ANALYTICAL INSTRUMENTS

A-96.250.771 / 031120

Operator’s Manual

Firmware V6.20 and higher

SWISS MADE

AMI ISE Universal

Customer Support
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02	Sept. 2016	Mainboard V2.5, update to FW version 6.00
03	July 2020	Mainboard V2.6, update to FW version 6.20

Table of Contents

AMI ISE Universal–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 AMI 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.

Download MSDS

The current Material Safety Data Sheets (MSDS) for the reagents listed below are available for downloading at **www.swan.ch**.

- SDS standard solution Ammonium-Nitrat
- SDS Fluoride standard 1000 ppm
- Reference filling solution for Swansensor Reference FL Swansensor pH SI and Swansensor Redox (ORP) SI

1.3. Restrictions for use

1.3.1 Fluoride measurement

Direct control of fluoride dosing is not permitted.

TISAB dosing is required to comply with certain potable water regulations.

The fluoride sensor measures only the activity of free fluoride ions. This means that:

- the sample pH must be higher than 5.5, otherwise the fluoride ion is present in its acid form HF and not measurable.
- no complexing metals like aluminium and iron must be present, they would hide fluoride ions.

The fluoride sensor measures other anions, mainly hydroxyl ions. This means that:

- the sample pH must be lower than 8.0, otherwise OH^- ions will interfere with the fluoride measurement.

If these conditions can not be maintained, a buffer solution containing a complexing agent must be added to the sample, usually the so called TISAB buffer is used.

2. Product Description

2.1. Description of the System

Application Range

The AMI ISE Universal is a monitor for continuous measurement of either Ammonium, Nitrate or Fluoride in potable water with an **I**on **S**elective **E**lectrode (ISE). The ISE electrodes are called sensor in the following.
The AMI ISE Universal can be operated with one of the following sensors:

- Swansensor Ammonium and a reference sensor
- Swansensor Nitrate and a reference sensor
- Swansensor Fluoride and a reference sensor

A temperature sensor is needed to keep the measured value stable if the sample temperature fluctuates.

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 Ohm

Third signal output available as an option. The third signal output can be operated as a current source or as a current sink (selectable via switch).

Relays

Two potential-free contacts programmable as limit switches for measured values, controllers or timer for system cleaning with automatic hold function. The relay contacts can be set as normally open or normally closed with a jumper.
Maximum load: 1 A/250 VAC

Alarm Relay

One potential free contact.
Alternatively:

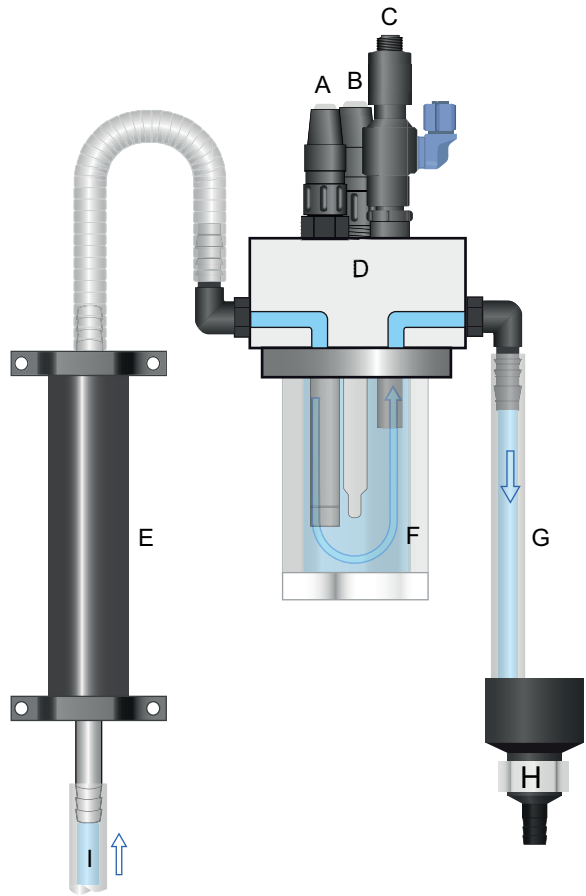
- Open during normal operation, closed on error and loss of power.
- Closed during normal operation, open on error and loss of power.

Summary alarm indication for programmable alarm values and instrument faults.

Input

For potential-free contact to freeze the signal outputs or to interrupt control in automated installations (*hold* function or *remote-off*).

Communication interface (optional)	◆ USB Interface for logger download ◆ Third signal output (can be used in parallel to the USB interface) ◆ RS485 with fieldbus protocol Modbus or Profibus DP ◆ HART interface
Safety Features	No data loss after power failure. All data is saved in non-volatile memory. Over voltage protection of in- and outputs. Galvanic separation of measuring inputs and signal outputs.
Temperature compensation	Temperature compensation according to Nernst.
Consumables	One 200 ml bottle 3.5 M KCl lasts for 1 month of operation.
Fluidics	The flow cell M-Flow 10-3PG consists of the flow cell block [D] and the calibration vessel [F]. The sensor [A], the temperature sensor [B] and the Reference sensor FL [C] are screwed into the flow cell block [D]. The sample enters at the sample inlet [I]. It flows through the deltaT flow sensor [E] (if installed) and then through the flow cell block into the calibration vessel [F], were ammonium, nitrate or fluoride is measured. The measured value depends on the sample temperature. The measured value of the temperature sensor [B] is used to compensate the ISE measured value to the standard temperature of 25 °C. The sample leaves the calibration vessel via flow cell block through the sample outlet [G] and flows into the pressure free drain [H].



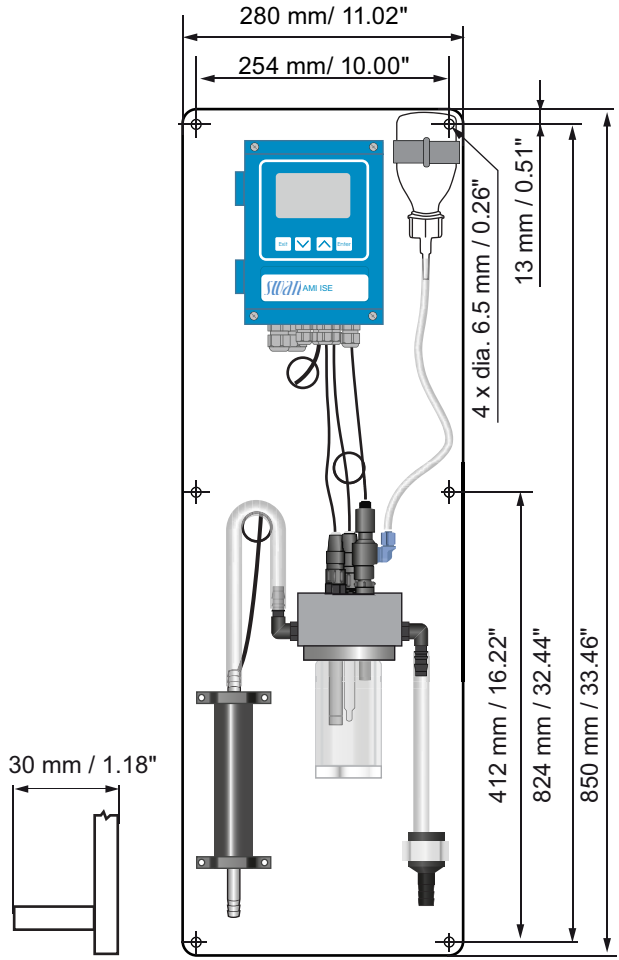
A *Sensor*
B *Temperature sensor*
C *Reference sensor*
D *Flow cell block*
E *deltaT flow sensor (option)*
F *Calibration vessel*
G *Sample outlet*
H *Drain*
I *Sample inlet*

2.2. Instrument Specification

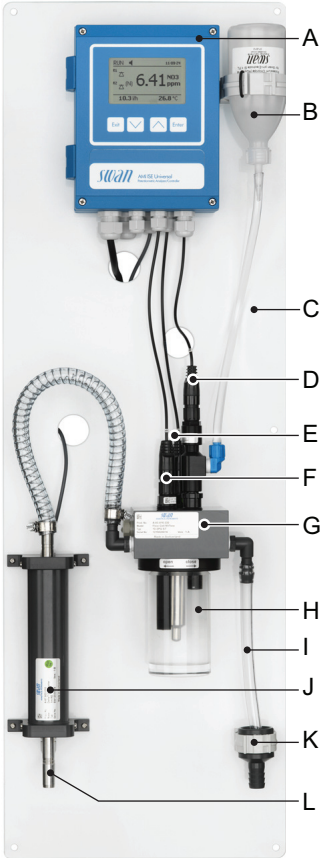
Power Supply	AC variant:	100–240 VAC (± 10%) 50/60 Hz (± 5%)
	DC variant	10–36 VDC
	Power consumption:	max. 35 VA
Transmitter specifications	Housing:	aluminum, with a protection degree of IP 66 / NEMA 4X
	Ambient temperature:	−10 to +50 °C
	Storage and transport:	−30 to +85 °C
	Humidity:	10–90 % rel., non condensing
	Display:	backlit LCD, 75 x 45 mm
Sample requirements	Flow rate:	4–15 l/h
	Temperature:	5–35 °C
	Inlet pressure:	up to 1 bar
	Outlet pressure:	pressure free
On-site requirements	The analyzer site must permit connections to:	
	Sample inlet:	Tube 1/4” (10 mm tube)
	Sample outlet:	1/2” hose nozzle for flexible tube diam. 20x15 mm

Dimensions

Panel:	PVC
Dimensions:	280x850x150 mm
Screws:	5 mm or 6 mm diameter
Weight:	9.0 kg



