ANALYTICAL INSTRUMENTS

A-96.250.851 / 031120

Operator’s Manual

Firmware V6.22 and higher

SWISS MADE

AMI SAC254

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Table of Contents

AMI SAC254–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.

2. Product Description

2.1. Description of the System

Application

The AMI SAC254 is a complete monitoring system for the continuous measurement of UV absorption at 254 nm for organic carbon trending in potable water and waste water effluent.
It includes an optional turbidity correction according to DIN EN 38404-3.

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 used as normally open or normally closed.
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).

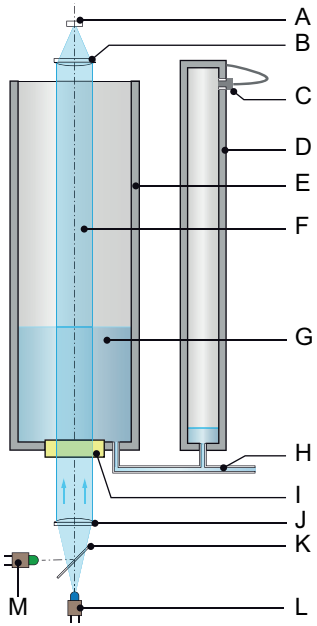
Communication interface (optional)

- third signal output
- a Profibus or Modbus connection
- a HART connection
- a USB Interface

Safety Features

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

Measuring Principle



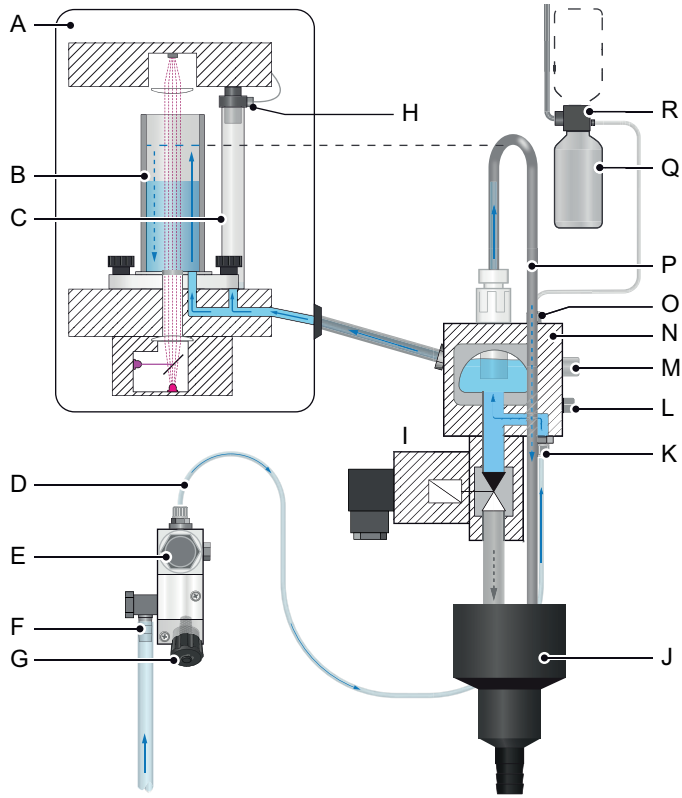
A *Photodiode*
B *Lens*
C *Tube connection to pressure sensor*
D *Pressure tube*
E *Cuvette*
F *Light beam*
G *Sample*
H *Sample inlet*
I *Quartz window*
J *Lens*
K *Beam splitter 45°*
L *UV LED (254 nm)*
M *Green LED (550 nm)*

The AMI SAC254 is equipped with a two-wavelength photometer with one optical channel. The light beam [F] irradiates the cuvette [E] through the quartz window [I] from bottom to top.
The sample enters the cuvette [E] and the pressure tube [D] from the bottom. The water level in the cuvette is calculated from the pressure difference inside and outside the pressure tube [D].
During a filling cycle, the transmitted light intensity is continuously measured as a function of the filling height. From the evaluation of this logged curve results the Spectral Absorption Coefficient SAC.
When the cuvette is completely filled, it is emptied automatically through a siphon tube.

Fouling compensation

Due to measuring at multiple water levels, the measurement does not depend on the initial intensity I_0 of the light source. Instead, only the change of absorption in relation to the changing water level is taken into account. This makes the instrument insensitive to fouling and aging of optical components.

Fluidics



A *Photometer unit*
B *Cuvette*
C *Pressure tube*
D *Capillary tube*[1)]
E *Pressure reducing valve*[1)]
F *Flow controller sample inlet*[1)]
G *Inlet strainer*[1)]
H *Tube connection to pressure sensor*
I *Magnetic valve*
J *Waste funnel*
K *Instrument sample inlet*
L *Blind plug / inlet for optional cleaning module*
M *Grab sample valve*
N *Flow cell block*
O *Grab sample inlet*
P *Siphon*
Q *Grab sample bottle*
R *Grab sample holder*

[1)] If flow controller option is installed

Online operation

If the optional flow controller is installed, the sample enters at sample inlet [F], flows through the inlet strainer [G], the pressure reducing valve [E] and the capillary tube [D]. Otherwise, the sample enters directly at sample inlet [K].
From there, the sample flows into the

- siphon tube [P],
- pressure tube [C] and
- cuvette [B].

The water level in the cuvette is calculated from the pressure difference inside and outside the pressure tube.
The measurement of UV absorption takes place while the cuvette is being filled. During this time, the change of absorption in relation to the raising water level is measured. Shortly before the upper end of the cuvette is reached, the instrument is automatically emptied through the siphon tube and a new filling cycle begins.
The instrument is emptied via the magnetic valve [I] when

- there is no sample flow,
- during calibration, verification or grab sample measurement,
- when selecting the <Empty system> menu item.

Grab sample

Grab sample functionality for manual measurement, verification and calibration.
See Grab Sample, p. 37.

Calibration

Correlation of the UV absorbance to organic carbon related parameters (DOC, TOC, BOD, etc.) via one-point or two-point calibration or manual configuration of the correlation parameters.
If necessary, a calibration of the absorbance measurement is also possible, e.g. to adjust the values measured by the AMI SAC254 relative to a reference instrument.
See Calibration, p. 41.

Verification

Certified standard solution available for instrument verification.
See Verification, p. 45.

Flow controller

Optional accessory to protect the instrument from occasional particles and to adjust the flow rate. The option consists of inlet strainer [G], pressure reducing valve [E] and capillary tube [D].

Cleaning Module-II

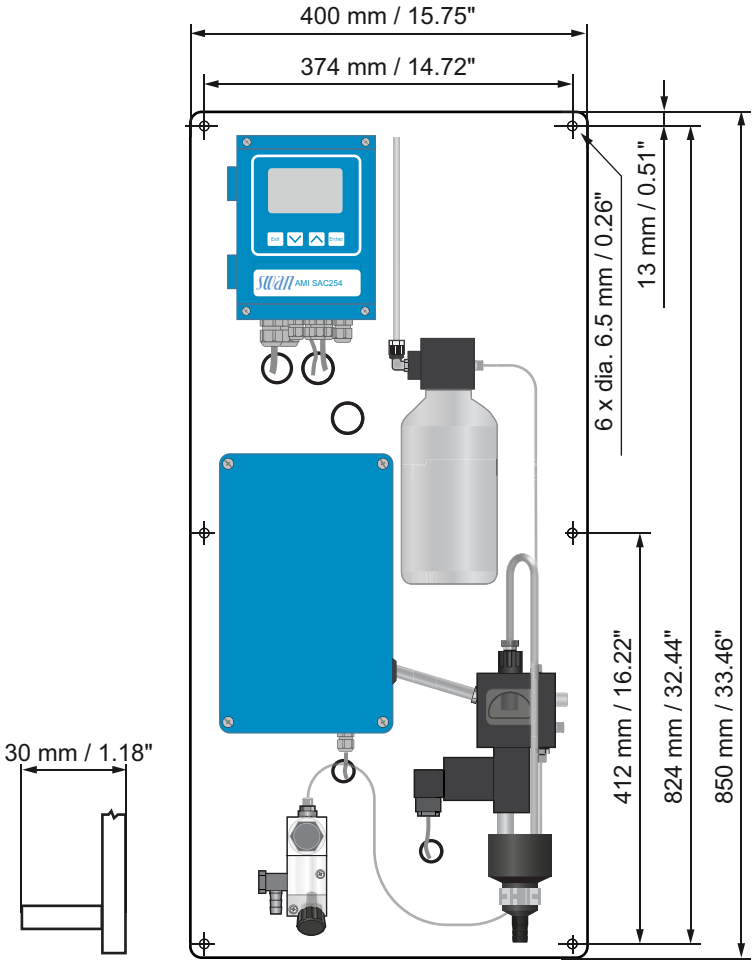
Optional module for automatic chemical cleaning.

2.2. Instrument Specifications

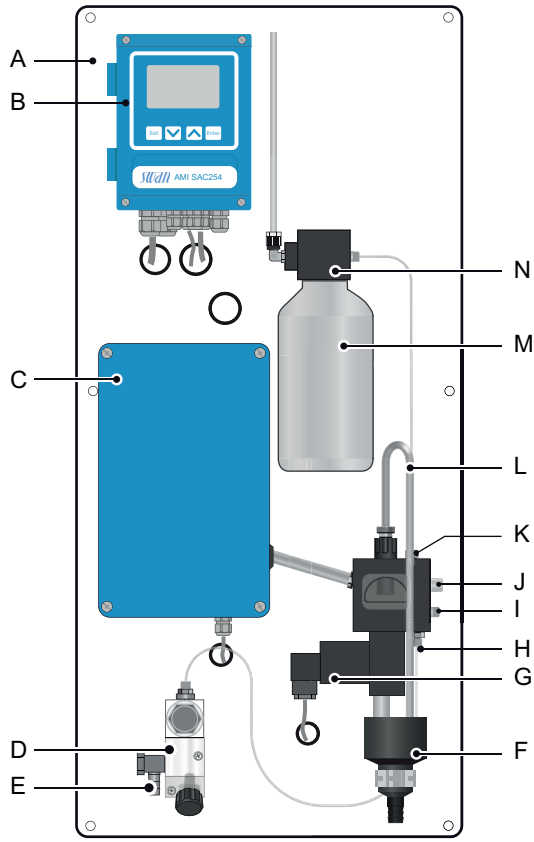
Power Supply	AC variant:	100–240 VAC (± 10%) 50/60 Hz (± 5%)
	DC variant	10–36 VDC
	Power consumption:	max. 35 VA
Transmitter specifications	Housing:	aluminum, with a protection degree of IP 66 / NEMA 4X
	Ambient temperature:	−10 to +50 °C
	Storage and transport:	−30 to +85 °C
	Humidity:	10–90% rel., non condensing
	Display:	backlit LCD, 75 x 45 mm
Measuring	UV absorption measurement at 254 nm in accordance with DIN 38404-3.	
	Measuring range:	0 to 300 /m absorbance 0 to 100% UV transmission
	Parameter	SAC254, UV transmission, concentration
	Wavelength:	254 nm (550 nm for turbidity correction)
	Dimension:	/m, /cm
	Measuring interval:	30 s to 3 min
	Precision	+/- (1% + 0.01 /m)
Sample requirements	Flow rate:	2 to 12 l/h
	Temperature:	5 to 30 °C (not higher than ambient temperature)
	Sample inlet pressure:	0.5 to 10 bar with flow controller option
	Sample outlet pressure:	pressure free
	Prefiltration recommended in case of high particle load. No oil. Install in a vibration free environment.	
On-site requirements	The analyzer site must permit connections to:	
	Sample inlet:	Ø 10 mm tube; hose nozzle with 1/4” thread (instrument) or 1/8” thread (flow controller)
	Sample outlet:	Ø 20 mm tube
	No vibrations, no shocks.	

