ANALYTICAL INSTRUMENTS

A-96.150.441 / 280624

AMU-II pH/Redox

Operator's Manual

SWISS MADE

AMU-II pH/Redox

Customer Support

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This manual applies to firmware V1.02 and higher.
The information contained in this document is subject to change without notice.

Table of Contents

Operator's Manual

This document describes the main steps for instrument setup, operation and maintenance.

1. Safety Instructions

General

The instructions included in this section explain the potential risks associated with instrument operation and provide important safety practices designed to minimize these risks.
If you carefully follow the information contained in this section, you can protect yourself from hazards and create a safer work environment.
More safety instructions are given throughout this manual, at the respective locations where observation is most important. Strictly follow all safety instructions in this publication.

Target audience

Operator: Qualified person who uses the equipment for its intended purpose.
Instrument operation requires thorough knowledge of applications, instrument functions and software program as well as all applicable safety rules and regulations.

OM location

Keep the Operator's Manual in proximity of the instrument.

Qualification, training

To be qualified for instrument installation and operation, you must:

- read and understand the instructions in this manual as well as the Material Safety Data Sheets.
- know the relevant safety rules and regulations.

1.1. Warning Notices

The symbols used for safety-related notices have the following meaning:

DANGER

Your life or physical wellbeing are in serious danger if such warnings are ignored.

- Follow the prevention instructions carefully.

WARNING

Severe injuries or damage to the equipment can occur if such warnings are ignored.

- Follow the prevention instructions carefully.

CAUTION

Damage to the equipment, minor injury, malfunctions or incorrect process values can be the consequence if such warnings are ignored.

- Follow the prevention instructions carefully.

Mandatory signs

The mandatory signs in this manual have the following meaning:

Safety goggles

Safety gloves

Warning signs The warning signs in this manual have the following meaning:


Electrical shock hazard


Corrosive


Harmful to health


Flammable


Warning general


Attention general

1.2. General Safety Regulations

Legal requirements

The user is responsible for proper system operation. All precautions must be followed to ensure safe operation of the instrument.

Spare parts and disposables

Use only official Swan spare parts and disposables. If other parts are used during the normal warranty period, the manufacturer's warranty is voided.

Modifications

Modifications and instrument upgrades shall only be carried out by an authorized service technician. Swan will not accept responsibility for any claim resulting from unauthorized modification or alteration.

WARNING

Electrical Shock Hazard

If proper operation is no longer possible, the instrument must be disconnected from all power lines, and measures must be taken to prevent inadvertent operation.

- To prevent from electrical shock, always make sure that the ground wire is connected.
- Service shall be performed by authorized personnel only.
- Whenever electronic service is required, disconnect instrument power and power of devices connected to.
  - relay 1,
  - relay 2,
  - alarm relay

WARNING

For safe instrument installation and operation you must read and understand the instructions in this manual.

WARNING

Only SWAN trained and authorized personnel shall perform the tasks described in this document.

2. Product Description

2.1. Description of the System

Application

pH and ORP are measured in many applications as for example potable water, high purity water or waste water. Each application requires different fittings, flow cells, and sensors.

pH measuring principle (simplified)

The pH measurement is based on a voltage measurement. A voltage can only be measured between two different potentials, therefore, the pH measuring chain contains a measuring electrode and a reference electrode. The reference electrode maintains a constant potential whereas the potential of the measuring electrode changes with the pH value. The voltage which results from this potential difference is measured and displayed on the transmitter as pH value. The measuring chain is designed so that the voltage is zero at pH 7.

ORP measuring principle (simplified)

The ORP (redox) measurement is based on a voltage measurement. A voltage can only be measured between two different potentials, therefore, the ORP (redox) measuring chain contains a measuring electrode and a reference electrode. The reference electrode maintains a constant potential whereas the potential of the measuring electrode changes with the ORP value. The voltage which results from this potential difference is measured and displayed on the transmitter as ORP value in millivolt (mV).

Temperature compensation

- pH: The pH value depends on the sample temperature. To compensate temperature fluctuations a temperature sensor is installed in the flow cell.
- ORP: Temperature compensation is not necessary.

Potable water, waste water: Compensation according to Nernst.
High purity water (power plant, semiconductor): Nernst or non-linear solution temperature compensation, or linear compensation with coefficient.

Signal outputs

Two signal outputs programmable for measured values (freely scalable, linear, bilinear, log) or as continuous control output (control parameters programmable).

Current loop:	0/4–20 mA
Maximal burden:	510 Ω

Relays

Two potential-free contacts programmable as limit switches for measured values, controllers or timer with automatic hold function.
Maximum load: 100 mA/50 V

Alarm relays

Two potential-free contacts (one normally open and one normally closed). Summary alarm indication for programmable alarm values and instrument faults.

- Normally open contact: closed during normal operation, open on error and power loss.
- Normally closed contact: open during normal operation, closed on error and power loss

Maximum load: 100 mA / 50 V

Input

One input for potential-free contact to freeze the measuring value or to interrupt control in automated installations (hold function or remote off).

Communication interface (option)

- RS485 interface (galvanically separated) for communication via Modbus or Profibus DP
- USB interface for logger download
- HART interface
- RS232 interface for logger download with HyperTerminal

Safety features

No data loss after power failure. All data is saved in non-volatile memory. Overvoltage protection of inputs and outputs. Galvanic separation of measuring inputs from signal outputs.

pH electrode

For the AMU-II pH/Redox four types of pH electrodes are available.

- The Swansensor pH Standard is a combined gel electrode for application in drinking water and swimming pools. Gel electrodes can not be filled again and have a limited life time.
- The Swansensor pH SI is a combined electrode with liquid electrolyte (KCl) for the measurement of pH in power plants.
- The Swansensor pH AY is a combined gel electrode for application in waste water due to additional salt supplies
- The Swansensor pH FL for the measurement of pH in high purity water. This sensor can only be used in combination with Swansensor Reference FL, A-87.860.100.

ORP Electrode

For the AMU-II pH/Redox four types of redox (ORP) electrodes are available.

- The Swansensor redox (ORP) Standard is a combined gel electrode for application in drinking water and swimming pools. Gel electrodes can not be filled again and have a limited life time.
- The Swansensor redox (ORP) SI is a combined electrode with liquid electrolyte (KCl) for the measurement of redox (ORP) value in power plants.
- The Swansensor redox (ORP) AY is a combined gel electrode for application in waste water due to additional salt supplies.
- The Swansensor ORP FL for the measurement of the redox potential in high purity water. This sensor can only be used in combination with Swansensor Reference FL, A-87.860.100.

Reference electrode

Swansensor Reference FL, reference electrode for Swansensor pH FL or Swansensor Redox FL

Consumables

One 200 ml bottle of 3.5 M KCl lasts for 1 month.

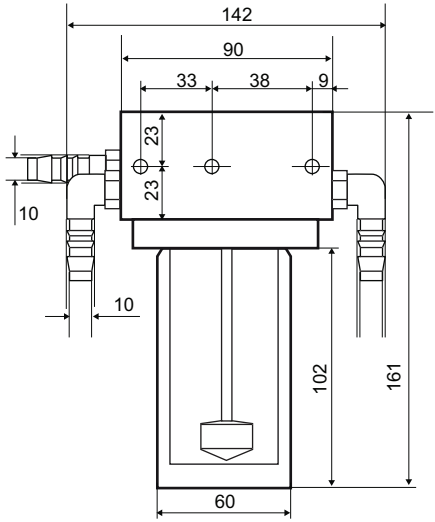
2.2. Single Components

2.2.1 AMU-II pH/Redox Transmitter

General	Electronics housing:	Noryl® resin
	Protection degree:	up to IP54 (front)
	Ambient temperature:	-10 to +50 °C
	Humidity:	10–90% rel., non condensing
	Display:	backlit LCD, 75 x 45 mm
	Dimensions:	96 x 96 x 85 mm
	Cutout size	92 x 92 mm (DIN IEC 61554:2002-08)
	Weight:	0.30 kg
Power supply	AC variant:	100–240 VAC (±10%) 50/60 Hz (±5%)
	DC variant:	10–36 VDC
	Power consumption:	max. 3 VA
pH measurement	Measuring range:	0.00 to 14.00
	Resolution	0.01
	Reference temperature:	25 °C
ORP measurement	Measuring range:	-500 to +1500 mV
	Resolution:	1 mV
Temperature measurement	Pt1000 type sensor (DIN class A)	
	Measuring range:	-30 to +250 °C
	Resolution:	0.1 °C
Sample flow measurment	with digital SWAN sample flow sensor	

2.2.2 Flow Cell M-Flow 10-3PG

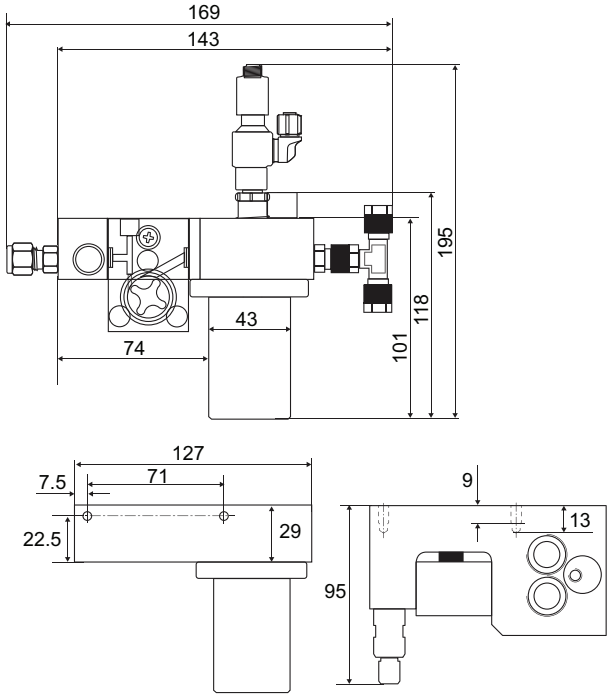
Flow cell for potable water applications for the installation of three sensors, i.e. a pH or redox sensor, a reference sensor and a temperature sensor. Sensor cleaning available as an option.



Connections	Sample:	G 1/4” thread
	Cleaning water:	G 1/4” thread
	Sensor:	Screw connection: PG 13.5 mm Installation depth:120 mm
	Equipped with elbow hose nozzle for 10 mm tube.	
Sample conditions	For the flow cell without electrodes!	
	Flow rate:	4 to 15 l/h
	Temperature:	up to 50 °C
	Inlet pressure:	up to 1 bar @ 25 °C
	Outlet pressure:	Pressure free
	Particle size:	below 0.5 mm
	No strong acids and bases.	
	No organic solvents.	
Dimensions	Width:	90 to 142 mm
	Front-to-back:	138 mm
	Height:	161 mm
	Mounting:	3 screws M5

2.2.3 Flow Cell QV-Flow SS316L pHRT

Made of stainless steel SS316L with built-in Pt1000 temperature sensor and a Swagelok connection for 1/4" tube. With flow measurement and needle valve.
For the installation of two sensors i.e. a pH or redox sensor and a reference sensor. Recommended for the use with Swansensor pH/Redox SI. Other sensors require an adapter set for installation.

