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ANALYTICAL INSTRUMENTS

AMI CACE

Version 6.20 and higher

Operator's Manual

A-96.250.871 / 121216

Customer Support
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Document Status

Title:	Monitor AMI CACE Operator's Manual	
ID:	A-96.250.871	
Revision	**Issue**	
00	Oct. 2016	First edition

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AMI CACE - 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 significance:

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 can be the consequence if such warnings are ignored.

- Follow the prevention instructions carefully.

Mandatory Signs

The importance of the mandatory signs in this manual.

Safety goggles

Safety gloves

Warning Signs The importance of the warning signs in this manual.

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.

1.3. Restriction for use

The AMI CACE is designed for determination of:

- specific (total) conductivity
- cation (acid) conductivity after the cation exchanger (CACE)

in power plant water.
It calculates the pH value and the concentration of the alkaline substance (NH_3, morpholine, etc.) if an alkaline substance is present in the water.
It is not suitable for pH determination in high purity water before alkalization agent addition.

Conditions for pH calculation:

- only 1 alkalization agent in the sample
- the contamination is mostly NaCl
- phosphate concentration is < 0.5 ppm
- pH value is > 7.5, and < 11.5
- if pH value is < 8, the concentration of contaminant must be small compared to the concentration of the alkalization agent

No sand. No oil. Use of film forming products may reduce lifetime of EDI module.

The sample must not contain any particles which may block the flow cell. Sufficient sample flow is coercive for the correct function of the instrument.

2. Product Description

2.1. Description of the System

Application Range

Complete monitoring system for the automatic, continuous measurement of the specific (total) conductivity before a cation exchanger and the cation (acid) conductivity after a cation exchanger (CACE).

Based on difference conductivity measurement, the pH of the sample can be calculated.

Special Features

- Temperature compensation curves for conductivity measurement:
  - Strong acids (HCl)
  - Strong bases (NaOH)
  - Ammonia
  - Morpholine
  - Ethanolamines (ETA)
  - Neutral salts
  - UPW
  - Coefficient
- Flow monitoring
- Calculation of pH according to VGB 450L, edition 2006
- Calculates the concentration of an alkaline substance present in the water (ammonia, morpholine or ethanolamines).

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
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 measuring values, controllers or timer for system cleaning with automatic hold function. Both 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

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 (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.

Measuring principle

When a voltage is set between two electrodes in an electrolyte solution, the result is an electric field which exerts force on the charged ions: the positively charged cations move towards the negative electrode (cathode) and the negatively charged anions towards the positive electrode (anode). The ions, by way of capture or release of electrons at the electrodes, are discharged and so a current *I* flows through this cycle and the Ohm's law $V = I \times R$ applies. From the total resistance *R* of the current loop, only the resistance of the electrolyte solution, respectively its conductivity $^1/_R$, is of interest.
The cell constant of the sensor is determined by the manufacturer and is printed on the sensor label. If the cell constant has been programmed in the transmitter, the instrument measures correctly. No calibration needs to be done, the sensor is factory calibrated. Measuring unit is µS/cm or µS/m.

Specific Conductivity

Conductivity from all ions in the sample, mainly the alkalization agent. The contribution of impurities is masked by the alkalization agent.

Cation Conductivity (Acid Conductivity)

The alkalization agent is removed by the cation exchange resin in the EDI module. All cationic ions are exchanged with H+, all anionic impurities (ions with negative charge) pass through the module unchanged and are measured by the second conductivity sensor.

Temperature compensation

The mobility of ions in water increases with higher temperature, which enlarges the conductivity. Therefore, the temperature is measured simultaneously by an integrated Pt1000 temperature sensor and the conductivity is compensated to 25 °C. Several temperature compensation curves designed for different water compositions can be chosen. After cation exchanger (cation conductivity), the temperature compensation curve strong acids has to be set.
For more information see: **Influence of Temperature on Electrical Conductivity, PPChem (2012).**

Standard Temperature

The displayed conductivity value is compensated to 25°C standard temperature.

Correction or calibration

Not necessary.
Auto zero is done automatically each day at 0:30 at night.

Fluidics

The sample flows into the flow cell block [D] via the sample inlet [L]. With the first conductivity sensor [A] the specific conductivity of the sample is measured. A capillary tube [F] placed after the first conductivity sensor regulates the sample flow. Then the sample is led through the sample chamber [I] containing a cation exchange resin. Afterwards the cation conductivity of the sample is measured with the second conductivity sensor [B]. The temperature is measured with the temperature sensors integrated in the conductivity sensors.

After the measurement of specific and cation conductivity, the sample leaves the measuring cell via flow meter [E] and flows through the anode chamber, where protons are generated by electrolysis of water:

$$H_2O \rightarrow \frac{1}{2} O_2 + 2 H^+ + 2e^-$$

The water is then led through the cathode chamber where it is reduced according to:

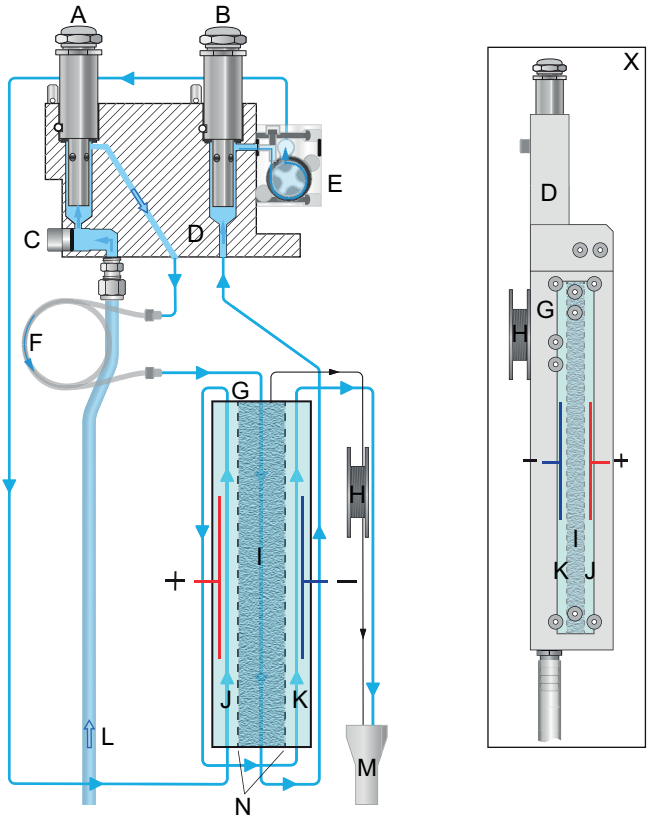
$$2 H^+ + 2 e^- \rightarrow H_2 \text{ resp. } 2 H_2O + 2 e^- \rightarrow \frac{1}{2} H_2 + 2 OH^-$$

Finally, the sample leaves the EDI module and flows into the waste.

Regeneration of the cation exchange resin

Under the influence of the electrical field generated by the two electrodes, the protons produced at the anode are drawn towards the cathode. They pass through the membrane and are absorbed by the cation exchange resin in the sample chamber. At the same time, the cations captured in the resin are released and move towards the cathode chamber, where they are dissolved by the sample water and flushed out of the EDI module. This process ensures that the resin is continuously regenerated.

NOTICE: *To visualize the sample flow more clearly, the EDI module is shown only schematically. Lateral view X shows the correct positions of the chambers and electrodes.*



A *First conductivity sensor*
B *Second conductivity sensor*
C *Blind plug*
D *Flow cell block*
E *Flow meter*
F *Capillary tube*
G *EDI module*
H *Deaeration tube*
I *Sample chamber*
J *Anode chamber*
K *Cathode chamber*
L *Sample inlet*
M *Waste*
N *Membranes*
X *Lateral view of the EDI module*

2.2. Instrument Specification

Power Supply

Voltage:	100–240 VAC (± 10%) 50/60 Hz (± 5%) or 24 VDC (± 10%)
Power consumption:	max. 30 VA

Sample requirements

Flow rate:	3–4 l/h
Temperature:	up to 50 °C
Inlet pressure:	up to 0.5 bar
Outlet pressure:	pressure free

Use of a SWAN Backpressure Regulator is highly recommended.
Particle filtration recommended in case of high iron concentration.

NOTICE: *No oil, no grease, no sand. Use of film forming products may reduce lifetime of EDI module.*

On-site requirements

The analyzer site must permit connections to:

Sample inlet:	Swagelok 1/4” adapter for stainless steel tube
Sample outlet:	G 3/8” adapter for flexible tube diam. 20 x 15 mm

Measuring range

Measuring range	Resolution
0.055 to 0.999 µS/cm	0.001 µS/cm
1.00 to 9.99 µS/cm	0.01 µS/cm
10.0 to 99.9 µS/cm	0.1 µS/cm
100 to 1000 µS/cm	1 µS/cm

Automatic range switching.

