds the:

- A. 1x Trough Module for 3 calibration solution troughs
- B. 1x ApH Measurement Module (ApH MM)
- C. 1x Charging Module (for charging the batteries in the ApH Measurement Module)
- D. 1x Additional MFX Position (e.g. MFX MTP or DWP position)
- E. 1x Washer Module
- F. 1x Dryer Module



2.2 Multiflex Carrier Interface

The Multiflex Carrier and the Liquid Dispenser are connected via a Y-Cable to TCC1 or TCC2 of the Microlab STAR Periphery Connector.



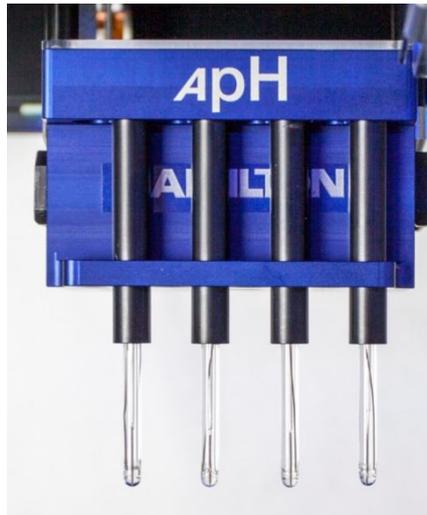
2.3 Trough Module

The Trough Module holds 3 troughs for calibration and reference solutions. Under the Calibration Solutions Module is storage for the pH dummy probes and the pH Cable Tool.



2.4 ApH Measurement Module

The ApH Measurement Module is used for measuring the actual pH of a solution on a STARline system using up to 4 electrochemical probes. It is a wireless module communicating by Bluetooth and operated by CO-RE Grippers.



2.4.1 Loading and Unloading

The ApH Measurement Module and the troughs with calibration solutions are loaded manually by the user.



ATTENTION

When handling the ApH Measurement Module manually from and to the Charging Module, the Microlab STAR Instrument must be switched off to prevent damage.

2.4.2 Transport on the Liquid Handler

The ApH Measurement Module can be transported with the CO-RE Gripper.

With the CO-RE Gripper, the ApH Measurement Module can be transported to the Washer Module, Dryer Module and the troughs in the Calibration Solutions Module on the carrier and to the measurement positions of the used labware.

2.4.3 Interface, Power and Batteries

Communication takes place via Bluetooth to the controlling PC.

The ApH Measurement Module is powered by rechargeable batteries. The batteries will be replaced during the Preventive Maintenance by a Hamilton Trained Field Service Engineer.



ATTENTION

*The rechargeable batteries **cannot** be exchanged by the user.*

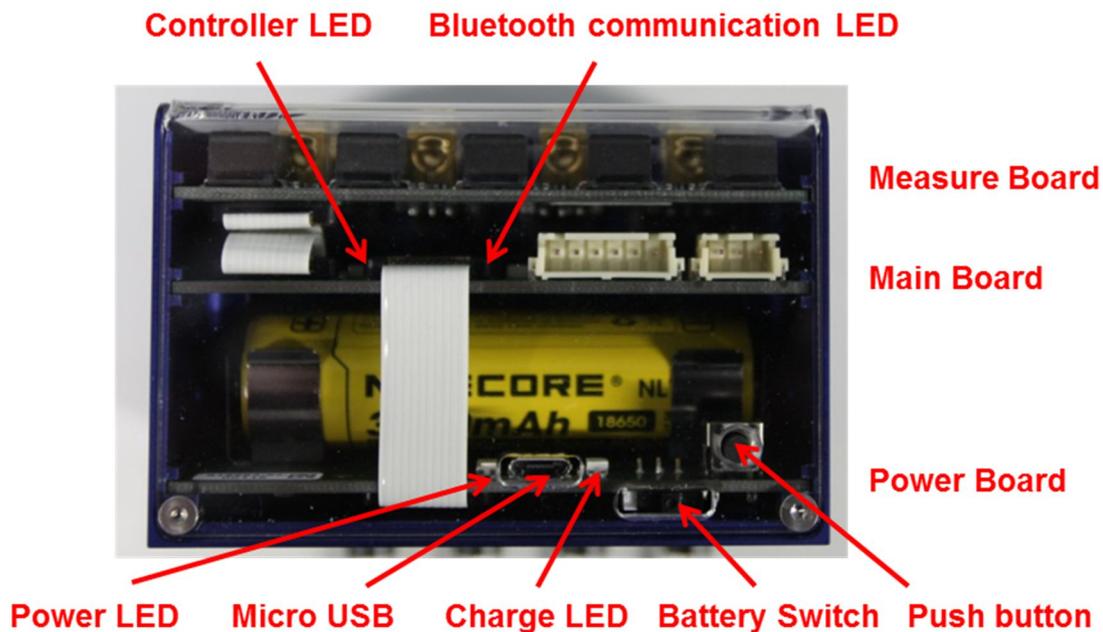
The batteries can be charged on the Charging Module located on the Multiflex Carrier using the charging method (see [Section 3.6 Charging Method](#)). They can also be charged by an external Micro USB Charger not included in the ApH module (See [Section 2.4.4 External Micro USB Charger](#)). The batteries charge in 8 hours (overnight). Fully charged batteries provide power for at

least 10 hours for taking measurements. The batteries charge status can be monitored during operation.

Life Span of the batteries is at least 1 year (equal to around 250 overnight charging cycles).

The ApH Measurement Module is automatically shut down if there is no communication for 5 minutes and the module is being powered by the batteries.

If Auto Charge is enabled **ON**, the ApH Measurement Module is automatically charged when the batteries charge status is too low. For further information, see [Section 3.6 Charging Method](#).



Bluetooth Communication Yellow LED

- Flashing indicates no Bluetooth Communication
- Steady ON indicates Bluetooth Communication

Charge LED

- There is one GRY (Green, Red, Yellow) LED that indicates the charge status:
 - Orange: Normal charge is in progress
 - Green: Charge finished
 - Yellow flashing: Charge is activated, but there are no batteries detected



NOTE: This can happen if there are no batteries in the ApH Module or the Battery Switch is set to disconnect the batteries.

- Yellow: Pre-charge in progress (this happens for a couple of minutes if the batteries voltage is < 3V)

Power LEDs

- There is one blue LEDs that indicate if STAR Power or USB Power is available

Controller Red LED

- Flashing 1/ second – OK
- Flashing with 4/second – Battery Powered

Push button

- The push button starts the module when it is not on the system. This function is usually not required during regular use.

Battery switch

- You can use this switch to physically separate the battery from the module. If the battery is separated, the module cannot be switched on again.

2.4.4 External Micro USB Charger



The ApH Measurement Module batteries can be charged externally using a Micro USB Charger (5V, $\geq 1.5A$). When plugged in, it will be charged. No specific commands are required.



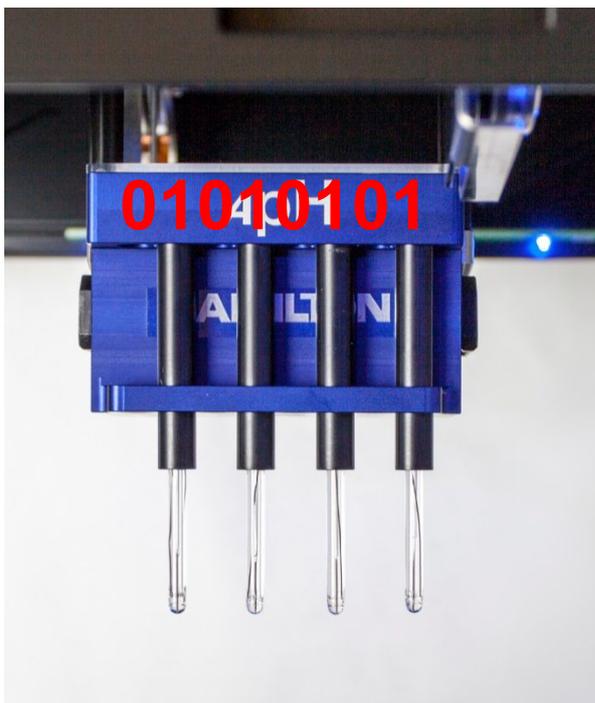
NOTE

The Micro USB Charger is not included with the ApH Module, and must be locally obtained.