2.3. Instrument Overview

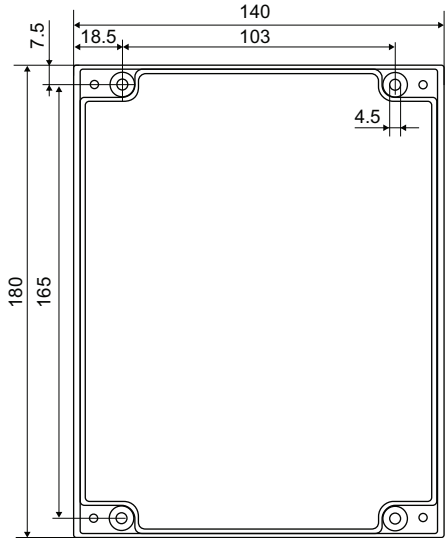


A *Transmitter*
B *KCl bottle*
C *Panel*
D *Reference sensor*
E *Temperature sensor*
F *Sensor*
G *Flow cell block*
H *Calibration vessel*
I *Sample outlet*
J *DeltaT flow sensor (option)*
K *Drain*
L *Sample inlet*

2.4. Single Components

2.4.1 AMI ISE Transmitter

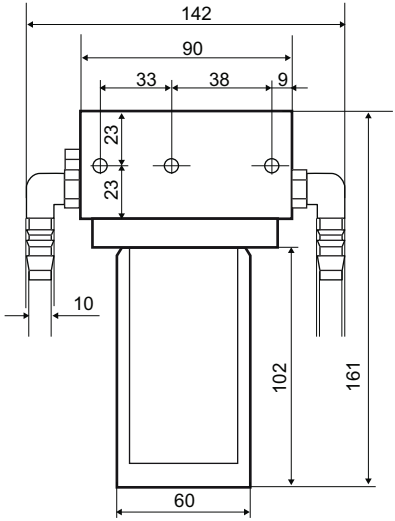
Electronic transmitter and controller for ammonium, nitrate or fluoride measurement.



Dimensions	Width:	140 mm
	Height:	180 mm
	Depth:	70 mm
	Weight:	1.5 kg
Specifications	Electronics case:	Cast aluminum
	Protection degree:	IP 66 / NEMA 4X
	Display:	backlit LCD, 75 x 45 mm
	Electrical connectors:	screw clamps

2.4.2 Flow Cell M-Flow 10-3PG

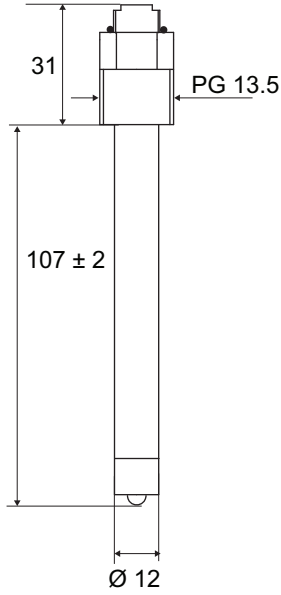
Flow cell for potable water applications.



Connections	Sample:	G 1/4” thread
	Equipped with elbow hose nozzle for 10 mm tube.	
Sample conditions	For the flow cell without sensors!	
	Flow rate:	4 to 15 l/h
	Temperature:	up to 50 °C
	Inlet pressure:	up to 1 bar @ 25 °C
	Outlet pressure:	Pressure-free outlet (atmospheric drain)
	Particle size:	below 0.5 mm
	No strong acids and bases. No organic solvents.	
Dimensions	Width:	90 to 200 mm
	Front-to-back:	138 mm
	Height:	161 mm
	Panel mounting:	3 screws M5

2.4.3 Swansensor Ammonium or Nitrate

Ammonium, Nitrate or Fluoride sensitive sensor system for measuring in potable water.

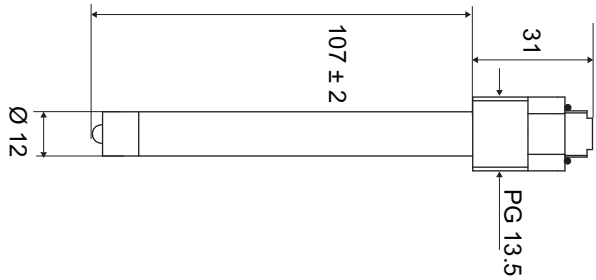


Specifications

Operative and measuring range:	0.1 to 1000 ppm (= mg/l)
Measurement:	Ion sensitive membrane
Operating temperature:	5–35 °C
Pressure:	< 2 bar
Case material:	isotactic polypropylene, PPO
Connection:	plug PG 13.5

2.4.4 Swansensor Fluoride

Fluoride sensitive sensor system for measuring in potable water.



Specifications

Operative and measuring range:	0.1 to 1000 ppm (= mg/l)
Measurement:	Ion sensitive membrane
Operating temperature:	5–35 °C
Pressure:	< 2 bar
Case material:	isotactic polypropylene, PPO
Connection:	plug PG 13.5

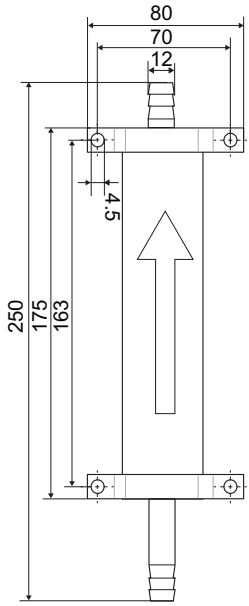
Interferences: OH^- (OH^- is displayed if $OH^- > 0.001\ F^-$) as well as high concentration of lanthanum binding anions (i.e. citrate, phosphate, bicarbonate) deteriorate the response (F^- as SiF_6^{2-} is displayed as well). The fluoride complexing agents Fe^{3+}, Al^{3+} and Ca^{2+} can be eliminated by adding TISAB (e.g. 2%) to the sample solution.

Precision: Better than ± 0.25 mV according to ± 1% of the measured F-concentration (without interfering substances).

Response time: From low to high concentration below 10^{-4} mol/l the response time is about 1 minute. Above 10^{-4} mol/l the response time is less than 1 minute.
From high to low concentration response time is several minutes.

2.4.5 Swansensor deltaT

Calorimetric flow meter based on heat dissipation. For applications in potable water, surface water treatment and effluent.



Specifications

Measuring range/Flow rate:	0–40 l/h
Accuracy:	± 20%
Response time t_{90}:	ca. 1 min
Sample temperature:	5–35 °C
Sample inlet and outlet:	for tubing diam. 10–11 mm
Max. cable length:	1 m

3. Installation

3.1. Installation Checklist Monitors

On site requirements	AC variant: 100–240 VAC (± 10%), 50/60 Hz (± 5%) DC variant: 10–36 VDC Power consumption: 35 VA maximum. Protective earth connection required. Sample line with sufficient sample flow and pressure (see Instrument Specification, p. 14).
Installation	Mount the instrument in vertical position. Display should be at eye level. Connect sample and waste.
Electrical Wiring	Connect all external devices like limit switches, current loops and pumps. Connect power cord.
Sensors	Install the sensors (see Install the Sensor, p. 24). Connect to sensor cables. Store the protective caps for later use.
Power-up	Turn on the sample flow and wait until the flow cell is completely filled. Switch on power.
Instrument set-up	Adjust sample flow. Choose the sensor according your requirements: ◆ NH^4 (N) ◆ NH^4 ◆ NO^3 (N) ◆ NO^3 ◆ Fluoride Further information see Instrument Setup, p. 41. Program external devices (interface, recorders, etc.). Program all parameters for instrument operation (limits, alarms).
Run-in period	Let the instrument run continuously for 1 h.
Calibration	Perform a calibration or a process calibration, see Calibration, p. 52 or Process Calibration, p. 56.

3.2. Mounting of Instrument Panel

The first part of this chapter describes the preparing and placing of the instrument for use.

- The instrument must only be installed by trained personnel.
- Mount the instrument in vertical position.
- For ease of operation mount it so that the display is at eye level.
- For the installation a kit containing the following installation material is available:
  - 6 Screws 6x60 mm
  - 6 Dowels
  - 6 Washers 6.4/12 mm

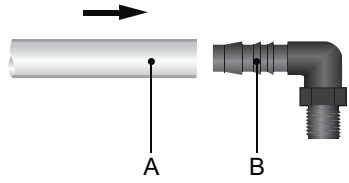
Mounting requirements

The instrument is only intended for indoor installation.
For dimensions see Dimensions, p. 15.

3.3. Connecting Sample Inlet and Outlet

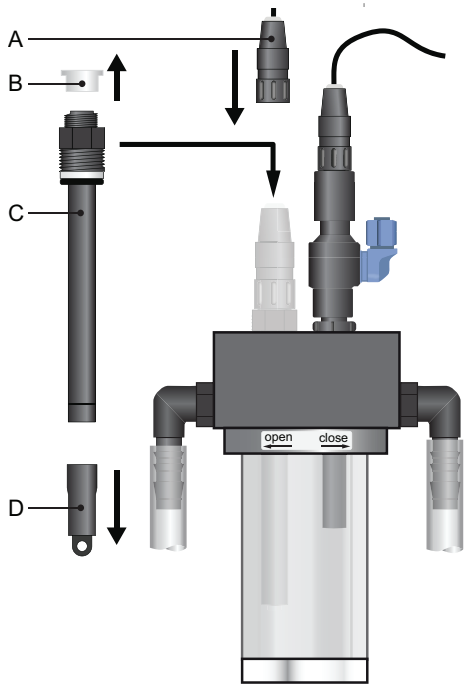
3.3.1 Elbow Hose Nozzle

Use plastic tube (FEP, PA, or PE 10 x 12 mm) to connect the sample inlet and outlet.