EDI capacity

SC_{max} = 40 µS/cm as NH_4OH
SC_{max} = 350 µS/cm as NaOH

Accuracy

±1% of measuring value or ±1 digit (whichever is greater)

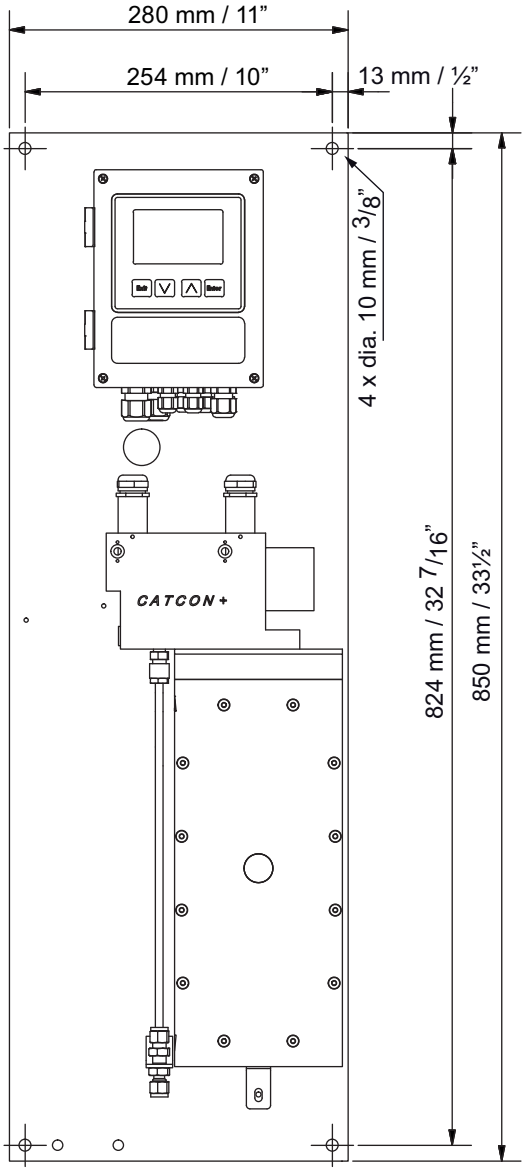
Electronics housing

Aluminum with a protection degree of IP 66 / NEMA 4X

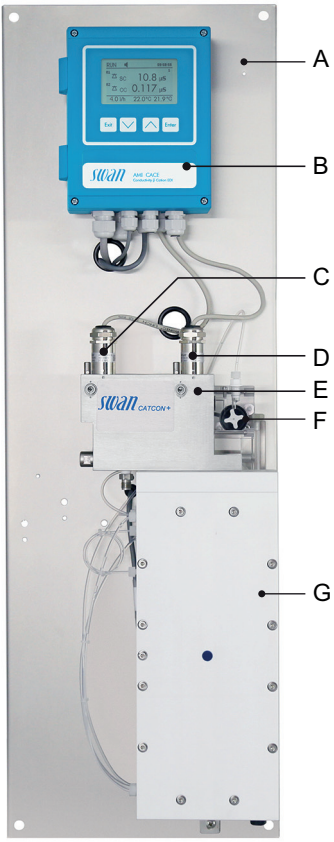
Ambient temperature:	-10 to +50 °C
Humidity:	10–90% rel., non condensing
Display:	backlit LCD, 75 x 45 mm

Dimensions

Panel: Dimensions:	280 x 850 x 200 mm
Screws:	8 mm diameter
Weight:	14 kg


280 mm / 11”
254 mm / 10”
13 mm / ½”
4 x dia. 10 mm / 3/8”
824 mm / 32 7/16”
850 mm / 33½”
CATCON+

2.3. Instrument Overview



A *Panel*
B *Transmitter*
C *Specific conductivity sensor*
D *Cation conductivity sensor*
E *Flow cell*
F *Flow meter*
G *Electrodeionization (EDI) module*

3. Installation

3.1. Installation Checklist Monitors

Check	Instrument's specification must conform to your AC power ratings. Do not turn on power until instructed to do so.
On site requirements	100–240 VAC (± 10%), 50/60 Hz (± 5%) or 24 VDC, isolated (±10%) power outlet with ground connection and 30 VA For sample requirements see Instrument Specification, p. 12).
Installation	◆ Mount the instrument in vertical position. ◆ Display should be at eye level. ◆ Remove the end caps from tubes 1, 2, 3, 5 and 10 and connect the tubes according to Tube numbering, p. 43. ◆ Connect sample inlet and outlet.
Electrical Wiring	◆ Connect all external devices like limit switches, current loops and pumps (see Connection Diagram, p. 20). ◆ Connect power cord; do not switch on power yet!
Power-up	◆ Open sample flow and wait until the instrument is completely filled. ◆ Check inlet pressure. ◆ Switch on power.
Instrument set-up	◆ Program all sensor parameters (see Sensor parameters, p. 28). ◆ If required activate calculations (see Calculations, p. 29). ◆ Program all parameters for external devices (interface, recorders, etc.). ◆ Program all parameters for instrument operation (limits, alarms). ◆ Program display screens.
Run-in period	Let the instrument run continuously for 1 h.

3.2. Mounting of Instrument Panel

The first part of this chapter describes the preparing and placing of the system 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:
  - 4 Screws 8x60 mm
  - 4 Dowels
  - 4 Washers 8.4/24 mm

Mounting requirements

The instrument is only intended for indoor installation.
For dimensions see Dimensions, p. 12.

3.3. Connecting Sample Inlet and Outlet

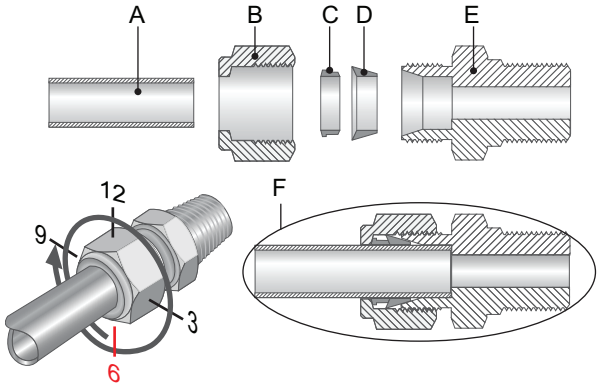
3.3.1 Swagelok Fitting Stainless Steel at Sample Inlet

Preparation

Cut the tube to length and deburr it. The tube must be straight and free from blemishes for approximately 1,5 x tube diameter from the end.
Lubrication with lubricating oil, MoS2, Teflon etc. is recommended for the assembly and reassembly of bigger sized unions (thread, compression cone).

Installation

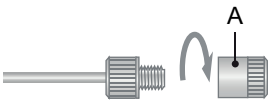
1. Insert the compression ferrule [C] and the compression cone [D] into the union nut [B].
2. Screw the union nut onto the body, do not tighten it.
3. Push the stainless steel pipe through the union nut as far as it reaches the stop of the body.
4. Mark the union nut at 6 o'clock position.
5. While holding the fitting body steady, tighten the nut union 1¼ rotation using an open ended spanner.



A *Stainless steel tube*
B *Union nut*
C *Compression ferrule*
D *Compression cone*
E *Body*
F *Tightened connection*

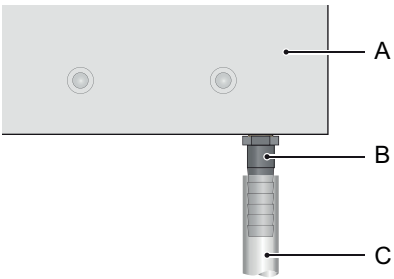
3.3.2 EDI module tubing

Remove the end caps [A] from tubes 1, 2, 3, 5 and 10 and connect the tubes according to Tube numbering, p. 43.



A *End cap*

3.3.3 Tube at Sample Outlet



A *EDI module*
B *Hose nozzle*
C *Plastic tube 20 x 15 mm*

Connect a plastic tube [C] to the hose nozzle [B] and place it into a drain with atmospheric pressure.

3.4. Electrical Connections

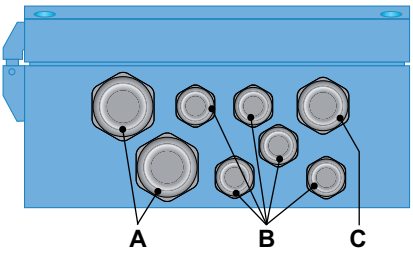
WARNING

Electrical hazard.