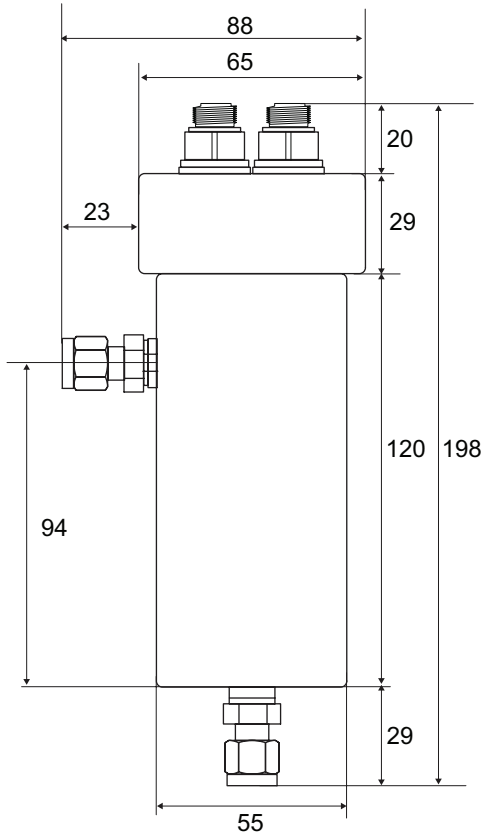


Technical data

Sample inlet:	Swagelok G 1/4” thread
Sample outlet:	Serto 90° angle for 8x6 mm tube (tube 1.5 m included in delivery)
Sample temperature:	0–50 °C
Sample flow:	5–10 l/h
Pressure:	max. 2 bar at 50 °C Sample outlet pressure free
Sensor:	Screw connection: PG 13,5 mm Installation depth: 75 mm

2.2.4 Flow Cell B-Flow IS1000

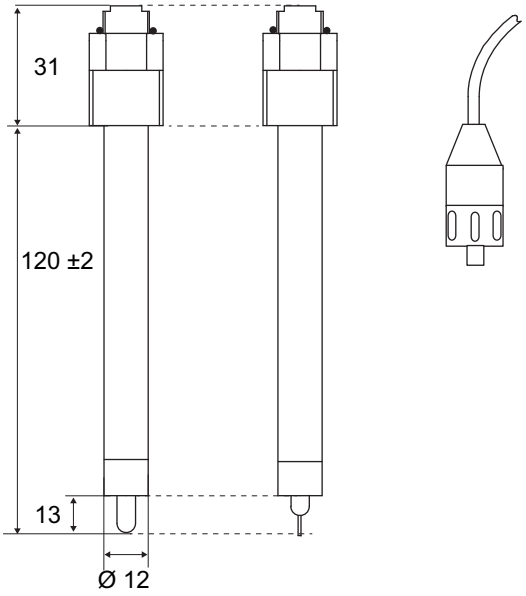
Stainless steel flow cell for 2 sensors with integrated Pt1000 temperature sensor. Suitable for all sensors with PG13.5 screw head and a max. shaft length of 120 mm.



Technical data		
	Sample inlet and outlet:	2 x ¼" NPT female thread
	Operating temperature flow cell:	up to 130 °C
	Operating temperature sensors:	up to 50 °C
	Operating pressure flow cell:	max. 10 bar
	Operating pressure sensors:	max. 5 bar

2.2.5 Swansensor pH and Redox Standard

Combined electrode with gel electrolyte for application in drinking water and swimming pools.

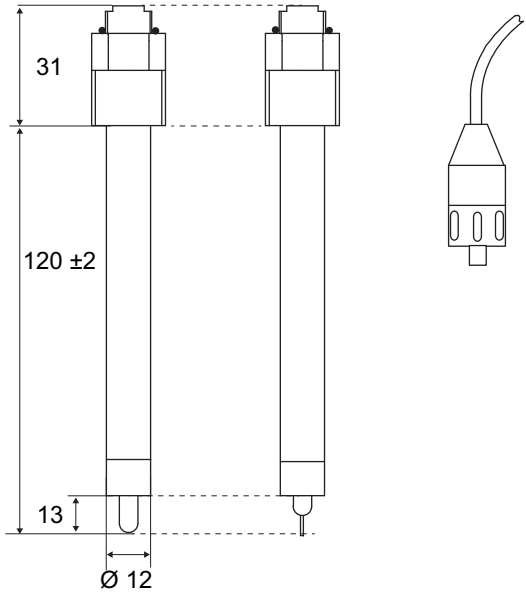


pH Sensor **Redox Sensor** **Sensor cable with plug**

Specifications pH Sensor	Operative and measuring range:	1 to 13 pH
	Operating temperature:	0–50 °C
	Pressure:	<2 bar
	Conductivity measuring medium:	>150 µS/cm
	Connection:	plug PG 13.5
Specifications ORP Sensor	Operative and measuring range:	-400 to +1200 mV
	Operating temperature:	0–50 °C
	Pressure:	<2 bar
	Conductivity measuring medium:	>150 µS/cm
	Connection:	plug PG 13.5

2.2.6 Swansensor pH and Redox AY

Combined electrode with gel electrolyte for application in waste water due to additional salt supplies.

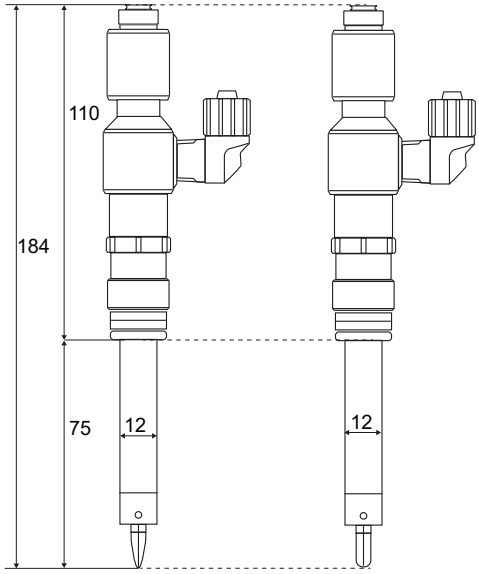


pH Sensor **Redox Sensor** **Sensor cable with plug**

Specifications pH-Sensor	Operative and measuring range:	1 to 13 pH
	Operating temperature:	0–50 °C
	Pressure:	<2 bar
	Conductivity measuring medium:	>100 µS/cm
	Connection:	plug PG 13.5
Specifications ORP-Sensor	Operative and measuring range:	-400 to +1200 mV
	Operating temperature:	0–50 °C
	Pressure:	<2 bar
	Conductivity measuring medium:	>100 µS/cm
	Connection:	plug PG 13.5

2.2.7 Swansensor pH and Redox SI

pH/Redox electrode with reference electrode for the measurement of pH/Redox value in power plants.

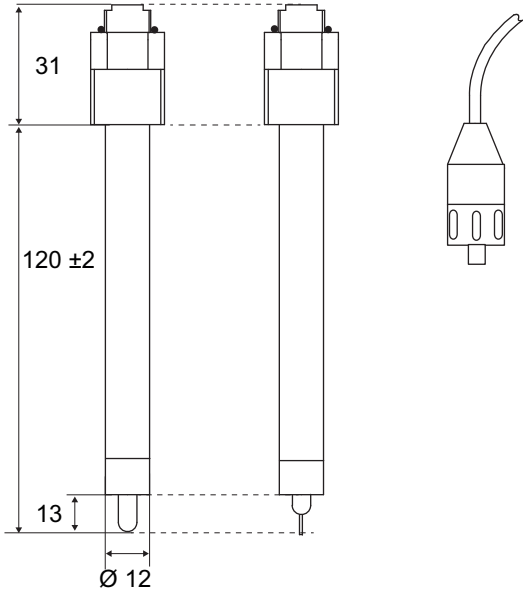


pH Sensor **Redox Sensor**

Specifications pH-Sensor	Operative and measuring range:	1 to 12 pH
	Operating temperature:	0–50 °C
	Electrolyte:	KCl, 3.5 M
	Pressure:	pressure free
	min. Conductivity:	0.055 µS/cm
	Connection:	plug PG 13.5
Specifications Redox-Sensor	Operative and measuring range:	-500 to +1500 mV
	Operating temperature:	0–50 °C
	Electrolyte:	KCl 3.5 M
	Pressure:	pressure free
	min. Conductivity:	3 µS/cm
	Connection:	plug PG 13.5

2.2.8 Swansensor pH and Redox FL

pH/Redox electrode for the measurement of pH value or redox potential in high purity water. Only in combination with Swansensor Reference FL.

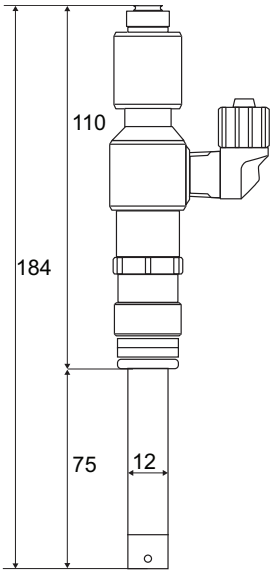


pH Sensor **ORP Sensor** **Sensor cable with plug**

Specifications pH-Sensor	Operative and measuring range:	1 to 12 pH
	Reference electrode:	Reference FL
	Operating temperature:	0–50 °C
	Pressure:	pressure free
	Conductivity measuring medium:	min. 0.055 µS/cm
	Connection:	plug PG 13.5
Specifications Redox-Sensor	Operative and measuring range:	-500 to +1500 mV
	Reference electrode:	Reference FL
	Operating temperature:	0–50 °C
	Pressure:	pressure free
	Conductivity measuring medium:	min. 0.055 µS/cm
	Connection:	plug PG 13.5

2.2.9 Swansensor Reference FL

Reference electrode for Swansensor pH FL or Swansensor Redox FL.

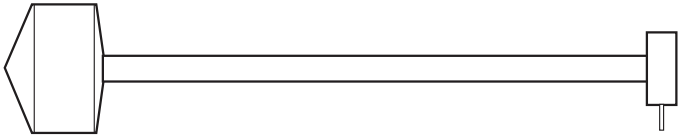


Specifications

Reference system:	Ag/AgCl
Electrolyte:	KCl, 3.5 M
Operating temperature:	0–50 °C
Pressure:	pressure free
Min. Conductivity:	min. 0.055 µS/cm
Connection:	plug PG 13.5

2.2.10 Spray Nozzle

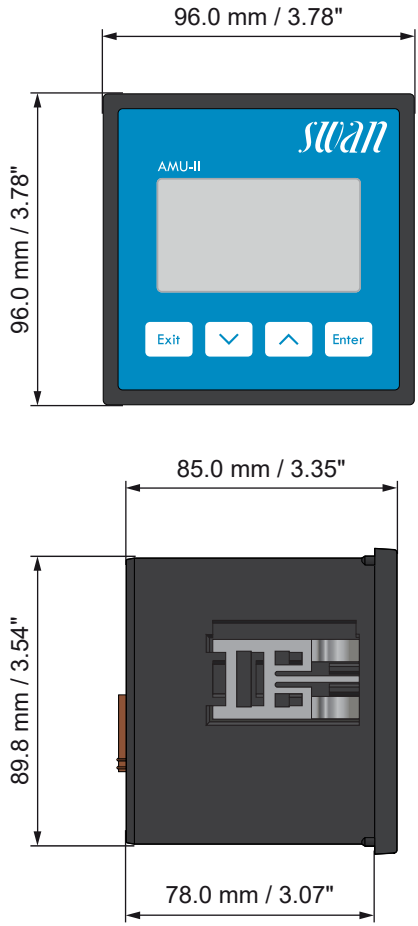
For automatic cleaning of the sensor tips applicable with flow cell M-Flow 10-3PG.