A *Plastic tube 10 x 12*
B *Elbow hose nozzle*

3.4. Install the Sensor



A Connector
B Connector cap
C Sensor
D Protective cap

1 Carefully remove the protective cap [D] from the sensor tip. Turn it clockwise only.

2 Rinse the sensor tip with clean water.

3 Insert the sensor through the flow cell block into the vessel.

4 Tighten it hand-tight.

5 Remove the connector cap [B].

6 Screw the connector [A] onto the sensor.

7 Keep the protective caps on a secure place for later use

8 Connect the sensor cable to the AMI transmitter according to chapter Connect the Swansensor, p. 27.

3.5. Install Reference sensor FL

The sensor is supplied separately and is installed into the flow cell after the installation of the monitor has been finished. It is protected with a cap filled with KCl.

CAUTION

KCl is corrosive

Avoid splashing KCl onto the flow cell cover when preparing the KCl bottle.

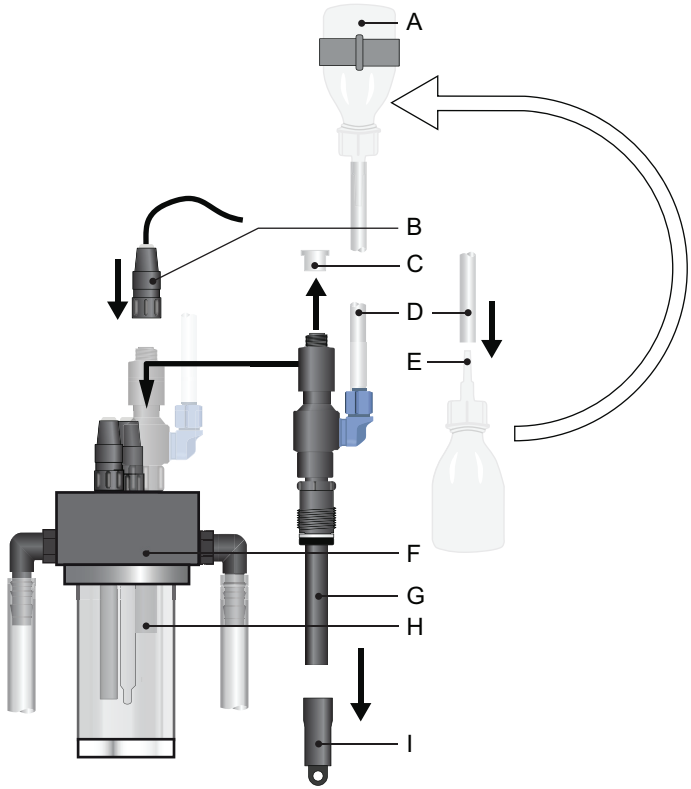
Prepare the KCl bottle

A *Seal cap*
B *Dosing tip*
C *KCl bottle*

1 Remove the seal cap [A] from the dosing tip [B].

2 Cut off the upper sealed part of the dosing tip.

Install the reference sensor FL



A *KCl bottle*
B *Connector*
C *Connector cap*
D *KCl supply tube*
E *Dosing tip*
F *Flow cell block*
G *Sensor*
H *Calibration vessel*
I *Protective cap*

1 Carefully remove the protective cap [I] from the sensor tip. Turn it clockwise only.

2 Rinse the sensor tip with clean water.

3 Insert the sensor through the flow cell block [F] into the vessel [H].

4 Tighten it hand-tight.

5 Remove the connector cap [C].

6 Screw the connector [B] onto the sensor.

7 Keep the protective caps on a secure place for later use.

8 Attach the KCl supply pipe to the dosing tip of the KCl bottle

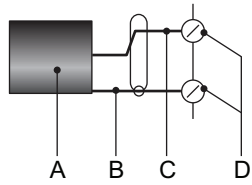
9 Mount the KCl bottle to the bottle holder fixed on the panel.

10 Puncture the bottom of the KCl bottle.

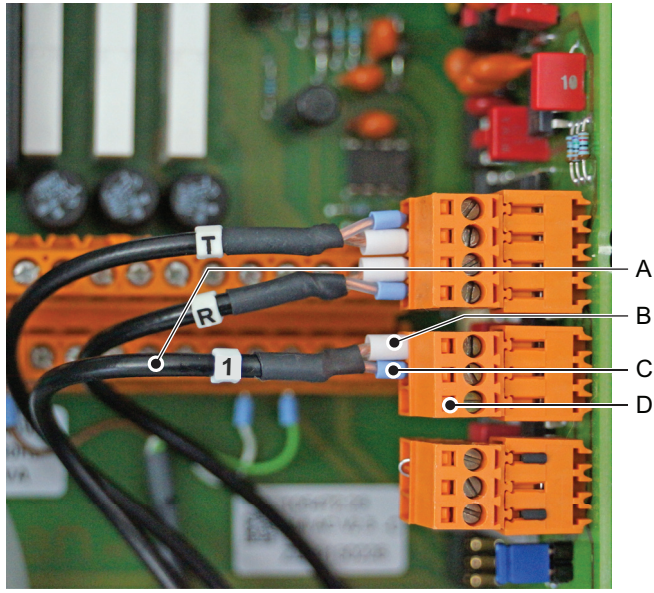
11 Connect the sensor cable to the AMI transmitter according to chapter Connect the Swansensor, p. 27.

3.5.1 Connect the Swansensor

The coaxial cable [A] of the sensor plug consists of the inner conductor [C] marked blue and the shield [B], marked white. When connecting the cable to the plug, do not interchange shield and inner conductor.



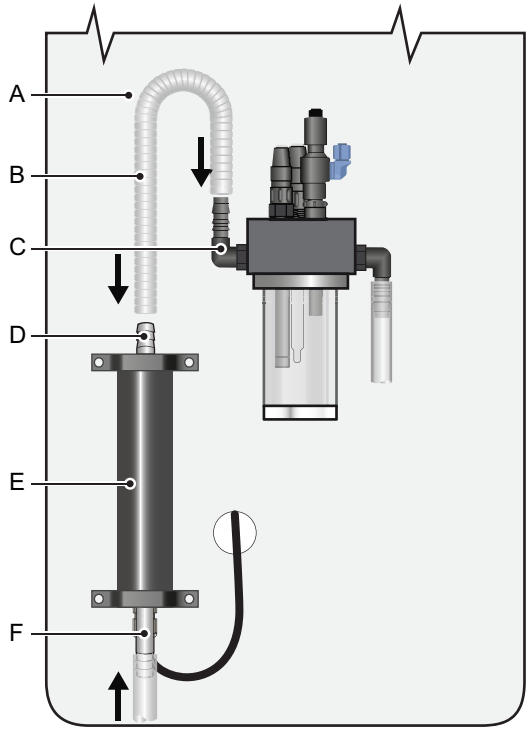
A *Coaxial cable*
B *Shield*
C *Inner conductor*
D *Terminals or plug*



A *Coaxial cable*
B *Shield (outer conductor)*
C *Inner conductor*
D *Terminals or plug*

3.6. Install Swansensor deltaT (Option)

Overview



A *Panel*
B *Tube connection*
C *Elbow hose nozzle*
D *Hose nozzle at deltaT sensor outlet*
E *deltaT sensor*
F *Hose nozzle at deltaT sensor inlet*

Installation

1 Mount the deltaT sensor [E] in vertical position to the panel [A].

2 Connect the sample inlet tube to the hose nozzle [F] of the deltaT sensor inlet.

3 Connect the tube [B] supplied with the installation kit to the sample outlet [D] of the deltaT sensor and to the elbow hose nozzle [C].

Electrical Connection

WARNING

Electrical shock hazard!

- Before opening the AMI Transmitter switch power off.

1. Use one of the PG7 cable glands to feed the cable of the sensor into the AMI transmitter housing.
2. Connect the cable to the terminals according to the Connection Diagram, p. 33.

3.7. Electrical Connections

WARNING

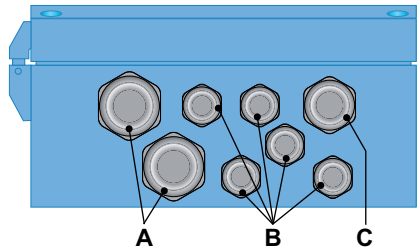
Risk of electrical shock.

Do not perform any work on electrical components if the transmitter is switched on. Failure to follow safety instructions could result in serious injury or death.

- Always turn off power before manipulating electric parts.
- Grounding requirements: Only operate the instrument from a power outlet which has a ground connection.
- Make sure the power specification of the instrument corresponds to the power on site.

Cable thicknesses

In order to comply with IP66, use the following cable thicknesses



A *PG 11 cable gland: cable $Ø_{outer}$ 5–10 mm*
B *PG 7 cable gland: cable $Ø_{outer}$ 3–6.5 mm*
C *PG 9 cable gland: cable $Ø_{outer}$ 4–8 mm*

Note: *Protect unused cable glands*

Wire

- For Power and Relays: Use max. 1.5 mm^2 / AWG 14 stranded wire with end sleeves.
- For Signal Outputs and Input: Use 0.25 mm^2 / AWG 23 stranded wire with end sleeves.