- Always turn off AC power before manipulating electric parts.
- Grounding requirements: Only operate the instrument from an 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

NOTICE: *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

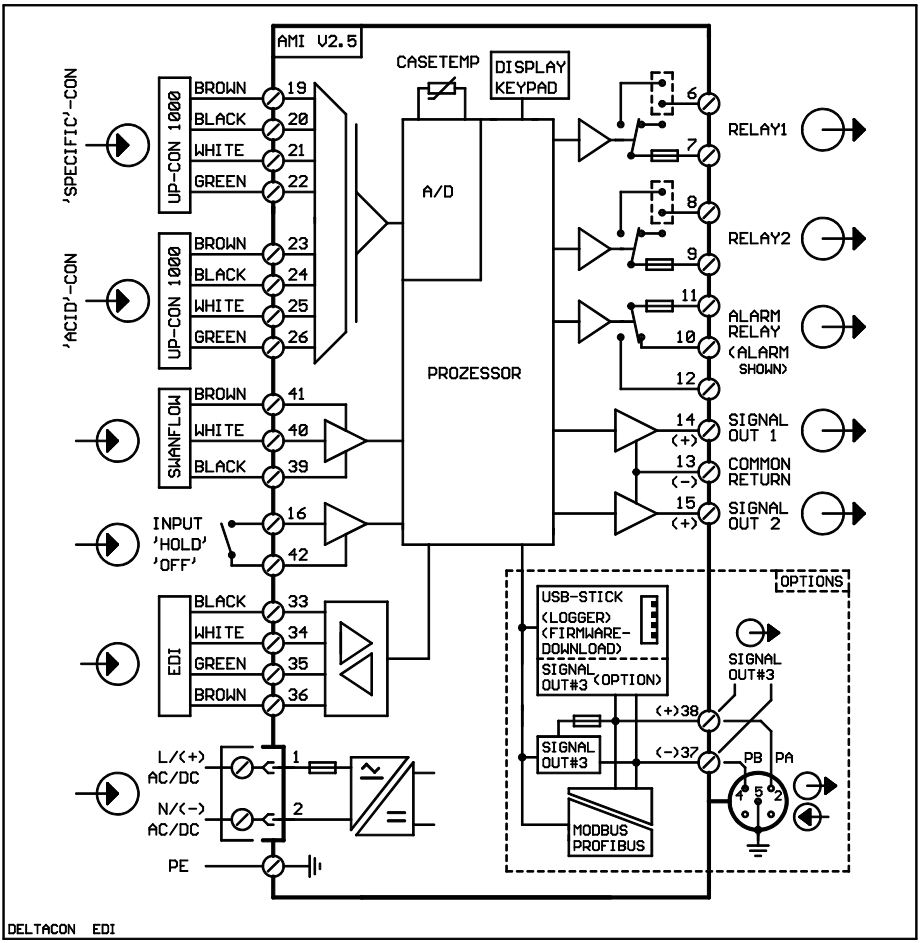
To prevent from electrical shock, do not connect the instrument to the power unless the ground wire (PE) is connected.

- Do not connect unless specifically instructed to do so.

WARNING

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

3.5. Connection Diagram



CAUTION

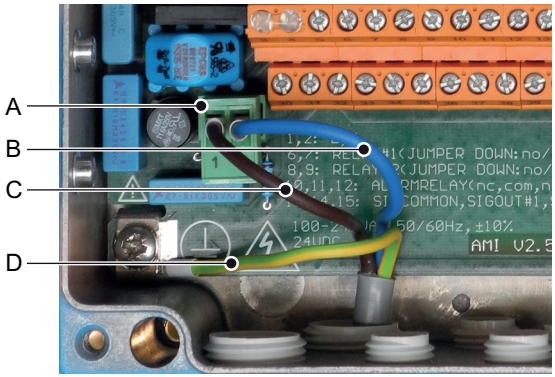
Use only the terminals shown in this diagram, and only for the mentioned purpose. Use of any other terminals will cause short circuits with possible corresponding consequences to material and personnel.

WARNING

Electrical shock hazard

Installation and maintenance of electrical parts must be performed by professionals.

- Always turn off AC power before manipulating electric parts.



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

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

Installation requirements

The installation must meet the following requirements.

- Mains fuse 1.6 AT
- 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 CACE

3.6. Relay Contacts

3.6.1 Input

NOTICE: *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.

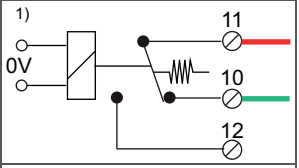
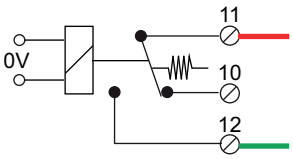
Terminals 16/42
For programming see Program Overview, p. 45.

3.6.2 Alarm Relay

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

Alarm output for system errors.
Error codes see Troubleshooting, p. 38.

NOTICE: *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.	

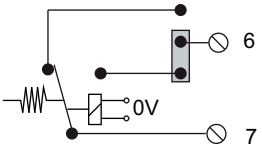
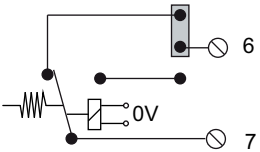
1) *usual use*

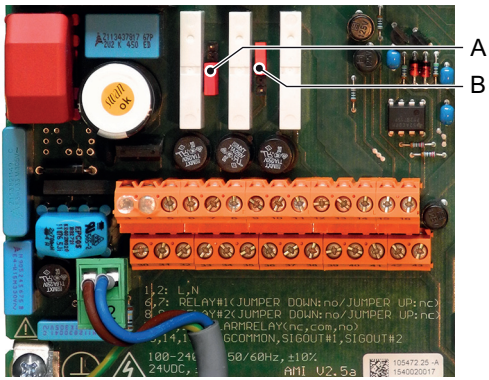
3.6.3 Relay 1 and 2

NOTICE: *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.

NOTICE: *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 Program Overview, p. 45, Menu Installation

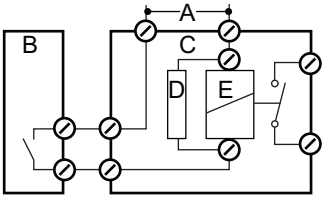
CAUTION

Risk of damage of 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

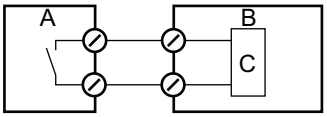
Small inductive loads (max 0.1 A) as for example the coil of a power relay can be switched directly. To avoid noise voltage in the AMI Transmitter it is mandatory to connect a snubber circuit in parallel to the load.
A snubber circuit is not necessary if an AMI relaybox is used.



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

Resistive load

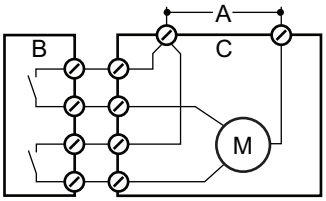
Resistive loads (max. 1 A) and control signals for PLC, impulse pumps and so on can be connected without further measures



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*

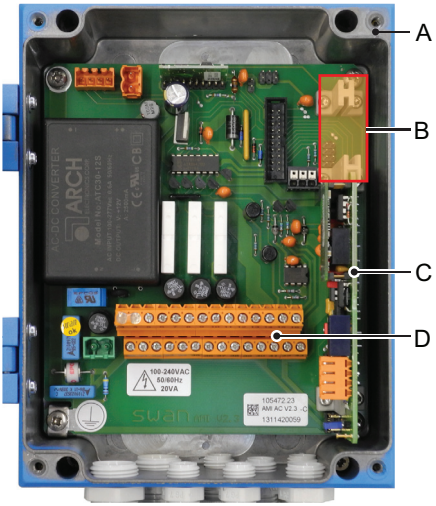
3.7. Signal Outputs

3.7.1 Signal Output 1 and 2 (current outputs)

NOTICE: *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 Overview, p. 45, Menu Installation

3.8. 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:

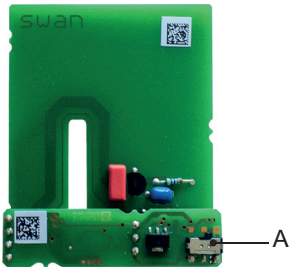
- Third signal output
- a Profibus or Modbus connection
- a HART connection
- an USB Interface

3.8.1 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.

NOTICE: *Max. burden 510 Ω.*



Third signal output 0/4 - 20 mA PCB

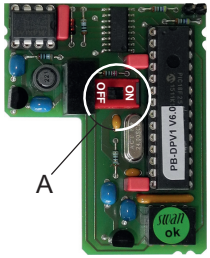
A Operating mode selector switch

3.8.2 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.

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



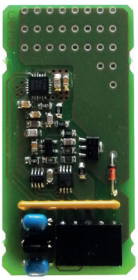
Profibus, Modbus Interface PCB (RS 485)

A *On - OFF switch*

3.8.3 HART Interface

Terminals 38 (+) and 37 (-).

The HART interface PCB allows for communication via the HART protocol. For detailed information, consult the HART manual.

