swan
ANALYTICAL INSTRUMENTS

AMI INSPECTOR
Hydrogen

Version 6.22 and higher

Operator's Manual

A-96.250.741 / 170719

Customer Support
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Table of Contents

AMI INSPECTOR Hydrogen - 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

The AMI Operator's Manual shall be kept in proximity of the instrument.

Qualification, Training

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

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

1.1. Warning Notices

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

DANGER

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

- Follow the prevention instructions carefully.

WARNING

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

- Follow the prevention instructions carefully.

CAUTION

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

- Follow the prevention instructions carefully.

Mandatory Signs

The importance of the mandatory signs in this manual.

Safety goggles

Safety gloves

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


Electrical shock hazard


Corrosive


Harmful to health


Flammable


Warning general


Attention general

1.2. General Safety Regulations

Legal Requirements

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

Spare Parts and Disposables

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

Modifications

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

WARNING

Risk of Electrical Shock

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

This chapter contains technical data, requirements and performance data.

2.1. Description of the System

The portable AMI INSPECTOR instrument is a complete monitoring system mounted on a small panel with supporting stand and a rechargeable battery for stand-alone operation (>24h), designed as an inspection equipment for quality assurance of online process monitors.

Features

General Features of AMI INSPECTORs are:

- Battery life after full charge:
  - >24 h at full load (use of 3 relays, USB, signal output, logger)
  - >36 h at minimum load (use of logger only)
- Charging time: approx. 6 hours
- Controlled shut-down if battery is empty.
- Display of remaining battery life in hours.
- For longer battery life the back light of the LC Display is disabled.
- Continuous operation using power adapter. The battery should be discharged at least once a month (normal usage until the monitor automatically shuts down).

Battery

The Li-Ion battery is located in the housing of the AMI transmitter.

See chapter Power Supply, p. 18 regarding power supply and charging of the battery.

Safety features

No data loss after power failure, all data is saved in non-volatile memory. Over voltage protection of in- and outputs.

Galvanic separation of measuring inputs and signal outputs.

USB interface

Built-in USB interface for logger download. Use the USB stick supplied by Swan only (other USB sticks can dramatically reduce battery life).

Signal Output

One signal output programmable for measured values (freely scaleable, linear or bilinear) or as continuous control output (control parameters programmable).

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

Relay

Two potential-free contacts programmable as limit switches for measuring values, controllers or timer for system cleaning with automatic hold function.

Maximum load: 100 mA/50 V

Alarm Relay

One potential free contact.

Alternatively:

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

Summary alarm indication for programmable alarm values and instrument faults.

Input

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

Measuring principle

Hydrogen is measured by an amperometric method. A small voltage, called polarization voltage, is applied between two electrodes. If a hydrogen molecule hits the positively charged platinum electrode (anode) it will be oxidized. This means that two electrons are removed under the influence of the positive voltage and the catalytic properties of the platinum. This leaves two (charged) protons and two electrons behind.

(1) $H2 \longrightarrow 2 H^+ + 2 e^-$

The two electrons are transported by the polarization voltage source to the negatively charged silver-silver chloride electrode (cathode), causing the following reaction:

(2) $AgCl + 2 e^- \longrightarrow Ag + 2 Cl^-$

Finally the two kinds of ions produced will combine into a small amount of hydrochloric acid:

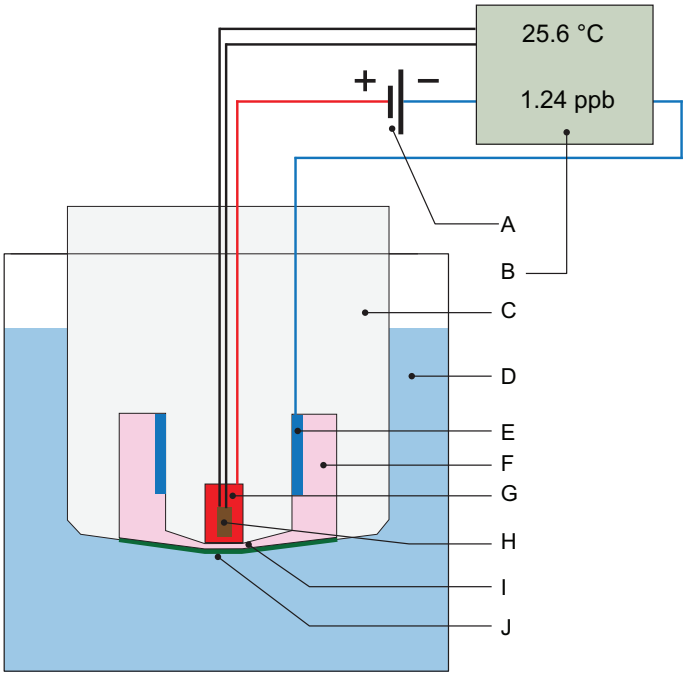
(3) $2 H+ + 2 Cl^- \longrightarrow 2 HCl$

If the hydrogen concentration in the sample increases more hydrogen molecules will hit the platinum anode within a given time. Therefore more electrons will be transported within a given time which corresponds to an increased electrical current. This current can be measured by the electronics. It is directly proportional to the concentration of hydrogen in the sample. Formula (2) indicates that

in the course of the hydrogen measurement the silver chloride is reduced to elemental silver. If all silver chloride has been converted to silver the hydrogen sensor has to be refurbished in the factory. However there is enough silver chloride provided to keep the sensor operational during two years under normal conditions.

The actual SWAN hydrogen-sensor design is based on the well-known Clark principle. Clark-type hydrogen sensors have been successfully in use for many years.