WARNING

External Voltage.
External supplied devices connected to relay 1 or 2 or to the alarm relay can cause electrical shocks

- Make sure that the devices connected to the following contacts are disconnected from the power before resuming installation.
  - relay 1
  - relay 2
  - alarm relay

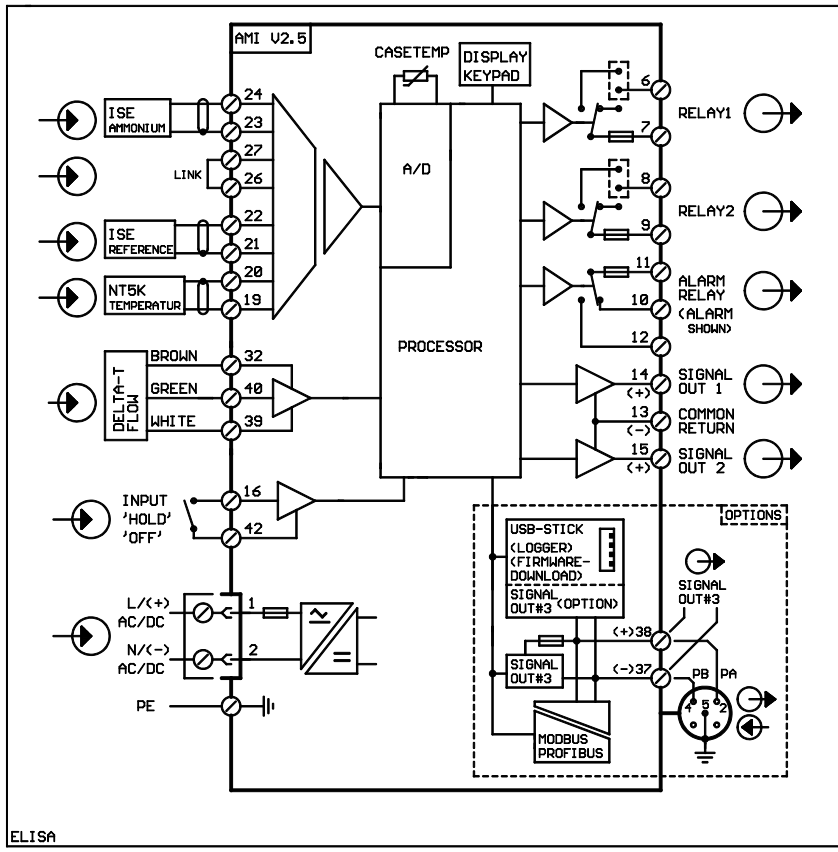
WARNING

To prevent from electrical shock, do not connect the instrument to the power unless the ground wire (PE) is connected.

WARNING

The mains of the AMI Transmitter must be secured by a main switch and appropriate fuse or circuit breaker.

3.7.1 Connection Diagram



CAUTION

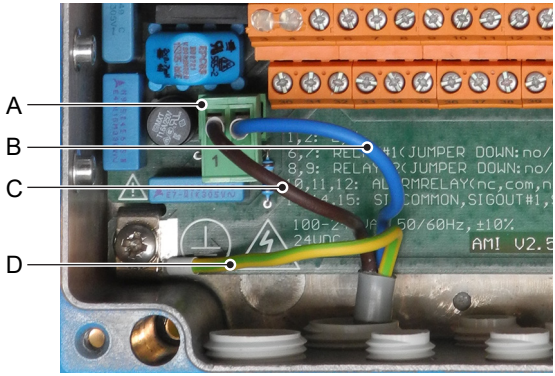
Use only the terminals shown in this diagram, and only for the mentioned purpose. Use of any other terminals will cause short circuits with possible corresponding consequences to material and personnel.

3.7.2 Power Supply

WARNING

Electrical shock hazard

Installation and maintenance of electrical parts must be performed by professionals. Always turn off power before manipulating electric parts.



A *Power supply connector*
B *Neutral conductor, Terminal 2*
C *Phase conductor, Terminal 1*
D *Protective earth PE*

Note: *The protective earth wire (Ground) has to be connected to the grounding terminal.*

Installation requirements

The installation must meet the following requirements.

- Mains cable to comply with standards IEC 60227 or IEC 60245; flammable rating FV1
- Mains equipped with an external switch or circuit-breaker
  - near the instrument
  - easily accessible to the operator
  - marked as interrupter for AMI ISE Universal

3.8. Input

Note: *Use only potential-free (dry) contacts.*
The total resistance (sum of cable resistance and resistance of the relay contact) must be less than 50 Ω.

Terminals 16/42
For programming see chap. 9, menu Installation, 5.3.4, p. 80.

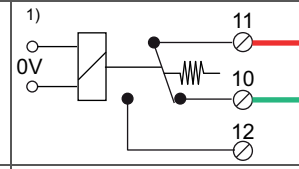
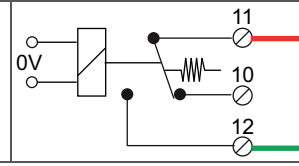
3.9. Relay Contacts

3.9.1 Alarm Relay

Note: *Max. load 1 A / 250 VAC*

Alarm output for system errors.
Error codes see Troubleshooting, p. 58.

Note: *With certain alarms and certain settings of the AMI transmitter the alarm relay does not switch. The error, however, is shown on the display.*

	Terminals	Description	Relay connection
NC[1)] Normally Closed	10/11	Active (opened) during normal operation. Inactive (closed) on error and loss of power.	
NO Normally Open	12/11	Active (closed) during normal operation. Inactive (opened) on error and loss of power.	

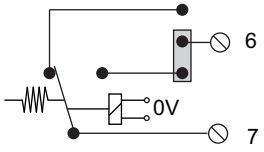
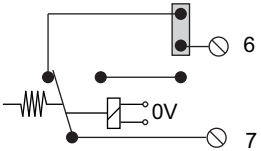
1) *usual use*

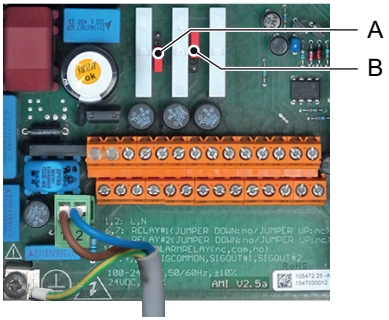
3.9.2 Relay 1 and 2

Note: *Max. load 1 A/250 VAC*

Relay 1 and 2 can be configured as normally open or as normally closed. Standard for both relays is normally open. To configure a Relay as normally closed, set the jumper in the upper position.

Note: *Some error codes and the instrument status may influence the status of the relays described below.*

Relay config.	Terminals	Jumper pos.	Description	Relay configuration
Normally Open	6/7: Relay 1 8/9: Relay 2		Inactive (opened) during normal operation and loss of power. Active (closed) when a programmed function is executed.	
Normally Closed	6/7: Relay 1 8/9: Relay 2		Inactive (closed) during normal operation and loss of power. Active (opened) when a programmed function is executed.	



A *Jumper set as normally open (standard setting)*
B *Jumper set as normally closed*

For programming see menu Installation 5.3.2 and 5.3.3, p. 76.

CAUTION

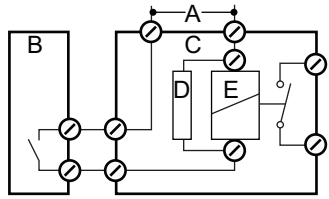
Risk of damage to the relays in the AMI Transmitter due to heavy inductive load.

Heavy inductive or directly controlled loads (solenoid valves, dosing pumps) may destroy the relay contacts.

- To switch inductive loads > 0.1 A use an AMI relay box available as an option or suitable external power relays.

Inductive load

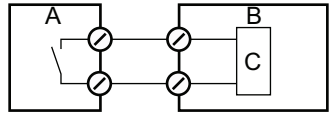
Small inductive loads (max 0.1 A) as for example the coil of a power relay can be switched directly. To avoid noise voltage in the AMI Transmitter it is mandatory to connect a snubber circuit in parallel to the load.
A snubber circuit is not necessary if an AMI relay box is used.



A *AC or DC power supply*
B *AMI Transmitter*
C *External power relay*
D *Snubber*
E *Power relay coil*

Resistive load

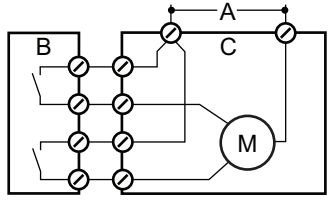
Resistive loads (max. 1 A) and control signals for PLC, impulse pumps and so on can be connected without further measures



A *AMI Transmitter*
B *PLC or controlled pulse pump*
C *Logic*

Actuators

Actuators, like motor valves, are using both relays: One relay contact is used for opening, the other for closing the valve, i.e. with the 2 relay contacts available, only one motor valve can be controlled. Motors with loads bigger than 0.1 A must be controlled via external power relays or an AMI relay box.



A *AC or DC power supply*
B *AMI Transmitter*
C *Actuator*

3.10. Signal Outputs

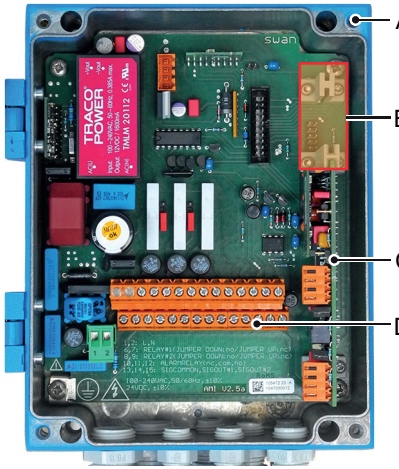
3.10.1 Signal Output 1 and 2 (current outputs)

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

Signal output 1: Terminals 14 (+) and 13 (-)
Signal output 2: Terminals 15 (+) and 13 (-)

For programming see Program List and Explanations, p. 67.

3.11. Interface Options



A *AMI Transmitter*
B *Slot for interfaces*
C *Frontend PCB*
D *Screw terminals*

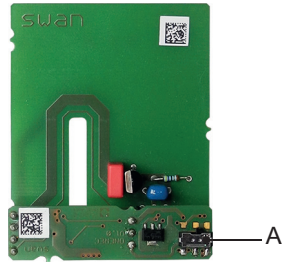
The slot for interfaces can be used to expand the functionality of the AMI instrument with either:

- Third signal output
- a Profibus or Modbus connection
- a HART connection
- an USB Interface

3.11.1 Signal Output 3

Terminals 38 (+) and 37 (-).
Requires the additional board for the third signal output 0/4–20 mA. The third signal output can be operated as a current source or as a current sink (switchable via switch [A]). For detailed information see the corresponding installation instruction.

Note: *Max. burden 510 Ω*



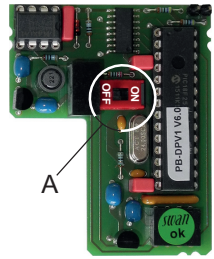
Third signal output 0/4 - 20 mA PCB

A *Operating mode selector switch*

3.11.2 Profibus, Modbus Interface

Terminal 37 PB, Terminal 38 PA
To connect several instruments by means of a network or to configure a PROFIBUS DP connection, consult the PROFIBUS manual. Use appropriate network cable.