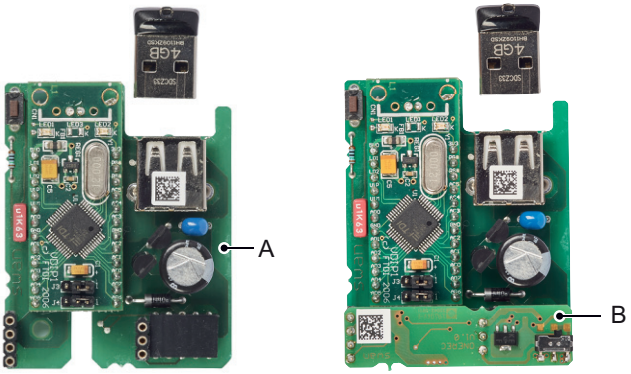


HART Interface PCB

3.8.4 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

After the analyzer is installed according to the previous instructions, connect the power cord. Do not switch on power, yet!

4.1. Establish sample flow

1. Open the sample tap
2. Check inlet pressure
3. Wait until the system has been completely filled
4. Switch on power
5. Let the instrument run in for 1 h

4.2. Programming

Sensor parameters

Program all sensor parameters in Menu Installation-Sensors:
menu 5.1.2.1.1 for sensor 1 and
menu 5.1.2.2.1 for sensor 2.
The sensor characteristics are printed on the label of each sensor.

87-344.203	UP-Con1000SL	Sensor type
SW-xx-xx-xx	ZK = 0.0417	Cell constant
SWAN AG	DT = 0.06 °C	Temperature correction

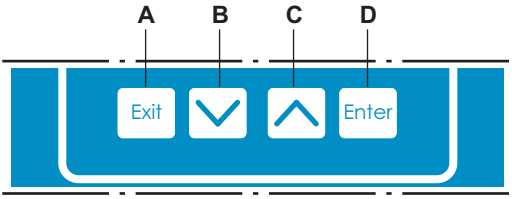
Enter for each sensor separately the:

- Cell constant [cm^{-1}]
- Temperature correction [°C]
- Cable length. If the flow cell is installed on the monitor, set the cable length to 0.0 m.
- Temperature compensation: The default setting for sensor 1 (specific conductivity) is ammonia. For sensor 2 (cation conductivity), the default setting is strong acids.

Calculations	Menu 5.1.1.1 Set <Calculations> to “Yes” if you want to have pH and alkalization agent calculated and displayed.
Measuring unit	Menu 5.1.1.2 Set the <Measuring unit> according to your requirements: ◆ µS/cm ◆ µS/m
Display	Menu 4.4.1, Screen 1 Menu 4.4.2, Screen 2 Program display screens according to your requirements, see program list and explanations 4.4 Display, p. 54.
External devices	Program all parameters for external devices (interface, recorders, etc.) See program list and explanations 5.2 Signal Outputs, p. 56 and 4.2 Relay Contacts, p. 53.
Limits Alarms	Program all parameters for instrument operation (limits, alarms). See program list and explanations 4.2 Relay Contacts, p. 53.

5. Operation

5.1. Keys



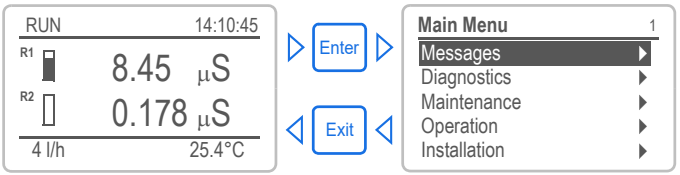
A to exit a menu or command (rejecting any changes)
to move back to the previous menu level

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

C to move UP in a menu list and to increase digits
to switch between display 1 and 2

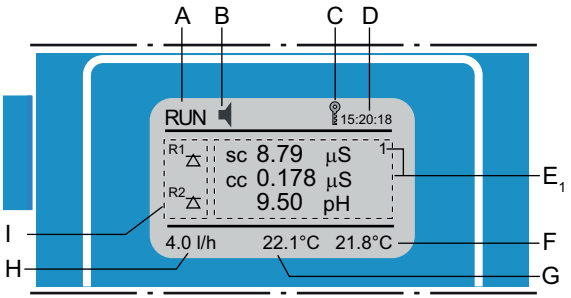
D to open a selected sub-menu
to accept an entry

Program Access, Exit

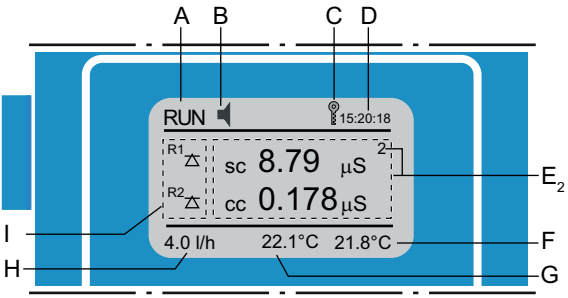


5.2. Display

Example of Display 1



Example of Display 2



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 E_1 Process values Display 1; E_2 Process values Display 2

F Sample temperature 2

G Sample temperature 1

H Sample flow in l/h

I 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

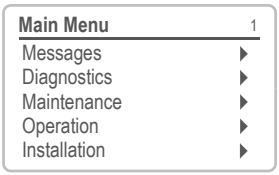
motor valve closed

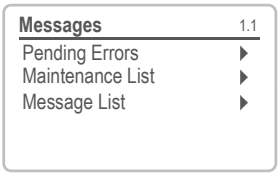
motor valve: open, dark bar indicates approx. position

timer

timer: timing active (hand rotating)

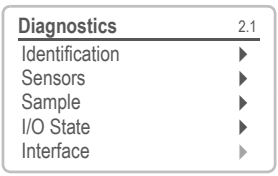
5.3. Software Structure





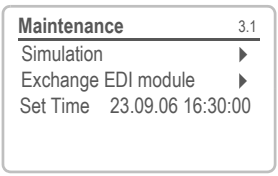
Menu **Messages 1**

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.



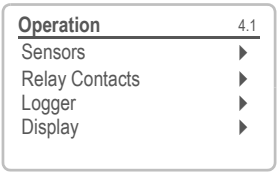
Menu **Diagnostics 2**

Provides user relevant instrument and sample data.



Menu **Maintenance 3**

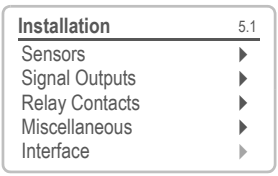
For instrument calibration, relay and signal output simulation, and to set the instrument time.
It is used by the service personnel.



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.



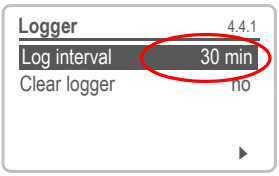
Menu **Installation 5**

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

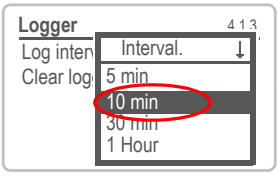
Changing parameters

The following example shows how to change the logger interval:



1 Select the parameter you want to change.

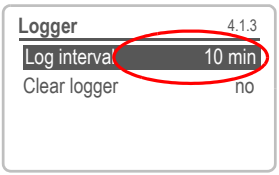
2 Press [Enter]



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

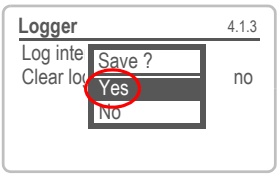
4 Press [Enter] to confirm the selection or [Exit] to keep the previous parameter).

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



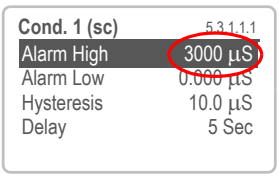
5 Press [Exit].

⇒ *Yes is highlighted.*



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

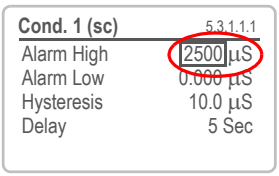
Changing values



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

WARNING

Stop operation before maintenance.

- Stop sample flow.
- Shut off power of the instrument.

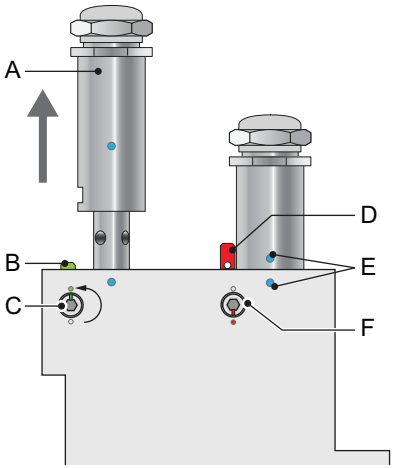
6.1. Maintenance Schedule

Monthly	◆ Check sample flow. ◆ Check inlet pressure.
If required	◆ Clean conductivity sensors. ◆ Replace inlet filter (if installed).