Dimensions

Panel:	PVC
Dimensions:	400x850x150 mm
Screws:	5 mm or 6 mm diameter
Weight:	12 kg



2.3. Instrument Overview



A *Panel*
B *Transmitter*
C *Photometer unit*
D *Flow controller (option)*
E *Sample inlet of flow controller*
F *Waste funnel*
G *Magnetic valve*
H *Sample inlet of instrument*
I *Inlet for optional cleaning module*
J *Grab sample valve*
K *Grab sample inlet*
L *Siphon*
M *Grab sample bottle*
N *Grab sample holder*

3. Installation

3.1. Installation Checklist

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 Specifications, p. 13).
Installation	Mounting of Instrument Panel, p. 17. Connecting Sample and Waste, p. 17. Aligning the Photometer, p. 19.
Electrical wiring	◆ Connect all external devices like limit switches, current loops and pumps, see Connection Diagram, p. 22. ◆ Connect the power cord, see Power Supply, p. 23.
Power-up	◆ Establish Sample Flow, p. 30. ◆ Switch on power. ◆ Adjust sample flow.

Instrument set-up	◆ Program all necessary parameters, see Programming, p. 30.
	◆ Program all parameters for external devices (interface, recorders, etc.).
	◆ Program all parameters for instrument operation (limits, alarms).
	◆ Set all necessary sensor parameters in menu 5.1 <Installation>/<Sensors>:
	  ◆ Optical path length
	  ◆ Moving average
	  ◆ Name of the concentration parameter (e.g. DOC)
	  ◆ Turbidity correction <yes> or <no>
	◆ Perform a local calibration, see Calibration, p. 41.

3.2. Mounting of Instrument Panel

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

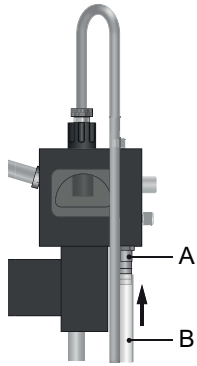
- The instrument must only be installed by trained personnel.
- Exactly align the instrument in vertical and horizontal position.
- For ease of operation mount it so that the display is at eye level.
- For the installation a kit containing the following installation material is available:
  - 6 Screws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

Mounting requirements

The instrument is only intended for indoor installation.
The location has to be free from vibrations and shocks.
Instrument Specifications, p. 13.

3.3. Connecting Sample and Waste

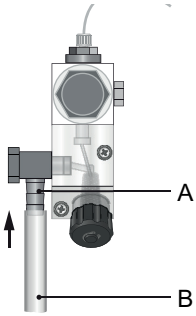
Sample inlet (without flow controller)



A *Hose nozzle with 1/4" thread*
B *10 mm tube*

Connect a 10 mm tube to the hose nozzle [A].

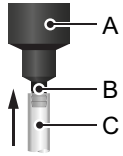
Sample inlet (with flow controller)



A *Hose nozzle with 1/8" thread*
B *10 mm tube*

Connect a 10 mm tube to the hose nozzle [B].

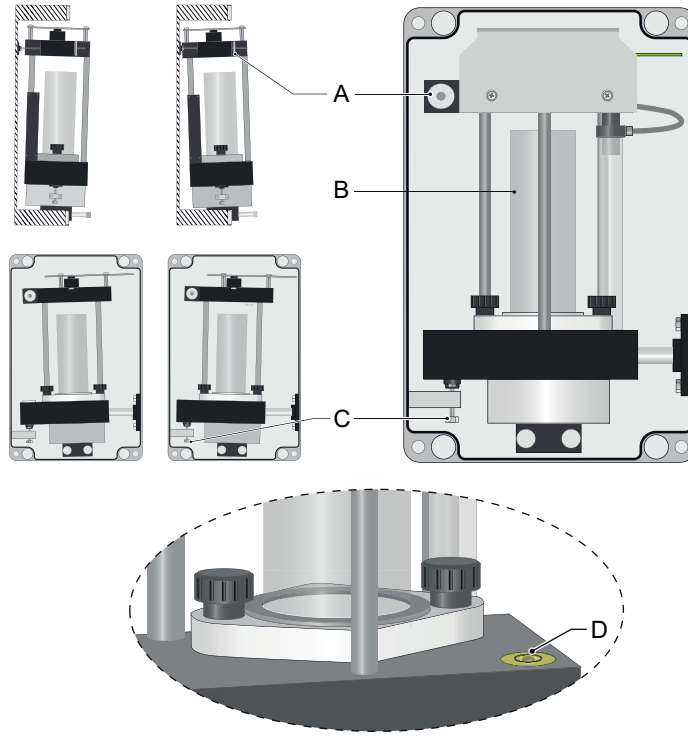
Waste



A *Waste funnel*
B *Hose nozzle*
C *20 mm tube*

Connect a 20 mm tube [C] to the hose nozzle [B] and place it into a pressure free drain.

3.4. Aligning the Photometer



A *Horizontal adjustment screw*
B *Cuvette*
C *Vertical adjustment screw*
D *Spirit level*

After installation, align the photometer using screws [A] and [C].

3.5. Electrical Connections

WARNING

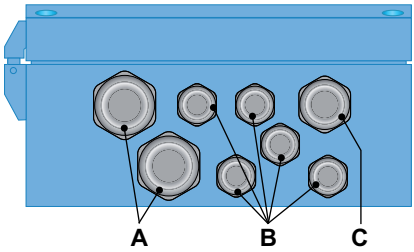
Risk of electrical shock.

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 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*

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

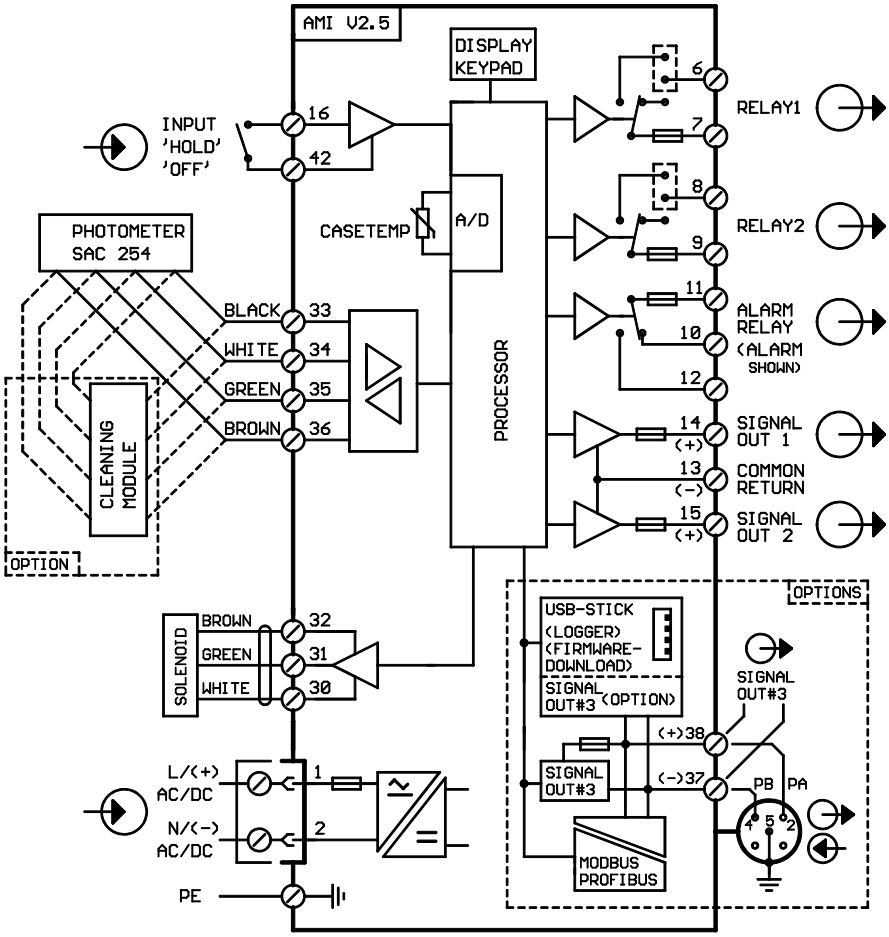
WARNING

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

WARNING

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

3.5.1 Connection Diagram



CAUTION

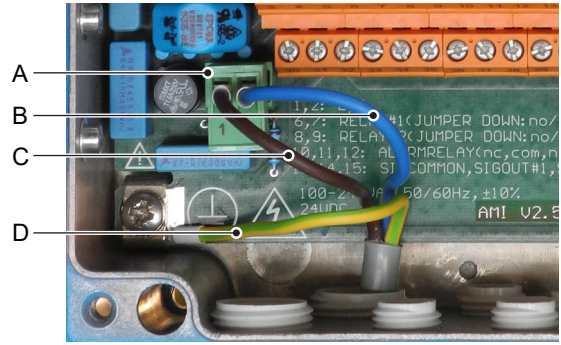
Use only the terminals shown in this diagram, and only for the mentioned purpose. Use of any other terminals will cause short circuits with possible corresponding consequences to material and personnel.

3.5.2 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 SAC254

3.6. Relay Contacts

Programming of the relay contacts see 5.3 Relay Contacts, p. 74

3.6.1 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.

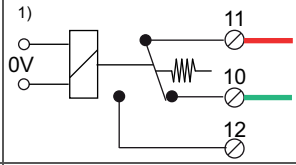
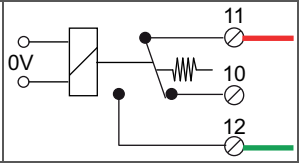
For programming see menu 5.3.4, p. 80.