2.4.5 Dimension and Weight

The dimensions of the ApH Measurement Module are compatible with the SBS format.

- Weight: < 500g
- The ApH Measurement Module holds up to 4 pH probes in a minimum raster of 8x9mm with a default probe pattern of 10101010. The probe pattern is always read from the back of the system.



- The maximum immersion depth of the device is 32mm. Only the glass part of the probe should be immersed, not the barrel. Due to the dimensions, deeper plates might require a higher minimum volume.

For instructions how to exchange see chapter [3.7 pH Probe Exchange Method](#).

2.4.6 Labware

The ApH Measurement Module is able to measure pH in the following labware types:

- 96 well MTP; all shapes of wells as long as the wells are cylindrical and have a diameter of at least 6.5mm
- 96 well DWP; up to a height of 45mm
- 24 well MTP; all shapes of wells
- 24 well DWP; up to the height of 45mm
- Tubes and Troughs with a minimum immersion depth of 7mm and a maximum immersion depth of 20mm
- Reaction vials and flip tubes on a flip tube rack



ATTENTION

- Physical restrictions for use of the ApH Module might occur in certain combinations of carriers on the deck (e.g. plate carrier to measure directly right of the ApH Module Carrier). The height of the Drying and Washing Modules may interfere with the ApH Measurement Module movement if a DWP and a MTP are on the same height carrier.

<p>Right!</p> <p>Carrier for DWPs with only DWPs: No crash</p>	<p>Wrong!</p> <p>Carrier for DWPs with (partially) MTPs: ApH Measurement module might crash into Washer and Dryer</p>

Other labware might be used but has to be tested. It might be required to use a lower number of probes on certain positions. Please note that the probes will not be centered on specific lower density labware, e. g. on the 24 well plates and flip tube racks due to the geometry of these devices.



ATTENTION

The diaphragm of the probe is up to 5mm. However, the recommended submerge depth is 7mm. A lower submerge depth might lead to wrong measurements as the diaphragm might not be completely covered.

The minimum volumes for different types of plates are:

- PCR plate: ~100µl
- MTP: ~180µl
- DWP: ~900µl



NOTE

The lower the volume, the more chance that the probe itself might influence measurement.

The access to measure plates or other labware using the ApH Measurement Module might be limited, depending on the carriers and labware used. Having a higher carrier to the left of the measured plate might lead to a collision.



ATTENTION

Remove all lids from troughs and samples during calibration and measurement. Not removing them might result in a collision and might lead to damage of the ApH Measurement Module.



ATTENTION

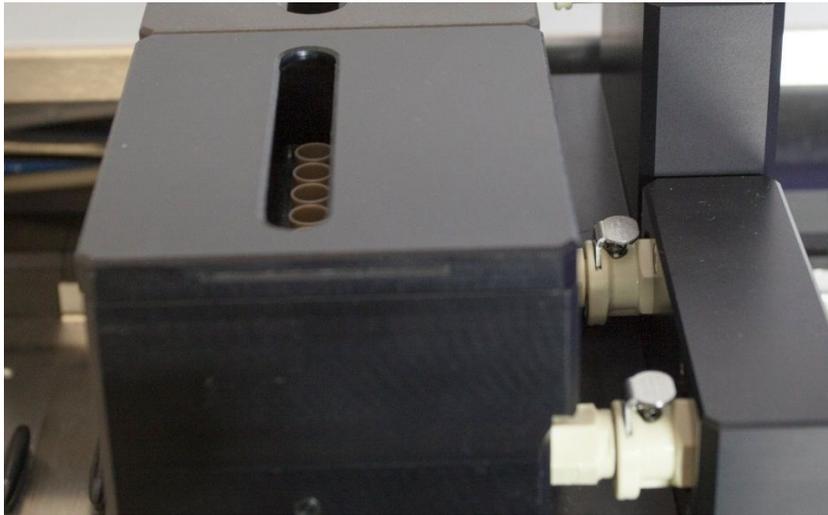
Always use the dummy probes delivered with the system to test all transports and measuring positions when programming the method to prevent collision.



ATTENTION

If the ApH Measurement Module is dropped, the probes might be damaged or broken. There is the risk of injury. Please use appropriate protective equipment and handle with care. Exchange any damaged probes immediately. Follow the rules of conduct appropriate for the substances measured. Please clean the deck thoroughly and Hoover off remaining slivers of glass.

2.5 Washer Module



The Washer Module is placed on one of the MFX positions on the ApH Module Carrier. It can easily be cleaned. The rinsing liquid is deionized water. Power is provided by the Periphery Board. A waste and a source container is required that are not part of the delivery.

As washing liquid, deionized water should be used.

The dimensions are compatible with the SBS format. It fits one of the 5 MFX positions on the ApH Module Carrier. The immersion depth is 25mm.

2.5.1 Liquid Dispenser

The Liquid Dispenser provides the washer fluid from two source containers. A 25ml syringe is driven by a Dispenser Drive delivers the wash fluid into the Washer Module. A waste pump in the Liquid Dispenser drains the Washer Module reservoir into the Waste Container.



ATTENTION

Substances such as Ethanol should not be used as washing fluid as it will damage the Liquid Dispenser.



ATTENTION

There is no liquid level detection in the source and waste containers. Optionally, the Multiflex Liquid Dispenser Kit C PN 188134APE can be ordered and installed to monitor the container liquids.

2.6 Dryer Module



The Dryer Module is placed on one of the MFX positions on the ApH Module Carrier. It fits to a usual lab pressure air supply (max 6 bar) connection, interface to the lab supply with a 6/8 PE tubing. A valve is used to control the Dryer Module by software commands. Power and communication is supplied from the Periphery Board.



ATTENTION

The Dryer Module allows connection to compressed air of maximum 6 bar. This is reflected in the attention sign on the Dryer Module close to the air connection.



ATTENTION

Use dried and filtered compressed air for the Dryer Module. Using non-dry and non-filtered compressed air might lead to issues with the measurement or contamination of the sample.

- The dimensions of the Dryer Module are compatible with the SBS format.

3 ApH Module Driver Library and Methods

3.1 General Information

The ApH Module Driver Library:

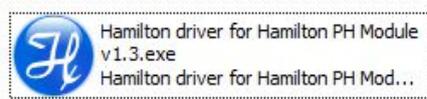
- Provides steps for transport of the ApH Measurement Module to the various positions of the liquid handler in form of a library
- It is able to collect and show data from the pH probes
- Monitor the batteries status
- Is able to switch the Washer on/off
- Is able to switch the Dryer on/off