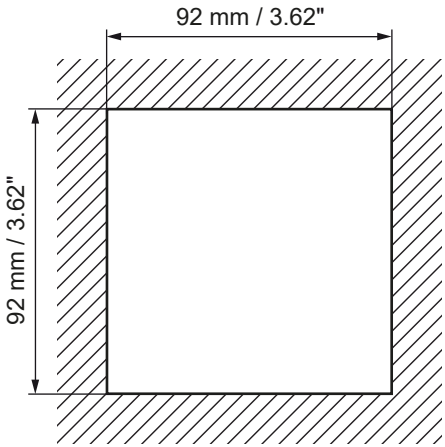
3. Installation

3.1. Mounting of the AMU-II Transmitter

Transmitter dimensions

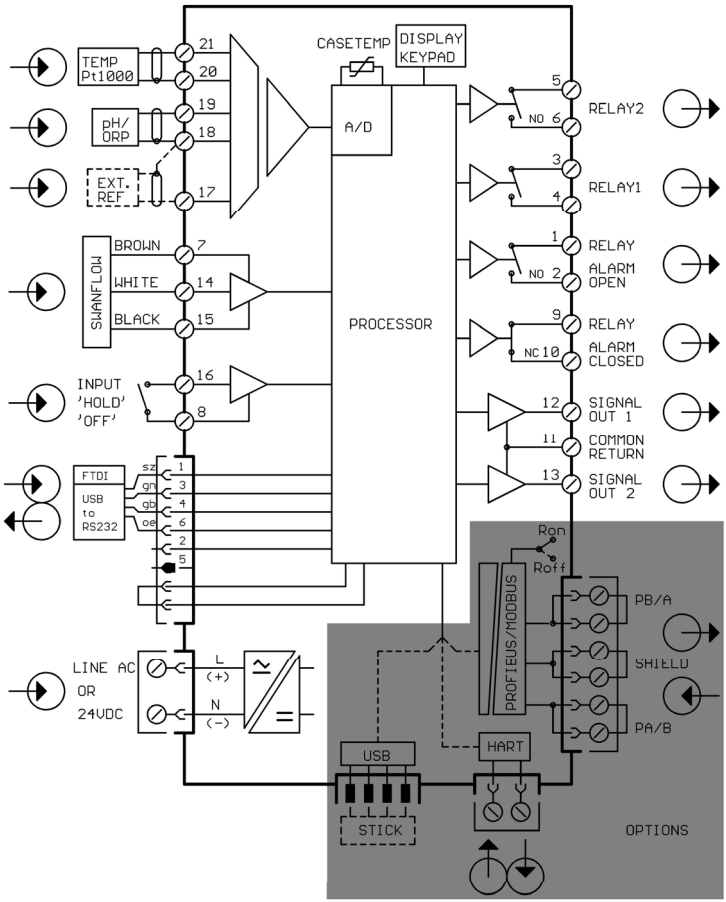


Cutout dimensions



3.2. Electrical Connections

Connection diagram



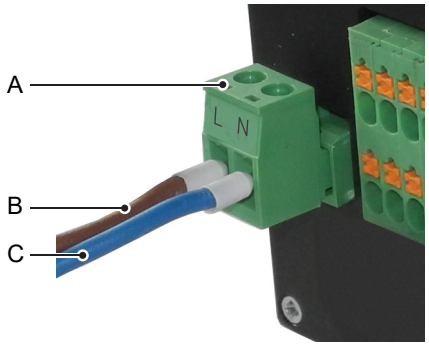
CAUTION

Use only the terminals shown in this diagram, and only for the mentioned purpose. Use of any other terminals will cause short circuits with possible corresponding consequences to material and personnel.

3.3. Power Supply

CAUTION

Do not apply power to the transmitter until all electrical connections have been made.



A *Pluggable terminal block*
B *Phase/(+) conductor*
C *Neutral/(-) conductor*

Installation requirements

The installation must meet the following requirements:

- Mains cable according to standards IEC 60227 or IEC 60245; flammability rating FV1
- Mains equipped with an external switch or circuit-breaker
  - near the instrument
  - easily accessible to the operator
  - marked as interrupter for AMU-II pH/Redox

3.4. Sensor

Terminals: see Connection diagram, p. 21.
Sensor settings: see Instrument Setup, p. 25.

3.5. Swan Flow Meter

Terminals: see Connection diagram, p. 21.

3.6. Input

Note: *Use only potential-free (dry) contacts.*

Terminals 16/8
For programming see Program List and Explanations, p. 55.

3.7. Relay Contacts

3.7.1 Alarm Relay

Note: *Max. load 100 mA/50 V*

Alarm output for system errors. For error codes see Error List, p. 47.

	Terminals	Description
NC Normally Closed	9/10	Active (opened) during normal operation. Inactive (closed) on error and loss of power.
NO Normally Open	1/2	Active (closed) during normal operation. Inactive (opened) on error and loss of power.

3.7.2 Relay 1 and 2

Note: *Max. load 100 mA/50 V*

Terminals 3/4: Relay 1
Terminals 5/6: Relay 2
For programming see Program List and Explanations, p. 55, Installation menu.

3.8. Signal Output 1 and 2 (Current Outputs)

Note: *Max. burden 510 Ω*
If signals are sent to two different receivers, use signal isolator (loop isolator).

Signal output 1: Terminals 12 (+) and 11 (-)
Signal output 2: Terminals 13 (+) and 11 (-)
For programming see Program List and Explanations, p. 55, Installation menu.

3.9. Interface Options

The functionality of the AMU-II pH/Redox can be expanded with one of the following interface options:

- RS485 with Modbus or Profibus protocol
- HART
- USB

3.9.1 Installation

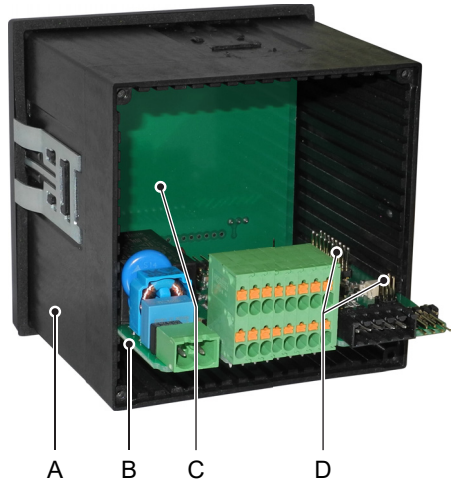
WARNING

Electrical shock hazard

Before opening the housing, disconnect the AMU-II transmitter from the power supply.

CAUTION

Observe precautions for handling electrostatic discharge sensitive devices.



A *Housing*
B *Mainboard*
C *Display board*
D *Pins for interface option*

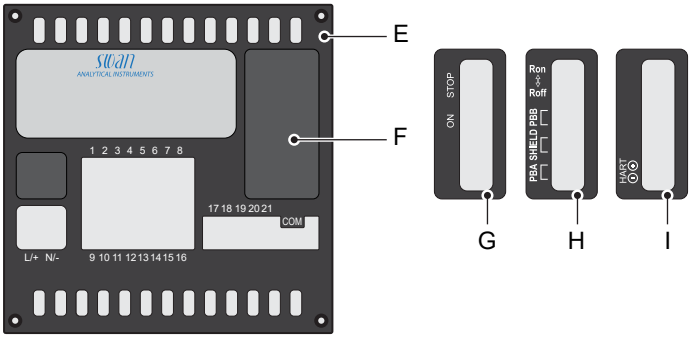
To install an interface option, proceed as follows:

1 Switch power off.
2 Loosen the four screws at the back of the AMU-II transmitter and remove the backplate.
3 Pull the mainboard [B] completely out of the housing.
4 Plug the interface option onto the pins [D] on the mainboard.
5 Reinsert the mainboard into the housing, making sure to insert both boards into the correct guide grooves.

   Mainboard: Fourth guide groove from the bottom
   Interface option: First guide groove from the right

6 Carefully press the mainboard [B] against the display board [C] until it snaps into place.

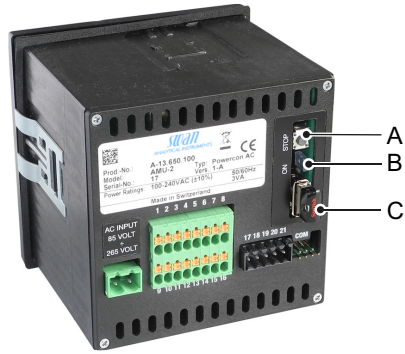
Connector field



E *Backplate*
F *Covered connector field (condition at delivery)*
G *Labeling for USB option*
H *Labeling for RS485 option*
I *Labeling for HART option*

7 Remove the cover [F] from the connector field.
8 Apply the supplied sticker [G], [H] or [I] to the connector field.
9 Reinstall the backplate [E] onto the housing.

3.9.2 USB Option



A *Pushbutton*
B *Blue LED*
C *USB stick*

Menu item

Calling up the <Operation>/<Eject USB Stick> menu item performs the following actions:

- the calibration history and the event history are copied to the USB stick,
- the logger file is completed (the next time the USB stick is inserted, a new file will be created),
- the USB stick is deactivated and can be removed.

Pushbutton

Pressing the pushbutton [A] has the same effect as calling up the <Eject USB Stick> menu item.

Blue LED

The blue LED is **on** if the USB stick is plugged in and ready to record data.
The blue LED is **off** when the USB stick has been deactivated and is ready to be removed.

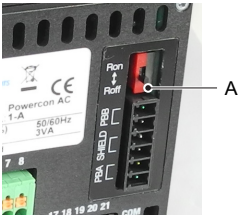
3.9.3 RS485 Option

Menu items

After the RS485 option has been installed, the <Installation>/<Interface> menu item becomes visible. Select Modbus RTU or Profibus as protocol.

Terminating resistor

On the last RS485 interface in the network, move the switch to the position marked “Ron” to activate the terminating resistor.



A *Switch for terminating resistor*

Interface Description

The Modbus and Profibus interface descriptions can be downloaded from www.swan.ch.

3.9.4 HART Option

Menu items

The configuration is done via the following menu items:
<Installation>/<Signal Outputs>/<Signal Output 3>:
<Installation>/<Interface>/<Device Address>:

Field Device Description

The HART® 7.x Field Device Specification can be downloaded from www.swan.ch.

3.10. RS232 Interface

The RS232 interface is located on the back of the AMU-II transmitter. Use the USB to RS232 interface converter available from Swan.

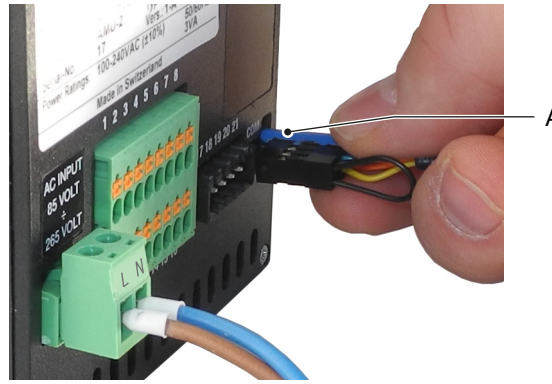
Downloading SwanTerminal

To use the functions provided via the RS232 interface, the SwanTerminal program is required, which can be downloaded from www.swan.ch.

Establishing a connection

To establish a connection between the PC and the AMU-II transmitter, proceed exactly in the following order:

1. Apply power to the AMU-II transmitter.
2. First connect the interface converter to the USB port of the PC without the AMU-II connected to the other end of the cable.
3. Wait a few seconds for the interface converter to be detected by the operating system.
4. Connect the other end of the cable to the pins labeled “COM” on the back of the AMU-II transmitter. The blue coding pin [A] must be at the top right corner.
   ⇒ *The AMU-II transmitter reboots automatically.*



5. Start the SwanTerminal program on the PC and select the correct COM port.
6. Click the button in SwanTerminal to connect to the AMU-II transmitter.

4. Instrument Setup

4.1. Establish Sample Flow

1 Open sample flow tap.
2 Wait until the flow cell is completely filled.
3 Switch on power.

4.2. Programming

Programming

Set all necessary sensor parameters in menu 5.1 Installation/Sensors, further information see 5.1 Sensors, p. 59:

- Type of sensor: set the type of sensor to pH or Redox according to your application
- Flow measurement: Set the flow measurement according to the installed flow sensor.
- Temperature:
  If a temperature sensor is installed, set Temp. sensor to yes. If no temperature sensor is used, set the default temperature to the expected sample temperature.
- Standard solution(s): Program the buffer values (pH buffer table) or the ORP calibration solution if you do not use the SWAN standard

Program all parameters for external devices (interface, recorders, etc.). Program all parameters for instrument operation (limits, alarms). See Program List and Explanations, p. 55 for explanations.

Calibration of pH electrode

The instrument should be operating for 1 h before performing a pH calibration.
Calibrate the pH electrode with two buffers, e.g. pH 7.00 and pH 9.00. See Process Calibration, p. 36, for details.

Calibration of ORP electrode

The instrument should be operating for 1 h before performing an ORP calibration. See Process Calibration, p. 36, for details.

Set buffer values

Please note that this list is only valid for Swan buffers. If you use different buffers please ask the manufacturer.
The temperature curves for the buffer solutions

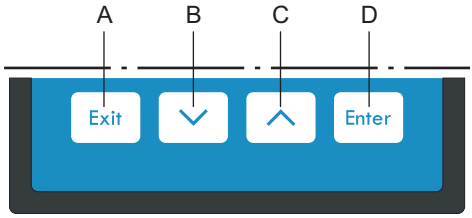
- standard 1 (pH7) and
- standard 2 (pH9)

are already implemented in the transmitter firmware. To program the temperature curve for the buffer solution pH4 overwrite standard 2.