3.6.2 Alarm Relay

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

Alarm output for system errors.
Error codes see Troubleshooting, p. 47
Programming see menu 5.3.1, p. 74

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.	

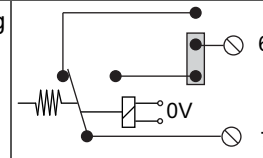
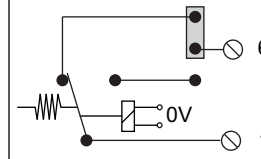
1) *usual use*

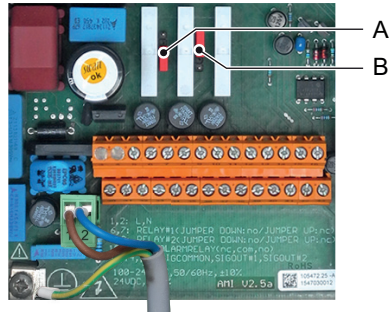
3.6.3 Relay Contacts 1 and 2

Note: *Rated load 1 AT / 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

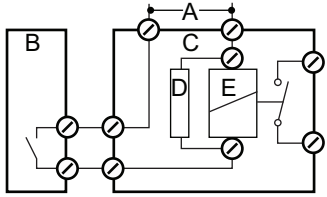
Risk of damage of the relays in the AMI Transmitter due to heavy inductive load.

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

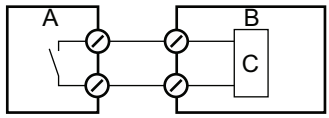
Small inductive loads (max 0.1 A) as for example the coil of a power relay can be switched directly. To avoid noise voltage in the AMI Transmitter it is mandatory to connect a snubber circuit in parallel to the load. A snubber is not necessary if an AMI relaybox is used.



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

Resistive load

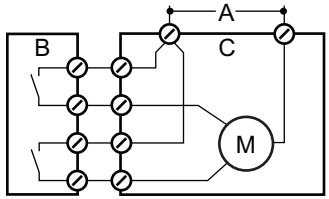
Resistive loads (max. 1 A) and control signals for PLC, impulse pumps and so on can be connected without further measures



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*

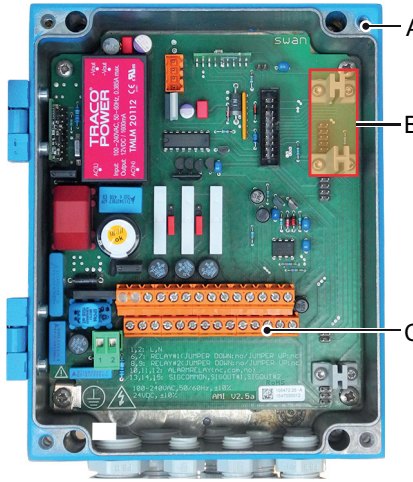
3.7. Signal Outputs

3.7.1 Signal Output 1 and 2 (current outputs)

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 Chapter 9, 5.2 Signal Outputs, p. 70, Menu Installation

3.8. Interface Options



A *AMI Transmitter*
B *Slot for interfaces*
C *Screw terminals*

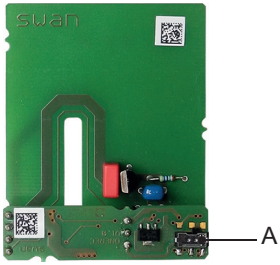
The slot for interfaces can be used to expand the functionality of the AMI instrument with either:

- a third signal output
- a Profibus or Modbus connection
- a HART connection
- a 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.

Note: *Max. burden 510 Ω.*



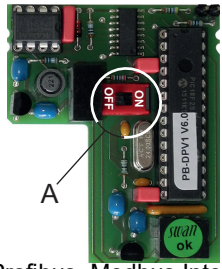
Third signal output 0/4 - 20 mA PCB

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.

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

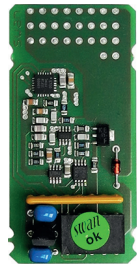


Profibus, Modbus Interface PCB (RS 485)

A *On - OFF switch*

3.8.3 HART Interface

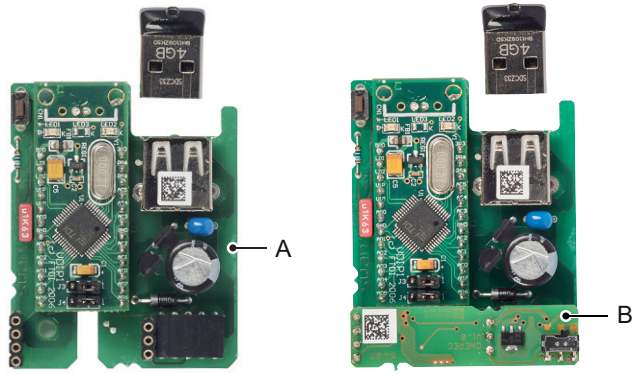
Terminals 38 (+) and 37 (-).
The HART interface PCB allows for communication via the HART protocol. For detailed information, consult the HART manual.



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

4.1. Establish Sample Flow

1 Start sample flow. Set the flow rate according to Instrument Specifications, p. 13.

2 Switch on power.

4.2. Programming

Set all necessary sensor parameters in menu 5.1 <Installation>/ <Sensors>. For further information see 5.1 Sensors, p. 69.

- Optical path length
- Moving average
- Name of the concentration parameter (e.g. DOC)
- Turbidity correction <yes> or <no>

Program all parameters for external devices (interface, recorders, etc.) and for instrument operation (limits, alarms).
See Program List and Explanations, p. 63.

4.3. Run-in period

Let the instrument run in for approximately 1 h.

4.4. Calibration

Perform a local calibration, see Calibration, p. 41.

4.5. Fine tuning of turbidity correction

The turbidity correction of the AMI SAC254 is based on the DIN EN 38404-3 standard. According to this standard, a reference measurement at 550 nm is subtracted from the measurement at 254 nm. The standard does not provide for a scaling of the reference measurement.
In practice, however, it makes sense to scale the reference measurement with an empirically determined coefficient to compensate for spectral effects. This coefficient can be set in 5.1.1, p. 69. The determination of the coefficient requires collecting instrument data over a longer period of time and therefore cannot be done directly during commissioning of the instrument.

> ***Note:*** *Since the calibration constants are applied to the turbidity-corrected value (see also Calculation of process values, p. 53), a recalibration should be considered after setting the coefficient.*

There are two methods for determining the coefficient.

- Method 1: Continuous collection of data
- Method 2: Use of a reference measurement

The necessary steps for both methods are briefly explained below.

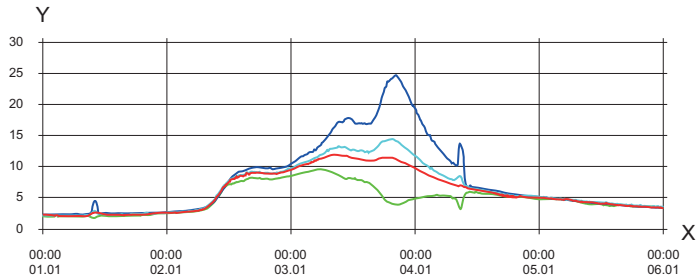
Method 1

Continuous collection of data:
Collect the photodiode raw values (SAC 254 raw and SAC 550 raw) continuously over a longer period of time (e. g. one month). This can be done using the USB option or via fieldbus. Enter the collected data into a spreadsheet and calculate the turbidity corrected SAC 254 values according to the equation below. Assume that the coefficient is 1.

SAC corr = SAC 254 raw - coefficient * SAC 550 raw

Repeat the same calculation with other coefficient values. Create a curve diagram similar to the following example.

Example



X Time [d]
Y SAC corr [/m]
Coefficient 0.0
Coefficient 1.0
Coefficient 1.3
Coefficient 2.0

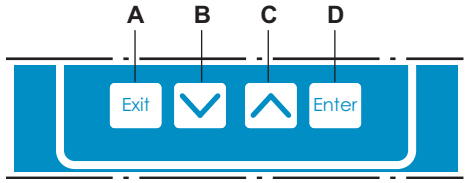
When analyzing the curve, pay special attention to events that cause increased turbidity (e. g. backwashing of a filter). Vary the coefficient until the curve runs as smoothly as possible.

Method 2 Use of a reference measurement

1. Write down the photodiode raw values (SAC 254 raw and SAC 550 raw) at multiple measuring points. At the same time, take samples.
2. Filter the samples and measure them with a laboratory spectrometer.
3. Perform the following calculation for each measuring point: Coefficient = (SAC254 raw - reference value) / SAC550 raw
4. Average the values calculated in step 3.

5. Operation

5.1. Keys



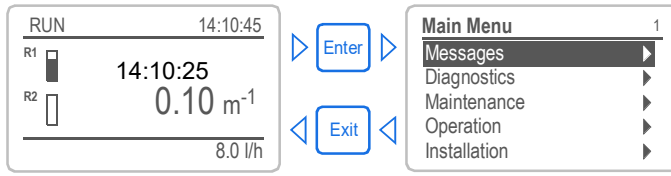
A to exit a menu or command (rejecting any changes)
to move back to the previous menu level

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

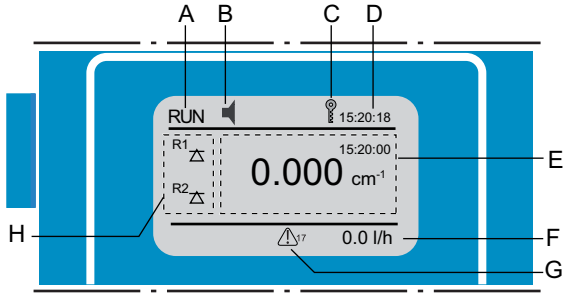
C to move UP in a menu list and to increase digits

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

Program Access, Exit



5.2. Display



A RUN — normal operation

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

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

B ERROR — Error — Fatal Error

C Keys locked, transmitter control via Profibus

D Time

E Process value with time stamp

F Sample flow

G Cleaning solution low, indicates remaining cleaning solution in %

H Relay status

Relay status, symbols

upper/lower limit not yet reached

upper/lower limit reached

control upw./downw. no action

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

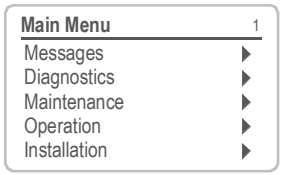
motor valve closed

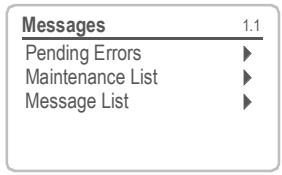
motor valve: open, dark bar indicates approx. position

timer

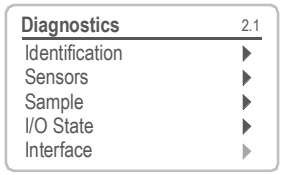
timer: timing active (hand rotating)

5.3. Software Structure

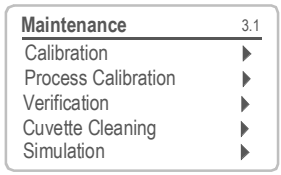




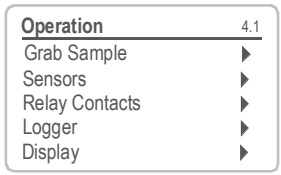
Menu **Messages 1**
Reveals pending errors as well as an event history (time and state of events that have occurred at an earlier point of time).
It contains user relevant data.