3.2 Installing the ApH Module Driver Library and Methods

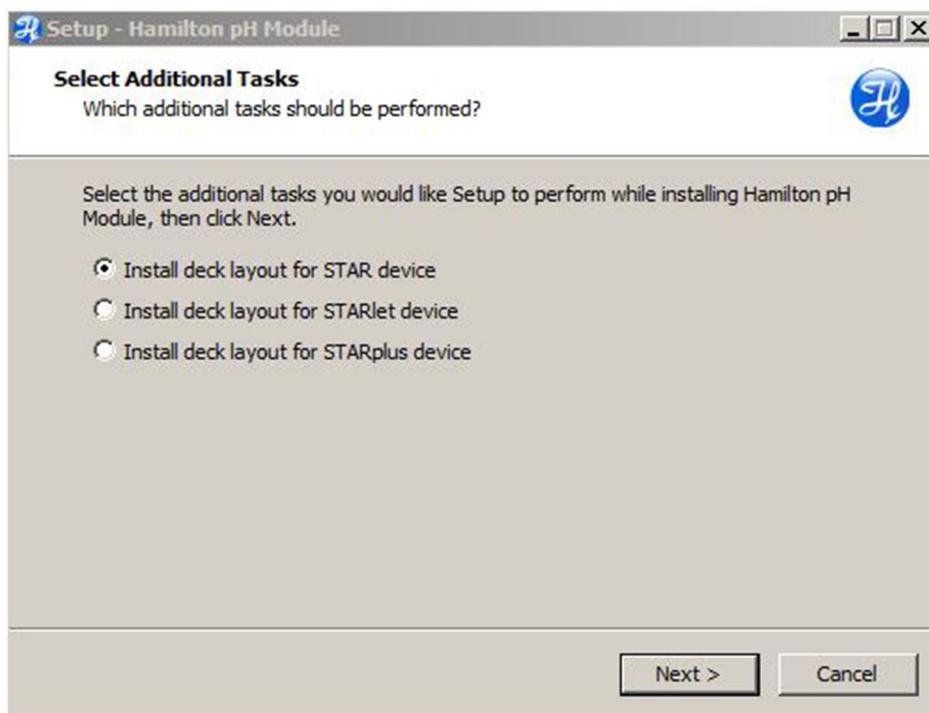
The “Hamilton Driver for the ApH Module vx.x.exe” is an executable file to upload the necessary library information into the VENUS Software.

To install the ApH Module Driver:

1. Double-click the Hamilton Driver executable.



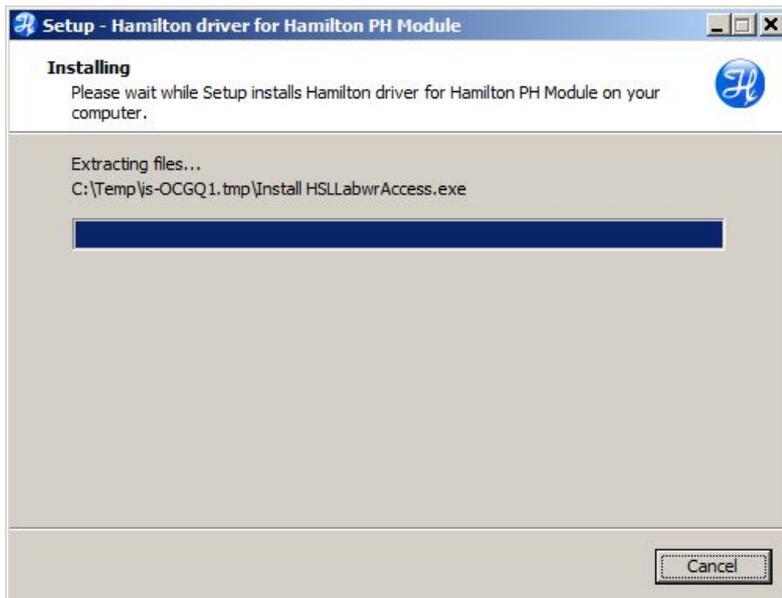
2. Choose the Deck Layout compatible to your liquid handler.



3. On the Setup Window, click the Install Button.



4. The files are then extracted from the executable.



5. Click the "Finish" Button to complete the Hamilton Driver installation process. The Demo Method for the ApH Module will be opened.

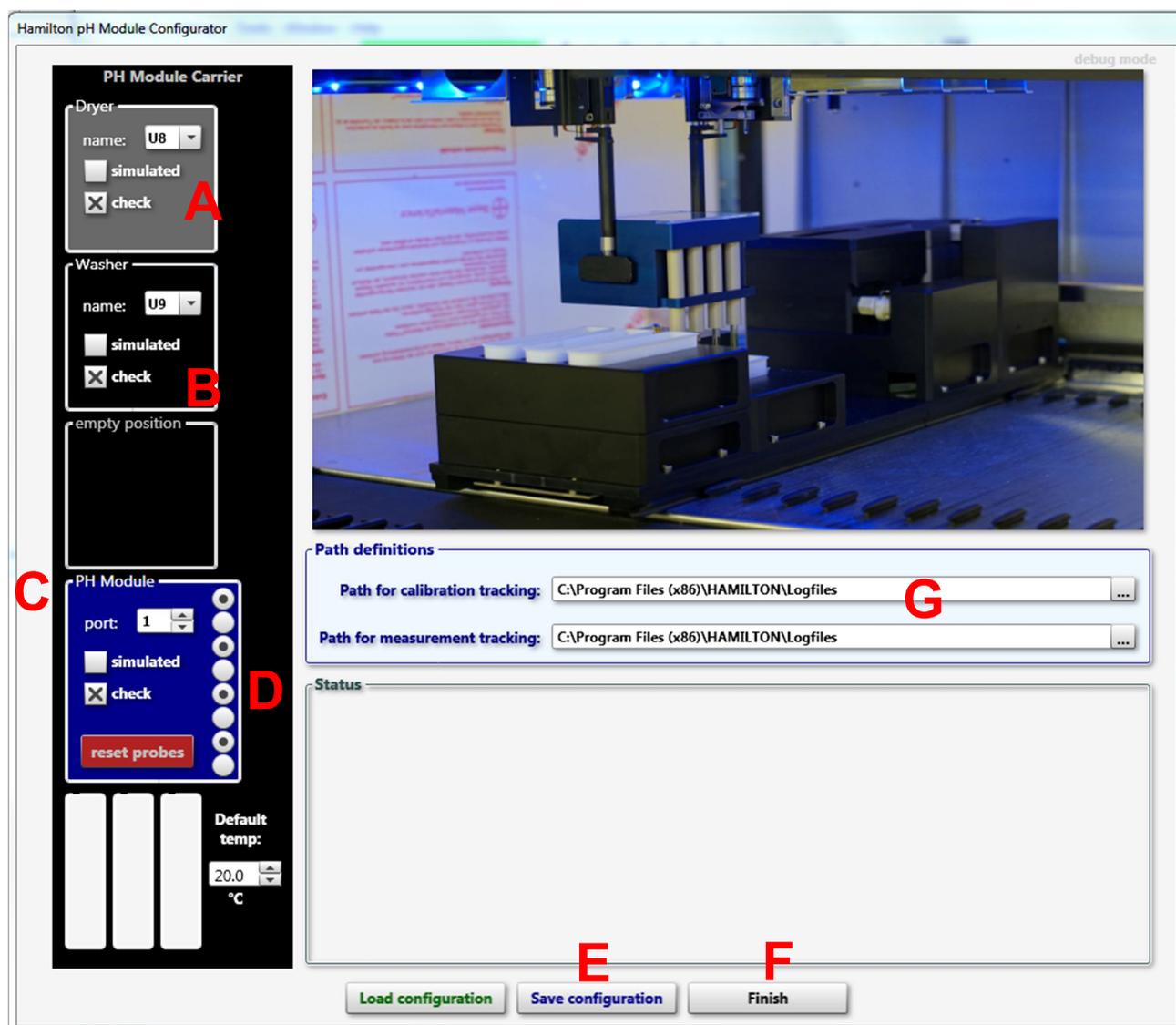


3.3 Configuration Method

The configuration method enables the user to set the correct modules addresses and thus is a tool for simple configuration. As default, this should be U8 for the Dryer Module (A) and U9 for the Washer Module (B). Both can also be switched to Simulation Mode.

The COM Port for the Bluetooth Adapter has to be set (C). This depends on the port assigned during installation of the Bluetooth Adapter. You can set the standard probe pattern for the ApH Measurement Module (D), switching on and off probes as required for the setup.