Hydrogen sensor schematic view

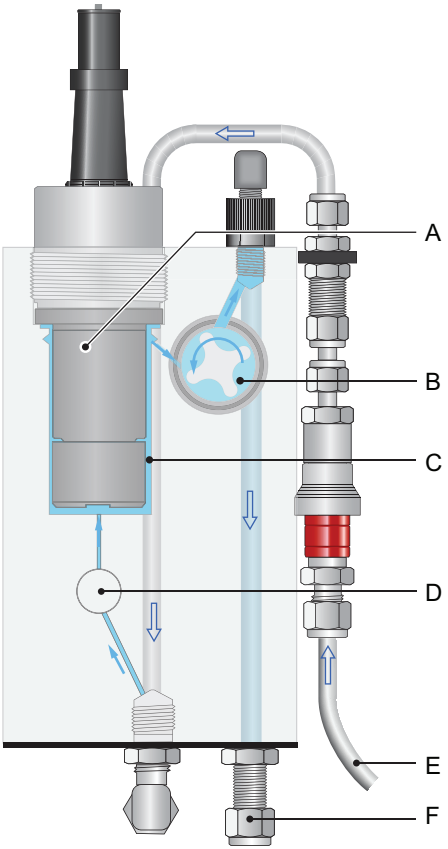


A *Polarization voltage source*
B *Display*
C *Sensor Body*
D *Sample*
E *Cathode*
F *Electrolyte*
G *Anode*
H *Temperature sensor*
I *Thin layer of electrolyte*
J *Hydrogen permeable membrane*

Fluidics

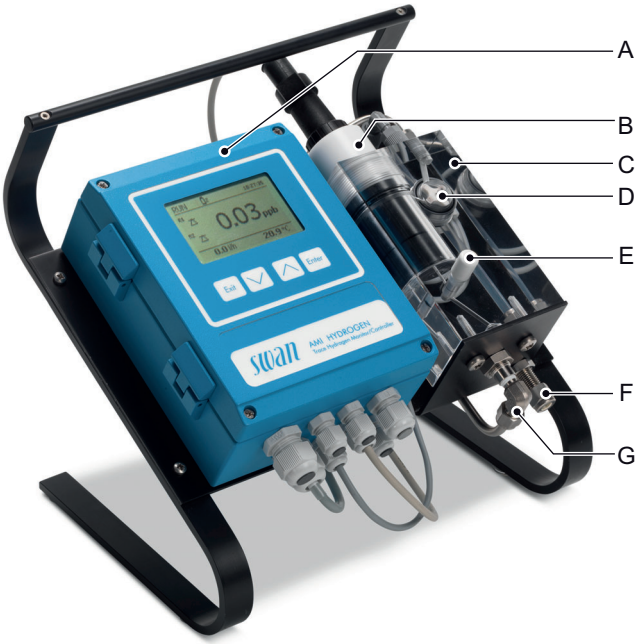
The sample flows via sample inlet [E] through the flow regulating valve [D], where the flow rate can be adjusted. Then the sample flows into the measuring cell [C] were the hydrogen concentration of the sample is measured.

The sample leaves the measuring cell via flow sensor [B] through the sample outlet [F].



A *Hydrogen sensor*
B *Flow sensor*
C *Measuring cell*
D *Flow regulating valve*
E *Sample inlet*
F *Sample outlet*

2.2. Instrument Overview



A *AMI Transmitter*
B *Hydrogen sensor*
C *Flow cell*
D *Flow sensor*
E *Flow regulating valve*
F *Sample outlet*
G *Sample inlet*

2.3. Technical Data

Power Supply	Battery	
	Use original, supplied power adapter only.	
	Voltage:	85–265 VAC, 50/60 Hz
	Power consumption:	max. 20 VA
	Charging time:	6h
	Battery type:	Li-Ion
	During charging protect from heat impact and keep splash-proof (not IP66).	
Operating time	Stand-alone (Battery):	> 24h
	Connected adapter:	continuous
	Controlled shut-down when battery is empty, remaining time is displayed.	
Electronics housing	Aluminium with a protection degree of IP 66 / NEMA 4X	
	Ambient temperature:	-10 to +50 °C
	Humidity:	10–90% rel., non condensing
	Display:	backlit LCD, 75 x 45 mm
Sample requirements	Flow rate:	6 to 20 l/h
	Temperature:	up to 45 °C
	Inlet pressure:	0.2 to 1 bar
	Outlet pressure:	pressure free
Flow cell and connection	Flow cell made of acrylic glass with built-in flow adjustment valve and digital sample flow meter	
	Sample inlet:	1/4” Swagelok tube adapter
	Sample outlet:	flexible tube 8x6 mm

Measuring Range	Range	Resolution
	0.1 to 199 ppb	0.1 ppb
	200 to 800 ppb	1 ppb
	0 – 50% saturation	0.1% Saturation

Accuracy	±5 % of measured value or ±0.5 ppb
Reproducibility	±1 % of measured value or ±0.5 ppb

3. Installation

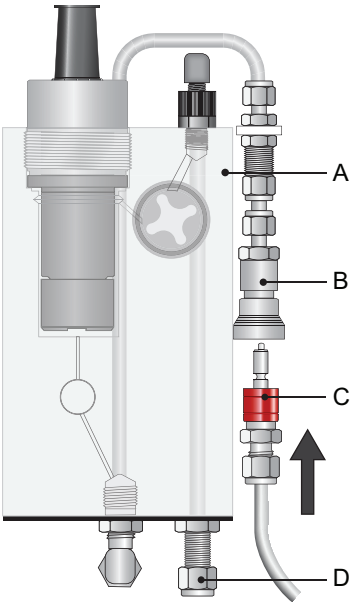
3.1. Installation Check List

Check	◆ Instrument's specification must conform to your AC power ratings. See External power adapter, p. 19. ◆ Check if the battery is fully charged.
Installation	◆ Connect the sample and waste line.
Power-up	◆ Open the flow regulating valve. ◆ Switch on power ◆ Adjust the sample flow to 6–20 l/h.
Instrument Setup	◆ Program all parameters for external devices (interface, recorders, etc.) ◆ Program all parameters for instrument operation (limits, alarms).
Run-in period	◆ Let the instrument run continuously for 1 h.