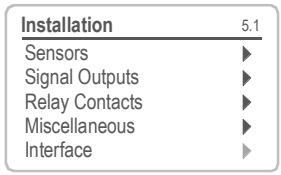
Menu **Diagnostics 2**
Provides user relevant instrument and sample data.



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



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

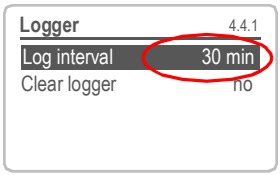


Menu **Installation 5**
For initial instrument set up by SWAN authorized person, to set all instrument parameters. Can be protected by means of password.

5.4. Changing Parameters and Values

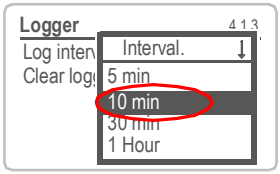
Changing parameters

The following example shows how to change the logger interval:



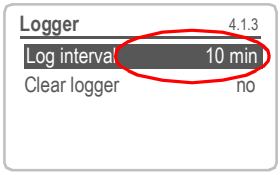
1 Select the parameter you want to change.

2 Press [Enter]



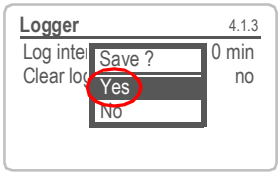
3 Press [▲] or [▼] key to highlight the required parameter.

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



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

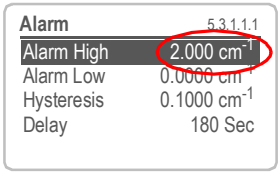
5 Press [Exit].



⇒ *Yes is highlighted.*

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

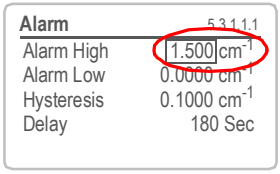
Changing values



1 Select the value you want to change.

2 Press [Enter].

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



4 Press [Enter] to confirm the new value.

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

6 Press [Enter] to save the new value.

5.5. Grab Sample

The grab sample function can be used for manual measurement of a sample or to check the instrument performance using a user-defined standard solution.
The result is saved in the grab sample history (see 2.2.3.3, p. 65).

Procedure

Status of relays and signal outputs during the procedure:
- Signal outputs are on hold
- All limits are switched off

1. Navigate to menu <Operation>/<Grab Sample>.
2. Select the unit (SAC254, UV transmission or concentration).
3. Enter an ID for the sample and confirm with [Enter].
   ⇒ *This ID will be stored in the grab sample history together with the measured value.*
4. Stop sample flow and confirm with [Enter].
   ⇒ *The instrument is automatically drained.*
5. Wait until the instrument is empty and the next screen is shown.
6. Screw the grab sample bottle to the holder and swing it upwards. Open the grab sample valve on the flow cell block (see Fluidics, p. 11). Press [Enter] and wait for the next prompt.
   ⇒ *The grab sample measurement takes approximately 10 minutes. At the end of the procedure, there may still be a small amount of liquid in the bottle.*
7. Swing down and unscrew the grab sample bottle and press [Enter].
   ⇒ *The instrument is automatically drained.*
8. Wait until the instrument is empty and the next screen is shown.
9. Close the grab sample valve on the flow cell block.
10. Start sample flow and press [Enter].
11. The measured value and time stamp are displayed on the screen. Press [Enter] to save.
    ⇒*The grab sample is saved in the grab sample history.*

    Note: *After 20 minutes without key input, the result is automatically discarded.*

6. Maintenance

6.1. Maintenance Table

If required

- Clean the instrument manually, see 6.3., 38 (if no cleaning module is installed).
- Clean the inlet strainer, see 6.4., 39.
- Clean the cuvette, see 6.5., 40.
- Perform a verification, see 6.7., 45.

6.2. Stop of Operation for Maintenance

1. Stop sample flow.
2. Select <Operation>/<Service>/<Empty system>. Wait until the instrument is empty.
3. Switch off power of the instrument.

6.3. Manual Chemical Cleaning

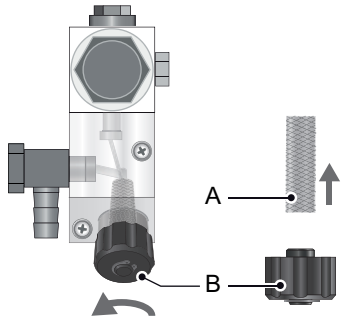
If no cleaning module is installed, the instrument can be rinsed with a cleaning solution using the grab sample function. See table below for recommended cleaning solutions.
Proceed as follows:

1. Fill the cleaning solution to the grab sample bottle.
2. Select <Operation>/<Grab Sample> and follow the instructions on the screen.
3. When the grab sample procedure is finished, press [Exit] to discard the measured value.

Recommended cleaning solutions

Contamination	Cleaning solution
Lime deposits	◆ phosphoric acid 0.5% or ◆ citric acid 1.0%
Biofilm	◆ javel 0.5%

6.4. Cleaning the Inlet Strainer



A *Inlet strainer*
B *Screw cap*

1 Stop sample flow.

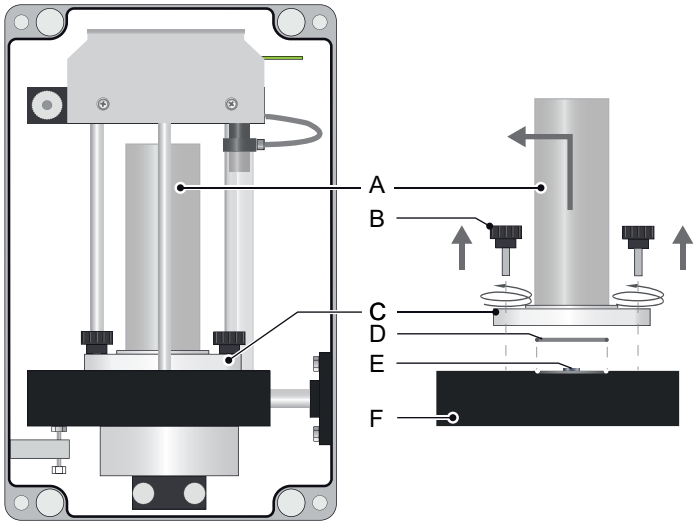
2 Select <Operation>/<Service>/<Empty system>. Wait until the instrument is empty.

3 Unscrew and remove the screw cap [A] and the strainer [B] from the flow cell.

4 Remove any dirt from the strainer.

5 Reassemble the inlet strainer

6.5. Cleaning the Cuvette



A *Cuvette tube*
B *Knurled screws*
C *Flange*
D *O-ring*
E *Quartz window*
F *Base plate*

Procedure

Status of relays and signal outputs during the procedure:
- Signal outputs are on hold
- All limits are switched off

1. Navigate to menu <Maintenance>/<Cuvette cleaning>.
2. Stop sample flow and confirm with [Enter].
   ⇒ *The instrument is automatically drained.*
3. Open the photometer housing.
4. Unscrew the knurled screws [B] and pull away the cuvette from the base plate [F].
5. Clean the quartz window [E] and the cuvette tube [A] using a soft cloth.

   Note: *Be careful not to scratch the quartz window.*
6. Reassemble the cuvette.
7. Close the photometer housing.

6.6. Calibration

The AMI SAC254 issues the three process values absorbance, UV transmission and concentration, of which the absorbance and concentration can be independently calibrated. The UV transmission is calculated from the absorbance, therefore no independent calibration of this process value is possible.
The calculation of the process values is described in detail in section Calculation of process values, p. 53.

Absorbance

The absorbance measurement of the AMI SAC254 is factory-calibrated. The factory calibration is stored in a protected memory area and is retained even if the firmware is completely reset. In addition to the factory calibration, a local calibration by the user is possible, but optional.
On the absorbance axis, only the slope can be adjusted.

Concentration

The correlation between the SAC254 and parameters related to the organic carbon concentration (e.g. DOC) is empirical and highly sample-specific. Therefore, a local calibration of the concentration measurement is mandatory in order to obtain meaningful results.
On the concentration axis, both the slope and the offset can be adjusted.

Types of calibration

Three types of calibration can be selected both for absorbance and concentration measurement:

- Process calibration, p. 42
- External calibration, p. 43
- Standard calibration, p. 44

Swan recommends to use a process calibration for the absorption measurement and an external calibration to establish a correlation with an organic carbon related parameter (e.g. DOC).

Calibration history

The calibration constants for absorbance and concentration are saved in two separate calibration histories (2.2.3.1, p. 65 and 2.2.3.2, p. 65).

6.6.1 Process calibration

Performs a one-point calibration using the actual process water. The reference value of the sample is determined using a laboratory instrument. With this method, only a slope is defined, the offset is set to zero.
The process calibration is the recommended method to calibrate the absorbance. Ensure that the sample taken is representative.

Procedure

The process calibration consists of the following steps:

- Take a sample and send it to a laboratory. At the same time, register the reading of the AMI SAC254 (steps 1 to 6).
- Once available, enter the reference value obtained from the laboratory (steps 7 to 11).

Register the reading of the AMI SAC254

1 Select <Maintenance>/<Process Calibration>.

2 Select <Absorbance> or <Concentration>.

3 Select <Take a sample>.
⇒ *The value and the timestamp of the last valid measurement are displayed.*

4 Take a sample (if necessary, stop the sample flow).

5 Press [Enter] to register the measurement.

6 Send the sample to the laboratory.

Enter the reference value

7 Select <Maintenance>/<Process Calibration>.

8 Select <Absorbance> or <Concentration>.

9 Select <Insert ref. value>.
⇒ *The value and the timestamp of the registered reading are displayed.*

10 Enter the reference value obtained from the laboratory.

11 Press [Enter] to save.
⇒ *The slope is updated accordingly, the offset is set to zero.*

6.6.2 External calibration

Manual entry of a calibration curve based on data points collected over an extended period of time. The external calibration is the recommended way to establish a correlation to a parameter related to organic carbon concentration (e.g. DOC).