After settings have been finished, you should click the "Save configuration" Button to save the settings (E) and then click the "Finish" Button (F). The computer path for storing the Log Files for Calibration Tracking and Measurement Tracking can be defined in the "Path definitions" (G) section of the screen.



3.4 Calibration Method

Precise measurement requires regular calibration of the probes (e. g. once after each 96 well plate). Long measurement times without calibration might impair precision of the measurement.

If the pH Probe is stored dry for a longer period of time, e.g. overnight, it should be calibrated using at least 1 minute in each calibration solution. A two point calibration is used with the third position being used for confirmation. The slope models are the correlation between pH and measured pH Probe signal.

3.4.1 Preparing the Module



ATTENTION

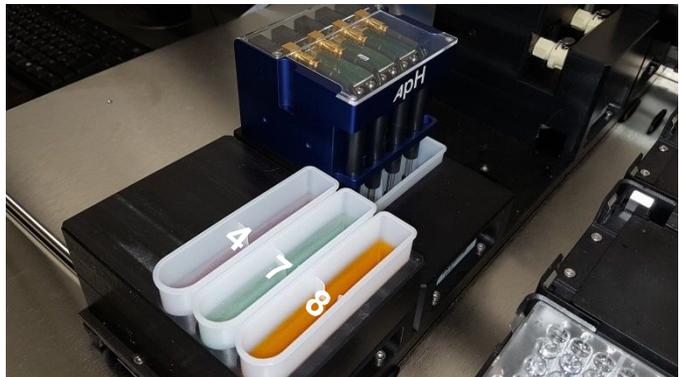
The Microlab STAR Instrument should be switched OFF when placing or removing the ApH Measurement Module from the Charging Module.

1. When the ApH Measurement Module has not been used for a long time, switch OFF the Microlab STAR Instrument.
2. Carefully remove the watering cap of the pH probes.
3. Rinse the pH probes with water manually.
4. Check the interior of the pH glass membranes for air bubbles. If air bubbles are present, gently shake the module for the bubbles to rise to the top.
5. Fill the calibration troughs with 25 ml fresh buffer solution (e.g. pH 4, pH 7, pH 8).



NOTE

There is a Low Calibration and a High Calibration. Low calibration should be always on the left, high calibration in the center.



6. Make sure the waste container is empty and source containers are full for the Liquid Dispenser Module.
7. Place the ApH Measurement Module onto the Charging Station.
8. Switch ON the Microlab STAR Instrument.

3.4.2 Calibration and Reference Measurement

For calibration, it is recommended to use unused HAMILTON DURACAL pH Buffer.

- pH 4.01 = P/N 238317
- pH 7.00 = P/N 238318
- pH 8.00 = P/N 238277
- pH 9.21 = P/N 238319
- pH 10.01 = P/N 238321



ATTENTION

Samples and calibration buffers have to be uniform in temperature before the calibration or measurement procedures are performed.



ATTENTION

Precise measurement requires regular calibration of the probes. This can be required within a run.

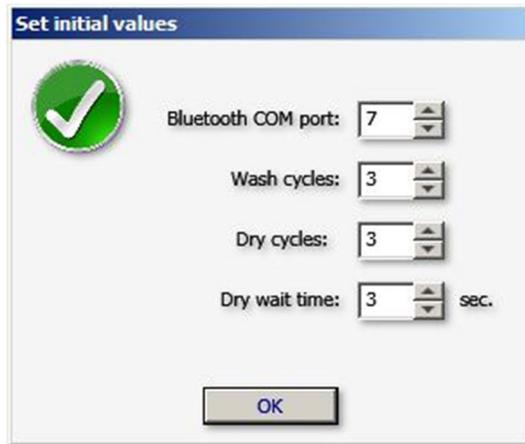
3.4.3 Settings/Dialogues

When starting the Calibration Method, you can set 4 different parameters. Bluetooth COM Port, Wash Cycles, Dry Cycles and Dry wait time. The Bluetooth COM Port should be set to the port used by the Bluetooth device.



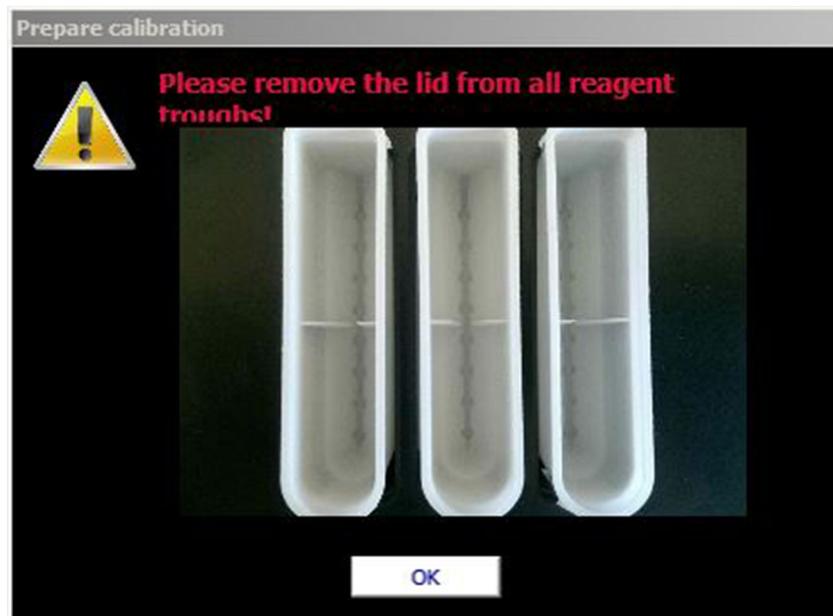
NOTE

Wash cycles means the number of strokes of the Liquid Dispenser Pump. The standard settings are 3 strokes. However, depending on the time required and potential contamination, this can be modified. The dryer cycles refer to the repetition of drying. One cycle consists of moving down, staying down for the drying wait time and moving up again.



ATTENTION

If in use, all lids have to be removed from the reagent troughs in order to avoid any collisions.



For calibration, a two point calibration is done. Enter the pH value and the temperature used for the calibration.



ATTENTION

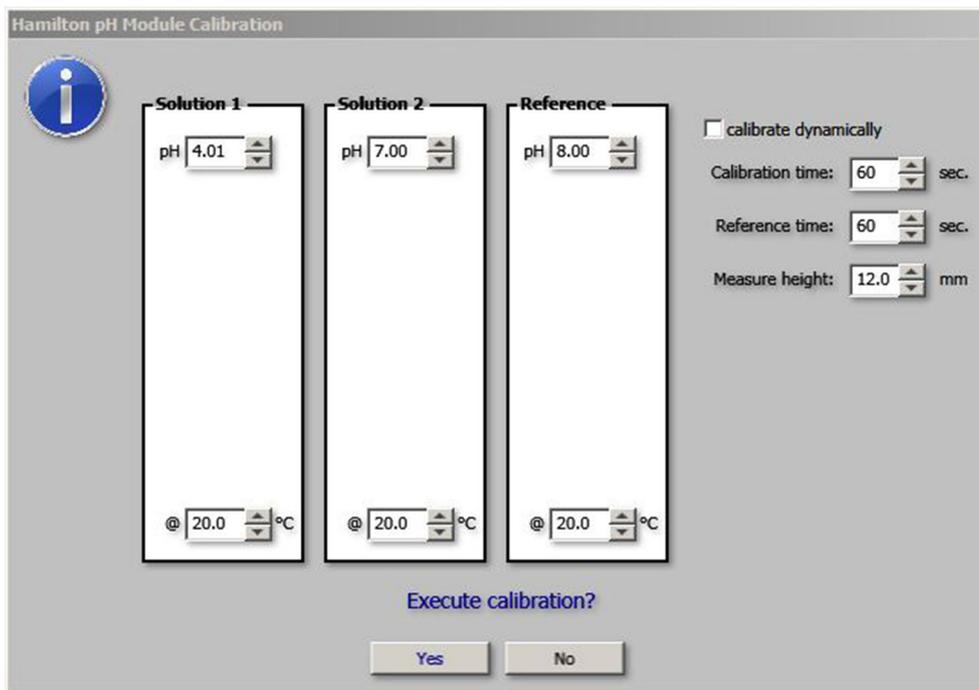
pH values of calibration solutions vary with different temperature. If temperature of calibration solutions does not reflect the actual pH of the solution at this temperature, the calibration might be wrong.