3.2. Connecting Sample Inlet and Outlet

3.2.1 Connect the Sample Inlet to the Quick-Lock Coupling

The AMI INSPECTOR Hydrogen is delivered with a quick-lock coupling. To connect the sample line to the AMI INSPECTOR Hydrogen, simply push the nipple into the quick-lock coupling.

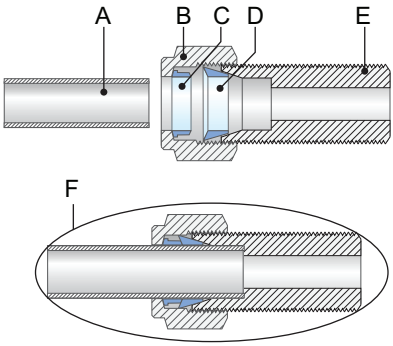


A *Flow cell block*
B *Quick-lock coupling*
C *Nipple*
D *Sample outlet*

3.2.2 Connect the Sample Outlet

Installation

1. Loosen the union nut [B] but do not remove it.
2. Push the FEP tube [A] through the union nut [B] as far as it reaches the stop of the threaded tube [E].
3. Tighten the union nut 1¾ rotation using an open ended spanner. Hold Body from turning with a second wrench.
4. Put the FEP Tube into a pressure free drain with sufficient capacity.



A *FEP tube 8x6*
B *Union nut*
C *Compression ferrule*
D *Compression cone*
E *Threaded tube*
F *Tightened connection*

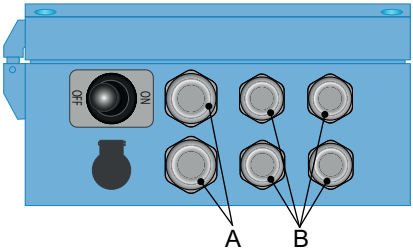
3.3. Electrical Connections

WARNING

Always turn off DC power before manipulating electric parts. 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 9 cable gland: cable $Ø_{outer}$ 4–8 mm*
B *PG 7 cable gland: cable $Ø_{outer}$ 3–6.5 mm*

NOTICE: *Protect unused cable glands*

Wire

- For 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.

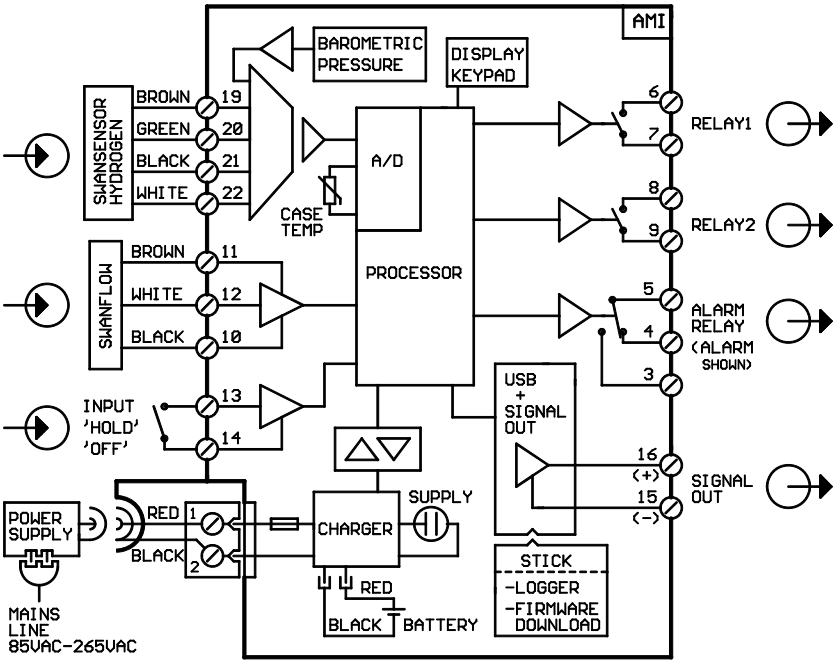
WARNING

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 continuing the installation.
  - relay 1
  - relay 2
  - alarm relay

3.4. 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.

3.4.1 Power Supply

Contrary to all other Swan online process monitors the AMI INSPECTOR transmitter is supplied with power by battery only. The rechargeable battery (Li-Ion) enables a stand-alone operation for at least 24 hours.

WARNING

Do not provide power directly to the transmitter as this will destroy the motherboard. All AMI INSPECTOR transmitters are supplied with power by battery only.

Charging

Use the original supplied power adapter to charge AMI INSPECTOR only. Charging time: approx 6h.

Fully charged a stand-alone operating time of at least 24h is guaranteed:

- >24h at full load (use of 3 relays, USB, signal outputs, logger)
- >36h at minimal load (use of logger only)

In case that the battery is discharged completely the firmware will automatically shut down.

Switch Power ON - OFF

Switch the instrument ON or OFF using the toggle switch on the transmitter.

Continuous operation

For continuous operation use the power adapter as well.