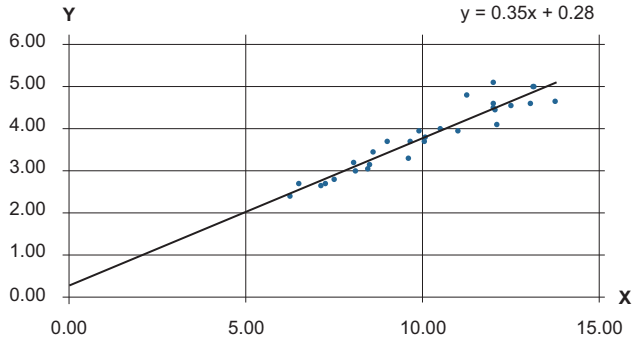
Establish a correlation

To obtain the calibration equation, proceed as follows:

- Take a minimum of five samples at representative time points. Each time, write down the absorbance reading of the AMI SAC254.
- Divide the absorbance values of the AMI SAC254 by the calibration slope (visible under <Diagnostics>/<Sensors>/<History>/<Cal. History Abs.>).
- Analyze the samples in the laboratory to obtain the reference values.
- Perform a linear regression of the data pairs in a spreadsheet (see example below). Use the units m^{-1} for the absorbance value and ppm for the concentration.

Example

Correlation of the SAC254 value with DOC:



X SAC254 [m^{-1}] Y DOC [mg/l]

y = 0.35x + 0.28

Enter the calibration curve

To enter the calibration curve:

1. Select <Maintenance>/<Process Calibration>
2. Select <Absorbance> or <Concentration>
3. Select <External Calibration>
4. Enter the offset and the slope.
   ⇒*The calibration curve is updated accordingly.*

6.6.3 Standard calibration

Two-point calibration using two standard solutions of known absorbance or concentration.

Preparations

The two standard solutions have to be prepared by the customer. One liter of each standard solution is needed.
Points to consider:

- Select two suitable reference values based on the measuring range to be covered.
- When calibrating the absorbance measurement:
  - The absorbance standard must have an UV absorbance spectrum similar to that of the sample in the relevant spectral range (240–270 nm).
- When calibrating the concentration measurement:
  - The carbon concentration standard must have a similar UV absorbance per ppm of TOC, DOC etc. as the sample.
  - If non-absorbing organic species or absorbing non-organic species are present, they need to be added or considered in the standard composition as well.

Procedure

The two solutions are filled into the grab sample bottle and measured one after another, taking approximately 10 minutes per bottle. The reference values can be entered during the routine.
To start the standard calibration, select <Maintenance>/<Calibration> 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

6.7. Verification

The verification checks the stability of the instrument using a certified standard solution provided by Swan. For this purpose, the raw SAC254 value is compared with a reference value indicated on the standard bottle.
The result is saved in the verification history (see 2.2.3.4, p. 65).

Note: *The raw value used for verification does not take turbidity correction and local calibration into account. Therefore, the value displayed during a verification can differ significantly from the value displayed during other routines or during online operation.*

Procedure

Status of relays and signal outputs during the procedure:
- Signal outputs are on hold
- All limits are switched off

1 Navigate to menu <Maintenance>/<Verification>.

2 Enter the reference value indicated on the standard bottle.

3 Stop sample flow and confirm with [Enter].
⇒ *The instrument is automatically drained.*

4 Wait until the instrument is empty and the next screen is shown.

5 Screw the grab sample bottle to the holder and swing it upwards. Open the grab sample valve on the flow cell block (see Fluidics, p. 11). Press [Enter] and wait for the next prompt.
⇒ *The measurement takes approximately 10 minutes. At the end of the procedure, there may still be a small amount of liquid in the bottle.*

6 Swing down and unscrew the grab sample bottle and press [Enter].
⇒*The instrument is automatically drained.*

7 Wait until the instrument is empty and the next screen is shown.

8 Close the grab sample valve on the flow cell block.

9 Start sample flow and press [Enter].

10 The measured value and the timestamp are displayed on the screen. Press [Enter] to save.
⇒ *The verification is saved in the verification history.*

Note: *After 20 minutes without key input, the result is automatically discarded.*

If the deviation between the measured value and the reference value is too high, clean the instrument according to sections Manual Chemical Cleaning, p. 38 and Cleaning the Cuvette, p. 40. Then repeat the verification.

6.8. Longer Stop of Operation

1. Stop sample flow.
2. Select <Operation>/<Service>/<Empty system>. Wait until the instrument is empty.
3. Switch off power of the instrument.

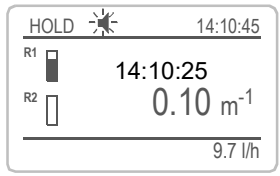
7. Troubleshooting

7.1. Error List

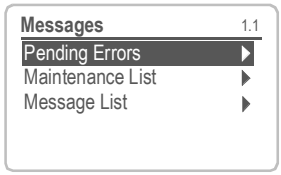
Error
Non-fatal Error. Indicates an alarm if a programmed value is exceeded. Such Errors are marked **E0xx** (bold and black).

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:

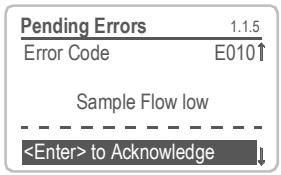
- Errors which disappear if correct measuring conditions are recovered (i.e. Sample Flow low).
  Such Errors are marked **E0xx** (bold and orange)
- Errors which indicate a hardware failure of the instrument.
  Such Errors are marked **E0xx** (bold and red)



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	SAC 254 Alarm high	– Check process. – Check programmed value 5.3.1.1.1, p. 75.
E002	SAC 254 Alarm low	– Check process. – Check programmed value 5.3.1.1.25, p. 75.
E003	UV Transm. Alarm high	– Check process. – Check programmed value 5.3.1.2.1, p. 75.
E004	UV Transm. Alarm low	– Check process. – Check programmed value 5.3.1.2.25, p. 75.
E005	Conc. Alarm high	– Check process. – Check programmed value 5.3.1.3.1, p. 75.
E006	Conc. Alarm low	– Check process. – Check programmed value 5.3.1.3.25, p. 75.
E008	No Sample Flow	– Check inlet pressure – Check connection from the pressure tube to the photometer PCB. – Check whether emptying via the siphon tube works. If necessary, Cleaning the siphon tube, p. 52.
E009	Sample Flow high	– Check inlet pressure. – Readjust sample flow. – Check programmed value 5.3.1.4.2, p. 76.
E010	Sample Flow low	– Check inlet pressure. – If necessary: ◆ readjust sample flow ◆ clean instrument – Check programmed value 5.3.1.4.35, p. 76.

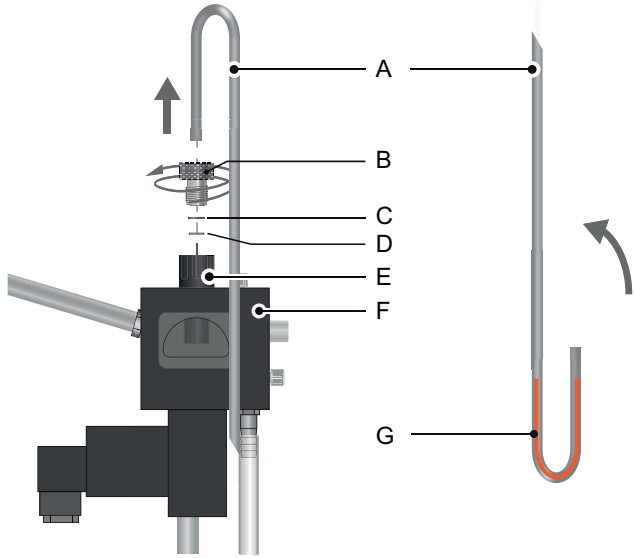
Error	Description	Corrective action
E011	Turbidity Correction	– The turbidity correction results in a negative absorbance value. Possible causes: ◆ The coefficient is set too high. Check programmed value in 5.1.1.2, p. 69. ◆ The sample absorbs at 550 nm.
E012	Concentration Offset	– The concentration offset is too far in the negative range, resulting in a negative concentration value. Recalibrate the concentration measurement, see Calibration, p. 41.
E013	Case Temp. high	– Check case/environment temperature. – Check programmed value 5.3.1.5, p. 76.
E014	Case Temp. low	– Check case/environment temperature. – Check programmed value 5.3.1.6, p. 76.
E015	MV disconnected	– Check connection of the magnetic valve. – Use the “Empty system” function (4.6.1, p. 69) to check whether the magnetic valve switches and the instrument is emptied. – If the magnetic valve is defective, call service.
E016	Invalid measurement	– Check if all installation requirements are met (see Instrument Specifications, p. 13): ◆ no shocks, no vibrations ◆ stable flow rate – If E065 is also active, clean the cuvette. – If a highly absorbing sample is measured, reduce the flow rate. – If the error persists, call service.
E017	Control Timeout	– Check control device or programming in Installation, Relay contact, Relay 1/2 see 5.3.2 and 5.3.3, p. 76.

Error	Description	Corrective action
E018	SAC disconnected	– Instruments without Cleaning Module-II: Check connection between the AMI transmitter and the photometer. – Instruments with Cleaning Module-II: Check connection between the cleaning module pump and the photometer.
E019	Temp. out of range	– Check connection of the sensor. – If the error persists, call service.
E020	Heater Temp. low	– Increase sample temperature (minimum 5 °C). – If the error persists, call service.
E021	Pressure sensor error	– Call service.
E023	Cleaning Solution	– Refill cleaning solution.
E024	Input active	– No action necessary. – This message is displayed if “Fault = Yes” is programmed, see 5.3.4, p. 80.
E026	IC LM75	– Call service.
E028	Signal output open	– Check wiring on signal outputs 1 and 2.
E030	EEProm Frontend	– Call service.
E031	Calibration Recout	– Call service.
E032	Wrong Frontend	– Call service.
E033	Power-on	– None, normal status.

Error	Description	Corrective action
E034	Power-down	– None, normal status.
E065	Cuvette dirty	– Clean the cuvette. – If the error persists, call service.
E066	Siphon blocked	– Observe several filling/emptying cycles. If emptying via the siphon tube works reliably, acknowledge this error. – If the magnetic valve switches, the siphon tube needs to be unscrewed and cleaned (see Cleaning the siphon tube, p. 52).
E067	Cleaning solution low	– Refill cleaning solution. – The number next to the triangle on the operating display indicates the remaining cleaning solution in %.