6.2. Stop of Operation for Maintenance

1. Stop sample flow.
2. Shut off power of the instrument.

6.3. Maintenance of the Sensor



A *Conductivity sensor*
B *Locking pin unlocked*
C *Locking screw open*
D *Locking pin locked*
E *Alignment marks*
F *Locking screw closed*

6.3.1 Remove the Sensor from the Flow Cell

The sensors are fixed in the flow cell with Swan's slot lock system. To remove the sensor from the flow cell proceed as follows:

1. Press the locking pin [B] down.
2. Turn the locking screw [C] with a 5 mm allen key counterclockwise 180°.
   ⇒*The locking pin remains down.*
3. Remove the sensor.

Cleaning If the sensor is slightly contaminated, clean it with soapy water and a pipe cleaner. If the sensor is strongly contaminated, dip the tip of the sensor into 5% hydrochloric acid for a short time.

6.3.2 Install the Sensor into the Flow Cell

1. Make sure that the locking mechanism is in unlocked position (locking screw in position [C] and locking pin in position [B]).
2. Put the sensor into the flow cell with the alignment marks [E] in line.
3. Turn the locking screw with a 5 mm allen key clockwise 180°.
   ⇒*The locking pin moves up in lock position.*

6.4. Replacing Fuses

WARNING

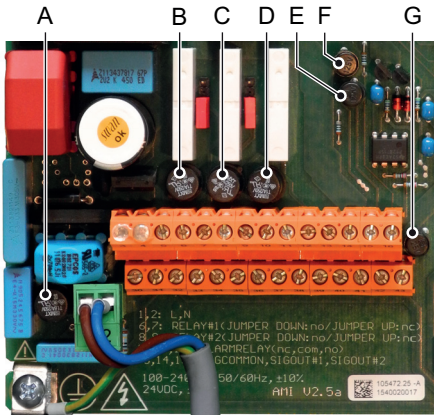
External Voltage

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 *1.6 AT/250V 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*

6.5. Longer Stop of Operation

1 Stop sample flow.
2 Shut off power of the instrument.

7. Troubleshooting

This chapter provides some hints to make troubleshooting easier. For any detailed information on how to handle/clean parts please see chapter Maintenance, p. 34.

For any detailed information on how to program the instrument please see chapter Program List and Explanations, p. 50.

If you need help please contact your local distributor. Note serial number of instrument and all diagnostic values before.

Conditions for pH calculation

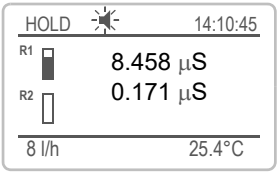
- only 1 alkalization agent (acid-base pair) in the sample (no mixture)
- the contamination is mostly NaCl
- phosphate concentration is < 0.5 ppm
- if pH value is < 8, the concentration of contaminant must be small compared to the concentration of the alkalization agent
- pH value is > 7.5, and < 11.5

Problem	Possible Reason
Cond. value <0.055 µS/cm	◆ Air bubble at sensor tip or sensor in air.
No pH/alkalization agent value available in display, relay, signal output	◆ Switch on calculations in <Installation> / <Sensor> / <Miscellaneous> / <Calculations>. ◆ Afterwards program screen 1 and 2 in <Operation> / <Display> / <Screen 1>, <Screen 2>.

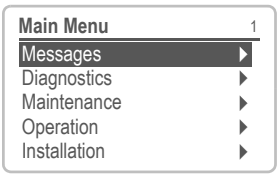
7.1. Error List

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:

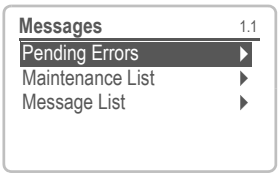
- Errors which disappear if correct measuring conditions are recovered (i.e. Sample Flow low).
  Such Errors are marked **E0xx** (bold and orange)
- Errors which indicate a hardware failure of the instrument.
  Such Errors are marked **E0xx** (bold and red)



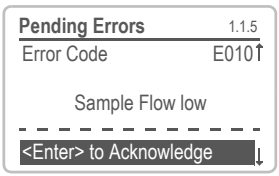
Error or fatal Error
Error not yet acknowledged.
Check **Pending Errors 1.1.5 *** and take corrective action.
Press [ENTER].



Navigate to menu Messages.
Press [ENTER].



Navigate to menu Pending Errors.
Press [ENTER].



Press [ENTER] to acknowledge the Pending Errors. The Error is reset and saved in the Message List.

* Menu numbers see
Program Overview, p. 45

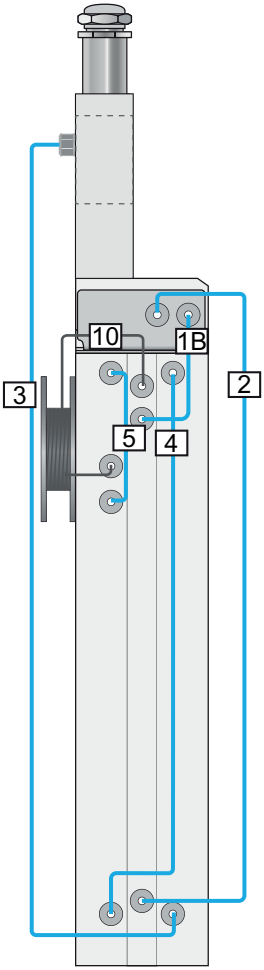
Error	Description	Corrective action
E001	Cond. 1 Alarm high	– check process – check programmed value, see 5.3.1.1, p. 62
E002	Cond. 1 Alarm low	– check process – check programmed value, see 5.3.1.1, p. 62
E003	Cond. 2 Alarm high	– check process – check programmed value, see 5.3.1.1.2.1, p. 63
E004	Cond. 2 Alarm low	– check process – check programmed value, see 5.3.1.1.2.25, p. 63
E007	Temp. 1 Alarm high	– check process – check programmed value, see 5.3.1.1.4, p. 63
E008	Temp. 1 Alarm low	– check process – check programmed value, see 5.3.1.1.4, p. 63
E009	Sample Flow high	– check sample inlet pressure
E010	Sample Flow low	– check sample inlet pressure – check if the following components are clogged: ◆ inlet filter (if installed) ◆ tubes ◆ EDI module – If necessary, replace clogged parts. See Tube numbering, p. 43 and Replacing the EDI module, p. 44.
E011	Temp. 1 shorted	– Check wiring of temperature sensor – Check temperature sensor
E012	Temp. 1 disconnected	– Check wiring of temperature sensor – Check temperature sensor
E013	Case Temp. high	– check case/environment temperature – check programmed value, see 5.3.1.4.1, p. 65

Error	Description	Corrective action
E014	Case Temp. low	– check case/environment temperature – check programmed value, see 5.3.1.4.2, p. 65
E015	pH Calculation undef.	– Calculated pH value < 7.5 or > 11.5
E017	Control time-out	– Check control device or programming in Installation, Relay contact, Relay 1/2 5.3.2 and 5.3.3, p. 66
E019	Temp. 2 shorted	– check wiring of temperature sensor – check temp. sensor
E020	Temp. 2 disconnected	– check wiring of temperature sensor – check temp. sensor
E024	Input active	– See If Fault Yes is programmed in Menu see 5.3.4, p. 70
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	pH Alarm high	– check process – check programmed value, see 5.3.1.1.4.1, p. 63
E034	pH Alarm low	– check process – check programmed value, see 5.3.1.1.4.25, p. 63
E035	Alkali Alarm high	– check process – check programmed value, see 5.3.1.1.5, p. 64
E036	Alkali Alarm low	– check process – check programmed value, see 5.3.1.1.5, p. 64
E037	Temp. 2 Alarm high	– check process – check programmed value, see 5.3.1.2.2.1, p. 64

Error	Description	Corrective action
E038	Temp. 2 Alarm low	– check process – check programmed value, see 5.3.1.2.2.25, p. 64
E043	EDI out of range	– check sample inlet pressure and acknowledge this error message – If the problem persists, stop sample flow and call service
E044	No sample flow	– check sample inlet pressure. – check if the following components are clogged: ◆ inlet filter (if installed) ◆ tubes ◆ EDI module – If necessary, replace clogged parts. See Tube numbering, p. 43 and Replacing the EDI module, p. 44.
E045	EDI DAC disconnected	– Stop sample flow and call service
E046	EDI ADC disconnected	– Stop sample flow and call service
E049	Power-on	– none, normal status
E050	Power-down	– none, normal status
E065	EDI module exhausted	– replace EDI module, see Replacing the EDI module, p. 44.

7.2. Tube numbering

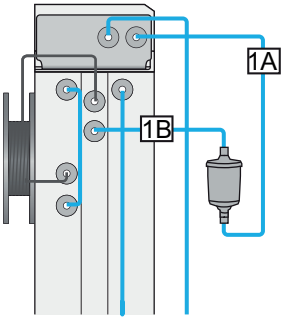
To replace tube no. 10, the EDI module needs to be unmounted. Proceed according to Replacing the EDI module, p. 44 (select <no> at the end of the procedure).