CAUTION

- If the AMI powers ON and then immediately shuts OFF, the battery is empty. Do not hold the toggle switch in ON position, as this can damage the battery.

CAUTION

- During charging protect from heat impact and keep splash-proof (plug of power adapter is not IP66).
- Do not supply external devices, e.g. pumps, magnetic valves or any other current consumers with AMI INSPECTOR

CAUTION

- Use the original supplied power adapter to charge AMI INSPECTOR only. Use of any other power adapter can damage the battery or cause malfunction

External power adapter

- Universal input range 85 - 265 VAC
- Continuous short circuit protection
- Over voltage protection
- LED indicator for power on
- 2-pin AC inlet (IEC 320-C8) for country-specific power cord

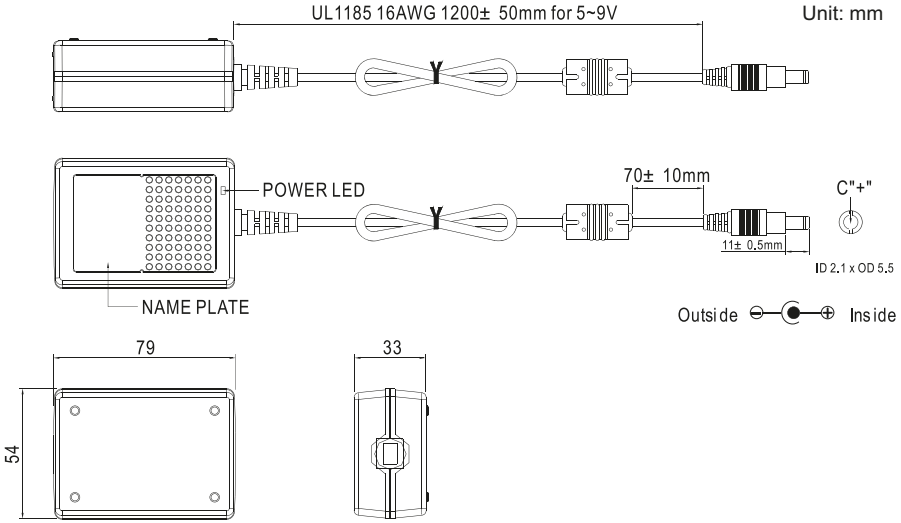
Power cords

Two different power cords are supplied:

- Power cord with type C plug (Europlug)
- Power cord with type A plug (NEMA-1)

If a different plug type is needed, please purchase a suitable power cord from your local supplier.

Dimensions



3.5. Relay Contacts

Programming of the relay contacts see 5.3 Relay Contacts, p. 58

3.5.1 Input

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

Terminals 13/14

If signal output is set to hold, measurement is interrupted if input is active.

For programming see menu 5.3.4, p. 64.

3.5.2 Alarm Relay

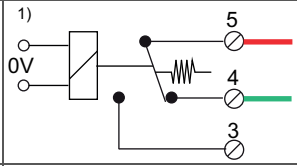
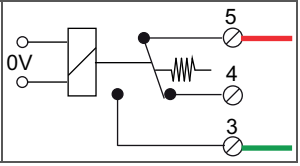
NOTICE: *For resistive loads only; do not use with capacitive or inductive loads. Max. load 1 A / 250 VAC*

Alarm output for system errors.

Error codes see Error List, p. 40

Programming see menu 5.3.1, p. 58

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

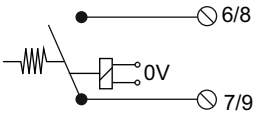
	Terminals	Description	Relay connection
NC[1] Normally Closed	5/4	Active (opened) during normal operation. Inactive (closed) on error and loss of power.	
NO Normally Open	5/3	Active (closed) during normal operation. Inactive (opened) on error and loss of power.	

1) *usual use*

3.5.3 Relay Contacts 1 and 2

NOTICE: *For resistive loads only; do not use with capacitive or inductive loads. Rated load 100 mA / 50 V*

For programming see Menu Installation 5.3.2 and 5.3.3, p. 60

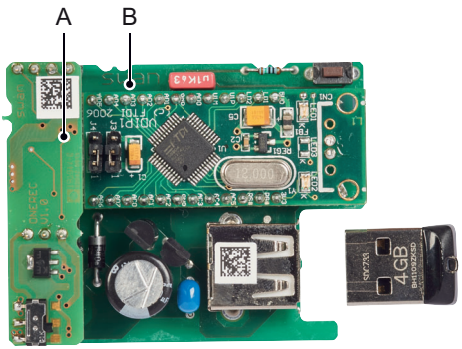
	Terminals	Description	Relay connection
NO Normally Open	6/7: Relay 1 8/9: Relay 2	Inactive (opened) during normal operation and loss of power. Active (closed) when a programmed function is executed.	

3.6. Signal Output

The signal output 0/4–20 mA PCB is plugged onto the USB interface PCB.

NOTICE: *Max. burden 510 Ω.*

Terminals 16 (+) and 15 (-).
For programming see menu 5.2 Signal Outputs, p. 54.



A *Signal output 0/4–20 mA PCB*
B *USB interface*

4. Instrument Setup

Establish Sample Flow

1. Switch off the instruments.
2. Connect sample lines, see Connect the sample lines, p. 34.
3. Open the flow regulating valve.
4. Switch the instrument ON using the toggle switch of the battery.
5. Check if the battery is fully charged.
6. Adjust the flow to 6–20 l/h. The actual flow is shown on the transmitter.

4.1. Programming

Sensor parameters

Check the sensor parameters in menu <Installation>\ <Sensors>\<Sensor parameters>.