Note: *The switch must be ON, if only one instrument is installed, or on the last instrument in the bus.*

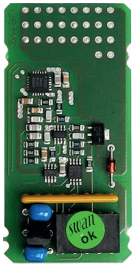


Profibus, Modbus Interface PCB (RS 485)

A *On - OFF switch*

3.11.3 HART Interface

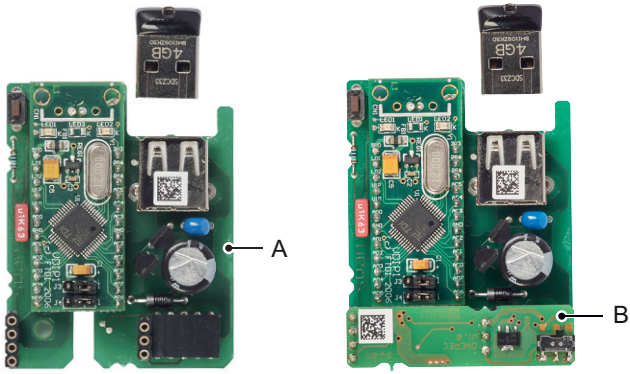
Terminals 38 (+) and 37 (-).
The HART interface PCB allows for communication via the HART protocol. For detailed information, consult the HART manual.



HART Interface PCB

3.11.4 USB Interface

The USB Interface is used to store Logger data and for Firmware upload. For detailed information see the corresponding installation instruction.
The optional third signal output 0/4 – 20 mA PCB [B] can be plugged onto the USB interface and used in parallel.



USB Interface

A USB interface PCB
B Third signal output 0/4 - 20 mA PCB

4. Instrument Setup

4.1. Establish Sample Flow

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

4.2. Programming

Set all necessary sensor parameters in menu 5.1 <Installation>/ <Sensors>, further information see 5.1 Sensors, S. 70:

- Type of sensor
- Standard 1 (N)
- Standard 2 (N)
- Flow measurement.

Type of sensor

Choose the sensor according your requirements:

- NH_4 (N)
- NH_4
- NO_3 (N)
- NO_3
- Fluoride

Example with 10 ppm (N)

Based on a standard solution of 10 ppm (N) the chosen type of sensor has the following effect to the measuring results:

Type of sensor	Standard solution	Measured value
NH_4 (N)	10 ppm (N)	10 ppm
NH_4	10 ppm (N)	12.9 ppm
NO_3 (N)	10 ppm (N)	10 ppm
NO_3	10 ppm (N)	44.3 ppm
Fluoride	10 ppm (F)	10 ppm

Note: *The standard concentration in menu <Installation>/ <Sensors>/<Standard 1 and 2 (N)> can only be programmed in ppm (N).*

Standard 1 and 2

Prepare standard 1 and 2 according to the instruction Prepare a 1 ppm Standard NH4/NO3 expressed as N, S. 52 in chapter 6.

Flow measurement

Chose a flow sensor according to your requirements. Available flow sensors are:

- Q-flow
- deltaT

Program all parameters for external devices (interface, recorders, etc.).
Program all parameters for instrument operation (limits, alarms and standard concentration).
See Program List and Explanations, S. 67.

Calibration

The instrument should be operating for 1 h before performing a calibration.

4.3. Adjusting the deltaT Flow Sensor (Option)

The accuracy of the flow measurement depends on the ambient temperature of the installation location. The deltaT flow sensor is factory calibrated at 20 °C (±20 % accuracy). If the temperature is higher or lower, the deltaT flow sensor can be adjusted.
To adjust the deltaT sensor proceed as follows:

Run in

After installation let the sensor run in for at least 1 h.

Determine the flow rate

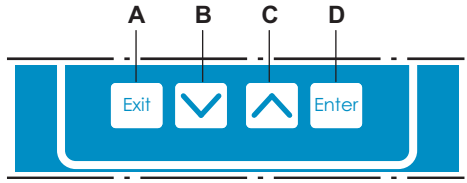
1. Put the sample outlet of the instrument into a measuring cup with a sufficient volume for 10 min.
2. To get the flow rate in l/h, calculate the amount of water contained in the measuring cup with factor 6.
   ⇒ *The flow rate in l/h results from the multiplication of the amount of water after 10 min by 6.*

Adjust slope

1. Navigate to <Installation>/<Sensors>/<Flow>, choose <Slope> and press [Enter].
2. If the calculated flow rate is higher than the displayed flow rate increase the Slope value.
3. If the calculated flow rate is lower than the displayed flow rate decrease the Slope value.
4. Press [Exit] and save with [Enter].
5. Compare the calculated flow rate with the displayed flow rate.
   ⇒ *If the flow rates are roughly equal, the adjustment is finished.*
6. Else repeat steps 1 to 5.

5. Operation

5.1. Keys



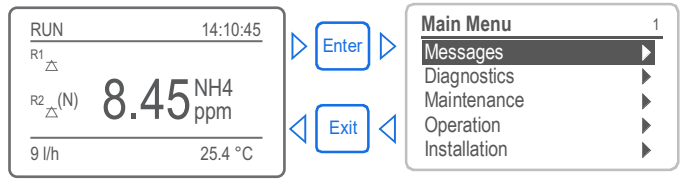
A to exit a menu or command (rejecting any changes)
to move back to the previous menu level

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

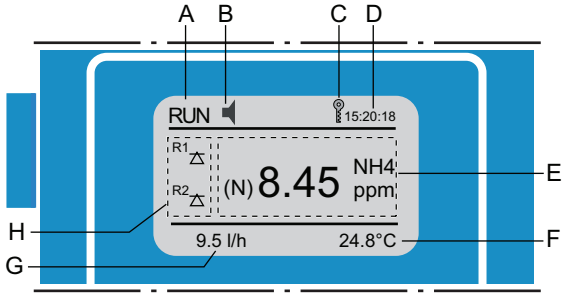
C to move UP in a menu list and to increase digits

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 values

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

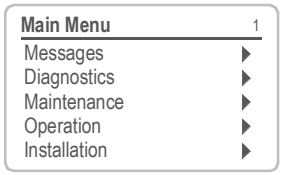
motor valve closed

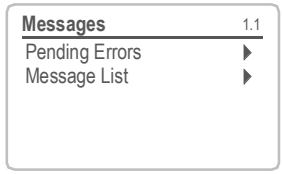
motor valve: open, dark bar indicates approx. position

timer

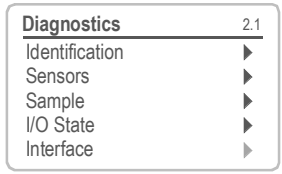
timer: timing active (hand rotating)

5.3. Software Structure

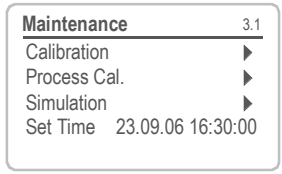




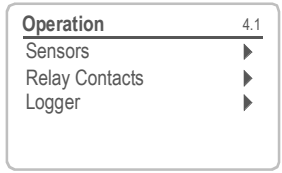
Menu **Messages 1**
Reveals pending errors as well as an event history (time and state of events that have occurred at an earlier point of time).
It contains user relevant data.



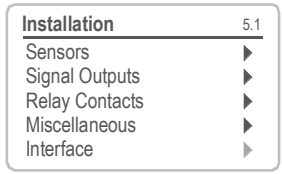
Menu **Diagnostics 2**
Provides user relevant instrument and sample data.



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.

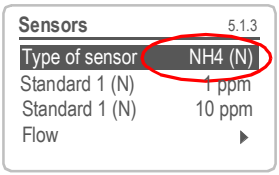


Menu **Installation 5**
For initial instrument set up by SWAN authorized person, to set all instrument parameters. Can be protected by means of password.

5.4. Changing Parameters and values

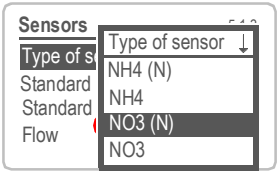
Changing parameters

The following example shows how to choose a Swansensor:



1 Select the parameter you want to change.

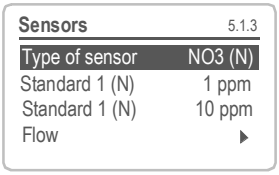
2 Press [Enter]



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

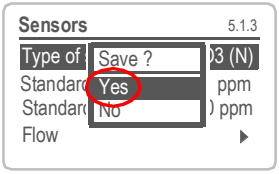
4 Press [Enter] to confirm the selection or [Exit] to keep the previous parameter).

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



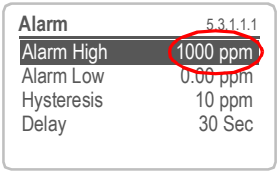
5 Press [Exit].

⇒ *Yes is highlighted.*



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

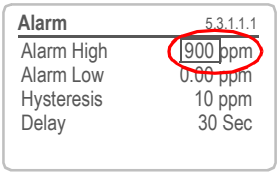
Changing values



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. Maintenance Table

Swansensor Ammonium, Nitrate

Weekly	– Perform a calibration or – Perform a process calibration
Monthly	– Replace the ammonium or the nitrate sensor ***Note:*** *Both sensors can be regenerated for later re-use, therefore SWAN recommends to send the ammonium or nitrate sensor back for regeneration.*

Swansensor Fluoride

If required	– Clean the fluoride sensor ***Note:*** *Refill electrolyte if the response time is too long or if the potential is unstable.*

Swansensor Reference FL

Weekly	– Check level in electrolyte bottle ***Note:*** *One 200 ml bottle 3.5 M KCl lasts for 1 month*
Monthly	– If necessary, change electrolyte bottle. – Calibrate sensor
Quarterly	Slightly open the sensor cap of reference sensor and allow a little electrolyte to flow out. See Clean Reference Sensor, p. 48.