Tube no.	Length
1A*	440 mm
1B	440 mm
2	360 mm
3	530 mm
4	360 mm
5	152 mm
10	2500 mm

*Only needed if the optional inlet filter is installed

Tubing for optional inlet filter:



7.3. Replacing the EDI module

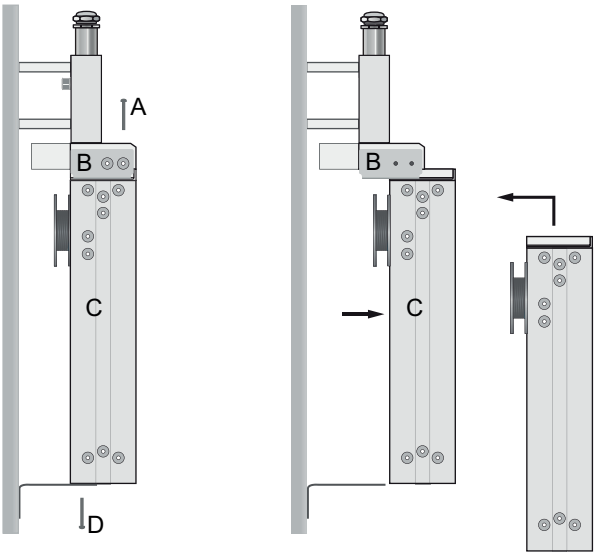
Select Menu 3.3 (Maintenance/Exchange EDI) and follow the instructions on the display.

Status of relays and signal outputs during the procedure:

- Signal outputs are on hold
- All limits are switched off

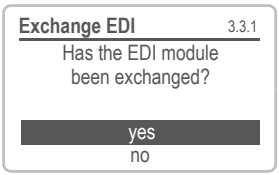
Overview

To unmount the EDI module, unscrew screws [A] and [D] and the upper ends of tubes [1], [2] and [3].



A *Top screws (2x)*
B *Holder*
C *EDI module*
D *Bottom screw*

Totalizers and date of exchange



At the end of the procedure, the user is asked if the EDI module has been exchanged.

If <yes> is selected, the totalizers in the diagnostics menu are reset and the date of exchange is saved.

8. Program Overview

For explanations about each parameter of the menus see Program List and Explanations, p. 50

- 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
Maintenance List 1.2*	*Maintenance List*	1.2.5*	
Message List 1.3*	*Number*	1.3.1*	
	Date, Time		

8.2. Diagnostics (Main Menu 2)

Identification	Designation	AMI CACE		* Menu numbers
2.1*	Version	V6.20-10/16		
	Factory Test	*Instrument*	2.1.4.1*	
	2.1.4*	*Motherboard*		
		Front End		
	Operating Time	*Years / Days / Hours / Minutes / Seconds*		2.1.5.1*
	2.1.5*			
Sensors	**Conductivity**	Sensor 1	*Current value*	2.2.1.1.1*
2.2*	2.2.1*	2.2.1.1*	*Raw value*	
			Cell constant	
		Sensor 2	*Current value*	2.2.1.1.2*
		2.2.1.2*	*Raw value*	
			Cell constant	
	Miscellaneous	Case Temp.	*2.2.2.1**	
	2.2.2*			
	EDI	Actual current	*2.2.3.1**	
	2.2.3*	Actual voltage		
		Total current		
		Total flow		
		Last exchange		
Sample	*Sample ID*	2.3.1*		
2.3*	Sample Flow	*Sample Flow*	2.3.2.1*	
	2.3.2*	*Raw value*		
	Sample Temp.	*Temp.1*	2.3.3.1*	
	2.3.3*	*(Pt1000)*		
		Temp.2		
		(Pt1000)		
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*	*Device Address*			
	Baud Rate			(only with RS485
	Parity			interface)

8.3. Maintenance (Main Menu 3)

Simulation	*Alarm Relay*	3.1.1*	*Menu numbers
3.1*	*Relay 1*	3.1.2*	
	Relay 2	3.1.3*	
	Signal Output 1	3.1.4*	
	Signal Output 2	3.1.5*	
Exchange EDI			
3.2*			
Set time	*(Date), (Time)*		
3.3*			

8.4. Operation (Main Menu 4)

Sensors	*Filter Time Const.*	4.1.1*		
4.10*	*Hold after Cal*	4.1.2*		
Relay Contacts	**Alarm Relay**	**Cond. 1 (sc)**	*Alarm High*	4.2.1.1.1*
4.2*	4.2.1*	4.2.1.1*	*Alarm Low*	4.2.1.1.25*
			Hysteresis	4.2.1.1.35*
			Delay	4.2.1.1.45*
		Cond. 2 (cc)	*Alarm High*	4.2.1.2.1*
		4.2.1.2*	*Alarm Low*	4.2.1.2.25*
			Hysteresis	4.2.1.2.35*
			Delay	4.2.1.2.45*
	Relay 1 / 2	*Parameter*		
	4.2.2* / 4.2.3*	*Setpoint*	4.2.x.200*	
		Hysteresis	4.2.x.300*	
		Delay	4.2.x.40*	
	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*		* Menu numbers
Display	**Screen 1**	Row 1	4.4.1.1*	
4.4*	4.4.1*	Row 2	4.4.1.2*	
		Row 3	4.4.1.3*	
	Screen 2	Row 1	4.4.2.1*	
	4.4.2*	Row 2	4.4.2.2*	
		Row 3	4.4.2.3*	

8.5. Installation (Main Menu 5)

Sensors	**Miscellaneous**	*Calculations*	5.1.1.1*		
5.1*	*5.1.1**	*Maes. unit*	5.1.1.2*		
	Sensor parameters	**Sensor 1**	Cell Constant	5.1.2.1.1*	
	5.1.2*	5.1.2.1*	Temp. Corr.	5.1.2.1.2*	
			Cable length	5.1.2.1.3*	
			Temp. comp.	*Comp.*	
			5.1.2.1.5*	5.1.2.1.5.1*	
		Sensor 2	Cell Constant	5.1.2.2.1*	
		5.1.2.2*	Temp. Corr.	5.1.2.2.2*	
			Cable length	5.1.2.2.3*	
			Temp. comp.	*Comp.*	
			5.1.2.2.5*	5.1.2.2.5.1*	
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**	**Conductivity**	**Cond. 1 (sc)**	*Alarm High*	5.3.1.1.1.1*
5.3*	5.3.1*	5.3.1.1*	*5.3.1.1.1**	*Alarm Low*	5.3.1.1.1.25*
				*Hysteresis**	5.3.1.1.1.35
				Delay	5.3.1.1.1.45*
			Cond. 2 (cc)	*Alarm High*	5.3.1.1.2.1*
			*5.3.1.1.2**	*Alarm Low*	5.3.1.1.2.25*
				*Hysteresis**	5.3.1.1.2.35
				Delay	5.3.1.1.2.45*
		Sample Temp.	**Temp. 1**	*Alarm High*	5.3.1.2.1.1*
		5.3.1.2*	5.3.1.2.1*	*Alarm Low*	5.3.1.2.1.25*
			Temp. 2	*Alarm High*	5.3.1.2.2.1*
			5.3.1.2.2*	*Alarm Low*	5.3.1.2.2.25*
		Case Temp.	Alarm High	5.3.1.4.1*	
		5.3.1.3*	*Alarm low*	5.3.1.4.2*	

	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*		
5.5*	*Device Address*	5.5.21*		
	Baud Rate	5.5.31*		(only with RS485 interface)
	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 Maintenance List

1.2.5 Provides the list of necessary maintenance. Cleared maintenance messages are moved to the Message list.

1.3 Message List

1.3.1 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. V6.20-10/16)

2.1.4 **Factory Test**: Test date of the Instrument, Motherboard and Frontend

2.1.5 **Operating Time:** Years / Days / Hours / Minutes / Seconds

2.2 Sensors

2.2.1 **Conductivity**:

2.2.1.1 **Sensor 1**: Shows the
Current value in µS
Raw value in µS
Cell Constant

2.2.1.2 **Sensor 2**: Shows the
Current value in µS
Raw value in µS
Cell Constant

2.2.2 **Miscellaneous**:

2.2.2.1 *Case Temp:* Shows the current temperature in [°C] inside the transmitter.

2.2.3 **EDI**:

2.2.3.1 *Actual current:* Current in mA applied to the EDI module.

Actual voltage: Resulting voltage in mV.

Total current: Amount of electric charge in Ah since the last exchange of the EDI module.

Total flow: Amount of sample water in L since the last exchange of the EDI module.

Last exchange: Date of the last exchange.

2.3 Sample

2.3.1 *Sample ID:* Shows the identification assigned to a sample. This identification is defined by the user to identify the location of the sample.

2.3.2 **Sample Flow**: Shows the current sample flow in l/h and the Raw Value in Hz.