The sensor characteristics are printed on the label of each sensor.

SwanSensor Hydrogen	
A-87.260.001	I_s: 3.025 µA
xxxxxxx	p: 953 hPa

The following parameters are required:

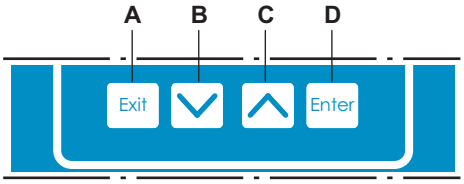
- I_s (saturation current)
- p (air pressure)

Programming

Program all parameters for external devices (interface, recorders, etc.) Program all parameters for instrument operation (limits, alarms). See Program Overview, p. 43 and for explanations, see Program List and Explanations, p. 49.

5. Operation

5.1. Keys



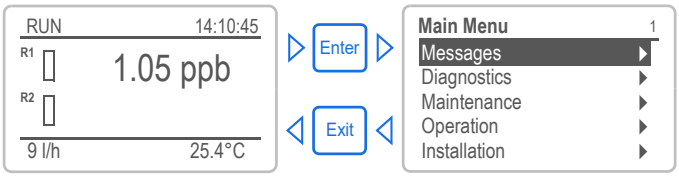
A to exit a menu or command (rejecting any changes)
to move back to the previous menu level

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

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

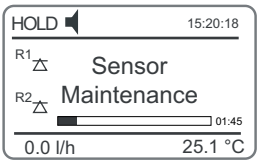
D to open a selected sub-menu
to accept an entry

Program Access, Exit

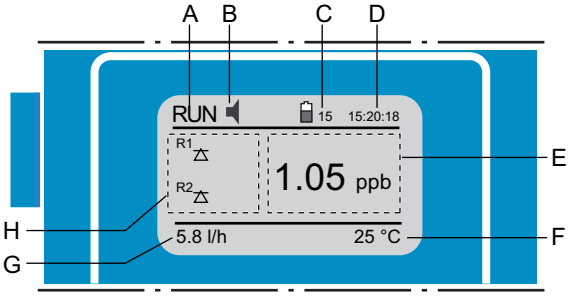


Sensor Maintenance

An automatic sensor regeneration is carried out at configurable intervals and takes 2 minutes. During this time the signal outputs are set to hold.



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 Battery status (remaining operating time in h)

D Time

E Process values

F Sample temperature

G Sample flow

H Relay status

Relay status, symbols

upper/lower limit not yet reached

upper/lower limit reached

control upw./downw. no action

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

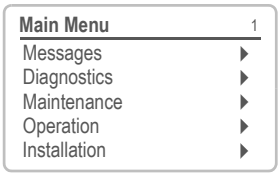
motor valve closed

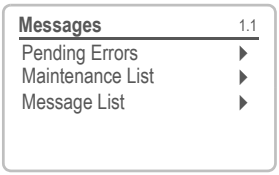
motor valve: open, dark bar indicates approx. position

timer

timer: timing active (hand rotating)

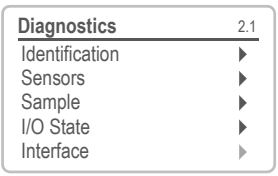
5.3. Software Structure





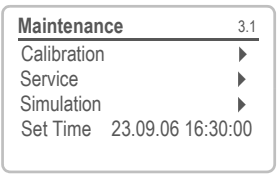
Menu **Messages 1**

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



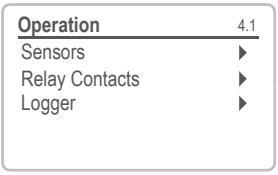
Menu **Diagnostics 2**

Provides user relevant instrument and sample data.



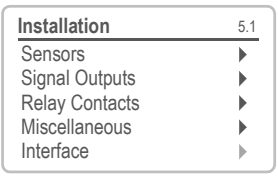
Menu **Maintenance 3**

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



Menu **Operation 4**

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



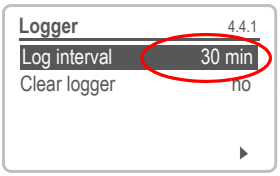
Menu **Installation 5**

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

5.4. Changing Parameters and values

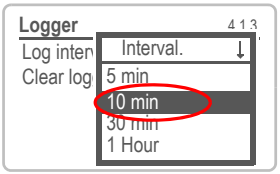
Changing parameters

The following example shows how to change the logger interval:



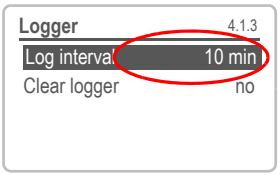
1 Select the parameter you want to change.

2 Press [Enter]



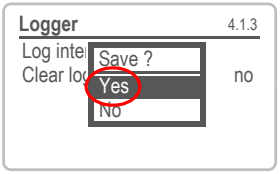
3 Press [▲] or [▼] key to highlight the required parameter.

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



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

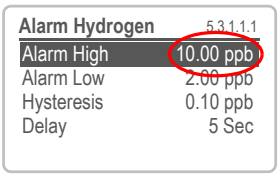
5 Press [Exit].