Temperature	Value pH7	Value pH9	Value pH4
Buffer value at 0 °C	**7.13**	**9.24**	**3.99**
Buffer value at 5 °C	**7.07**	**9.19**	**3.99**
Buffer value at 10 °C	**7.05**	**9.14**	**3.99**
Buffer value at 15 °C	**7.03**	**9.08**	**3.99**
Buffer value at 20 °C	**7.01**	**9.05**	**3.99**
Buffer value at 25 °C	**7.00**	**9.00**	**4.00**
Buffer value at 30 °C	**6.99**	**8.96**	**4.01**
Buffer value at 35 °C	**6.98**	**8.93**	**4.01**
Buffer value at 40 °C	**6.98**	**8.90**	**4.03**
Buffer value at 50 °C	**6.98**	**8.84**	**4.05**

5. Operation

5.1. Keys



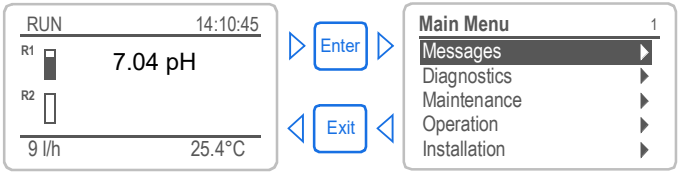
A *to exit a menu or command (rejecting any changes)*
to move back to the previous menu level

B *to move DOWN in a menu list and to decrease digits*

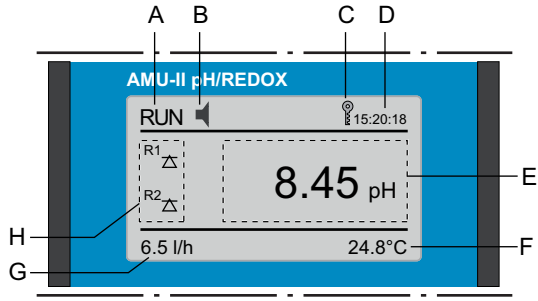
C *to move UP in a menu list and to increase digits*

D *to open a selected sub-menu*
to accept an entry

Program Access, Exit



5.2. Display



A RUN — normal operation

HOLD — input closed or cal delay: Instrument on hold (shows status of signal outputs).

OFF — input closed: control/limit is interrupted (shows status of signal outputs).

B ERROR — Error — Fatal Error

C Keys locked, transmitter control via Profibus

D Time

E Process value

F Sample temperature

G Sample flow

H Relay status

Relay status, symbols

upper/lower limit not yet reached

upper/lower limit reached

control upw./downw. no action

control upw./downw. active, dark bar indicates control intensity

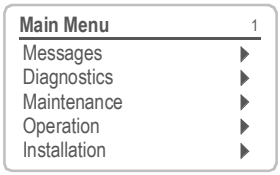
motor valve closed

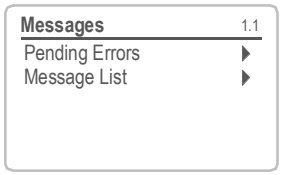
motor valve: open, dark bar indicates approx. position

timer

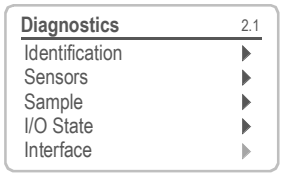
timer: timing active (hand rotating)

5.3. Software Structure

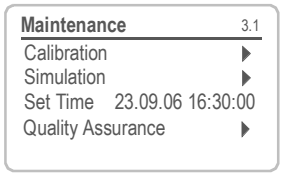




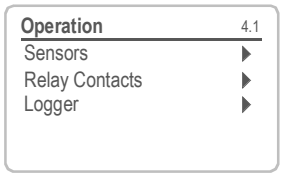
Menu **Messages 1**
Reveals pending errors as well as an event history (time and state of events that have occurred at an earlier point of time).
It contains user relevant data.



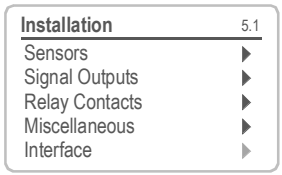
Menu **Diagnostics 2**
Provides user relevant instrument and sample data.



Menu **Maintenance 3**
For instrument calibration, relay and signal output simulation, and to set the instrument time.
It is used by the service personnel.



Menu **Operation 4**
User relevant parameters that might need to be modified during daily routine. Normally password protected and used by the process-operator.
Subset of menu 5 - Installation, but process-related.

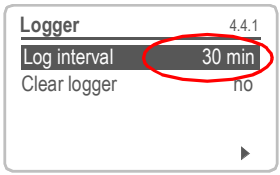


Menu **Installation 5**
For initial instrument set up by SWAN authorized person, to set all instrument parameters. Can be protected by means of password.

5.4. Changing Parameters and values

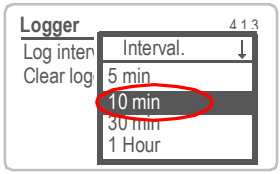
Changing parameters

The following example shows how to change the logger interval:



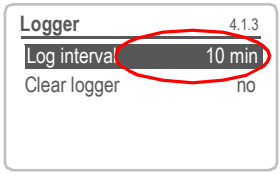
1 Select the parameter you want to change.

2 Press [Enter]



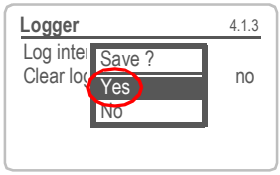
3 Press [▲] or [▼] key to highlight the required parameter.

4 Press [Enter] to confirm the selection or [Exit] to keep the previous parameter).



⇒ *The selected parameter is highlighted but not saved yet.*

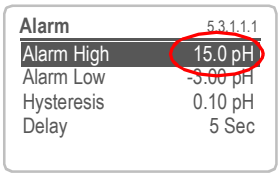
5 Press [Exit].



⇒ *Yes is highlighted.*

6 Press [Enter] to save the new parameter.
⇒ *The system reboots, the new parameter is set.*

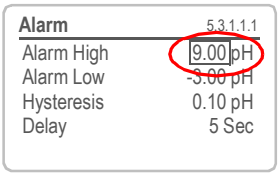
Changing values



1 Select the value you want to change.

2 Press [Enter].

3 Set required value with [▲] or [▼] key.



4 Press [Enter] to confirm the new value.

5 Press [Exit].
⇒ *Yes is highlighted.*

6 Press [Enter] to save the new value.

6. Maintenance

6.1. Stop of Operation for Maintenance

1 Stop sample flow.

2 Shut off power of the instrument.

6.2. Process Calibration

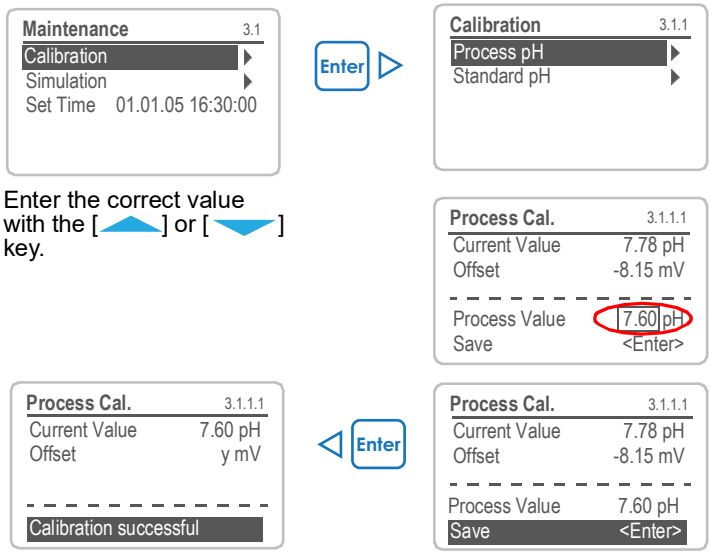
Process pH or ORP Calibration

The process calibration is based on a comparative measurement of the on-line instrument with a correct manual measurement.
Compare the measured values of the manual measurement and the on-line instrument with each other. If necessary, enter the correct value in the <Maintenance>/<Process Cal.> menu of the on-line instrument.

Note:

- *For a reliable process calibration, the process value has to be stable.*
- *Calibration must be performed with a clean sensor.*

The deviation of the measured values is shown as offset in mV.
Select <Save> and press [Enter] to save the correct value.



Error messages

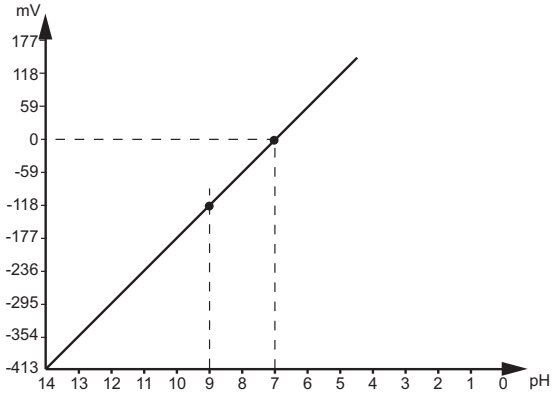
Possible reasons for Offset error:

Last calibration wrong.
Electrode old or dirty.
Cable wet or broken.
Reference measurement wrong.

6.3. Standard Calibration

Standard pH Calibration

The ideal pH electrode has an offset of 0 mV at pH 7 and a slope of 59.16 mV/pH unit. Real electrodes differ from this ideal. Therefore, pH electrodes are calibrated with two buffer solutions of different pH values.



Standard ORP Calibration

Our reference electrode system is Ag/AgCl. The measured value is roughly 50 mV higher than the calomel reference system.
The slope of the ORP electrode is not defined. To compensate the offset of gel electrodes, a calibration can be done with one buffer solution. Because ORP electrodes are slow, it can take some time after calibration until the measured value is stable again.

Procedure

Navigate to <Maintenance>/<Calibration> and select <Standard pH> or <Standard ORP>. Follow the instructions on the screen.

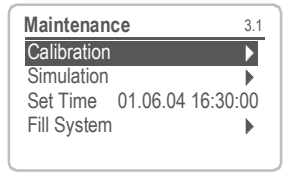
Note:

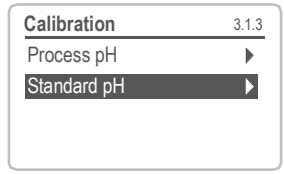
- *Calibration must be performed with a clean sensor (and a clean calibration vessel).*
- *Calibration solutions have to be clean. Do not use if expired.*
- *Always rinse and dry electrodes before immersing them into the calibration solutions.*

Error messages

Possible reason for Offset error or Slope error:
Old, dirty or wrong buffer solutions.
Electrode old or dirty.
Cable wet or broken.

Standard pH or ORP calibration





1. Navigate to menu <Maintenance>/ <Calibration>.
2. Press [Enter].
3. Remove the pH sensor (and, if applicable, temp. sensor) from the flow cell.
4. Press [Enter].
5. Follow the instructions on the display.

Calibration solutions have to be clean. Do not use if expired. Always rinse electrode before dipping it into the solution.

Display instructions

1. Rinse and dry the pH sensor and put it into standard 1.
2. [Enter] to continue.
   ⇒ *The progress of the measurement and the current value of Standard 1 is shown.*
3. [Enter] to save.
4. Rinse and dry the pH sensor and put it in standard 2.
5. [Enter] to continue.
   ⇒ *The progress of the measurement and the current value of Standard 2 is shown.*
6. [Enter] to save.
7. Rinse and dry the pH sensor and put it into the flow cell.
8. [Enter] to continue.
   ⇒ *Calibration Successful*
   or: Offset Error!
   or: Slope Error!

Possible reason for Offset error or Slope error:

Old, dirty or wrong buffer solutions.
Electrode old or dirty.
Cable wet or broken.

6.4. Quality Assurance of the Instrument

Every SWAN on-line instrument is equipped with integrated, autonomous quality assurance functions to survey the plausibility of each measurement.
For AMU-II pH/Redox these are:

- continuous monitoring of sample flow
- continuous monitoring of the temperature inside the transmitter case

Further a manual, menu driven inspection procedure can be carried out using a certified reference instrument. Running at the same sampling point as an inspection equipment, the AMI Inspector pH, verifies the measuring results. After enabling the quality assurance procedure by defining the quality assurance level, the instrument reminds the user periodically to run the procedure and results are stored in a history for review.