6.2. Stop of Operation for Maintenance

1 Stop sample flow.

2 Shut off power of the instrument.

6.3. Maintenance of Sensors

WARNING

Chemicals can be toxic, caustic, and flammable.

- Read the Material Safety Data Sheets (MSDS) first.
- Only persons trained in handling dangerous chemicals are allowed to prepare the reagents.
- Wear suitable protective clothing, gloves and eye/face protection.

Note:

- *Do not remove the KCl supply pipe from the KCl bottle when removing the reference sensor.*
- *Do not put the sensors into acids to clean them.*

6.3.1 Clean Reference Sensor

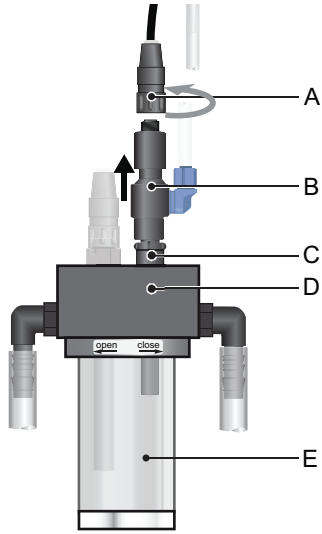
To remove the sensors from the flow cell proceed as follows:

Remove sensors from flow cell

1 Unscrew and remove the connector [A] from the sensor [B].

2 Unscrew the union screw [C] completely from the flow cell block [D].

3 Remove the sensor [B] from the flow cell block [D].

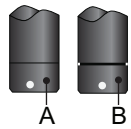


A *Connector*
B *Reference sensor*
C *Union screw*
D *Flow cell block*
E *Calibration vessel*

Clean reference sensor

1 If necessary, wipe off dirt cautiously with a soft, clean, and damp paper tissue.

2 Slightly open the sensor cap of reference sensor and allow a little electrolyte to flow out.



A *Sensor cap tightened*
B *Sensor cap slightly opened*

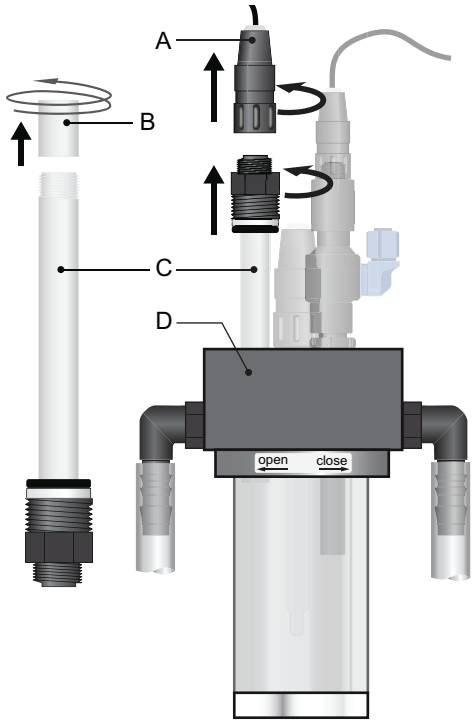
3 Fasten the sensor cap hand tight.

4 Rinse the reference sensor tip thoroughly with clean water.

5 Install the sensor into the flow cell again.

6 Let the sensor run-in for 1 h before the first calibration.

6.3.2 Clean the Fluoride Sensor, Refill Electrolyte



A *Connector*
B *Membrane module*
C *Fluoride sensor*
D *Flow cell block*

Cleaning

1. Unscrew and remove the connector [A] from the sensor [C].
2. Unscrew and remove the sensor [C] from the flow cell block [D] by turning the union screw counterclockwise.
3. Carefully remove deposits on the mono crystal with a moistened tissue.

   ⚠ *Avoid damage (scratches) of the surface of the crystal.*
4. After cleaning a conditioning of the sensor in a diluted fluoride solution (ca. 10^{-2} mol/l) for about 10 min is necessary.

Refill electrolyte

1. Remove the sensor, see Cleaning, p. 50 step 1 to 2.
2. Turn the sensor so that the membrane module [B] is pointing upwards.
3. Unscrew and remove the membrane module.
4. Fill the sensor shaft bubble free with inner filling solution.
5. Fill the membrane module with internal filling solution.
6. Screw the membrane module onto the sensor shaft.
7. To remove possible air bubbles from the membrane module, shake the sensor on time vigorously with the membrane module pointing downwards.
8. Thoroughly flush the sensor with ion free water.
9. Then condition the sensor in a diluted fluoride solution (ca. 10^{-2} mol/l) for about 10 min.

Storage

The fluoride sensor can be stored dry or in a diluted fluoride solution.

Note: *Do not store the fluoride sensor in solutions containing TISAB!*

6.4. Calibration

A periodic calibration is necessary to check whether the sensor accuracy is in a good range. The Instrument provides a one point calibration and a two point calibration.
If the measuring range is not larger than factor 10, i.e. 1 to 10 ppm, only a one point calibration should be performed. Use a two point calibration only for very large measuring ranges.
To perform a one point calibration, a calibration solution which is within the expected range of the sample, must be prepared.

Ammonium Nitrate

To prepare a calibration solution for the Swansensor Ammonium and the Swansensor Nitrate the following aids are required:

- NH4/NO3 Standard solution 1000 ppm
- High purity water
- A pipette 1 ml
- A volumetric flask 1 l

Fluoride

To prepare a calibration solution for the Swansensor Fluoride the following aids are required:

- Fluoride standard 1000 ppm
- High purity water
- A pipette 1 ml
- A volumetric flask 1 l

The following description of the preparation of the calibration solutions refers to the factory default settings stored in the transmitter for Standard 1 and Standard 2. The concentrations of Standard 1 and Standard 2 however, can be adapted according to your requirements (see 5.1.2, p. 70 and 5.1.3, p. 70).

6.4.1 Prepare a 1 ppm Standard NH_4/NO_3 expressed as N

To prepare the standard of 1 ppm N dilute 1.0 ml of standard 1000 ppm N in 1 liter high purity water.

Note: *A standard solution of 1 ppm as N converted in NO_3 or NH_4 produces the following values:*
Nitrate: 1 ppm N ≙ 4.43 ppm NO_3
Ammonia: 1 ppm N ≙ 1.29 ppm NH_4

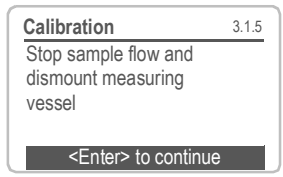
6.4.2 Prepare a 1 ppm (F) Standard Fluoride

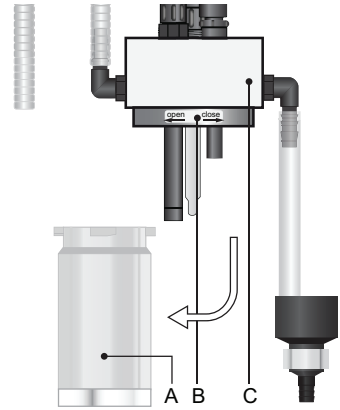
To prepare the standard of 1 ppm dilute 1.0 ml of standard 1000 ppm N in 1 liter high purity water.

6.4.3 Perform a One Point Calibration

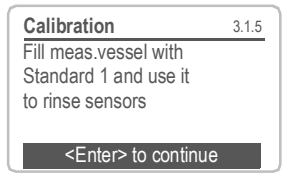
Note: *Make sure that the sensor and the reference sensor are in the same sample.*

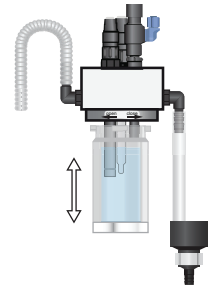
Navigate to the menu <Maintenance>/<Calibration>.
Press [Enter].
Follow the dialog on the screen.

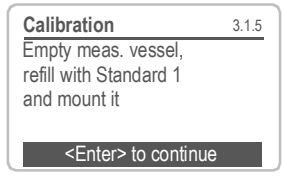


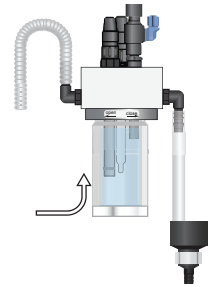


A *Calibration vessel (measuring vessel)*
B *Bayonet socket*
C *Flow cell block*









Calibration	3.1.5
Standard 1	1 ppm
Current Value	xx ppm
Offset	xx mV
Progress	

Calibration is running.

Calibration	3.1.5
Offset	xx mV
<Enter> to continue	
<Enter> to finish	

After calibration has finished, select [Enter] to finish.
The measured offset is stored.

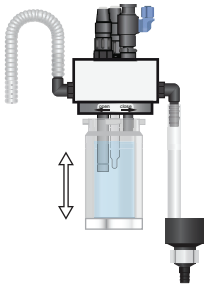
6.4.4 Perform a Two Point Calibration

Proceed as for the one point calibration. If the procedure with standard 1 has finished:

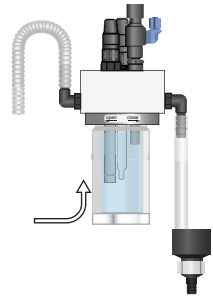
Calibration	3.1.5
Offset	xx mV
<Enter> to continue	
<Enter> to finish	

Select [Enter] to continue.
Then follow the dialog on the screen.

Calibration	3.1.5
Fill meas.vessel with Standard 2 and use it to rinse sensors	
<Enter> to continue	



Calibration 3.1.5
Empty meas. vessel, refill with Standard 2 and mount it
<Enter> to continue



Calibration 3.1.5	
Standard 2	10 ppm
Current Value	xx ppm
Slope	xx mV
Progress	

Second calibration is running

Calibration 3.1.5	
Slope	xx mV
<Enter> to continue	

Calibration 3.1.5	
Calibration Successful	
Offset	xx mV
Slope	xx mV
<Enter> to continue	

Press [Enter].
The measured offset and slope are stored and all new measurements are based on them.