⇒ *Yes is highlighted.*

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

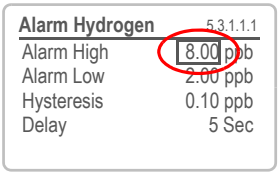
Changing values



1 Select the value you want to change.

2 Press [Enter].

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



4 Press [Enter] to confirm the new value.

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

6 Press [Enter] to save the new value.

6. Maintenance

6.1. Maintenance Table

If required	Perform a calibration.
Two years or if required	◆ Send the sensor to Swan for revision. ◆ After installation of the revised sensor, program saturation current and air pressure (5.1.3.1, p. 53 and 5.1.3.2, p. 53) as indicated on the sensor label. To avoid a longer interruption of the measuring operation, a second hydrogen sensor can be purchased. The two sensors can then be used alternately. If two sensors are available, the following procedure is recommended: ◆ Send the replacement sensor to Swan for revision shortly before replacement. ◆ After installing the revised sensor, store the unused sensor in its original packaging in a cold, dry and dark place.

6.2. Stop of Operation for Maintenance

1 Shut off power of the instrument.

2 Stop sample flow by closing the flow regulating valve.

6.3. Maintenance of the Hydrogen Sensor

6.3.1 Hydrogen Sensor Handling

- Never attempt to open the hydrogen sensor.
- Always store the sensor in water or in the wet flow cell.
- Always keep the sensor connected to the AMI transmitter.
- Always keep the sensor polarized. Without polarization the sensor suffers a loss of sensitivity.
  The AMI INSPECTOR Hydrogen has a buffered polarization source which will keep the hydrogen sensor polarized for some days, even if the AMI INSPECTOR Hydrogen is switched off.
  However, it is a good idea to keep the AMI running all the time. The AMI INSPECTOR Hydrogen should be connected to the power supply and switched on even if it is not in use.
- During calibration, do not expose the sensor to 100% hydrogen for more than 6 minutes. Otherwise the extremely dry gas might dry out the capillary layer of electrolyte between platinum anode and plastic membrane, which makes the sensor response unstable.
- The hydrogen molecule is very small and migrates into almost any material including electrolyte, plastics and even metals and will remain there for some time. After a calibration it may take a few hours until the residual current of the sensor has dropped enough to measure very low levels of hydrogen again.
- The hydrogen sensor usually shows a small positive offset, which means there is a small positive value in air (without hydrogen, normally below one ppb). This value can be set to zero: <Installation > Sensors > Miscellaneous > Offset. Use with care!

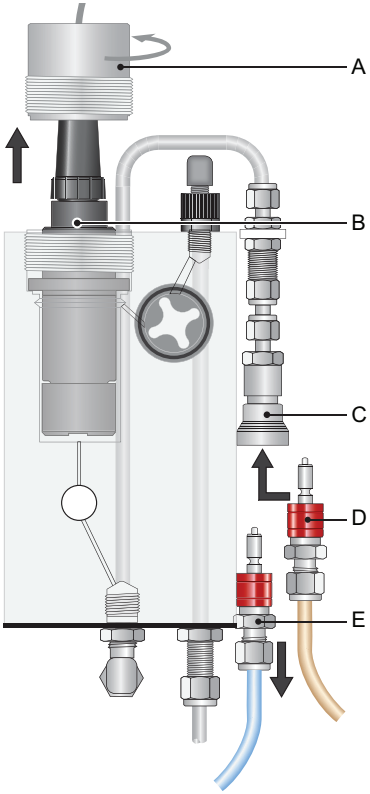
6.3.2 Calibration

The hydrogen sensor of the AMI INSPECTOR Hydrogen is calibrated with pure hydrogen. To perform a calibration proceed as follows:

NOTICE: *Do not expose the sensor to 100% hydrogen for more than 6 minutes.*

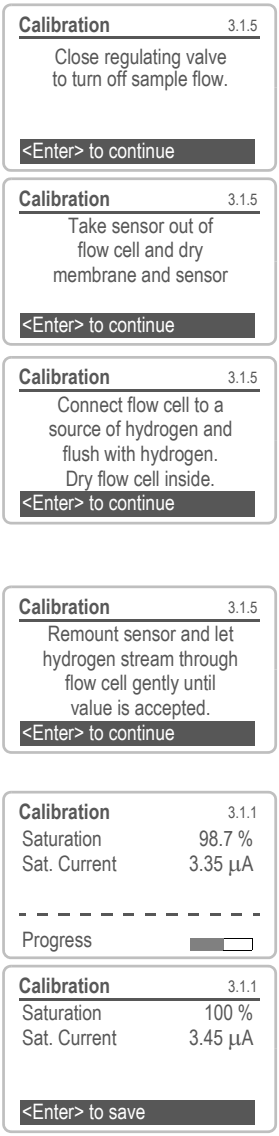
1 Stop the sample flow at the main tap.

2 Navigate to menu <Maintenance> / <Calibration>.



A *Threaded sleeve*
B *Hydrogen sensor*
C *Quick-lock coupling*
D *Hydrogen tube*
E *Sample tube*

3 Press [Enter] to start the calibration and follow the dialog on the display.



4 Unscrew and remove the threaded sleeve [A].

5 Remove the hydrogen sensor [B] from the flow cell.

6 Dry the sensor membrane and the flow cell with a soft paper tissue.

7 Remove the sample inlet [E] from the quick-lock coupling [C].

8 Connect the hydrogen supply tube [D] to the quick-lock coupling.

9 Flush the flow cell with hydrogen.

10 Stop hydrogen flow and dry the flow cell.

11 Re-insert the hydrogen sensor into the flow cell.
⇒ *Make sure that the sensor membrane is dry.*

12 Start the hydrogen flow

13 Press [Enter] to start the calibration measurement.

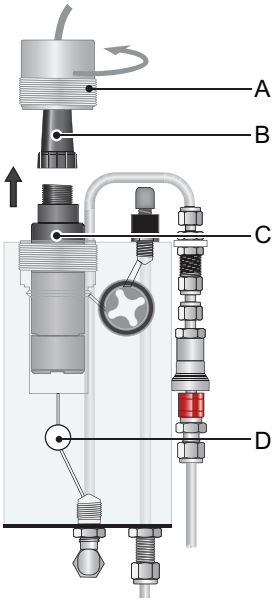
The saturation should reach 100%, the saturation current should be about 2.0 µA to 4.5 µA. If the measuring values are not stable during the measuring period, the calibration will be discarded.