7.2. Cleaning the siphon tube

If the siphon tube is heavily contaminated, it can be unscrewed and cleaned.



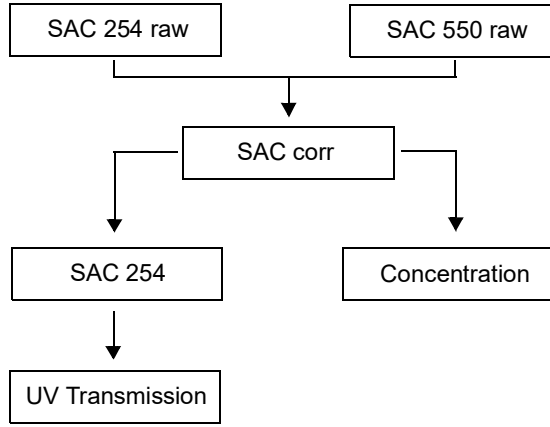
A *Siphon tube*
B *Knurled screw*
C *Washer*
D *O-ring*
E *Suction piece*
F *Flow cell*
G *Tube bend*

1. Unscrew the knurled screw [B].

   Note: *Do not unscrew the suction piece [E].*
2. Pull out the siphon tube from the suction piece [E].
3. Turn the siphon tube over and place it in a bucket. Fill the tube bend [G] with a cleaning solution (e.g. citric acid, javel, or ethanol) and allow it to work for 10 minutes.
4. Empty the tube bend.
5. If necessary, clean the tube bend [G] additionally with a pipe cleaner.
6. Reinstall the siphon tube.

7.3. Calculation of process values

The values of the AMI SAC254 are calculated as follows:



Value	Description
SAC 254 raw	Raw value of the measurement at 254 nm. This value is visible in the diagnostics menu 2.2.1, p. 63.
SAC 550 raw	Raw value of the measurement at 550 nm. This value is visible in the diagnostics menu 2.2.1, p. 63.
SAC corr	Intermediate value after turbidity correction. This value is not displayed in the firmware. SAC corr = SAC 254 raw - coefficient * SAC 550 raw If turbidity correction is set to “No”: coefficient = 0 and SAC corr = SAC 254 raw
SAC 254	SAC254 = slope_abs * SAC corr
Concentration	Concentration = slope_conc * SAC corr + offset_conc
UV Trans-mission	UV Transmission = 100 * 10^(-SAC 254)

Value	Description
slope_abs	Slope of the absorption measurement. This value is adjusted during the local calibration and can be seen in the calibration history 2.2.3.1, p. 65.
slope_conc	Slope of the concentration measurement. This value is adjusted during the local calibration and can be seen in the calibration history 2.2.3.2, p. 65.
offset_conc	Offset of the concentration measurement. This value is adjusted during the local calibration and can be seen in the calibration history 2.2.3.2, p. 65.

7.4. Replacing Fuses

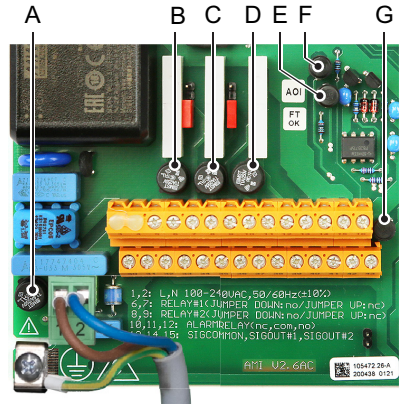
WARNING

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

8. Program Overview

For explanations about each parameter of the menus see Program List and Explanations, p. 63.

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

8.2. Diagnostics (Main Menu 2)

Identification 2.1*	*Designation*	*AMI SAC254*	
	Version	*V6.22-10/19*	
	Peripherals 2.1.3*	*SAC254*	2.1.3.1*

	Factory Test 2.1.4*	*Instrument* *Motherboard* *Front End*	2.1.4.1*	* Menu numbers
	Operating Time 2.1.5*	*Years / Days / Hours / Minutes / Seconds*		2.1.5.1*
Sensors 2.2*	**Photometer Unit** 2.2.1*	**SAC254** 2.2.1.1*	*SAC254* *SAC254 raw* *SAC550 raw* *I0254* *I0550*	2.2.1.1.1*
		Concentration 2.2.1.2*	*Unit* *Meas. value*	2.2.1.2.1*
		UV Transmission *Measuring cycle*		
		Raw values 2.2.1.5*	*LED 254* *LED 550* *Water level* *Temperature* *Samples* *Subsampling*	2.2.1.5.1
		Temperature 2.2.1.6*	*Temperature* *NT5K*	2.2.1.6.1
		Factory Parameters 2.2.1.7*	*Bias* *Slope*	2.2.1.7.1
	Miscellaneous 2.2.2*	*Case Temp.* *State Machine* *Optical path length* *Turbidity correction*		
	History 2.2.3*	**Cal. History Abs.** 2.2.3.1*	*Number* *Date, Time* *Slope*	2.2.3.1.1*
		Cal. History Con. 2.2.3.2*	*Number* *Date, Time* *Offset* *Slope*	2.2.3.2.1*

		Grab Sample. 2.2.3.3*	*Number* *Date, Time* *Sample ID* *Sample*	*2.2.3.3.1**
		Verif. History 2.2.3.4*	*Number* *Date, Time* *Meas. Value* *Reference value* *Deviation*	*2.2.3.4.1**
Sample 2.3*	*Sample ID* *Sample Flow*	2.3.1*		
I/O State 2.4*	*Alarm Relay* *Relay 1 and 2 Input* *Signal Output 1 and 2*	2.4.1* 2.4.2*		
Interface 2.5*	*Protocol* *Baud rate*	2.5.1*		(only with RS485 interface)

8.3. Maintenance (Main Menu 3)

Calibration 3.1*	**Absorbance** 3.1.1*	*(Progress)*		* Menu numbers
	Concentration 3.1.2*	*(Progress)*		
Process Calibration 3.2*	**Absorbance** 3.2.1*	*Take a sample*	3.2.1.1*	
		Insert ref. value	3.2.1.2*	
		External Calibration	3.2.1.3*	
	Concentration 3.2.2*	*Take a sample*	3.2.2.1*	
		Insert ref. value	3.2.2.2*	
		External Calibration	3.2.2.3*	
Verification 3.3*	*(Progress)*			
Cuvette Cleaning 3.4*	*(Progress)*			

Simulation	*Alarm Relay*	3.5.1*		
3.5*	*Relay 1*	3.5.2*		
	Relay 2	3.5.3*		
	Signal Output 1	3.5.4*		
	Signal Output 2	3.5.5*		
	Magnetic valve	3.5.6*		
Set Time	*(Date), (Time)*			
3.6*				
Cleaning	**Parameters**	**Mode**	3.7.1.1*	
3.7*	3.7.1*	**Interval**	*Interval*	3.7.1.20*
		3.7.1.1*	*Delay*	3.7.1.3*
			Signal Outputs	3.7.1.4*
			Output/Control	3.7.1.5*
		Daily	*Start time*	3.7.1.21
		3.7.1.1*	*Delay*	3.7.1.3*
			Signal Outputs	3.7.1.4*
			Output/Control	3.7.1.5*
		Weekly	**Calendar**	*Start time*
		3.7.1.1*	*Delay*	*Mo. to Su*
			Signal Outputs	3.7.1.4*
			Output/Control	3.7.1.5
		Off	3.7.1.1*	
	Fill Channel 11	*(Progress)*	3.7.2.5*	
	3.7.2*			
	Fill Channel 12	*(Progress)*	3.7.3.5*	
	3.7.3*			

8.4. Operation (Main Menu 4)

Grab Sample 4.1	*(Progress)*	4.1.5*		* Menu numbers
Sensors 4.2*	*Hold after Cal.*	4.2.1*		
Relay Contacts 4.3*	**Alarm Relay** 4.3.1*	**SAC254** 4.3.1.1*	*Alarm High*	4.3.1.1.1*
			Alarm Low	4.3.1.1.22*
			Hysteresis	4.3.1.1.32*
			Delay	4.3.1.1.42*
		UVT 4.3.1.2*	*Alarm High*	4.3.1.2.1*
			Alarm Low	4.3.1.2.22*
			Hysteresis	4.3.1.2.32*
			Delay	4.3.1.2.42*
		Concentration 4.3.1.3*	*Alarm High*	4.3.1.3.1*
			Alarm Low	4.3.1.3.22*
			Hysteresis	4.3.1.3.32*
			Delay	4.3.1.3.42*
		Sample Flow 4.3.1.4*	*Flow Alarm*	4.3.1.4.1*
			Alarm High	4.3.1.4.2*
			Alarm Low	4.3.1.4.32*
	Relay 1 and 2 4.3.2* and 4.3.3*	*Setpoint*	4.3.x.200*	
		Hysteresis	4.3.x.300*	
		Delay	4.3.x.40*	
	Input 4.3.4*	*Active*	4.3.4.1*	
		Signal Outputs	4.3.4.2*	
		Output / Control	4.3.4.3*	
		Fault	4.3.4.4*	
		Delay	4.3.4.5*	
Logger 4.4*	*Log Interval*	4.4.1*		
	Clear Logger	4.4.2*		
Display 4.5*	*Displayed value*	4.5.1*		
Service **4.6***	*Empty system*	4.6.1*		

8.5. Installation (Main Menu 5)

Sensors	**SAC254**	**Turbidity correction**	*Turbidity correction*	5.1.1.1.1*
5.1*	5.1.1*	5.1.1.1*	*Coefficient*	5.1.1.1.2*
		Average meas.	5.1.1.31*	
		Optical path length	5.1.1.41*	
		Concentration	5.1.1.51*	
	Standards	**Absorbance**	*Standard 1*	
	5.1.2*	5.1.2.1*	*Standard 2*	
		Concentration	*Standard 1*	
		5.1.2.2*	*Standard 2*	
	Cleaning	*1 solution*	5.1.3.1*	
	5.1.3*	*2 solutions*	5.1.3.2*	
Signal Outputs	**Signal Output 1 and 2**	*Parameter*	5.2.1.1 - 5.2.2.1*	
5.2*	5.2.1* and 5.2.2*	*Current Loop*	5.2.1.2 - 5.2.2.2*	
		Function	5.2.1.3 - 5.2.2.3*	
		Scaling	*Range Low*	5.2.x.40.10/10*
		5.2.x.40	*Range High*	5.2.x.40.20/20*
Relay Contacts	**Alarm Relay**	**SAC254**	*Alarm High*	4.3.1.1.1*
5.3*	5.3.1*	4.3.1.1*	*Alarm Low*	4.3.1.1.22*
			Hysteresis	4.3.1.1.32*
			Delay	4.3.1.1.42*
		UVT	*Alarm High*	4.3.1.2.1*
		4.3.1.2*	*Alarm Low*	4.3.1.2.22*
			Hysteresis	4.3.1.2.32*
			Delay	4.3.1.2.42*
		Concentration	*Alarm High*	4.3.1.3.1*
		4.3.1.3*	*Alarm Low*	4.3.1.3.22*
			Hysteresis	4.3.1.3.32*
			Delay	4.3.1.3.42*
		Sample Flow	*Flow Alarm*	4.3.1.4.1*
		4.3.1.4*	*Alarm High*	4.3.1.4.2*
			Alarm Low	4.3.1.4.32*
	Relay 1 and 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*	* Menu numbers
	5.3.4*	*Signal Outputs*	5.3.4.2*	
		Output/Control	5.3.4.3*	
		Fault	5.3.4.4*	
		Delay	5.3.4.5*	
Miscellaneous	*Language*	5.4.1*		
5.4*	*Set defaults*	5.4.2*		
	Load Firmware	5.4.3*		
	Password	*Messages*	5.4.4.1*	
	5.4.4*	*Maintenance*	5.4.4.2*	
		Operation	5.4.4.3*	
		Installation	5.4.4.4*	
	Sample ID	5.4.5*		
	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 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. V6.22-10/19).