Quality assurance level

Central feature of the quality assurance function is the assignment of the monitored process to a Quality assurance level.
There are three predefined levels plus a user level. Hereby the inspection interval, the deviation limits of temperature and measuring result between the inspection equipment and the monitoring instrument are defined.

- Level 1: Trend; Measurement used as an additional information to follow the process indicating trends.
- Level 2: Standard; Monitoring of several parameters of a process (e.g. oxygen, hydrazine and pH in feedwater). In case of instrument failure, other parameters can be used for process monitoring.
- Level 3: Crucial; Monitoring of critical processes, value is used for control of another part or subsystem (valve, dosing unit, etc.).

Additional level:

- Quality level 4: User; User defined inspection interval, maximal deviation of temperature and measuring result.

Limits and interval for AMU-II pH/Redox

Quality Level	max. deviation temperature [°C][a)]	max. deviation result [%]	min. inspection interval
0: Off	**Off**	**Off**	Off
1: Trend	**0.5 °C**	**10%**	annual
2: Standard	**0.4 °C**	**5%**	quarterly
3: Crucial	**0.3 °C**	**5%**	monthly
4: User	**0–2 °C**	**0–20%**	annual, quarterly, monthly

a) sample temperature must have 25°C +/- 5°C.

Procedure The standard workflow contains following procedures:

1. Activate SWAN Quality assurance procedure
2. Pre-test
3. Connect instruments
4. Carry out comparison measurement
5. Completion of the measurement

Note: *The procedure should only be carried out through qualified personnel.*

Materials / Inspection equipment:
- Reference instrument: AMI Inspector pH
- Two tubes made of FEP

6.4.1 Activate SWAN Quality assurance procedure

Enable quality assurance procedure at each instrument by selecting the quality level in menu 5.1.2.1 Quality Assurance <Installation>/ <Sensors>.
The corresponding submenus are then activated.

Note: *The activation is necessary the first time only.*

6.4.2 Pre-test

- Reference instrument: AMI Inspector pH:
  - Check certificate; reference instrument certificate not older then one year.
  - Check battery; Battery of the AMI Inspector pH should be completely charged. Remaining operating time on display minimum 20 hours.
  - Disable temperature compensation (set to “none”)
- On-line instrument: AMU-II pH/Redox:
  - Good order and condition; Flow cell free of particles, Sensor surface free of deposits.
  - Check message list; Review the message list in menu 1.3 and check for alarms (as for example flow alarms). If alarms occur frequently remove cause before starting the procedure.

6.4.3 Connect instruments

The AMI Inspector pH sample inlet is equipped with a serto fitting for stainless steel pipes. The choice of sampling depends strongly on local conditions on site. Possible sampling:

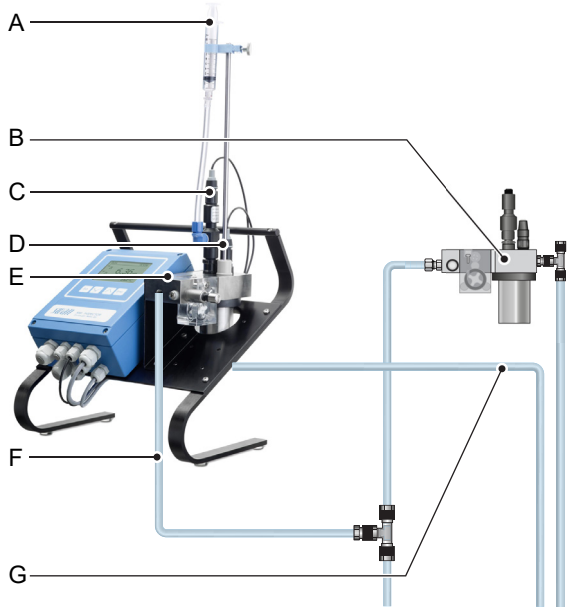
- via Sample point,
- via T-fitting or
- as piggyback / downstream

Note: *Important for correct measurements are in any case:*

- *sample as near as possible to the process monitor,*
- *wait approx. 10 minutes, whilst measurement is running, until measurement value and temperature are stabilized.*

Example: Sampling via T-fitting

The reference instrument, AMI Inspector pH, is connected in parallel to the flow cell of the online instrument by installing a T-Fitting at the sample inlet tube and dividing the sample stream to each instrument.



A *KCl reservoir*
B *Flow cell of online instrument*
C *pH electrode*
D *Temperature sensor*
E *Flow cell of reference instrument*
F *Sample inlet*
G *Sample outlet*

1 Stop sample flow to the online flowcell by closing the appropriate valve, e.g. back pressure regulator, sample preparation or flow regulating valve at flow cell.

2 Connect sample line of the AMU-II pH/Redox [A] with the sample inlet of the reference instrument AMI INSPECTOR pH. Use the supplied tube, made of FEP.

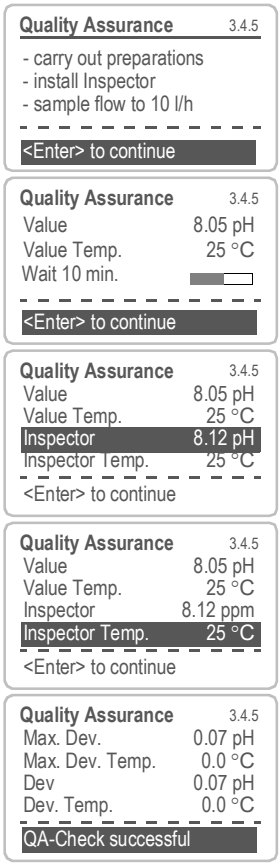
3 Connect sample outlet of the reference instrument AMI INSPECTOR pH to the sample outlet funnel of the monitor.

4 Switch on AMI INSPECTOR pH. Open the flow regulating valve and regulate the sample flow.

6.4.4 Carry out comparison measurement

The comparison measurement is menu driven. Start by selecting Quality assurance in menu 3.4 of the monitor AMU-II pH/Redox.

***Note:** Temperature compensation is automatically deactivated during comparison measurement.*



1 Carry out pre test preparations.
Connect instruments.
Regulate sample flow to 10 l/h using the appropriate valve.

2 Wait 10 minutes whilst measurement is running.
[Enter] to continue.

3 Read the pH value of the reference instrument and enter under “Inspector.” by using the [▲] or [▼] keys. [Enter] to confirm.

4 Read temperature value of the reference instrument and enter under “Inspector Temp.” by using [▲] or [▼] keys. [Enter] to confirm.
[Enter] to continue.

5 - Review result.
- Results are saved in QA-History regardless if successful or not.

If QA-Check is not successful it is recommended to clean the sensor, see Process Calibration, p. 36. If QA-Check fails again contact your local SWAN distributor for support.

6.4.5 Completion of the measurement

1. Stop the sample flow to the AMU-II pH/Redox by closing the appropriate valve, e.g. back pressure regulator, sample preparation or flow regulating valve at flow cell again.
2. Close flow regulating valve of the AMI Inspector.
3. Disconnect the AMI Inspector by removing the tubes and connect the sample outlet of the Monitor AMU-II pH/Redox to the sample outlet funnel again.
4. Start sample flow again and regulate sample flow.
5. Shut down AMI Inspector pH.

6.5. Longer Stop of Operation

1 Stop sample flow.
2 Shut off power of the instrument.
3 Unscrew and remove the connectors from the electrodes.
4 Put the connector caps on it.
5 Remove the electrodes from the flow cell.
6 If available remove the KCl bottle form the bottle holder.
7 Rinse the electrodes well with clean water.
8 If available remove the KCl supply pipe from the KCl bottle and close the supply pipe with a plug.
9 If available dispose the KCl according to your local regulations.
10 Fill 3.5 molar KCl (if not available: clean water) into the protective caps and put them on the tips of the electrodes.
11 Store the electrodes with the tips pointing downwards in a frost-protected room.
12 Empty and dry the calibration vessel

CAUTION

Damage of pH or ORP sensor

Wrong storage will damage the pH or ORP sensor.

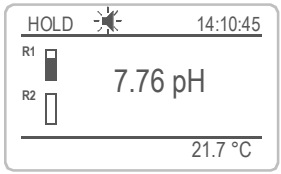
- Never store the sensors dry.
- Store the sensors with tip pointing downwards in a frost-protected room.

7. Error List

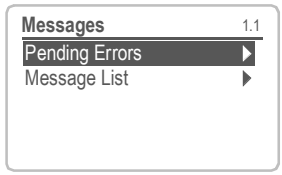
Error
Non-fatal Error. Indicates an alarm if a programmed value is exceeded.
Such Errors are marked **E0xx** (bold and black).

Fatal Error (blinking symbol)
Control of dosing devices is interrupted.
The indicated measured values are possibly incorrect.
Fatal Errors are divided in the following two categories:

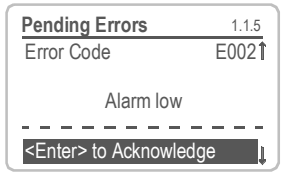
- Errors which disappear if correct measuring conditions are recovered (i.e. Sample Flow low).
  Such Errors are marked **E0xx** (bold and orange)
- Errors which indicate a hardware failure of the instrument.
  Such Errors are marked **E0xx** (bold and red)



Error or fatal Error
Error not yet acknowledged.
Check **Pending Errors 1.1.5** and take corrective action.



Navigate to menu <Messages>/ <Pending Errors>.



Press [ENTER] to acknowledge the Pending Errors.

⇒ *The error is reset and saved in the message list.*

Error	Description	Corrective action
E001	Alarm high	– check process – check programmed value, see 5.3.1.1.1, p. 65
E002	Alarm low	– check process – check programmed value, see 5.3.1.1.25, p. 65
E007	Sample temp. high	– check process – check programmed value, see 5.3.1.3.1, p. 66
E008	Sample temp. low	– check process – check programmed value, see 5.3.1.3.25, p. 66
E009	Sample flow high	– check sample flow – check programmed value, see 5.3.1.2.2, p. 66
E010	Sample flow low	– establish sample flow – clean instrument – check programmed value, see 5.3.1.2.35, p. 66
E011	Temp. shorted	– check wiring of temperature sensor, see , p. 21 – check temperature sensor
E012	Temp. disconnected	– check wiring of temperature sensor, see , p. 21 – check temperature sensor
E013	Case temp. high	– check case/environment temperature – check programmed value, see 5.3.1.4, p. 66
E014	Case temp. low	– check case/environment temperature – check programmed value, see 5.3.1.5, p. 66
E017	Control timeout	– check control device or programming in Installation, Relay contact, Relay 1 and 2 see 5.3.2 and 5.3.3, p. 67
E018	Quality assurance	– perform QA Procedure using reference instrument, e.g. AMI Inspector.
E024	Input active	– see if Fault = Yes is programmed in menu, see 5.3.4, p. 71
E026	IC LM75	– call service
E030	EEProm frontend	– call service

Error	Description	Corrective action
E031	Cal. recout	– call service
E032	Wrong frontend	– call service
E033	Power-on	– none, normal status
E034	Power-down	– none, normal status

8. Program Overview

For explanations about each parameter of the menus see Program List and Explanations, p. 55.

- Menu 1 **Messages** informs about pending errors and maintenance tasks and shows the error history. Password protection possible. No settings can be modified.
- Menu 2 **Diagnostics** is always accessible for everybody. No password protection. No settings can be modified.
- Menu 3 **Maintenance** is for service: Calibration, simulation of outputs and set time/date. Please protect with password.
- Menu 4 **Operation** is for the user, allowing to set limits, alarm values, etc. The presetting is done in the menu Installation (only for the system engineer). Please protect with password.
- Menu 5 **Installation**: Defining assignment of all inputs and outputs, measuring parameters, interface, passwords, etc. Menu for the system engineer. Password strongly recommended.