The Sample flow must be above 2.5 l/h.

2.3.3 Sample Temp:

2.3.3.1 *Temp 1:* Shows the current sample temperature at sensor 1 in °C.

(Pt 1000): Shows the current temperature at sensor 1 in Ohm.

Temp 2: Shows the current temperature at sensor 2 in °C.

(Pt 1000): Shows the current temperature at sensor 2 in Ohm.

2.4 I/O State

Shows current status of all in- and outputs.

2.4.1/2.4.2

Alarm Relay:	Active or inactive.
Relay 1/2:	Active or inactive.
Input:	Open or closed.
Signal Output 1/2:	Actual current in mA
Signal Output 3:(optional)	Actual current in mA

2.5 Interface

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

3 Maintenance

3.1 Simulation

To simulate a value or a relay state, select

- alarm relay
- relay 1/2
- signal output 1/2

with the [▲] or [▼] key.

Press the <Enter> key.

Change the value or state of the selected item with the [▲] or [▼] key.

Press the <Enter> key.

⇒ *The value is simulated by the relay/signal output.*

Alarm Relay:	Active or inactive
Relay 1/2:	Active or inactive
Signal Output 1/2:	Actual current in mA
Signal Output 3 (optional)	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.

3.2 Exchange EDI

See Replacing the EDI module, p. 44.

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. 22

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, measured value uncompensated, temperature, flow.
Range: 1 Second to 1 hour

4.3.1 *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

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

4.3.3 *Eject USB Stick*: With this function all logger data are copied to the USB stick before the USB stick is deactivated.
Only visible it the optional USB interface is installed.

4.4 Display

Process values are displayed on two screens. Toggle screens with the [▲] key. Each screen displays max. 3 process values.

4.4.1 Screen 1

4.4.1.1 Row 1

4.4.1.2 Row 2

4.4.1.3 Row 3

Possible settings for all rows are:

- None
- Cond 1 (sc)
- Cond 2 (cc)
- Difference
- pH (if <Calculations> = yes)
- Ammonia (depends on the settings in <Sensor parameters>/ <Temp. comp.>)

4.4.2 Screen 2

Same as screen 1.

5 Installation

5.1 Sensors

5.1.1 Miscellaneous

5.1.1.1 *Calculations:* Select “yes” if pH and ammonia concentrations should be calculated. pH and ammonia are now available on screen 1 or 2, on the signal outputs and as alarm or limit values.

5.1.1.2 *Meas. unit:* Choose the measuring unit as µS/cm or µS/m

5.1.2 Sensor parameters

5.1.2.1 Sensor 1

5.1.2.1.1 *Cell Constant*: Enter the cell constant printed on the sensor label.
Range: 0.0300 cm^{-1} to 0.0600 cm^{-1}

5.1.2.1.2 *Temp. Corr*: Enter the temperature correction printed on the sensor label.
Range: -1 °C to 1 °C

5.1.2.1.3 *Cable length*: Enter the cable length. If the flow cell is installed on the monitor, set the cable length to 0.0 m.
Range: 0.0 m to 30.0 m

5.1.2.1.5 Temp. comp

5.1.2.1.5.1 *Comp.*: Available compensation models:

- Strong acids (Never select strong acids for sensor 1!)
- Strong bases
- Ammonia
- Morpholine
- Ethanolamines
- Neutral salts
- High purity water
- Coefficient
- none

5.1.2.2 Sensor 2

5.1.2.2.1 *Cell Constant*: Enter the cell constant printed on the sensor label.
Range: 0.0300 cm^{-1} to 0.0600 cm^{-1}

5.1.2.2.2 *Temp. Corr*: Enter the temperature correction printed on the sensor label.
Range: -1 °C to 1 °C

5.1.2.2.3 *Cable length*: Enter the cable length. If the flow cell is installed on the monitor, set the cable length to 0.0 m.
Range: 0.0 m to 30.0 m

5.1.2.2.5 **Temp. comp**:

5.1.2.2.5.1 *Comp.*: Available compensation models:

- Strong acids

5.2 Signal Outputs

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

5.2.1 **Signal Output 1:** 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:

- Cond 1 (cc)
- Cond 2 (sc)
- Temp. 1
- Temp. 2
- Difference
- Sample flow
- pH
- Ammonia

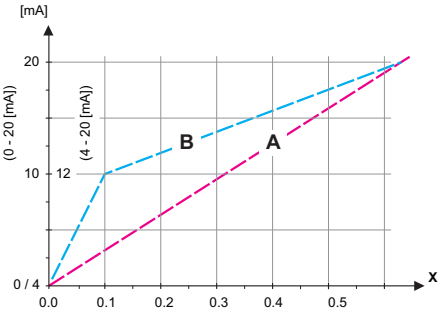
5.2.1.2 *Current Loop:* Select the current range of the signal output. Make sure the connected device works with the same current range.
Available ranges: 0–20 mA or 4–20 mA

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:

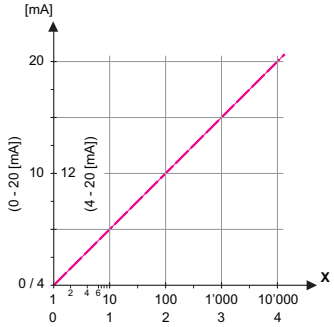
- Linear, bilinear or logarithmic for process values.
See As process values, p. 57
- Control upwards or control downwards for controllers.
See As control output, p. 59

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 Cond. 1(sc):
5.2.1.40.10	Range low: 0.000–3000 µS
5.2.1.40.20	Range high: 0.000–3000 µS
	Parameter Cond. 2(cc):
5.2.1.40.11	Range low: 0.000–3000 µS
5.2.1.40.21	Range high: 0.000–3000 µS
	Parameter Temp. 1
5.2.1.40.13	Range low: -25 to +270 °C
5.2.1.40.23	Range high: -25 to +270 °C
	Parameter Temp. 2
5.2.1.40.14	Range low: -25 to +270 °C
5.2.1.40.24	Range high: -25 to +270 °C
	Parameter Difference
5.2.1.40.16	Range low: 0.000–3000 µS
5.2.1.40.26	Range high: 0.000–3000 µS
	Parameter Sample flow
5.2.1.40.17	Range low: 0.0–20 l/h
5.2.1.40.27	Range high: 0.0–20 l/h
	Parameter pH
5.2.1.40.18	Range low: 0.00–14 pH
5.2.1.40.28	Range high: 0.00–14 pH
	Parameter Ammonia
5.2.1.40.19	Range low: 0.00–500 ppm
5.2.1.40.29	Range high: 00.0–500 ppm

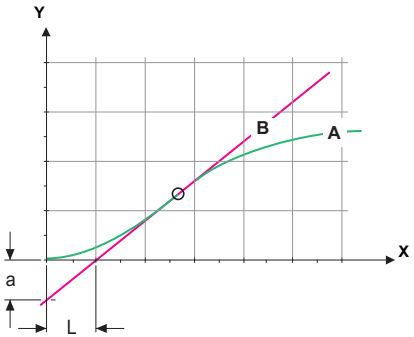
As control output

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.

Control upwards or 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.

5.2.1.40 **Control Parameters:** if Parameters = Cond. 1(sc)

5.2.1.40.10 Setpoint
Range: 0.000–3000 µS

5.2.1.40.20 P-Band:
Range: 0.000–3000 µS

5.2.1.40 **Control Parameters:** if Parameters = Cond. 2(cc)

5.2.1.40.11 Setpoint
Range: 0.000–3000 µS

5.2.1.40.21 P-Band:
Range: 0.000–3000 µS

5.2.1.40 **Control Parameters:** if Parameters = Temp.1

5.2.1.40.13 Setpoint
Range: -25 to +270 °C

5.2.1.40.23 P-Band:
Range: -25 to +270 °C

5.2.1.40 **Control Parameters:** if Parameters = Temp. 2

5.2.1.40.14 Setpoint
Range: -25 to +270 °C

5.2.1.40.24 P-Band:
Range: -25 to +270 °C

5.2.1.40 **Control Parameters:** if Parameters = Difference

5.2.1.40.16 Setpoint
Range: 0.000–3000 µS

5.2.1.40.26 P-Band:
Range: 0.000–3000 µS

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

5.2.1.40.17 Setpoint
Range: 0.0–20 l/h

5.2.1.40.27 P-Band:
Range: 0.0–20 l/h

5.2.1.40 **Control Parameters:** if Parameters = pH

5.2.1.40.18 Setpoint
Range: 0.00–14 pH

5.2.1.40.28 P-Band:
Range: 0.00–14 pH

5.2.1.40 **Control Parameters:** if Parameters = Ammonia

5.2.1.40.19 Setpoint
Range: 0.00–500 ppm

5.2.1.40.29 P-Band:
Range: 0.00–500 ppm

5.2.1.40.3 *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

5.2.1.40.4 *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

5.2.1.40.5 *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, hysteresis values and delay times for the following parameters:

- Cond.1 (sc)
- Cond.2 (cc)
- pH
- Ammonia
- Sample Temp. 1
- Sample Temp. 2
- Case Temperature low

5.3.1.1 Conductivity

5.3.1.1.1 Cond. 1 (sc)

5.3.1.1.1.1 *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: 0.000–3000 µS

5.3.1.1.1.25 *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.
Range: 0.000–3000 µS

5.3.1.1.1.35 *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.
Range. 0.000–3000 µS

5.3.1.1.1.45 *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

5.3.1.1.2 Cond. 2 (cc)

5.3.1.1.2.1 *Alarm High:* If the measured value rises above the alarm high value, the alarm relay is activated and E003, is displayed in the message list.
Range: 0.000 –3000 µS

5.3.1.1.2.25 *Alarm Low:* If the measured value falls below the alarm low value, the alarm relay is activated and E004 is displayed in the message list.
Range: 0.000 –3000 µS

5.3.1.1.2.35 *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.
Range. 0.000 –3000 µS

5.3.1.1.2.45 *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

5.3.1.1.4 pH (if Calculations = yes)

5.3.1.1.4.1 *Alarm High:* If the measured value rises above the alarm high value, the alarm relay is activated and E033, is displayed in the message list.
Range: 0.00–14 pH

5.3.1.1.4.25 *Alarm Low:* If the measured value falls below the alarm low value, the alarm relay is activated and E034 is displayed in the message list.
Range: 0.00–14 pH

5.3.1.1.4.35 *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.
Range: 0.00–14 pH

5.3.1.1.4.45 *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

5.3.1.1.5 **Ammonia** (if Calculations = yes)

5.3.1.1.5.1 *Alarm High:* If the measured value rises above the alarm high value, the alarm relay is activated and E035 is displayed in the message list.
Range: 0.00–500 ppm

5.3.1.1.5.25 *Alarm Low:* If the measured value falls below the alarm low value, the alarm relay is activated and E036 is displayed in the message list.
Range: 0.00–500 ppm

5.3.1.1.5.35 *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.
Range: 0.00–500 ppm

5.3.1.1.5.45 *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 Temp.**

5.3.1.2.1 **Temp. 1**

5.3.1.2.1.1 *Alarm High:* If the measured value rises above the alarm high value, the alarm relay is activated and E007, is displayed in the message list.
Range: 30–200 °C

5.3.1.2.1.25 *Alarm Low:* If the measured value falls below the alarm low value, the alarm relay is activated and E008 is displayed in the message list.
Range: -10 to +20 °C

5.3.1.2.2 **Temp. 2**

5.3.1.2.2.1 *Alarm High:* If the measured value rises above the alarm high value, the alarm relay is activated and E037, is displayed in the message list.
Range: 30–200 °C

5.3.1.2.2.25 *Alarm Low:* If the measured value falls below the alarm low value, the alarm relay is activated and E038 is displayed in the message list.
Range: -10 to +20 °C

5.3.1.4 Case Temp.

5.3.1.4.1 *Alarm 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

5.3.1.4.2 *Alarm low:* Set the alarm low value for temperature of electronics housing. If the value falls below the programmed value E014 is issued.
Range: -10 to +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 is defined by the user.

NOTICE: *The navigation in the menu <Relay 1> and <Relay 2> is equal. 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 Enter the necessary data depending on the selected function. The same values can also be entered in menu 4.2 Relay Contacts, p. 53

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
Cond. 1 (sc)	0–3000 µS
Cond. 2 (cc)	0–3000 µS
Temp. 1	-25 to +270 °C
Temp. 2	-25 to +270 °C
Difference	0–3000 µS
Sample flow	0–20 l/h
pH	0–14 pH
Ammonia	0–500 ppm

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
Cond. 1 (sc)	0–3000 µS
Cond. 2 (cc)	0–3000 µS
Temp. 1	0–100 °C
Temp. 2;	0–100 °C
Difference	0–3000 µS
Sample flow	0–20 l/h
pH	0–14 pH
Ammonia	0–500 ppm

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.

- Cond.1 (sc)
- Cond.2 (cc)
- Temp. 1
- Temp. 2
- Difference
- Sample Flow
- pH
- Ammonia

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 5.2.1.40, p. 60

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 5.2.1.40, p. 60

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 5.2.1.40, p. 60

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)
5.3.2.340	Interval/Start time/Calendar: Dependent on options operating mode.
5.3.2.44	*Run time:* 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 the behavior of the signal outputs when the relay closes. Available values: cont., hold, off
5.3.2.7	*Output/Control:* select the behavior of the control outputs when the relay closes. Available values: cont., hold, off

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.
Available settings: German / English / French / Spanish / Italian

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

- **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.

5.4.4 **Password:** Select a password different from 0000 to prevent unauthorized access to the menus “Messages”, “Maintenance”, “Operation” and “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 meaningful text, such as KKS number.

5.4.6 *Line Break Detection*: Define if message E028 should be issued in case of a line break on signal output 1 or 2.

Choose between <Yes> or <No>.

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 No.:	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**

5.5.24	Device address:	Range: 0–63

10. Default Values

Operation:

Sensors:	Filter Time Const.: ..... 20 Sec
	Hold after Cal.: ..... 0 sec
Relay Contacts	Alarm Relay ..... same as in Installation
	Relay 1/2 ..... same as in Installation
	Input ..... same as in Installation
Logger:	Logger Interval: ..... 30 Minutes
	Clear Logger: ..... no
Display:	Screen 1 and 2; Row 1: ..... Cond 1(sc)
	Screen 1 and 2; Row 2: ..... Cond 2(cc)
	Screen 1 and 2; Row 3: ..... None

Installation:

Sensors	Miscellaneous; Calculations: ..... no
	Miscellaneous; Meas. unit ..... µS/cm
	Sensor Parameters; Sensor 1 and 2;Cell Constant..... 0.0415 cm^{-1}
	Sensor Parameters; Sensor 1 and 2; Temp. corr. ..... 0.00 °C
	Sensor Parameters; Sensor 1 and 2; Cable length ..... 0.0 m
	Sensor Parameters; Sensor 1; Temp. comp.; Comp: ..... Ammonia
	Sensor Parameters; Sensor 2; Temp. comp.; Comp: ... Strong Acids
Signal Output 1	Parameter: ..... Cond 1(sc)
	Current loop: ..... 4 –20 mA
	Function: ..... linear
	Scaling: Range low: ..... 0.000 µS
	Scaling: Range high: ..... 1000.00 µS
Signal Output 2	Parameter: ..... Cond 2(cc)
	Current loop: ..... 4 –20 mA
	Function: ..... linear
	Scaling: Range low: ..... 0.000 µS
	Scaling: Range high: ..... 1000.00 µS
Alarm Relay:	Conductivity; Cond. 1 (sc) and Cond. 2 (cc):
	Alarm high: ..... 3000.00 µS
	Alarm low: ..... 0.000 µS
	Hysteresis: ..... 10.0 µS
	Delay: ..... 5 Sec
	Sample Temp: (Temp. 1 and Temp. 2)
	Alarm High: ..... 160 °C
	Alarm Low: ..... 0 °C

	Case temp. high: 65 °C
	Case temp. low: 0 °C
Relay 1/2	Function: limit upper
	Parameter: Relay 1: Cond 1(sc), Relay 2: Cond 2(cc)
	Setpoint: 1000 µS
	Hysteresis: 10 µS
	Delay: 30 Sec
	If Function = Control upw. or dnw:
	Parameter: Relay 1: Cond 1(sc), Relay 2: Cond 2(cc)
	Settings: Actuator: Frequency
	Settings: Pulse Frequency: 120/min.
	Settings: Control Parameters: Setpoint: 1000 µS
	Settings: Control Parameters: P-band: 10 µS
	Settings: Control Parameters: Reset time: 0 Sec
	Settings: Control Parameters: Derivative Time: 0 Sec
	Settings: Control Parameters: Control Timeout: 0 Min.
	Settings: Act. Time prop.: Cycle time: 60 s
	Settings: Act. Time prop.: Response time: 10 s
	Settings: Act. Motor valve: Run time: 60 s
	Settings: Act. Motor valve: Neutral zone: 5%
	If Function = Timer:
	Mode: Interval: 1 min.
	Mode: daily/weekly: Starting time: 00.00.00
	Run time: 10 Sec
	Delay: 5 Sec
	Signal output: cont.
	Output/Control: cont
Input:	Active when closed
	Signal Outputs hold
	Output/Control off
	Fault no
	Delay 10 Sec

Miscellaneous	Language:	English
	Set default:	no
	Load firmware:	no
	Password:	for all modes 0000
	Sample ID:	- - - - - - - - - - -
	Line break detection	no
Interface	Protocol:	depending on installed interface

11. Index

12. Notes

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