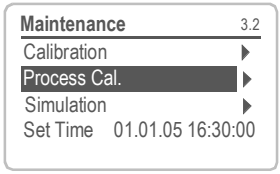
Calibration 3.1.5
Start sample flow

6.5. Process Calibration

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

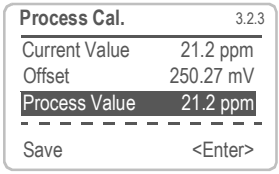
***Note:** For a reliable process calibration, the process value has to be stable.*

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



1 Navigate to <Maintenance>/ <Process Cal.>.

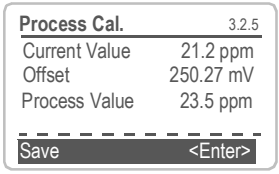
2 Press [Enter]



The following values are displayed:
- Current value
- Offset
- Process value

Current value and Process value are equal.

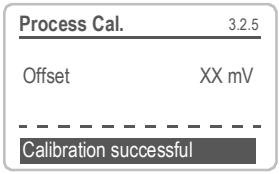
3 Press [Enter].



4 Enter the Process value measured with the calibrated comparative sensor.
⇒*Use the arrow keys to increase or decrease the process value.*

5 Press [Enter] to confirm.

6 Press [Enter] to save.



The process value is saved and the new Offset in mV is displayed.

6.6. Longer Stop of Operation

1. Stop sample flow.
2. Shut off power of the instrument.
3. Unscrew and remove the connectors from the sensors.
4. Put the connector caps on it.
5. Remove the sensors from the flow cell.
6. Remove the KCl bottle form the bottle holder.
7. Rinse the sensors well with clean water.
8. Remove the KCl supply pipe from the KCl bottle and close the supply pipe with a plug.
9. 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 sensors.
11. Store the sensors with the tips pointing downwards in a frost-protected room.
12. Empty and dry the calibration vessel

CAUTION

Damage of sensors

Wrong storage will damage the sensors.

- Never store the sensors dry.

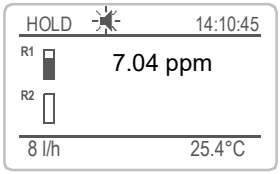
7. Troubleshooting

7.1. Error List

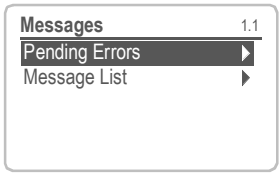
Error
Non-fatal Error. Indicates an alarm if a programmed value is exceeded.
Such Errors are marked **E0xx** (bold and black).

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:

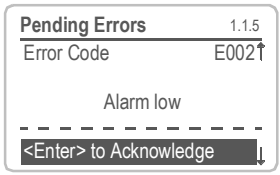
- Errors which disappear if correct measuring conditions are recovered (i.e. Sample Flow low).
  Such Errors are marked **E0xx** (bold and orange)
- Errors which indicate a hardware failure of the instrument.
  Such Errors are marked **E0xx** (bold and red)



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, S. 75
E002	Alarm low	– check process – check programmed value, see 5.3.1.1.26, S. 75
E007	Sample Temp. high	– check process – check programmed value, see 5.3.1.3.1, S. 76
E008	Sample Temp. low	– check process – check programmed value, see 5.3.1.3.25, S. 76
E009	Sample Flow high	– check Inlet pressure – readjust sample flow – check programmed value, see 5.3.1.2.2, S. 76
E010	Sample Flow low	– check Inlet pressure – readjust sample flow – clean instrument – check programmed value, see 5.3.1.2.35, S. 76
E011	Temp. shorted	– Check wiring of temperature sensor – Check temperature sensor
E012	Temp. disconnected	– Check wiring of temperature sensor – Check temperature sensor
E013	Case Temp. high	– check case/environment temperature – check programmed value
E014	Case Temp. low	– check case/environment temperature – check programmed value
E017	Control Timeout	– check control device or programming in Installation, Relay contact, Relay 1/2 see 5.3.2 and 5.3.3, S. 76
E024	Input active	– See If Fault Yes is programmed in Menu see 5.3.4, S. 80

Error	Description	Corrective action
E026	IC LM75	– call service
E028	Signal output open	– check wiring on signal outputs 1 and 2
E030	EEProm Frontend	– call service
E031	Cal. Recout	– call service
E032	Wrong Frontend	– call service
E033	Power-on	– none, normal status
E034	Power-down	– none, normal status

7.2. Replace Fuses

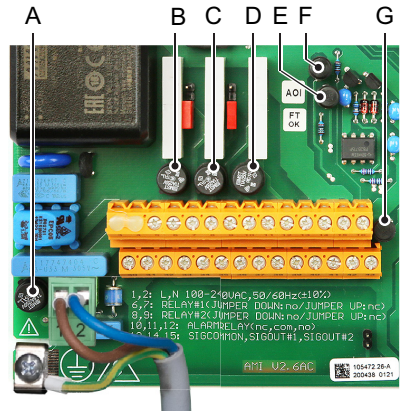
WARNING

External Voltage.

External supplied devices connected to relay 1 or 2 or to the alarm relay can cause electrical shocks.

- Make sure that the devices connected to the following contacts are disconnected from the power before resuming installation.
  - relay 1
  - relay 2
  - alarm relay

When a fuse has blown, find out the cause and fix it before replacing it with a new one.
Use tweezers or needle-nosed pliers to remove the defective fuse.
Use original fuses provided by SWAN only.



A *AC variant: 1.6 AT/250 V Instrument power supply*
DC variant: 3.15 AT/250 V Instrument power supply
B *1.0 AT/250V Relay 1*
C *1.0 AT/250V Relay 2*
D *1.0 AT/250V Alarm relay*
E *1.0 AF/125V Signal output 2*
F *1.0 AF/125V Signal output 1*
G *1.0 AF/125V Signal output 3*

8. Program Overview

For explanations about each parameter of the menus see Program List and Explanations, S. 67.

- Menu 1 **Messages** is always accessible for everybody. No password protection. 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.	AMI ISE		* Menu numbers
2.1*	Version	V6.20-05/18		
	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	Swansensor	*Current Value ppm*		
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*			
Sample	*Sample ID*	2.3.1*		
2.3*	*Temperature*			
	(Nt5K)			
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*		(only with RS485
2.5*	*Baud rate*			interface)

8.3. Maintenance (Main Menu 3)

Calibration	*Calibration*	3.1.5*	* Menu numbers
3.1*			
Process Cal.	*Process. Cal*	3.2.5*	
3.2			
Simulation	*Alarm Relay*	3.3.1*	
3.3*	*Relay 1*	3.3.2*	
	Relay 2	3.3.3*	
	Signal Output 1	3.3.4*	
	Signal Output 2	3.3.5*	
Set Time	*(Date), (Time)*		
3.4*			

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*	4.2.1.1.22*
			Hysteresis	4.2.1.1.32*
			Delay	4.2.1.1.42*
	Relay 1/2	*Setpoint*	4.2.x.100*	
	4.2.2* - 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	*Type of sensor*	5.1.1*		* Menu numbers
5.1*				
	Standard 1 (N)	5.1.2*		
	Standard 2 (N)	5.1.3*		
	Flow	*Flow measurement*	*none*	
	5.1.4*	5.1.4.1*	*Q-Flow*	
			deltaT	
Signal Outputs	**Signal Output 1/2**	*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.40.10/11*
		5.2.x.40	*Range High*	5.2.x.40.20/21*
Relay Contacts	**Alarm Relay**	**Alarm**	*Alarm High*	5.3.1.1.1*
5.3*	5.3.1*	5.3.1.1*	*Alarm Low*	5.3.1.1.22
			Hysteresis	5.3.1.1.32
			Delay	5.3.1.1.42
		Sample Temp.	*Alarm High*	5.3.1.3.1*
		5.3.1.3	*Alarm Low*	5.3.1.3.22*
		Case Temp. high	5.3.1.4*	
		Case Temp. low	5.3.1.5*	
	Relay 1/2	*Function*	5.3.2.1/5.3.3.1*	
	5.3.2/5.3.3*	*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*		* Menu numbers
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*		
	Line Break Detection	5.4.6*		
Interface	*Protocol*	5.5.1*		(only with RS485
5.5*	*Device Address*	5.5.21*		interface)
	Baud Rate	5.5.31*		
	Parity	5.5.41*		

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. V6.20-05/18)

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 1:**

- Current value: Shows the measured value in pH.
- Raw value: Shows the measured value in mV.

2.2.1.5 *Cal. History:* Review diagnostic values of the last calibrations.

- Number
- Date, Time
- Offset in mV
- Slope in mV

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

2.2.2 **Electrode 2:**

- Current value: Shows the measured value in mV.
- Raw value: Shows the measured value in mV.

2.2.2.5 *Cal. History:* Review diagnostic values of the last calibrations.
- o Number
- o Date, Time
- o Offset in mV
- o Slope in mV

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

2.2.3 **Miscellaneous**:

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

2.3 Sample

If <Flow measurement> = None

2.3.1
- 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 actual temperature in °C and the raw value NT5K in Ω.

If <Flow measurement> = Q-Flow additional:
- o Sample flow: Shows the actual sample flow in l/h and the Raw value in Hz

If <Flow measurement> = deltaT additional:
- o deltaT 1: Temperature measured at sample inlet of deltaT sensor.
- o deltaT 2: Temperature measured at sample outlet of deltaT sensor.

2.4 I/O State

Shows 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
o Signal Output 3 (option)	Actual current in mA

2.5 Interface

Only available if optional interface is installed.
Review programmed communication settings.

3 Maintenance

3.1 Calibration

See Calibration, p. 52.

3.2 Process Cal.

See Process Calibration, p. 56.