8.1. Messages (Main Menu 1)

Pending Errors 1.1*	*Pending Errors*	1.1.5*	* Menu numbers
Message List 1.2*	*Number*	1.2.1*	
	Date, Time		

8.2. Diagnostics (Main Menu 2)

Identification	Desig.	AMU-II pH/Redox		* Menu numbers
2.1*	Version	V1.02-02/23		
	Factory Test	*Instrument*	2.1.3.1*	
	2.1.3*	*Motherboard*		
		Front End		
	Operating Time	*Years / Days / Hours / Minutes / Seconds*		2.1.4.1*
	2.1.4*			
Sensors	Electrode	*Current Value pH*		
2.2*	2.2.1*	*(Raw value) mV*		
		Cal. History	*Number*	2.2.1.5.1*
		2.2.1.5*	*Date, Time*	
			Offset	
			Slope	
	Miscellaneous	*Case Temp.*	*2.2.2.1**	
	2.2.2*			
	QA History	*(If Quality Assurance is activated)*		
	2.2.3			
Sample	*Sample ID*	2.3.301*		
2.3*	*Temperature*			
	Sample flow			
	Raw value in Hz			
I/O State	*Alarm Relay*	2.4.1*		
2.4*	*Relay 1/2*	2.4.2*		
	Input			
	Signal Output 1/2			
Interface	*Protocol*	2.5.1*		
2.5*	*Baud rate*			

8.3. Maintenance (Main Menu 3)

Calibration	Process pH	*Process pH*	3.1.1.4*	* Menu numbers
3.1*	3.1.1*			
	Standard pH	*Standard pH*	3.1.2.5*	
	3.1.2*			
Simulation	*Alarm Relay*	3.2.1*		
3.2*	*Relay 1*	3.2.2*		
	Relay 2	3.2.3*		
	Signal Output 1	3.2.4*		
	Signal Output 2	3.2.5*		
Set Time	*(Date), (Time)*			
3.3*				

8.4. Operation (Main Menu 4)

Sensors	*Filter Time Const.*	4.1.1*		
4.1*	*Hold after Cal.*	4.1.2*		
Relay Contacts	**Alarm Relay**	**Alarm**	*Alarm High*	4.2.1.1.1*
4.2*	4.2.1*	4.2.1.1*	*Alarm Low*	4.2.1.1.26*
			Hysteresis	4.2.1.1.36*
			Delay	4.2.1.1.46*
	Relay 1 and 2	*Setpoint*	4.2.x.100*	
	4.2.2* and 4.2.3*	*Hysteresis*	4.2.x.200*	
		Delay	4.2.x.30*	
	Input	*Active*	4.2.4.1*	
	4.2.4*	*Signal Outputs*	4.2.4.2*	
		Output / Control	4.2.4.3*	
		Fault	4.2.4.4*	
		Delay	4.2.4.5*	
Logger	*Log Interval*	4.3.1*		
4.3*	*Clear Logger*	4.3.2*		

8.5. Installation (Main Menu 5)

Sensors	**Flow**	*Flow measurement*	5.1.1.1*	* Menu numbers
5.1*	5.1.1*			
	Parameter	Type of sensor	5.1.2.1*	
	5.1.2*	*Sensor Check*	5.1.2.2*	
	Temperature	*Temp. Sensor*	5.1.3.1*	
	5.1.3	*Default Temp.*	5.1.3.21*	
		Temp. Compensation	*Comp.*	5.1.3.3.1*
		5.1.3.3*		
	Standards	**Standard 1**	*@ 0 °C–50 °C*	5.1.40.1.1–10*
	5.1.40	5.1.40.1*		
		Standard 2	*@ 0 °C–50 °C*	5.1.40.2.1–10*
		5.1.40.2*		
	Quality Assurance	*Level*	5.1.5.1	
	5.1.5*			
Signal Outputs	**Signal Output 1 and 2**	*Parameter*	5.2.1.1 - 5.2.2.1*	
5.2*	5.2.1* - 5.2.2*	*Current Loop*	5.2.1.2 - 5.2.2.2*	
		Function	5.2.1.3 - 5.2.2.3*	
		Scaling	*Range Low*	5.2.x.40.10/10*
	5.2.x.40	*Range High*		5.2.x.40.20/20*
Relay Contacts	**Alarm Relay**	**Alarm**	*Alarm High*	5.3.1.1.1*
5.3*	5.3.1*	5.3.1.1*	*Alarm Low*	5.3.1.1.26
			Hysteresis	5.3.1.1.36
			Delay	5.3.1.1.46
		Sample Flow	*Flow Alarm*	
		5.3.1.2*	*Alarm High*	
			Alarm Low	
		Sample Temp.	*Alarm High*	5.3.1.3.1*
		5.3.1.3	*Alarm Low*	5.3.1.3.26*
		Case Temp. high	5.3.1.5*	
		Case Temp. low	5.3.1.60*	
	Relay 1 and 2	*Function*	5.3.2.1–5.3.3.1*	
	5.3.2* and 5.3.3*	*Parameter*	5.3.2.20–5.3.3.20*	
		Setpoint	5.3.2.300–5.3.3.301*	
		Hysteresis	5.3.2.400–5.3.3.401*	
		Delay	5.3.2.50–5.3.3.50*	

	Input	*Active*	5.3.4.1*
	5.3.4*	*Signal Outputs*	5.3.4.2*
		Output/Control	5.3.4.3*
		Fault	5.3.4.4*
		Delay	5.3.4.5*
Miscellaneous	*Language*	5.4.1*	
5.4*	*Set defaults*	5.4.2*	
	Load Firmware	5.4.3*	
	Password	*Messages*	5.4.4.1*
	5.4.4*	*Maintenance*	5.4.4.2*
		Operation	5.4.4.3*
		Installation	5.4.4.4*
	Sample ID	5.4.5*	
Interface	*Protocol*	5.5.1*	
5.5*	*Device Address*	5.5.21*	
	Baud Rate	5.5.31*	
	Parity	5.5.41*	

* Menu numbers

9. Program List and Explanations

1 Messages

1.1 Pending Errors

1.1.5 Provides the list of active errors with their status (active, acknowledged). If an active error is acknowledged, the alarm relay is active again. Cleared errors are moved to the Message list.

1.2 Message List

1.2.1 Shows the error history: Error code, date / time of issue and status (active, acknowledged, cleared). 65 errors are memorized. Then the oldest error is cleared to save the newest error (circular buffer).

2 Diagnostics

In diagnostics mode, the values can only be viewed, not modified.

2.1 Identification

Desig.: Designation of the instrument.
Version: Firmware of instrument (e.g. V1.02-02/23).

2.1.3 **Factory Test**: Test date of the instrument and motherboard.

2.1.4 **Operating Time:** Years/days/hours/minutes/seconds.

2.2 Sensors

2.2.1 **Electrode:**

- *Current value:* Shows the actual measuring value in pH or mV.
  (Raw value): Shows the actual measuring value in mV.

2.2.1.5 *Cal. History:* shows the diagnostic values of the last calibrations.
pH:
- *Number*: Counter of the calibrations.
- *Date, Time*: Date and time assigned to a number.
- *Offset*: Zero point displacement from the reference position in mV.
- *Slope*: Steepness of the straight line in mV/pH

or mV:
- *Number*: Counter of the calibrations.
- *Date, Time*: Date and time assigned to a number.
- *Offset*: Zero point displacement from the reference position in mV.

Max. 64 data records are memorized. One process calibration corresponds to one data record.

2.2.2 **Miscellaneous**:

2.2.2.1 *Case Temp:* Shows the actual temperature in °C inside the transmitter.

2.2.3 **QA History:** Shows the QA values of the last quality assurance procedures:

- o *Number*: Each QA measurement is assigned to a number.
- o *Date, Time*: Date and time of the assigned number.
- o *Deviation pH*: The pH deviation of the on-line instrument.
- o *Deviation Temperature*: The temperature deviation of the on-line instrument.
- o *QA Check successful*: <Yes> or <No>, information whether the quality assurance was successful or not.

2.3 Sample

If <Flow measurement> = None and <Temp. Sensor> = no

2.3.301
- o *Sample ID***:** Shows the assigned sample identification. This identification is defined by the user to identify the location of the sample.
- o *Temperature:* Shows the predefined comp. temperature in °C.

If <Flow measurement> = Q-Flow and <Temp. Sensor> = no

2.3.311
- o *Sample ID***:** Same as 2.3.301
- o *Temperature:* Same as 2.3.301
- o *Sample flow:* Shows the actual sample flow in l/h (*Raw value*) in Hz

If <Flow measurement> = Q-Flow and <Temp. Sensor> = yes

2.3.310
- o *Sample ID***:** Same as 2.3.301
- o *Temperature:* Shows the actual temperature in °C (*Pt1000*) raw value in Ohm
- o *Sample flow:* Shows the actual sample flow in l/h (*Raw value*) in Hz

2.4 I/O State

Shows the actual status of all in- and outputs.

2.4.1
- o *Alarm Relay*: Active or inactive
- o *Relay 1 and 2*: Active or inactive
- o *Input*: Open or closed
- o *Signal Output 1 and 2*: Actual current in mA

2.5 Interface

Only available if optional interface is installed.
Shows the programmed communication settings.

3 Maintenance

3.1 Calibration

3.1.1 **Process pH/Redox:** The process calibration is based on a comparative measurement of the current electrode with a calibrated comparative electrode. See Process Calibration, p. 36.

3.1.1.4
- o *Current Value*: shows the measuring value of the current electrode.
- o *Offset*: Shows the deviation of the measuring value of the current electrode and the calibrated comparative electrode in mV.
- o *Process Value*: Enter the measured value of the calibrated comparative electrode.

3.1.1 **Standard pH/Redox:** Performs a standard calibration. Follow the instruction on the screen. See Process Calibration, p. 36

3.2 Simulation

To simulate a value or a relay state, select the
- alarm relay
- relay 1 and 2
- signal output 1 and 2

with the [▲] or [▼] key.
Press the [Enter] key.
Change the value or state of the selected item with the [▲] or [▼] key.
⇒ *The value is simulated by the relay/signal output.*

3.3.1	*Alarm Relay:*	Active or inactive
3.3.2	*Relay 1*	Active or inactive
3.3.3	*Relay 2:*	Active or inactive
3.3.4	*Signal Output 1:*	Actual current in mA
3.3.5	*Signal Output 2:*	Actual current in mA

At the absence of any key activities, the instrument will switch back to normal mode after 20 min. If you quit the menu, all simulated values will be reset.

3.3 Set Time

Adjust date and time.

4 Operation

4.1 Sensors

4.1.1 *Filter Time Constant:* Used to damp noisy signals. The higher the filter time constant, the slower the system reacts to changes of the measured value.
Range: 5–300 Sec

4.1.2 *Hold after Cal:* Delay permitting the instrument to stabilize again after calibration. During calibration plus hold-time, the signal outputs are frozen (held on last valid value), alarm values, limits are not active.
Range: 0–6‘000 Sec

4.2 Relay Contacts

See Relay Contacts, p. 23

4.3 Logger

The instrument is equipped with an internal logger. The logger data can be downloaded to a PC using the built-in RS232 interface.
The logger can save approx. 1500 data records. Records consists of: Date, time, alarms, measured value, measured value uncompensated, temperature, flow.
Range: 1 second to 1 hour

4.4.1 *Log Interval:* Select a convenient log interval. Consult the table below to estimate the max logging time. When the logging buffer is full, the oldest data record is erased to make room for the newest one (circular buffer).

Interval	1 s	5 s	1 min	5 min	10 min	30 min	1 h
Time	25 min	2 h	25 h	5 d	10 d	31 d	62 d

4.4.2 *Clear Logger:* If confirmed with **yes**, the complete logger data is deleted. A new data series is started.

5 Installation

5.1 Sensors

5.1.1 Flow

5.1.1.1 *Flow measurement*: Select “Q-Flow” or “None”. The deltaT flow sensor is not supported by the AMU-II transmitter.

Flow measurement
None
Q-Flow
deltaT

Q-Flow

5.1.2 Parameters:

5.1.2.1 *Type of Sensor*: Set the type of installed sensor. Possible types:

Type of Sensor	
pH	Measuring values are displayed as pH
Redox	Measuring values are displayed in mV

5.1.2.2 *Sensor Check*: Default setting is: off. (*Only visible in pH measuring mode*).

Sensor check
off
on

The <Sensor Check> can be enabled for automatic, periodic check of the sensor aging (measuring the impedance). The measuring values are written in the logger file or transferred to a control room via Profibus or Modbus. It does not indicate an Alarm.

5.1.3 Temperature:

5.1.3.1 *Temp. Sensor*: The pH measurement is temperature dependent therefore it is possible to install a temperature sensor. Depending on your configuration set the Temp. Sensor to:

Temp. Sensor
Yes
No

If No is set the measuring value is compensated with the default temperature.