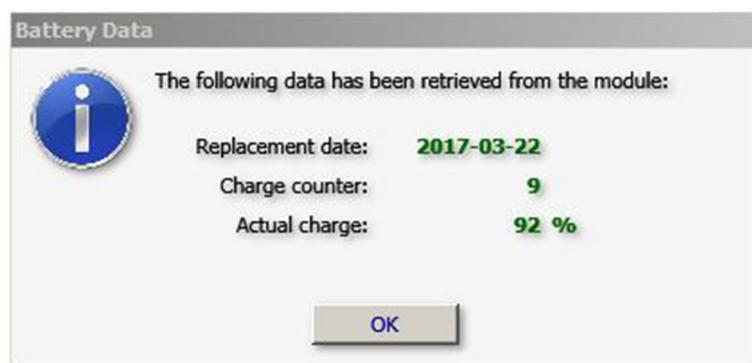
ATTENTION

Please make sure that the pH probes are sufficiently submerged in the calibration solution and that the time is sufficient!

Dynamic Calibration checkbox enables dynamic calibration, so to wait until the probes are settled. It queries the probes' voltage until it reaches a tolerance of 1mV. Calibration time is used as timeout for the calibration.



Before the actual measurement, the batteries charge status will be checked.



After the measurement, the slope ratio for the probes is shown.

For new probes, the slope ratios are typically greater than 90. For older probes, the values can decrease, however, they should all be within a comparable range.



The calibration data for each probe is saved in a path defined by the operator (see [Section 3.3 Configuration Method](#)).

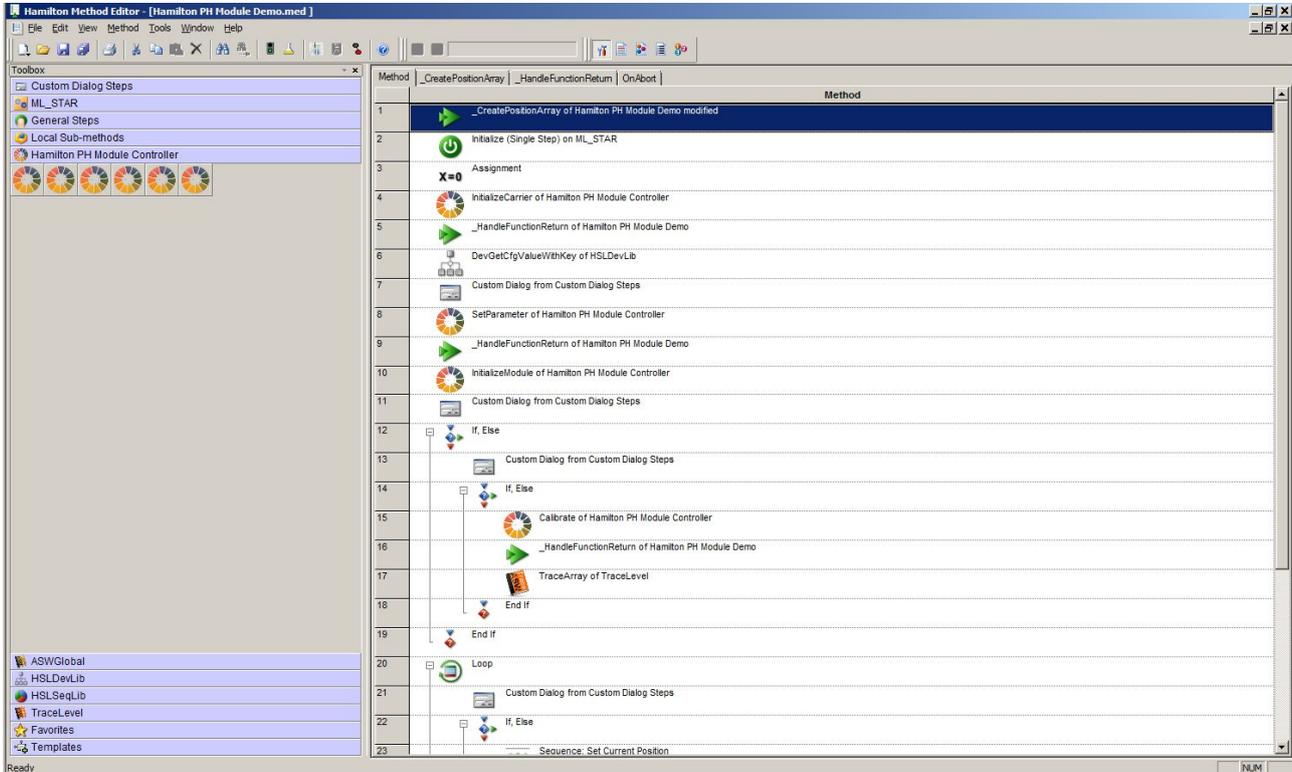
The excel file contains date and time of the calibration as well as measured pH value and voltage for each calibration point, low and high, and the reference. In addition, it contains the offset, slope and slope ratio in percent. In addition, it contains the measurement counter.

Each probe has its own tab. All calibration measurements are stored over time. This allows comparison of the results, and an enables an understanding when the probes turn used.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Module_Infc	Date	Time	pH_Low	Voltage_Lo	pH_High	Voltage_Hi	Temperatur	pH_Referer	pH_Measur	Offset	Slope	Slope_Ratic	Measurement_Counter	
2	0	2017.05.16	15:53:11	4.01	1.809	7.01	1.272	20	7.01	7.01	59.79	-55.45	95	8	
3															
4															
5															

3.5 Demo Method

The Demo Method is a basis for creating new methods and understanding all the functions, and is included with the installation of the ApH Module Driver for VENUS Software. It utilizes the driver library and shows all functionalities for measuring pH, pickup of CO-RE Grippers, transport of the pH module to the target labware, measuring washing and drying. A description of the individual command can be found in the help file or in: [Appendix D: Description of Driver Libraries](#).



For creating a new method or modifying an existing one, refer to chapter 4.2 Programming, Testing and Running a Method and the [VENUS Software Programmer's Manual](#).

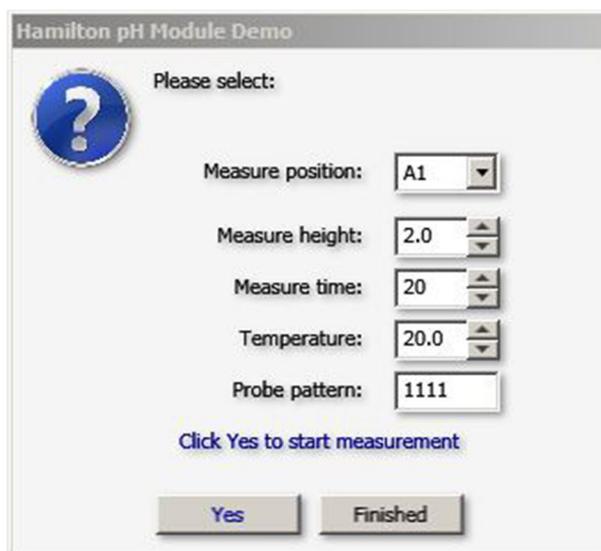
When starting the demo method, the system will remind the user to have a full source bottle and an empty waste bottle.