2.1.3 **Peripherals**:
o *SAC254*: Firmware of the photometer unit

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

2.1.5 **Operating Time:** Shows the operating time in years, days, hours, minutes and seconds.

2.2 Sensors

2.2.1 Photometer Unit:

2.2.1.1 *SAC254*: Diagnostic values of the last measuring cycle.

SAC254	SAC254 value in cm^{-1} or m^{-1}, turbidity correction and calibration taken into account.
SAC254 raw	SAC254 value in cm^{-1}, no user calibration and turbidity correction.
SAC550 raw	SAC550 value in cm^{-1}.

I0254	Light intensity of the UV LED measured with an empty cuvette (raw signal in V). A low signal indicates that the quartz window is dirty or that the UV LED needs to be replaced.
I0550	Light intensity of the green LED measured with an empty cuvette (raw signal in V). A low signal indicates that the quartz window is dirty or that the green LED needs to be replaced.

2.2.1.2 *Concentration:* Calculated concentration in ppb or ppm and name of the parameter (e.g. DOC).

2.2.1.3 *UV Transmission:* Calculated UV transmission in %. Refers to /m or /cm, depending on the selected dimension.

2.2.1.4 *Measuring cycle:* Duration of the last measuring cycle in seconds.

2.2.1.5 *Raw values:* Raw values of the current measuring cycle.

LED 254	Raw signal in V of the photo diode, measured while the UV LED is active.
LED 550	Raw signal in V of the photo diode, measured while the green LED is active.
Water level	Raw value in V of the pressure sensor.
Temperature	Raw value in V of the temperature sensor.
Samples	Counter of measuring points.
SubSampling	Sampling frequency (number of measuring points per second).

2.2.1.6 *Temperature:* Temperature of the quartz window.

2.2.1.7 *Factory Parameters:* Values of the factory calibration.

2.2.2 Miscellaneous:

2.2.2.1
- o *Case Temp.:* Shows the temperature in °C inside the transmitter.
- o *State Machine:* Shows the current process of the instrument:

WAIT TOP	Instrument is measuring. Waiting until top of cuvette is reached.
WAIT BOTTOM	Measurement finished. Waiting until a new filling cycle begins.

- o *Optical path length:* Shows the unit chosen for the optical path length.
- o *Turbidity correction:* Shows if turbidity correction is active or inactive.

2.2.3 **History:** Shows the values of the last calibrations, verifications and grab sample measurements.

2.2.3.1 Cal. History Absorbance
- o *Number*: Calibration counter
- o *Date, Time*: Date and time of calibration
- o *Slope*: Calibration factor

Max. 64 data records are memorized.

2.2.3.2 Cal. History Concentration:
- o *Number*: Calibration counter
- o *Date, Time*: Date and time of calibration
- o *Offset*: Concentration offset in ppm at zero UV absorption
- o *Slope*: Calibration factor (ppm x m)

Max. 64 data records are memorized.

2.2.3.3 Grab Sample
- o *Number*: Grab sample counter
- o *Date, Time*: Date and time of the grab sample
- o *Sample ID*: ID assigned during the grab sample routine
- o *Sample*: Measured value.

Max. 64 data records are memorized.

2.2.3.4 Verification History
- o *Number*: Verification counter
- o *Date, Time*: Date and time of the verification
- o *Measuring value*: Measured value
- o *Reference value:* Reference value of the standard.
- o *Deviation:* Deviation in % between measurement and reference value.

Max. 64 data records are memorized.

2.3 Sample

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 *Sample Flow:* Shows the sample Flow in l/h.

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. 41.

3.2 Process Calibration

See Process calibration, p. 42.

3.3 Verification

See Verification, p. 45.

3.4 Cuvette Cleaning

See Cleaning the Cuvette, p. 40.

3.5 Simulation

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

3.5.1	*Alarm Relay*	Active or inactive
3.5.2	*Relay 1*	Active or inactive
3.5.3	*Relay 2*	Active or inactive
3.5.4	*Signal Output 1*	Actual current in mA
3.5.5	*Signal Output 2*	Actual current in mA
3.5.6	*Magnetic valve*	Active or inactive

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 and the transmitter reboots.

3.6 Set Time

Adjust date and time.

3.7 Cleaning

Automatic cleaning process using the optional Cleaning Module-II.
Cleaning is not possible if one of the following errors is active:

- E009/E010 Sample flow high/low
- E018 SAC disconnected
- E021 pressure sensor error
- E023 Cleaning solution

3.7.1 Parameters

3.7.1.1 *Mode:* The following modes can be chosen: interval, daily, weekly or off.

If Mode = Interval

3.7.1.20 *Interval:* Select one of the following cleaning intervals:
1 h, 2 h, 3 h, 4 h, 6 h, 8 h, 12 h.

3.7.1.3 *Delay:* During cleaning plus the delay time, the status of the signal and control outputs is as set in 3.7.1.4 and 3.7.1.5.
Range: 0–6000 s

3.7.1.4 *Signal Outputs:* Select the operation mode of the signal outputs during cleaning:

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

Hold: Signal outputs hold the last valid measured value.
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.

3.7.1.5 *Output/Control:* Relay or signal output:

Cont.: Controller continues normally.

Hold: Controller continues based on the last valid value.

Off: Controller is switched off.

If Mode = daily

The start of the daily cleaning cycle can be set to any time of day.

3.7.1.21 *Start time:* Time of the automatic start of the cleaning process.
Range: 00:00:00–23:59:59

3.7.1.3 *Delay:* see mode interval.

3.7.1.4 *Signal Outputs:* see mode interval.

3.7.1.5 *Output/Control:* see mode interval.

If Mode = weekly

The start of the automatic cleaning cycle can be set to one or more weekdays and any time of day. The programmed time of day is valid for all selected weekdays.

3.7.1.22 **Calendar:**

- 3.7.1.22.1 Start time: Time of the automatic start of the cleaning process (valid for all selected weekdays).
- 3.7.1.22.2 Monday: Possible settings: on or off
  to
- 3.7.1.22.8 Sunday: Possible settings: on or off

3.7.1.3 *Delay:* see mode interval.

3.7.1.4 *Signal Outputs:* see mode interval.

3.7.1.5 *Output/Control:* see mode interval.

all modes

3.7.2 *Fill Channel 11:* Activates the cleaning pump and switches the valve to cleaning solution 1 (right canister).

3.7.3 *Fill Channel 12:* Activates the cleaning pump and switches the valve to cleaning solution 2 (left canister).

4 Operation

4.1 Grab Sample

See Grab Sample, p. 37.

4.2 Sensors

4.2.2 *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 s

4.3 Relay Contacts

See Relay Contacts 1 and 2, p. 25

4.4 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. The Records consist of: date, time, alarms, process values (SAC254, UV transmission and concentration), sample flow, quartz window temperature,

SAC254 raw, SAC550 raw, I0254, photodiode signal, water level, case temperature.

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).
Range: 1 second to 1 hour

Interval	1 s	5 s	1 min	5 min	10 min	30 min	1 h	event driven
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.

4.5 Display

Select the displayed process value.
Possible settings: SAC254, UV Transmission, Concentration.

4.6 Service

4.6.1 *Empty system:* Opens the magnetic valve to empty the system.

5 Installation

5.1 Sensors

5.1.1 SAC254:

5.1.1.1 *Turbidity correction:* Activates or deactivates turbidity correction.
Possible settings: yes or no

Note: *The turbidity correction should only be applied under the following conditions:*

- *The spectral attenuation coefficient must be significantly higher at 254 nm than at 550 nm.*
- *The absorbance at 550 nm must be close to zero.*

5.1.1.2 *Coefficient:* Empirically determined factor which is multiplied with the reference measurement at 550 nm.
Range: 0.5 to 5.0
See also Fine tuning of turbidity correction, p. 31.

5.1.1.31 *Average meas.:* Number of measuring points from which the moving average is calculated. The value can be increased to dampen noisy signals. The higher the number of measuring points, the slower the system reacts to changes of the measured value.
Range: 1 to 10

5.1.1.41 *Optical path length:* Unit to which the absorption value is normalized.
Range: cm^{-1} or m^{-1}

5.1.1.51 *Concentration:* Freely editable text field. Enter the name of the concentration parameter (e.g. DOC, COD, TOC, etc.).

5.1.2 Standards:

Default values used during a standard calibration.

5.1.2.1 Absorbance:

5.1.2.1.1 *Standard 1:* Default value for standard 1.
Range: 0.000 cm^{-1}–3.000 cm^{-1}
Standard 2: Default value for standard 2.
Range: 0.000 cm^{-1}–3.000 cm^{-1}

5.1.2.2 Concentration:

5.1.2.2.1 *Standard 1:* Default value for standard 1.
Range: 0.00 ppb–100 ppm
Standard 2: Default value for standard 2.
Range: 0.00 ppb–100 ppm

5.1.3 Cleaning: Program whether the cleaning module uses one or two solutions.
Range: 1 solution, 2 solutions

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:

- SAC254
- UV Transmission
- Concentration
- Sample Flow

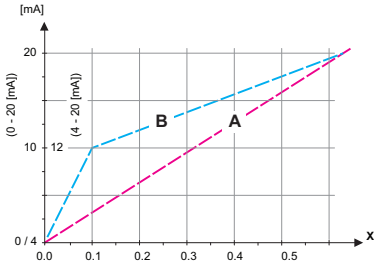
5.2.1.2 *Current Loop:* Select the current range of the signal output. Make sure the connected device works with the same current range.
Available ranges: 0–20 mA or 4–20 mA

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:

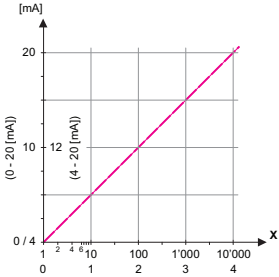
- Linear, bilinear or logarithmic for process values.
  See As process values, p. 71
- Control upwards or control downwards for controllers.
  See As control output, p. 72

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.