3.3 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
3.3.6	*Signal Output 3:*	Actual current in mA (if option is installed)

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.

3.4 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 5.3 Relay Contacts, p. 75.

4.3 Logger

The instrument is equipped with an internal logger. The logger data can be copied to a PC with an USB stick if option USB interface is installed.
The logger can save approx. 1500 data records. Records consist of: Date, time, alarms, measured value, 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 *Type of Sensor*: Set the type of installed sensor.
Possible types:

Type of sensor	
NH4(N)	Ammonium expresses the result as ppm N
NH4	Ammonium expresses the result as ppm NH_4^+
NO3(N)	Nitrate expresses the result as ppm N
NO3	Nitrate expresses the result as ppm NO_3^+
Fluoride	

Note: *Regardless of the sensor type selected, the standard concentrations 1 and 2 are always given in ppm (N).*

5.1.2 *Standard 1 (N)*: Set the concentration of the Standard 1 according to the prepared concentration.
Range: 0.1–100 ppm

5.1.3 *Standard 2 (N)*: Set the concentration of the Standard 2 according to the prepared concentration.
Range: 0.1–100 ppm

5.1.4 Flow

5.1.4.1 *Flow measurement*: Select the type of flow sensor if a flow sensor is installed. Possible flow sensors

Flow measurement
None
Q-Flow
deltaT

Q-Flow

deltaT

5.1.4.2 *Slope:* (if deltaT sensor is selected)
The slope is used to adjust the sample flow measurement. Starting from an average sample temperature of 25 °C

- increase the slope value if the temperature falls below 25 °C
- decrease the slope value if the temperature rises above 25 °C.

Range: 0.5–2
See Adjusting the deltaT Flow Sensor (Option), p. 42.

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)

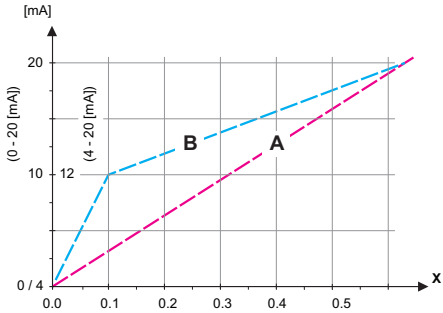
5.2.1.2 *Current Loop:* Select the current range of the signal output. Make sure the connected device works with the same current range. Available ranges: 0–20 mA or 4–20 mA

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:

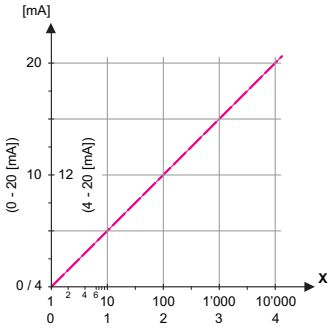
- Linear, bilinear or logarithmic for process values.
  See As process values, p. 72
- Control upwards or control downwards for controllers.
  See As control output, p. 73

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:

5.2.1.40.10 *Range low*: 0.00 ppm – 1000 ppm
5.2.1.40.20 *Range high*: 0.00 ppm – 1000 ppm

Parameter Temperature:

5.2.1.40.11 *Range low*: -30 °C to +130 °C
5.2.1.40.21 *Range high*: -30 °C to +130 °C

Parameter Sample flow:

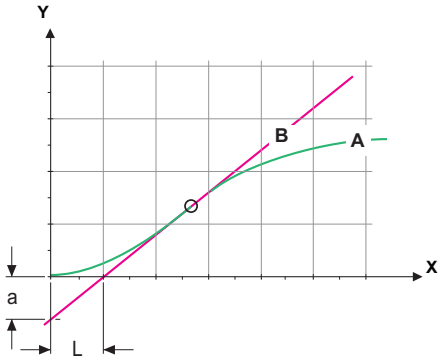
5.2.1.40.12 *Range low*: 0.0 l/h – 50 l/h
5.2.1.40.22 *Range high*: 0.0 l/h – 50 l/h

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 Function = Control upwards or Control downwards

Setpoint: User-defined process value for the selected parameter.
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 setpoint without overshooting.

5.2.1.43 **Control Parameters:** if Parameters = Meas. Value

5.2.1.43.10 Setpoint:
Range: 0.00 ppm – 1000 ppm

5.2.1.43.20 *P-Band:*
Range: 0.00 ppm – 1000 ppm

5.2.1.43 **Control Parameters:** if Parameters = Temperature

5.2.1.43.11 Setpoint:
Range: -30 °C to +130 °C

5.2.1.43.21 *P-Band:*
Range: 0 °C to +100 °C

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

5.2.1.43.12 Setpoint:
Range: 0.0 l/h – 50 l/h

5.2.1.43.22 *P-Band:*
Range: 0.0 l/h – 50 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.
Range: 0.00 ppm–1000 ppm

5.3.1.1.26 *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.
Range: 0.00 ppm–1000 ppm

5.3.1.1.36 *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.
Range. 0.00 ppm–1000 ppm

5.3.1.1.46 *Delay:* Duration, the activation of the alarm relay is retarded after the measured 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 measured values rises above the programmed value E009 will be issued.
Range QV-Flow: 10–50 l/h
Range deltaT: 10–50 l/h

5.3.1.2.35 *Alarm Low:* If the measured values falls below the programmed value E010 will be issued.
Range QV-Flow: 0–9 l/h
Range deltaT: 0–9 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: 30–100 °C

5.3.1.3.25 *Alarm Low:* If the measured value rises above the alarm high value, the alarm relay is activated.
Range: -10–20 °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. 36.
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. The same values may also be entered in menu 4.2 Relay Contacts, p. 70

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

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

Parameter	Range
Meas. Value	0 ppm–1000 ppm
Temperature	-30 °C to + 130 °C
Sample flow	0–50 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
Meas. Value	0 ppm–1000 ppm
Temperature	0 °C to + 100 °C
Sample flow	0–50 l/h

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

5.3.2.1 Function = Control upwards or control 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 (if a flow sensor is programmed)

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
See 5.2.1.43, p. 74

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.

5.3.2.32.4 Control Parameters
See 5.2.1.43, p. 74

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
See 5.2.1.43, p. 74

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 1–1440 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. 80.
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:

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:

Continuous:	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):

Continuous:	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 following menus:

5.4.4.1 Messages
5.4.4.2 Maintenance
5.4.4.3 Operation
5.4.4.4 Installation.
Each menu may 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 meaning full text, such as KKS number.

5.4.6 *Line Break Detection:* If activated, error message E028 is shown in case of line break on signal outputs 1 and 2.

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:* **USB-Stick:**

Only visible if an USB interface is installed. No further settings are possible.

5.5.1 *Protocol:* **HART**

Device address: Range: 0–63

10. Material Safety Data sheets

10.1. NH4/NO3 Standard Solution

Catalogue No.: A-85.144.400
Product name: SDS standard solution Ammonium-Nitrate

10.2. Fluoride Standard Solution

Catalogue No.: A-85.146.400
Product name: SDS Fluoride standard 1000 ppm

10.3. Reference Filling Solution KCl

Catalogue No.: A-87.893.300, A-87.893.500, A-85.893.600
Product name: Reference filling solution for Swansensor Reference FL Swansensor pH SI and Swansensor Redox (ORP) SI

Download MSDS The current Material Safety Data Sheets (MSDS) for the above listed Reagents are available for downloading at **www.swan.ch**.

11. Default Values

Operation:

Sensors:	Filter Time Const.:	20 s
	Hold after Cal.:	300 s
Relay Contacts	Alarm Relay	same as in Installation
	Relay 1 / 2	same as in Installation
	Input	same as in Installation
Logger:	Logger Interval:	30 min
	Clear Logger:	no

Installation:

Sensors	Type of sensor:	NH4 (N)
	Standard 1 (N):	1 ppm
	Standard 2 (N):	10 ppm
	Flow: Flow measurement	none
Signal Output 1	Parameter:	Meas. Value
	Current loop:	4–20 mA
	Function:	linear
	Scaling: Range low:	0.00 ppm
	Scaling: Range high:	100 ppm
Signal Output 2	Parameter:	Temperature
	Current loop:	4 –20 mA
	Function:	linear
	Scaling: Range low:	0.0 °C
	Scaling: Range high:	50.0 °C
Relay Contacts:	Alarm Relay:	
	Alarm: Alarm high	1000 ppm
	Alarm: Alarm low:	0.00 ppm
	Alarm: Hysteresis:	10 ppm
	Alarm: Delay:	30 s
	Sample Temp.: Alarm High:	55 °C
	Sample Temp.: Alarm Low:	0 °C
	Case temp. high:	65 °C
	Case temp. low:	0 °C
Relay 1	Function:	limit upper
	Parameter:	Meas. Value
	Setpoint:	100 ppm
	Hysteresis:	10 ppm
	Delay:	30 s

Relay 2
Function: ..... limit upper
Parameter: ..... Temperature
Setpoint: ..... 50 °C
Hysteresis: ..... 1 °C
Delay: ..... 30 s

If Function = Control upw. or dnw:

Relay 1
Parameter: ..... **Meas. value**
Settings: Actuator: ..... Frequency
Settings: Pulse Frequency: 120/min
Settings: Control Parameters: Setpoint: ..... 100 ppm
Settings: Control Parameters: P-band: ..... 10 ppm

Relay 2
Parameter: ..... **Temperature**
Settings: Actuator: ..... Frequency
Settings: Pulse Frequency: 120/min
Settings: Control Parameters: Setpoint: ..... 50 °C
Settings: Control Parameters: P-band: ..... 1 °C

Common settings:
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:	- - - - - - - -
	Line break detection	no

12. Index

13. Notes

swan
ANALYTICAL INSTRUMENTS

A-96.250.771 / 031120

Swan Products - Analytical Instruments for:

Swan is represented worldwide by subsidiary companies and distributors and cooperates with independent representatives all over the world. For contact information, please scan the QR code.

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