Before the actual measurement, the batteries charge status will be checked.



Then you can choose the positions for the first probe to be measured, height, time, temperature and probe pattern. Please note that all other probes are in relation to the first measured well in a 96 well plate.



If the measured position is set to A1, the probe at position 1 in the pH module will be placed into A1. With a probe pattern of 10101010, the second probe will be in C1, the third in E1 and the fourth in G1. If the measured position is B1, the first probe will be in B1, the second in D1 and so on. Please note that it might lead to crashes with the last probe, if starting in C1.

If the probe pattern changed, e. g. to 10100000, the first probe will be in A1, the second in C1. There is no other probe used.



NOTE

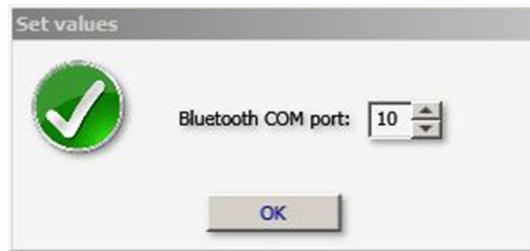
The required minimum measuring time depends on the sample and the precision required. For aqueous samples, usually 10-20 seconds are sufficient for one measurement with a precision of pH 0.1. If the samples are not aqueous or the viscosity is high, the required time might be extended.

3.6 Charging Method

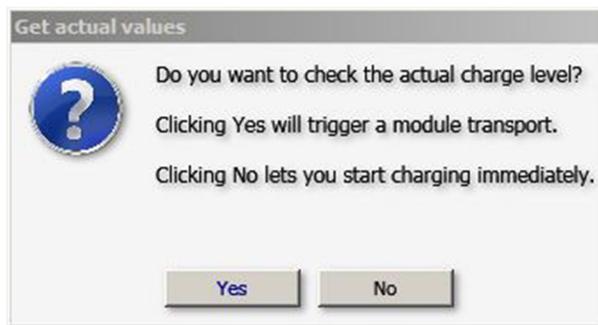
The Charging Method should be used to charge the ApH Measurement Module. This enables controlled charging; such as preventing overcharging and avoiding unnecessary charging. Thus, it extends the life time of the batteries and ensures stable connection between the batteries/module and the Charging Module.

Controlled charging of the ApH Measurement Module at the end of each run can make sure that the batteries are always fully charged.

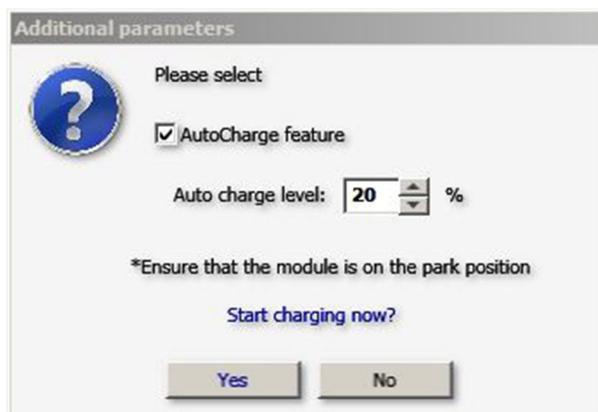
When starting the Charge Method, the Bluetooth COM Port should be set to the port used by the Bluetooth Adapter.



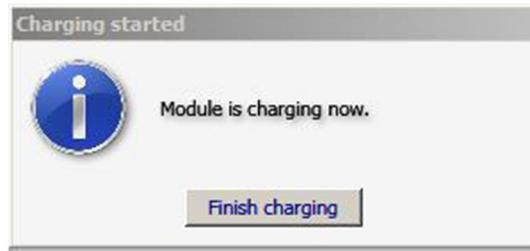
The systems ask you whether you want to measure the charge level. In this case, the ApH Measurement Module will be picked up by the CO-RE Gripper and moved off of the Charging Station to properly measure the charge level. Alternatively, you can decide not to measure the charge level and just choose to charge. Please note that fully charging the batteries will take approximately 8 hours.



The Auto Charge feature starts automated charging once the charge level is below a certain threshold. Whether the feature should be used and the "Auto charge level" threshold can be set in the "Additional Parameters" dialogue.



When charging, the method tells you clearly that it is charging. Please make sure to finish charging properly.



Every command to charge the ApH Measurement Module will be reset as soon as the Module leaves the Charging Module.



ATTENTION

When the ApH Measurement Module is charged on the Charging Module, the orange LED will be on. All functions will be deactivated to reduce power consumption and heat generation to a minimum. Please finish the charging method properly before removing the ApH Measurement Module. If the ApH Measurement Module is removed from the Charging Module during charging, these functions are still deactivated and the ApH Measurement Module is not ready to measure! The functions will only be restored when the ApH Measurement Module is on the Charging Module and is not being charged!

3.7 pH Probe Exchange Method



ATTENTION

When handling the ApH Measurement Module manually from and to the Charging Module, the instrument must be switched off.

To remove a pH Probe:

1. Remove the ApH Measurement Module from the Charging Module.



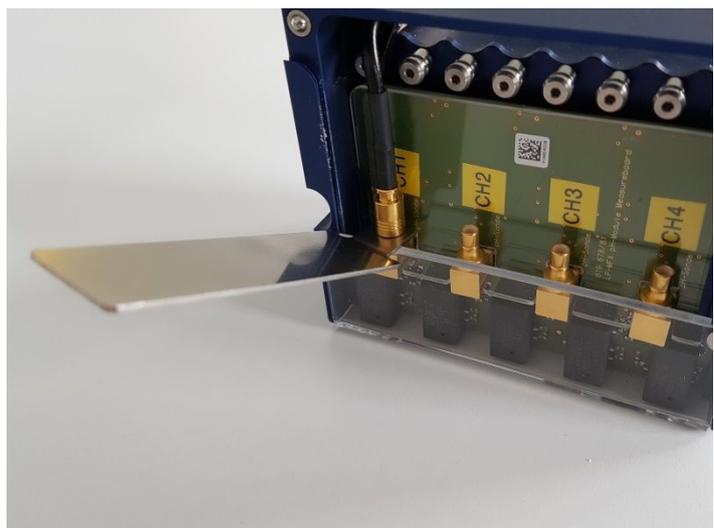
2. Remove the ApH Measurement Module Top Cover.



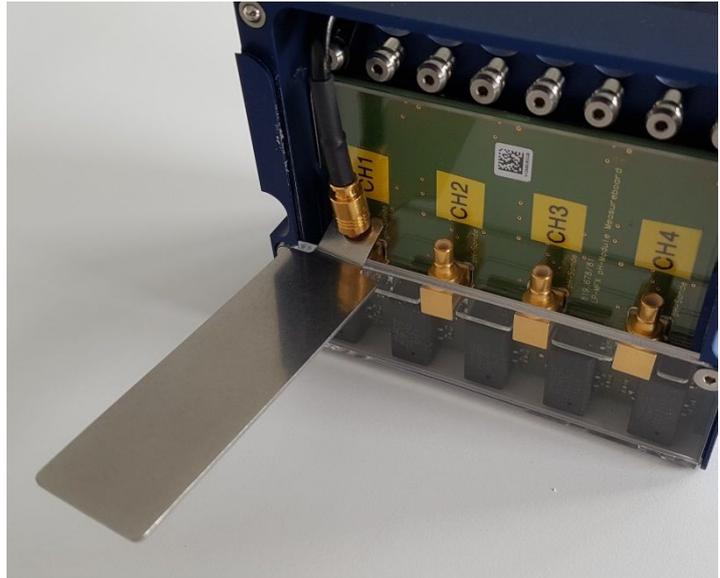
3. Remove the pH Cable Tool from the Trough Module Base.