If this is the case, check and if necessary correct your measurement arrangement and try again.

If the calibration was successful press [Enter] to save.

If the calibration fails again, the hydrogen sensor has to replaced by a new one.

6.3.3 Replace Hydrogen Sensor



A *Threaded sleeve*
B *Sensor connector*
C *Hydrogen sensor*
D *Flow regulating valve*

To replace the hydrogen sensor proceed as follows:

Remove the old sensor

1. Switch off the AMI Inspector Hydrogen.
2. Close the flow regulating valve [D].
3. Unscrew and remove the threaded sleeve [A] from the flow cell.
4. Remove the hydrogen sensor [C] from the flow cell.
5. Unscrew and remove the sensor connector [B] from the hydrogen sensor.

Install the new sensor

1. Screw the connector onto the hydrogen sensor and tighten it.
2. Put the hydrogen sensor into the flow cell.
3. Screw the threaded sleeve into the thread of the flow cell to fix the hydrogen sensor.
4. Open the flow regulating valve and adjust the sample flow to 6–20 l/h.
5. Switch on the AMI Inspector Hydrogen.
6. Let the new sensor run in for at least 1h.

6.4. Quality Assurance of the Instrument

Every SWAN on-line instrument is equipped with integrated, autonomous quality assurance functions to survey the plausibility of each measurement.
For the AMI Hydrogen these are:

- continuous monitoring of sample flow
- continuous monitoring of the temperature inside the transmitter case
- periodic accuracy test with ultra high precision resistors

Further a manual, menu driven inspection procedure can be carried out using a certified reference instrument. The AMI Inspector is connected to the same sample point and provides the reference value. After enabling the quality assurance procedure by defining the quality assurance level, the instrument reminds the user periodically to run the procedure and results are stored in a history for review.

Quality assurance level

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

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

Additional level:

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

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

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

Procedure The standard workflow contains following procedures:

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

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

6.4.1 Activate SWAN Quality assurance procedure

Enable quality assurance procedure at each instrument to be verified by selecting the quality level in menu 5.1.2.
The corresponding submenus are then activated.

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

6.4.2 Pre-test

- Reference instrument: AMI INSPECTOR Hydrogen:
  - Check certificate; reference instrument certificate not older than one year.
  - Check battery; Battery of the AMI INSPECTOR Hydrogen should be completely charged. Remaining operating time on display minimum 20 hours.
  - Sensor is in working condition
- On-line instrument: Monitor AMI Hydrogen:
  - Good order and condition; Flow cell free of particles, Sensor surface free of deposits.
  - Check message list; Review the message list in menu 1.3 and check for frequently alarms (as for example flow alarms). If alarms occur frequently remove cause before starting the procedure.

6.4.3 Connect the sample lines

See corresponding chapter in the manual of the process monitor which shall be checked with a reference instrument.

The choice of sampling depends strongly on local conditions on site. Possible sampling:

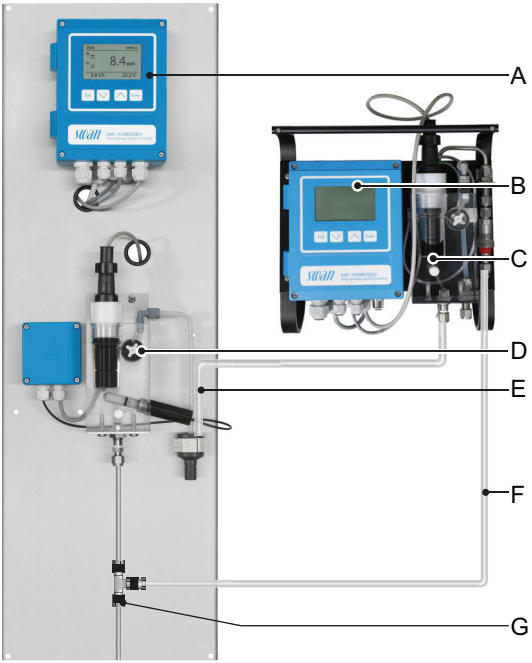
- via sample point,
- via T-fitting or
- via piggyback/downstream

NOTICE:

- *avoid ingress of air, use screwed fitting,*
- *sample as near as possible to the process monitor,*
- *wait approx. 10 minutes, whilst measurement is running, until measurement value and temperature are stabilized.*

Example

As an example following picture shows the connection of the reference instrument via T-fitting to the process monitor.



A *Monitor AMI Hydrogen*
B *AMI INSPECTOR Hydrogen*
C *Reference flow cell*
D *On-line flow cell*
E *Sample outlet*
F *Sample inlet*
G *T-fitting*

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

2 Connect sample line of the monitor AMI Hydrogen [A] with the sample inlet of the reference instrument AMI INSPECTOR Hydrogen [B]. Use the supplied tube.

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

4 Switch on the AMI INSPECTOR Hydrogen. Open the flow regulating valve and regulate the sample flow to 10 l/h. The actual flow is shown on the transmitter.