5.1.3.21 *Default Temp.*: If no temperature sensor is installed, set the default temperature to the assumed average temperature of the sample. The measuring value is then compensated with this value.

5.1.3.3 **Temp. Compensation:** (only available for pH measurement)

5.1.3.3.1 Comp.: Choose the compensation model which fits best to your application. Available compensation models:

Comp.	We recommend
Nernst	for potable water, waste water, swimming pools
non-linear	for high purity water
coefficient	for high purity water

5.1.40 **Standards:** (only visible if pH is selected)
A temperature curve is programmed for SWAN standard 1, pH 7 and SWAN standard 2, pH 9. If you want to use your own standards you can readjust the temperature curve according to your standards.

5.1.40.1 *Standard 1*: Assign the measured pH value to the according temperature from 0–50 °C in steps of 5 °C.

5.1.40.2 *Standard 2*: Assign the measured pH value to the according temperature from 0–50 °C in steps of 5 °C.

5.1.4 *Standard*: (only visible if redox is selected)
Enter the mV value of the redox standard.

5.1.5 **Quality Assurance:** Switch the Quality Assurance on or off (only available for pH measurement).

5.1.5.1 *Level*: Select quality level:

- Level 0: Off
  Quality assurance procedure switched off. Any additional QA menus are hidden.
- Level 1: Trend
- Level 2: Standard
- Level 3: Crucial
- Level 4: User

Edit user specific limits in menus 5.1.5.2 to 5.1.5.4.

5.2 Signal Outputs

Note: *The navigation in the menu <Signal Output 1> and <Signal Output 2> is identical. For reason of simplicity only the menu numbers of Signal Output 1 are used in the following.*

5.2.1 and 5.2.2 **Signal Output 1 and 2:** Assign process value, the current loop range and a function to each signal output.

5.2.1.1 *Parameter:* Assign one of the process values to the signal output. Available values:

- Meas. Value
- Temperature
- Sample Flow (if a flow sensor is selected)

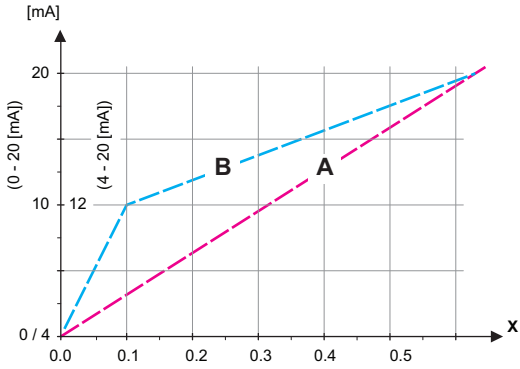
5.2.1.2 *Current Loop:* Select the current range of the signal output. Make sure the connected device works with the same current range. Available ranges: 0–20 mA or 4–20 mA

5.2.1.3 *Function:* Define if the signal output is used to transmit a process value or to drive a control unit. Available functions are:

- Linear, bilinear or logarithmic for process values.
  See As process values, p. 62
- Control upwards or control downwards for controllers.
  See As control output, p. 63

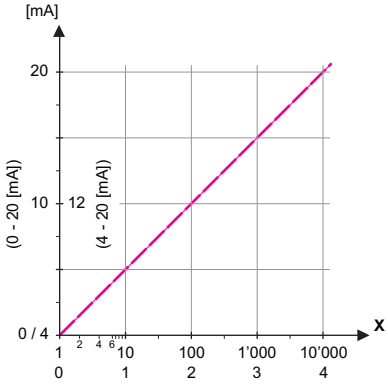
As process values

The process value can be represented in 3 ways: linear, bilinear or logarithmic. See graphs below.



A *linear*
B *bilinear*

X *Measured value*



X *Measured value (logarithmic)*

5.2.1.40 **Scaling:** Enter beginning and end point (Range low & high) of the linear or logarithmic scale. In addition, the midpoint for the bilinear scale.

Parameter Meas. Value:

		pH sensor	Redox sensor
5.2.1.40.10	*Range low*:	-3 pH to +15 pH	-500 mV to +1500 mV
5.2.1.40.20	*Range high*:	-3 pH to +15 pH	-500 mV to +1500 mV

Parameter Temperature:

5.2.1.40.11 *Range low*: -25 to +270 °C
5.2.1.40.21 *Range high*: -25 to +270 °C

Parameter Sample flow:

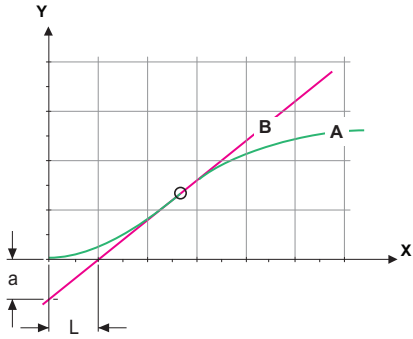
5.2.1.40.12 *Range low*: 0–200 l/h
5.2.1.40.22 *Range high*: 0–200 l/h

As control output

Signal outputs can be used for driving control units. We distinguish different kinds of controls:

- *P-controller:* The controller action is proportional to the deviation from the setpoint. The controller is characterized by the P-Band. In the steady-state, the setpoint will never be reached. The deviation is called steady-state error.
  Parameters: setpoint, P-Band
- *PI-controller:* The combination of a P-controller with an I-controller will minimize the steady-state error. If the reset time is set to zero, the I-controller is switched off.
  Parameters: setpoint, P-Band, reset time.
- *PD-controller:* The combination of a P-controller with a D-controller will minimize the response time to a fast change of the process value. If the derivative time is set to zero, the D-controller is switched off.
  Parameters: setpoint, P-Band, derivative time.
- *PID-controller:* The combination of a P-, an I - and a D-controller allows a proper control of the process.
  Parameters: setpoint, P-Band, reset time, derivative time.

Ziegler-Nichols method for the optimization of a PID controller:
Parameters: Setpoint, P-Band, Reset time, Derivative time



A *Response to maximum control output* ***Xp*** *= 1.2/a*
B *Tangent on the inflection point* ***Tn*** *= 2L*
X *Time* ***Tv*** *= L/2*

The point of intersection of the tangent with the respective axis will result in the parameters a and L.
Consult the manual of the control unit for connecting and programming details. Choose control upwards or downwards.
If Control upwards or Control downwards is active

5.2.1.43 Control Parameters

5.2.1.43.10 *Setpoint:* User-defined process value (Measured value or flow)

5.2.1.43.20 *P-Band:* Range below (upwards control) or above (downwards control) the set-point, within the dosing intensity is reduced from 100% to 0% to reach the set-point without overshooting.

5.2.1.43 Control Parameters: if Parameters = Meas. Value

		pH sensor	Redox sensor
5.2.1.43.10	*Setpoint*:	-3 pH to +15 pH	-500 mV to +1500 mV
5.2.1.43.20	*P-Band*:	0.00 pH to +2.00 pH	0 mV to +200 mV

5.2.1.43 Control Parameters: if Parameters = Temperature

5.2.1.43.11 *Setpoint*: -25 °C to +270 °C

5.2.1.43.21 *P-Band:* 0 °C to +100 °C

5.2.1.43 **Control Parameters:** if Parameters = Sample flow

5.2.1.43.12 *Setpoint*: 0.0 l/h – 200 l/h

5.2.1.43.22 *P-Band:* 0.0 l/h – 200 l/h

5.2.1.43.3 *Reset time:* The reset time is the time till the step response of a single I-controller will reach the same value as it will be suddenly reached by a P-controller.
Range: 0 – 9'000 sec

5.2.1.43.4 *Derivative time:* The derivative time is the time till the ramp response of a single P-controller will reach the same value as it will be suddenly reached by a D-controller.
Range: 0 – 9'000 sec

5.2.1.43.5 *Control timeout:* If a controller action (dosing intensity) is constantly over 90% during a defined period of time and the process value does not come closer to the setpoint, the dosing process will be stopped for safety reasons.
Range: 0 – 720 min

5.3 Relay Contacts

5.3.1 **Alarm Relay:** The alarm relay is used as cumulative error indicator. Under normal operating conditions the contact is active.
The contact is inactive at:

- Power loss
- Detection of system faults like defective sensors or electronic parts
- High case temperature
- Process values out of programmed ranges.

Program alarm levels for the following parameters:

- Meas. Value
- Temperature
- Sample Flow (if a flow sensor is programmed)
- Case Temperature high
- Case Temperature low

5.3.1.1 **Alarm**

5.3.1.1.1 *Alarm High:* If the measured value rises above the alarm high value, the alarm relay is activated and E001, is displayed in the message list.

	pH sensor	Redox sensor
Range:	-3 pH to +15 pH	-500 mV to +1500 mV

5.3.1.1.25 *Alarm Low:* If the measured value falls below the alarm low value, the alarm relay is activated and E002 is displayed in the message list.

	pH sensor	Redox sensor
Range:	-3 pH to +15 pH	-500 mV to +1500 mV

5.3.1.1.35 *Hysteresis:* Within the hyst. range, the relay does not switch. This prevents damage of relays contacts when the measured value fluctuates around the alarm value.

	pH sensor	Redox sensor
Range:	0.00 pH to 2.00 pH	0 mV to +200 mV

5.3.1.1.45 *Delay:* Duration, the activation of the alarm relay is retarded after the measuring value has risen above/fallen below the programmed alarm. Range: 0–28‘800 Sec

5.3.1.2 **Sample Flow:** Define at which sample flow a flow alarm should be issued.

5.3.1.2.1 *Flow Alarm:* Program if the alarm relay should be activated if there is a flow alarm. Choose between yes or no. The flow alarm will always be indicated in the display, pending error list, saved in the message list and the logger.
Available values: Yes or no

Note: *Sufficient flow is essential for a correct measurement. We recommend to program yes.*

5.3.1.2.2 *Alarm High:* If the measuring values rises above the programmed value E009 will be issued.
Range: 0–200 l/h

5.3.1.2.35 *Alarm Low:* If the measuring values falls below the programmed value E010 will be issued.
Range: 0–200 l/h

5.3.1.3 **Sample Temp.:** Define at which sample temperature an alarm should be issued.

5.3.1.3.1 *Alarm High:* If the measured value rises above the alarm high value, the alarm relay is activated.
Range: -25–270 °C

5.3.1.3.25 *Alarm Low:* If the measured value rises above the alarm high value, the alarm relay is activated.
Range: -25–270 °C

5.3.1.4 *Case Temp. high:* Set the alarm high value for temperature of electronics housing. If the value rises above the programmed value E013 is issued.
Range: 30–75 °C

5.3.1.5 *Case Temp. low:* Set the alarm low value for temperature of electronics housing. If the value falls below the programmed value E014 is issued.
Range: -10–20 °C

5.3.2 and 5.3.3 **Relay 1 and 2:** The contacts can be set as normally open or normally closed with a jumper. See Relay 1 and 2, p. 23.
The function of relay contacts 1 or 2 are defined by the user

Note: *The navigation in the menu <Relay 1> and <Relay 2> is identical. For reason of simplicity only the menu numbers of Relay 1 are used in the following.*

1 First select the functions as:
- Limit upper/lower
- Control upwards/downwards
- Timer
- Fieldbus

2 Then enter the necessary data depending on the selected function.

5.3.2.1 Function = Limit upper/lower:

When the relays are used as upper or lower limit switches, program the following:

5.3.2.20 *Parameter:* select a process value:
- Meas. Value
- Temperature
- Sample flow

5.3.2.300 *Setpoint*: If the measured value rises above respectively falls below the set-point, the relay is activated.

Parameter	**Range:** *pH sensor*	*Redox sensor*
Meas. Value	-3.00 pH to +15.00 pH	-500 mV to +1500 mV
Temperature	-25 °C to +270 °C	
Sample flow	0–200 l/h	

5.3.2.400 *Hysteresis:* within the hysteresis range, the relay does not switch. This prevents damage of relay contacts when the measured value fluctuates around the alarm value.