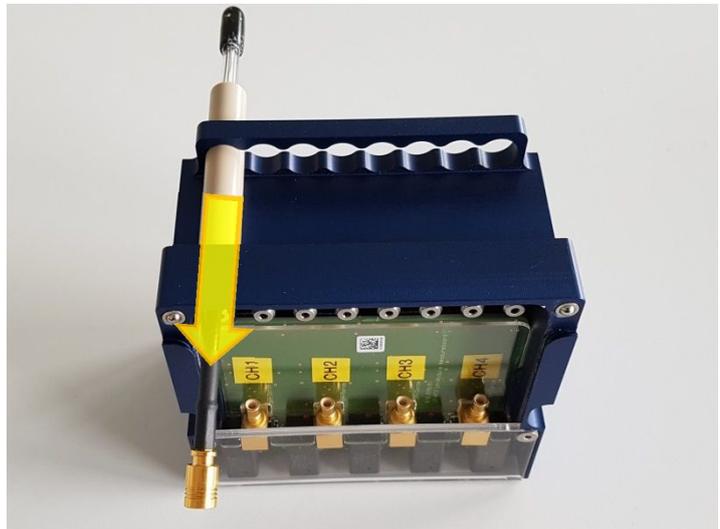
4. Insert the pH Cable Tool under the cable connector and pry the cable from the connector.



5. Remove the cable from the connector.



6. Un-clip and remove the pH Probe from the pH Module.



7. Assemble in the reverse order of removal.
8. After replacement of the probes, run the probe exchange method to reset measurement counter and date
9. Run the Calibration Method (see [Section 3.4 Calibration Method](#)). This is mandatory after each exchange

4 Running the ApH Measurement Module

4.1 Preparation

Before each run, whether it is a calibration run only or a real measurement run, make sure that the

- ApH Measurement Module is at the right position on the Charging Module, switched on and charged
- Troughs with calibration solution are filled and in place on the Calibration Solutions Module
- Waste bottle for the wash module is empty and source bottle is full
- The liquid handler is equipped with appropriate carriers, consumables and reagents



ATTENTION

Before each run, please make sure that the waste container is empty and the wash containers are filled with liquid. If there is insufficient liquid in the wash container, the washing performance could be impaired. If there is too much liquid in the waste container, it might overflow.

4.2 Programming, Testing and Running a Method

4.2.1 Programming

Programming can be done using the regular VENUS Software (see the [VENUS Software Programmer's Manual](#)). All methods delivered with the ApH Measurement Module can be used or incorporated into new methods.

Calibration is recommended before running the ApH Measurement Module. This can be done as separate method or incorporated into the regular method (see [Section 3.4 Calibration Method](#)).

Charging can be done at the end of the method. The library driver functions can be incorporated at the end of a method (see [Section 3.6 Charging Method](#)).

4.2.2 Testing



ATTENTION

Before starting a real run, all transport steps including measurement should be verified with the pH dummy probes in order to ensure proper transports and avoid crashes

Potential contamination should be evaluated during testing. Standard washing and drying times are 3 wash cycles in the washer and 3 seconds of drying in the dryer and lead to carry-over below $10E^{-4}$ with 90% Glycerin and Fluorescein independent on positions and number of pH probes used with the ApH Measurement Module. However, these values might require adaptation and suitable washing and drying times as have to be developed according to the application and speed required.

4.2.3 Running a Method

When running a measurement run, check first that the physical probe pattern is in line with the set one. Make sure that the pH probes are calibrated before each run and during the run in an appropriate way.

4.2.4 Results Files

Measurement data is all safe in an Excel file. There are two types of data, one being the reference measurement for the calibration, the second one being real measurement of the sample. All measurements for one day are located in the same file.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	
1	Module_Inf	Battery rep	ChargeLev	Function	Date	Time	Temperatu	pH Probe 1	pH Probe 2	pH Probe 3	pH Probe 4	Probe repl	Count	Prot	Count	Prot	Count	Prot
2	106	2017-06-06	31 %	Calibrate	2017.06.13	10:55:01	20	7.95	7.96	7.95	7.94	'2017-04-1	7	11	16	16		
3	106	2017-06-06	28 %	Calibrate	2017.06.13	11:00:33	20	7.93	7.94	7.93	7.92	'2017-04-1	7	12	17	17		
4	106	2017-06-06	25 %	MeasureCycl	2017.06.13	11:03:33	20	6.25	6.92	6.5	4.59	'2017-04-1	7	13	18	18		
5	106	2017-06-06	25 %	MeasureCycl	2017.06.13	11:05:02	20	8.18	6.34	5.88	5.42	'2017-04-1	7	14	19	19		
6	106	2017-06-06	23 %	MeasureCycl	2017.06.13	11:06:17	20	6.66	6.13	5.41	5.79	'2017-04-1	7	15	20	20		
7	106	2017-06-06	22 %	MeasureCycl	2017.06.13	11:07:35	20	5.94	6.13	5.74	5.56	'2017-04-1	7	16	21	21		
8																		
9																		
10																		

- **Module_Info:** Serial number of the ApH measurement module
- **Battery replacement date:** Date of the last replacement of the battery
- **Charge level:** Charge level of the battery
- **Function:** Either reference measurement during calibration (Calibration) or sample measurement (Measure Cycle)
- **Date:** System date
- **Time:** System time
- **Temperature:** The set temperature in the input dialogue. Might not reflect the real temperature in the system.
- **pH probe 1/2/3/4:** measured pH value for the respective probe.
- **Probe replacement date:** Dates when the probes have been replaced for the last time in 'YYYY-MM-DD' format. The dates are in the order of the probes, probe 1, probe 2, etc.
- **Count probe 1/2/3/4:** Number of measurements already taken with this probe.

5 Maintenance, Storage Safety Instructions and Life Time

Please refer to the [Microlab STAR Line Operator's Manual](#) for general cleaning of the instrument and components.

If a pH Probe has to be replaced, please use the Probe Exchange Method (refer to [Section 3.7 pH Probe Exchange Method](#)). Please note that recalibration of the pH Probe is mandatory.



ATTENTION

If the ApH Measurement Module is dropped, the probes might be damaged or broken. There is the risk of injury. Please use appropriate protective equipment and handle with care. Exchange any damaged probes immediately. Follow the rules of conduct appropriate for the substances measured. Please clean the deck thoroughly and Hoover off remaining slivers of glass.

The pH Probe is only to be used for the purpose intended and under safe conditions. Improper use or misuse can be dangerous. Assembly and maintenance should only be carried out by trained personnel only. Since these pH probes are made of glass, they should be handled with care. When cleaning or regenerating the pH probes with acids/bases or solvents, protective glasses and gloves are recommended.

5.1 pH Probe Storage

For long term secure storage, remove the pH probes from the ApH Measurement Module (see [Section 3.7 pH Probe Exchange Method](#)). Rubber caps should be installed over the dry pH probes. pH probes stored dry will temporarily exhibit drift in values when used without soaking. If the pH probe gets dried out inadvertently, it can be placed in Storage Solution (P/N 238931) overnight to regenerate.



ATTENTION

Only individual probes without the ApH Measurement Module should be put in Storage Solution.

5.2 Cleaning

In general, acids, alkalis and other common solvents can be used for brief periods to clean the pH probes. The pH probes must first be removed from the ApH Measurement Module (see [Section 3.7 pH Probe Exchange Method](#)). Rinse with water immediately afterwards. pH probes might exhibit sluggish response times for some time after cleaning, so place them for 15 minutes in Storage Solution before using them again.

In the event of protein contamination, immerse the pH probes in 0.4% HCl + 5 g/l pepsin. If blackening of the diaphragm is noted (due to silver compounds), immerse the pH Probes in 0.4% HCl + 76 g/l thiourea.



ATTENTION

Always rinse with deionized water after cleaning.