If Parameter = **SAC254**

5.2.1.40.10 Range low: 0.0000 cm^{-1}–3.000 cm^{-1}

5.2.1.40.20 Range high: 0.0000 cm^{-1}–3.000 cm^{-1}

If Parameter = **UV Transmission**

5.2.1.40.11 Range low: 0.0%–100.0%

5.2.1.40.21 Range high: 0.0%–100.0%

If Parameter = **Concentration**

5.2.1.40.12 Range low: 0.0 ppb–1.00 ‰

5.2.1.40.22 Range high: 0.0 ppb–1.00 ‰

If Parameter = **Sample Flow**

5.2.1.40.12 Range low: 0.0 l/h–15.0 l/h

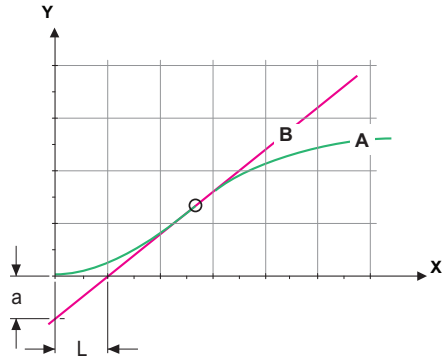
5.2.1.40.22 Range high: 0.0 l/h–15.0 l/h

As control output

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

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

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



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

The point of intersection of the tangent with the respective axis will result in the parameters a and L.
Consult the manual of the control unit for connecting and programming details. Choose control upwards or downwards.
If Control upwards or Control downwards is active
Setpoint: User-defined process value (Measured value or flow)
P-Band: Range below (upwards control) or above (downwards control) the set-point, within the dosing intensity is reduced from 100% to 0% to reach the set-point without overshooting.

5.2.1.43 **Control Parameters:** if Parameter = SAC254

5.2.1.43.10 Setpoint
Range: 0.0000 cm^{-1}–3.000 cm^{-1}

5.2.1.43.20 P-Band
Range: 0.0000 cm^{-1}–3.000 cm^{-1}

5.2.1.43 **Control Parameters:** if Parameter = UV Transmission

5.2.1.43.11 Setpoint
Range: 0.0%–100.0%

5.2.1.43.21 P-Band
Range: 0.0%–100.0%

5.2.1.43 **Control Parameters:** if Parameter = Concentration

5.2.1.43.12 Setpoint
Range: 0.00 ppb–1.00‰

5.2.1.43.22 P-Band
Range: 0.00 ppb–1.00‰

5.2.1.43 **Control Parameters:** if Parameter = Sample Flow

5.2.1.43.12 Setpoint
Range: 0.0 l/h–15.0 l/h

5.2.1.43.22 P-Band
Range: 0.0 l/h–15.0 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 s

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 s

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:

- SAC254
- UV Transmission
- Concentration
- Sample Flow
- Case Temp. high
- Case Temp. low

5.3.1.1 SAC254

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: 0.0000 cm^{-1}–3.000 cm^{-1}

5.3.1.1.25 *Alarm Low:* If the measured value falls below the alarm low value, the alarm relay is activated and E002 is displayed in the message list.
Range: 0.0000 cm^{-1}–3.000 cm^{-1}

5.3.1.1.35 *Hysteresis:* Within the hysteresis range, the relay does not switch. This prevents damage of relays contacts when the measured value fluctuates around the alarm value.
Range: 0.0000 cm^{-1}–3.000 cm^{-1}

5.3.1.1.45 *Delay:* Waiting time before the alarm relay is activated if the measured value has exceeded or fallen below the programmed alarm value.
Range: 0–28‘800 s

5.3.1.2 UV Transmission

5.3.1.2.1 *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: 0.0%–100.0%

5.3.1.2.25 *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: 0.0%–100.0%

5.3.1.2.35 *Hysteresis:* Within the hysteresis range, the relay does not switch. This prevents damage of relays contacts when the measured value fluctuates around the alarm value.
Range. 0.0%–100.0%

5.3.1.2.45 *Delay:* Waiting time before the alarm relay is activated if the measured value has exceeded or fallen below the programmed alarm value.
Range: 0–28‘800 s

5.3.1.3 Concentration

5.3.1.3.1 *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 ppb–1.00‰

5.3.1.3.25 *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: 0.00 ppb–1.00‰

5.3.1.3.35 *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 ppb–1.00‰

5.3.1.3.45 *Delay:* Waiting time before the alarm relay is activated if the measured value has exceeded or fallen below the programmed alarm value.
Range: 0–28‘800 s

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

5.3.1.4.1 *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.*

5.3.1.4.2 *Alarm High:* If the measured value rises above the programmed value E009 will be issued.
Range: 0.0 l/h–12.0 l/h

5.3.1.4.35 *Alarm Low:* If the measured value falls below the programmed value E010 will be issued.
Range: 0.0 l/h–12.0 l/h

5.3.1.5 *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

5.3.1.6 *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 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 Contacts 1 and 2, p. 25. The function of relay contacts 1 or 2 are defined by the user.

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

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

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

5.3.2.1 Function = Limit upper/lower:

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

5.3.2.20 *Parameter*: select a process value

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

Parameter	Range
SAC254	0.0000 cm^{-1}–3.000 cm^{-1}
UV Transmission	0.0%–100.0%
Concentration	0.0 ppb–1.00‰
Sample Flow	0.0 l/h–12.0 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
SAC254	0.0000 cm^{-1}–3.000 cm^{-1}
UV Transmission	0.0%–100.0%
Concentration	0.0 ppb–1.00‰
Sample Flow	0.0 l/h–12.0 l/h

5.3.2.50 *Delay:* Waiting time before the relay is activated if the measured value has exceeded or fallen below the programmed limit value. Range. 0–600 s

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*: select a process value:

- SAC254
- UV Transmission
- Concentration
- Sample Flow

5.3.2.32 Settings

Choose the respective actuator:

- Time proportional
- Frequency
- Motor valve

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 s

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

5.3.2.32.4 Control Parameters:
Range for each Parameter same as 5.2.1.43, p. 73

Actuator = Frequency

Examples of metering devices that are pulse frequency driven are the classic membrane pumps with a potential free triggering input. Dosing is controlled by the repetition speed of dosing shots.

5.3.2.32.21 *Pulse frequency:* Max. pulses per minute the device is able to respond to. Range: 20–300/min

5.3.2.32.31 Control Parameters:
Range for each Parameter same as 5.2.1.43, p. 73

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 s

5.3.2.32.32 *Neutral zone:* Minimal response time in % of the runtime. If the requested dosing output is smaller than the response time, no change will take place. Range: 1–20 %

5.3.2.32.4 Control Parameters:
Range for each Parameter same as 5.2.1.43, p. 73

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

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: 5–32400 s

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: 0–6000 s

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 on 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. 79.
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 is not de-energized 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 is de-energized 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 s

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 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-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**

5.5.22 Device address: Range: 0–63

10. Default Values

Operation

Sensors	Hold after Cal.: ..... 300 s
Alarm Relay	.....same as in Installation
Relay 1 and 2	.....same as in Installation
Input	.....same as in Installation
Logger	Logger Interval: ..... 30 min Clear Logger: ..... no
Display	Displayed value SAC254

Installation

Sensors	SAC254: Turbidity correction: Turbidity correction..... no SAC254: Turbidity correction: Coefficient: ..... 1 SAC254: Average meas.: ..... 1 SAC254: Optical path length: .....cm^{-1} SAC254: Concentration: .....-------- Standards: Absorbance: Standard 1:.....0.1000 cm^{-1} Standards: Absorbance: Standard 2:.....0.5000 cm^{-1} Standards: Concentration: Standard 1 ..... 1.00 ppm Standards: Concentration: Standard 2 ..... 10.0 ppm Cleaning *(if Cleaning Module is installed)*:.....2 solutions
Signal Outputs 1 and 2	Parameter: .....SAC254 Current loop: ..... 4 –20 mA Function: ..... linear Scaling: Range low: .....0.000 cm^{-1} Scaling: Range high:.....3.000 cm^{-1}
Alarm Relay	SAC254: Alarm high:.....3.000 cm^{-1} Alarm low: .....0.0000 cm^{-1} Hysteresis: .....0.1000 cm^{-1} Delay:..... 180 s UV Transmission: Alarm high:.....100.0% Alarm low: .....0.0% Hysteresis: .....5.0% Delay:..... 180 s Concentration: Alarm high:..... 1.00‰ Alarm low: ..... 0.00 ppb

Hysteresis: ..... 500 ppb
Delay: ..... 180 s

Sample Flow; Flow Alarm ..... yes
Sample Flow; Alarm high ..... 12.0 l/h
Sample Flow; Alarm low ..... 2.0 l/h

Case temp. high: ..... 65 °C
Case temp. low: ..... 0 °C

Relay 1 and 2

Function: ..... limit upper
Parameter: SAC254

Setpoint: ..... 3.000 cm^{-1}
Hysteresis: ..... 0.1000 cm^{-1}
Delay: ..... 30 s

If Function = Control upw. or dnw:

Parameter: **SAC254**
Settings: Actuator: ..... Frequency

Settings: Pulse Frequency: 120/min

Settings: Control Parameters: Setpoint: ..... 3.000 cm^{-1}
Settings: Control Parameters: P-band: ..... 0.1000 cm^{-1}

Parameter: ..... **UV Transmission**
Settings: Actuator: ..... Frequency

Settings: Pulse Frequency: 120/min
Settings: Control Parameters: Setpoint: 100%
Settings: Control Parameters: P-band: 5.0%

Parameter: ..... **Concentration**
Settings: Actuator: ..... Frequency

Settings: Pulse Frequency: 120/min
Settings: Control Parameters: Setpoint: ..... 1.00‰
Settings: Control Parameters: P-band: ..... 500 ppb

Parameter: ..... **Sample flow**
Settings: Actuator: ..... Frequency

Settings: Pulse Frequency: 120/min
Settings: Control Parameters: Setpoint: ..... 12.0 l/h
Settings: Control Parameters: P-band: ..... 1.0 l/h

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

11. Index

12. Notes

ANALYTICAL INSTRUMENTS

A-96.250.851 / 031120

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