Parameter	**Range:** *pH sensor*	*Redox sensor*
Meas. Value	0.00 pH to +2.00 pH	0 mV to +200 mV
Temperature	0 °C to +100 °C	
Sample flow	0–200 l/h	

5.3.2.50 *Delay:* Duration, the activation of the alarm relay is retarded after the measuring value has risen above/fallen below the programmed alarm. Range. 0–600 sec

5.3.2.1 Function = Control upwards/downwards:

The relays may be used to drive control units such as solenoid valves, membrane dosing pumps or motor valves. When driving a motor valve both relays are needed, relay 1 to open and relay 2 to close the valve.

5.3.2.22 *Parameter:* Choose on of the following process values.
- Meas. Value
- Temperature
- Sample Flow

5.3.2.32 **Settings***:* Choose the respective actuator:
- Time proportional
- Frequency
- Motor valve

5.3.2.32.1 Actuator = Time proportional

Examples of metering devices that are driven time proportional are solenoid valves, peristaltic pumps.
Dosing is controlled by the operating time.

5.3.2.32.20 *Cycle time:* duration of one control cycle (on/off change).
Range: 0–600 sec.

5.3.2.32.30 *Response time:* Minimal time the metering device needs to react.
Range: 0–240 sec.

5.3.2.32.4 **Control Parameters**
Range for each Parameter same as 5.2.1.43, p. 64

5.3.2.32.1	Actuator = Frequency
	Examples of metering devices that are pulse frequency driven are the classic membrane pumps with a potential free triggering input. Dosing is controlled by the repetition speed of dosing shots.
5.3.2.32.21	*Pulse frequency:* Max. pulses per minute the device is able to respond to. Range: 20–300/min.
5.3.2.32.31	**Control Parameters** Range for each Parameter same as 5.2.1.43, p. 64
5.3.2.32.1	Actuator = Motor valve
	Dosing is controlled by the position of a motor driven mixing valve.
5.3.2.32.22	*Run time:* Time needed to open a completely closed valve Range: 5–300 sec.
5.3.2.32.32	*Neutral zone:* Minimal response time in % of the runtime. If the requested dosing output is smaller than the response time, no change will take place. Range: 1–20 %
5.3.2.32.4	**Control Parameters** Range for each Parameter same as 5.2.1.43, p. 64
5.3.2.1	Function = Timer:
	The relay will be activated repetitively depending on the programmed time scheme.
5.3.2.24	*Mode:* Operating mode (interval, daily, weekly)
5.3.2.24	*Interval*
5.3.2.340	*Interval:* The interval can be programmed within a range of 1–1'440 min.
5.3.2.44	*Run Time*: Enter the time the relay stays active. Range: 5–32'400 sec.
5.3.2.54	*Delay*: during run time plus the delay time the signal and control outputs are held in the operating mode programmed below. Range: 0–6'000 sec.

5.3.2.6 *Signal Outputs*: Select operating mode of the signal output:

Cont.: Signal outputs continue to issue the measured value.

Hold: Signal outputs hold the last valid measured value. Measurement is interrupted. Errors, except fatal errors, are not issued.

Off: Signal outputs are switched off (set to 0 or 4 mA). Errors, except fatal errors, are not issued.

5.3.2.7 *Output/Control*: Select operating mode of the controller output:

Cont.: Controller continues normally.

Hold: Controller continues based on the last valid value.

Off: Controller is switched off.

5.3.2.24 *daily*

The relay contact can be activated daily, at any time of a day.

5.3.2.341 *Start time*: to set the start time proceed as follows:

1 Press [Enter], to set the hours.

2 Set the hour with the [▲] or [▼] keys.

3 Press [Enter], to set the minutes.

4 Set the minutes with the [▲] or [▼] keys.

5 Press [Enter], to set the seconds.

6 Set the seconds with the [▲] or [▼] keys.

Range: 00:00:00–23:59:59

5.3.2.44 *Run Time*: see Interval

5.3.2.54 *Delay*: see Interval

5.3.2.6 *Signal Outputs*: see Interval

5.3.2.7 *Output/Control*: see Interval

5.3.2.24 *weekly*

The relay contact can be activated at one or several days, of a week. The daily starting time is valid for all days.

5.3.2.342 **Calendar**:

5.3.2.342.1 *Start time*: The programmed start time is valid for each of the programmed days. To set the start time see 5.3.2.341, p. 70.
Range: 00:00:00–23:59:59

5.3.2.342.2 *Monday*: Possible settings, on or off
to

5.3.2.342.8 *Sunday*: Possible settings, on or off

5.3.2.44 *Run Time*: see Interval

5.3.2.54 *Delay*: see Interval

5.3.2.6 *Signal Outputs*: see Interval

5.3.2.7 *Output/Control*: see Interval

5.3.2.1 Function = Fieldbus:

The relay will be switched via the Profibus input. No further parameters are needed.

5.3.4 **Input:** The functions of the relays and signal outputs can be defined depending on the position of the input contact, i.e. no function, closed or open.

5.3.4.1 *Active:* Define when the input should be active:
The measurement is interrupted during the time the input is active.

No:	Input is never active.
When closed	Input is active if the input relay is closed
When open:	Input is active if the input relay is open

5.3.4.2 *Signal Outputs:* Select the operation mode of the signal outputs when the relay is active:

Cont.:	Signal outputs continue to issue the measured value.
Hold:	Signal outputs issue the last valid measured value. Measurement is interrupted. Errors, except fatal errors, are not issued.
Off:	Set to 0 or 4 mA respectively. Errors, except fatal errors, are not issued.

5.3.4.3 *Output/Control:* (relay or signal output):

Cont.:	Controller continues normally.
Hold:	Controller continues on the last valid value.
Off:	Controller is switched off.

5.3.4.4 *Fault:*

No:	No message is issued in pending error list and the alarm relay does not close when input is active. Message E024 is stored in the message list.
Yes:	Message E024 is issued and stored in the message list. The Alarm relay closes when input is active.

5.3.4.5 *Delay:* Time which the instrument waits after the input is deactivated before returning to normal operation.
Range: 0–6'000 sec

5.4 Miscellaneous

5.4.1 *Language:* Set the desired language.

Language
German
English
French
Spanish

5.4.2 *Set defaults:* Reset the instrument to factory default values in three different ways:

Set defaults
no
Calibration
In parts
Completely

- **Calibration**: Sets calibration values back to default. All other values are kept in memory.
- **In parts**: Communication parameters are kept in memory. All other values are set back to default values.
- **Completely**: Sets back all values including communication parameters.

5.4.3 *Load Firmware:* Firmware updates should be done by instructed service personnel only.

Load Firmware
no
yes

5.4.4 **Password:** Select a password different from 0000 to prevent unauthorized access to the menus “Messages”, “Maintenance”, “Operation” and “Installation”.
Each menu can be protected by a different password. If you forgot the passwords, contact the closest SWAN representative.

5.4.5 *Sample ID:* Identify the process value with any meaningful text, such as KKS number.

5.5 Interface

Select one of the following communication protocols. Depending on your selection, different parameters must be defined.

5.5.1 *Protocol:* **Profibus**

5.5.20	Device address:	Range: 0–126
5.5.30	ID-Nr.:	Range: Analyzer; Manufacturer; Multivariable
5.5.40	Local operation:	Range: Enabled, Disabled

5.5.1 *Protocol:* **Modbus RTU**

5.5.21	Device address:	Range: 0–126
5.5.31	Baud Rate:	Range: 1200–115200 Baud
5.5.41	Parity:	Range: none, even, odd

5.5.1 *Protocol:* **HyperTerminal**

	Baud Rate:	Range: 1200–115200 Baud

5.5.1 *Protocol:* **HART**

	Device address:	Range: 0–63

10. Default Values

Note: *The AMU-II pH/Redox has two different operating modes (pH or Redox) which can be set in menu <Type of sensor>. The instrument remains in selected operating mode even after the <Default Values> are reset completely. Therefore this default value list is divided in the two parts pH and Redox where necessary.*

Operation:

Sensors	Filter Time Const.: ..... 30 s
	Hold after Cal.: ..... 300 s
Relay Contacts	Alarm Relay ..... same as in Installation
	Relay 1 and 2 ..... same as in Installation
	Input ..... same as in Installation
Logger	Logger Interval: ..... 30 min
	Clear Logger: ..... no

Installation: **pH Sensor**

Sensors	Flow: Flow measurement: ..... None
	Parameter: Type of sensor: ..... pH
	Parameter: Sensor Check: ..... Off
	Temperature; Temp. Sensor: ..... No
	Default Temp. ..... 25 °C
	Temp. Compensation ..... Nernst
	Standards: pH Standard 1 ..... see Chap. 4 Set buffer values, S. 31
	Standards: pH Standard 2 ..... see Chap. 4 Set buffer values, S. 31
	Quality Assurance; Level: ..... 0: Off

Installation: **Redox Sensor**

Sensors	Flow: Flow measurement: ..... None
	Parameter: Type of sensor: ..... Redox
	Temperature; Temp. Sensor: ..... No
	Temperature; Default Temp. ..... 25 °C
	Standard ..... 475 mV
Signal Output 1	Parameter: ..... Meas. Value
	Current loop: ..... 4–20 mA
	Function: ..... linear
pH mode	Scaling: Range low: ..... 0.00 pH
	Scaling: Range high: ..... 14.00 pH
Redox mode	Scaling: Range low: ..... 0 mV
	Scaling: Range high: ..... 1000 mV

Signal Output 2	Parameter: ..... Temperature
	Current loop: ..... 4 –20 mA
	Function: ..... linear
	Scaling: Range low: ..... 0 °C
	Scaling: Range high: ..... 50 °C
Alarm Relay	Alarm:
pH mode	Alarm high: ..... 15.00 pH
	Alarm low: ..... -3.00 pH
	Hysteresis: ..... 0.10 pH
Redox mode	Alarm high: ..... 1500 mV
	Alarm low: ..... -500 mV
	Hysteresis: ..... 10 mV
	Delay: ..... 5 s
	Sample Temp; Alarm high: ..... 55 °C
	Sample Temp; Alarm low: ..... 5 °C
	Case temp. high: ..... 65 °C
	Case temp. low: ..... 0 °C
Relay 1and 2	Function: ..... limit upper
	Parameter: ..... Meas. Value
pH mode	Setpoint: ..... 14.00 pH
	Hysteresis: ..... 0.10 pH
Redox mode	Setpoint: ..... 1500 mV
	Hysteresis: ..... 10 mV
	Delay: ..... 30 s
	If Function = Control upw. or dnw:
	Parameter: ..... **Meas. Value**
	Settings: Actuator: ..... Frequency
	Settings: Pulse Frequency: 120/min
pH mode	Settings: Control Parameters: Setpoint: ..... 14.00 pH
	Settings: Control Parameters: P-band: ..... 0.10 pH
Redox mode	Settings: Control Parameters: Setpoint: ..... 1500 mV
	Settings: Control Parameters: P-band: ..... 10 mV
	Parameter: ..... **Temperature**
	Settings: Actuator: ..... Frequency
	Settings: Pulse Frequency: 120/min
	Settings: Control Parameters: Setpoint: ..... 50 °C
	Settings: Control Parameters: P-band: ..... 1 °C

	Parameter: **Sample flow**
	Settings: Actuator: Frequency
	Settings: Pulse Frequency: 120/min
	Settings: Control Parameters: Setpoint: 25.0 l/h
	Settings: Control Parameters: P-band: 1 l/h
	Settings: Control Parameters: Reset time: 0 s
	Settings: Control Parameters: Derivative Time: 0 s
	Settings: Control Parameters: Control Timeout: 0 min
	Settings: Actuator: Time proportional
	Cycle time: 60 s
	Response time: 10 s
	Settings: Actuator Motor valve
	Run time: 60 s
	Neutral zone: 5%
	If Function = Timer:
	Mode: Interval
	Interval: 1 min
	Mode: daily
	Start time: 00.00.00
	Mode: weekly
	Calendar; Start time: 00.00.00
	Calendar; Monday to Sunday: Off
	Run time: 10 s
	Delay: 5 s
	Signal output: cont
	Output/Control: cont
Input	Active when closed
	Signal Outputs hold
	Output/Control off
	Fault no
	Delay 10 s
Miscellaneous	Language: English
	Set default: no
	Load firmware: no
	Password: for all modes 0000
	Sample ID: - - - - - - - -

11. Notes

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ANALYTICAL INSTRUMENTS

A-96.150.441 / 280624

Swan Products - Analytical Instruments for:

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SWISS MADE

AMU-II pH/Redox