5.3 Regenerating

Remove the pH probes from the ApH Measurement Module. Immerse the pH probes for 10 minutes in 0.1 - 1M NaOH, then for 10 minutes in 0.1 - 1M HCl. After regeneration, place for a further 15 minutes in Storage Solution (P/N 238931).



ATTENTION

Only individual probes without the ApH Measurement Module should be put in Storage Solution.

5.4 Maintenance

Clean the Washer Module thoroughly after each run. Clogging of the Washer Module might lead to overflow and therefore contamination and potential damage of the instrument. If the Washer Module is clogged, clean and rinse thoroughly.

Clean the Dryer Module after each run as well.

5.5 Environment Conditions

- Temp Range: +15° C to +40 ° C
- Humidity: 15 % - 85 % relative humidity non-condensing
- Noise Emission: ≤ 65 dBA

5.6 Storage and Transportation Conditions

- Temp Range: +4° C to +40 ° C
- Humidity: 10 % to 90 % relative humidity non-condensing

5.7 Robustness and Life Span

- Life Span ≥ 7 years
- exchange of pH Sensors and Battery max 1x/Year

6 ApH Module Decontamination



ATTENTION

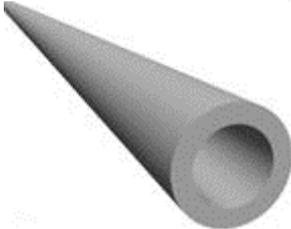
The Microlab STAR Instrument must be switched off for Decontamination.

To follow is the recommended procedure for decontaminating the ApH Module:

- Spray Deconex Solarsept Disinfectant Spray onto a lint-free cloth to wipe all the surfaces of the components of the ApH Module. They include:
 - ApH Measurement Module
 - Charging Station of the ApH Measurement Module
 - Washer Module
 - Dryer Module
 - Calibration Solutions Module
 - Multiflex Carrier
 - Liquid Dispenser
- Remove the Calibration Solutions Module to clean underneath with a lint-free cloth and Deconex Solarsept Disinfectant Spray
- Remove the dummy probes and clean with a lint-free cloth and Deconex Solarsept Disinfectant Spray
- Remove the Wash Station and clean with Deconex Solarsept Disinfectant Spray
- Remove the Dryer Cover and clean with a lint-free cloth and Deconex Solarsept Disinfectant Spray

7 Appendices

7.1 Appendix A: Ordering Information

P/N	Description	Images
187030	TUBING 2x6M FEP 2.0x2 (1.5 meters in length)	
187052	TUBING 2x6M FEP 2.0x2 (3 meters in length)	
188213	TUBING SET LIQUID DISPENSER (contains 2x 2x6 FEP Tubing (3 Meters) and PE6x4 Tubing (5 Meters)	
201400	SYRINGE 1025 AD (25ml Syringe)	
238036	3M KCL SOLUTION (100ml Bottle)	
238317	HAMILTON DURACAL pH BUFFER (pH 4.01)	
238318	HAMILTON DURACAL pH BUFFER (pH 7.00)	
238277	HAMILTON DURACAL pH BUFFER (pH 8.00)	
238319	HAMILTON DURACAL pH BUFFER (pH 9.21)	
238321	HAMILTON DURACAL pH BUFFER (pH 10.01)	
238931	STORAGE SOLUTION	
238936	3M KCL SOLUTION (500ml Bottle)	
369137	REPLACEMENT BATTERY (2x required)	
819780	pH PROBES (4x)	
7249044	TUBING PE 6x4, (L=0.30 meters required) (When ordering, specify the length in meters)	

7.2 Appendix B: Technical Specifications

Type of pH Probe	<ul style="list-style-type: none"> Hamilton Probe
Diameter of pH Probe	<ul style="list-style-type: none"> Maximum 5.5mm
Length of pH Probe	<ul style="list-style-type: none"> Measurement Part at least 20mm
Immersion Depth into Liquid	<ul style="list-style-type: none"> Minimum 7mm to ensure correct measurement
Range	<ul style="list-style-type: none"> Minimum pH 2.00 – 12.00
Accuracy	<ul style="list-style-type: none"> Better than 0.1 pH
Exchange of pH probes in the Field	<ul style="list-style-type: none"> Refer to Section 3.7 pH Probe Exchange Method

7.3 Appendix C: Regulatory Affairs

CE conformity is maintained for the ApH Module. The ApH Module is included in the Declaration of Conformity with the Microlab STAR Line.

7.3.1 Applied Company Quality Management Systems

Applied company quality management systems EN ISO 9001 and EN ISO 13485 Certification Body is TÜV Rheinland LGA Products GmbH, Am Grauen Stein 29, D-51105 Köln-Poll, Germany.

7.3.2 Recycling Process

After the life cycle of the instrument has terminated, please contact Hamilton for disposal regulations.

1. Request for disposal of the instrument

Access to the order registration is given by the Toolpoint homepage www.toolpoint.ch

Recycling Order registration form

2. Completion of the Decontamination form

Once the form has been completed, the request for disposal is automatically activated and transferred to Toolpoint. The confirmation of the order will be sent to the registered contact person.

3. Decontamination

The responsibility for decontamination remains at the ordering party. It is mandatory to sign the decontamination form and send a copy electronically to Toolpoint. Toolpoint forwards the documentation to RENE, who is in charge of instrument disposal.

4. Packing / Preparation for shipment

For the transportation of instruments with a weight of over 30kg need to be fixed on a euro pallet. Instruments below 30kg can be packed in a cardboard or plastic box. A signed copy of the decontamination form needs to be added to the outer part of the shipping box or instrument.

Refer to the Technical Note "Recycling of a Hamilton's ML STAR Line Instruments in accordance to EC directive WEEE".

7.4 Appendix D: Description of Driver Libraries

7.4.1 ApH Module Controller Library

Further details can be found in the help in the library.

Command	Icon	Action Performed
Calibrate		This function is used to calibrate the ApH Measurement Module.
Dry		This function is used to dry the probes of the pH module.
EnableExtendedLog		This function enables the extended log functions - use only when advised by Hamilton personell!
Initialize		This function is used to initialize the Hamilton pH Module Controller.
LastUsedConfigurationLoad		This function is used to retrieve the values of some basic parameters that were used the last time working with the Hamilton pH Module Controller.
LastUsedConfigurationSave		This function is used to save the values of some basic parameters of the Hamilton pH Module Controller.
Measure		This function is used to measure pH value(s) with the pH module.
MeasureCycle		This function is used to measure pH value(s) with the pH module..
ParkModule		This function is used to place the pH module on the charging position.
PickupModule		This function is used to pick up the pH module from the park position.
RequestBatteryData		This function is used to request the battery data from the pH module.
SetParameter		This function is used to set basic parameters for the controller.
Terminate		This function is used to terminate the controller.
Wash		This function is used to wash the probes of the pH module.

7.5 Appendix E: Troubleshooting

Error	Reason	Action
No Bluetooth connection	ApH Measurement Module is not switched on	Switch on the ApH Measurement Module (see Section 2.4 ApH Measurement Module)
	Bluetooth adapter not installed, plugged into computer or dongle not inside robot	Properly install hardware and software
	End of life of battery	Exchange battery
pH outside expected range	Calibration failed	Repeat calibration
	Measurement time too short for stable signal	Increase measurement time
	pH probe faulty	Exchange pH probe (see pH Probe Exchange Method)
Calibration failed	Calibration time too short	Increase calibration time
	pH probe faulty	Exchange pH probe (see pH Probe Exchange Method)
Implausible results	Failed calibration	Repeat calibration
	Calibration in wrong range	Use calibration solutions in right range; mind alkaline error
	Wrong sample	Check sample
	Wrong wash liquid	Check wash liquid
pH probe broken	Mechanical or chemical damage	Exchange pH probe (see pH Probe Exchange Method)



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To find a representative in your area, please visit hamiltonrobotics.com/contacts.