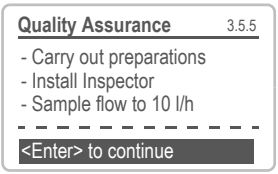
6.4.4 Carry out comparison measurement

The comparison measurement is menu driven. To carry out the comparison measurement, proceed as follows:

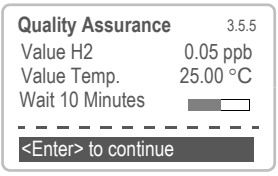
1 On the monitor AMI Hydrogen, navigate to the <Maintenance>/ <Quality Assurance> menu.

2 Press [Enter].

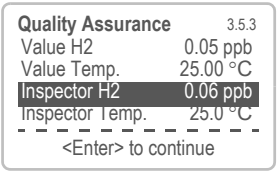
3 Follow the dialog on the Display.



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

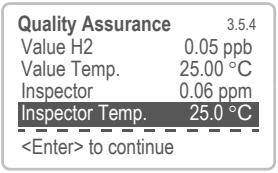


5 Wait 10 minutes whilst measurement is running.
Press [Enter] to continue.



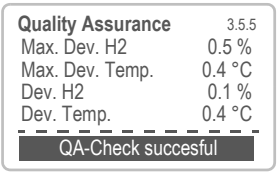
6 Read the hydrogen value of the reference instrument and enter under “Inspector.” by using the [▲] or [▼] keys.

7 Press [Enter] to confirm.



8 Read temperature value of the reference instrument and enter under “Inspector Temp.” by using the [▲] or [▼] keys.

9 Press [Enter] to confirm.



10 Press [Enter] to continue.
⇒ *The results are saved in QA-History regardless if successful or not*

6.4.5 Completion of the measurement

1. Stop the sample flow to the AMI INSPECTOR Hydrogen by closing the appropriate valve, e.g. back pressure regulator, sample preparation or flow regulating valve at flow cell again.
2. Close flow regulating valve of the AMI Inspector.
3. Disconnect the AMI Inspector by removing the tubes and connect the sample outlet of the Monitor AMI INSPECTOR Hydrogen to the sample outlet funnel again.
4. Start sample flow again and regulate sample flow.
5. Shutdown the AMI INSPECTOR Hydrogen.

If the AMI Inspector will not be used for a longer period of time, proceed according to section Longer Stop of Operation in the manual of the AMI Inspector.

6.5. Replacing Fuses

WARNING

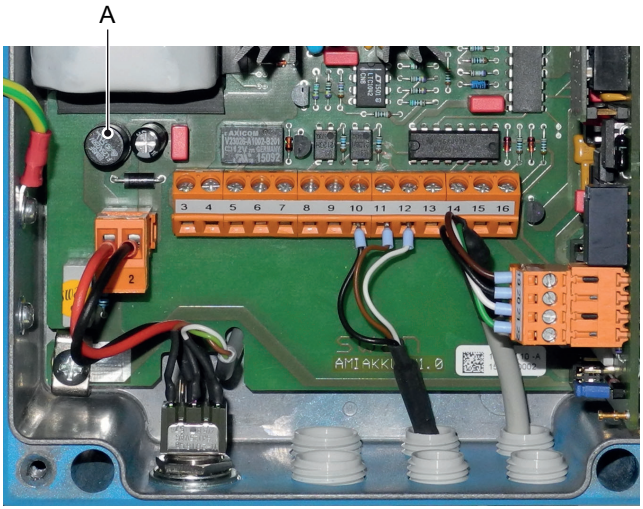
External Voltage.

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 continuing the installation.
  - relay 1
  - relay 2
  - alarm relay

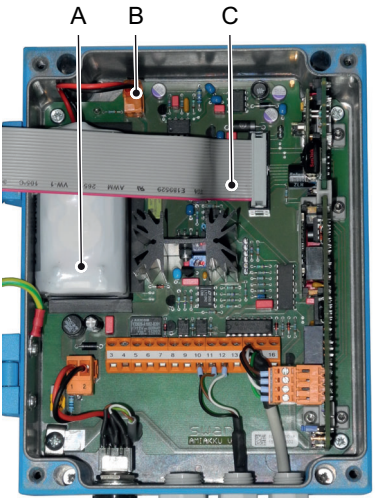
Find and repair the cause for the short circuit before replacing the fuse. Use tweezers or needle-nosed pliers to remove the defective fuse.

Use original fuses provided by SWAN only.



A *1.25 AF/250V Instrument power supply*

6.6. Replacing the Battery



A Battery
B Battery plug
C Ribbon cable

1 Switch the AMI Inspector off.
2 If connected, disconnect the power adapter from the power jack.
3 Open the transmitter housing.
4 Pull out the ribbon cable [C] from the mainboard.
5 Disconnect battery plug [B] and replace the battery.

6.7. Longer Stop of Operation

1 Stop sample flow.
2 Do not shut off power of the instrument.

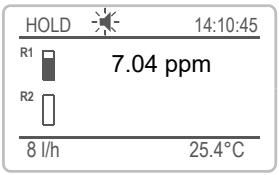
NOTICE: *The hydrogen sensor is polarized and a loss of polarization will result in loss of sensitivity. If the AMI INSPECTOR Hydrogen is switched off the polarization buffer will be discharged within a few days.*

3 Leave the sensor in the wet flow cell.

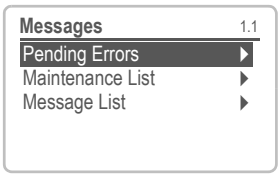
7. Error List

Error
Non-fatal Error. Indicates an alarm if a programmed value is exceeded.
Such Errors are marked **E0xx** (bold and black).
Fatal Error (blinking symbol)
Control of dosing devices is interrupted.
The indicated measured values are possibly incorrect.
Fatal Errors are divided in the following two categories:

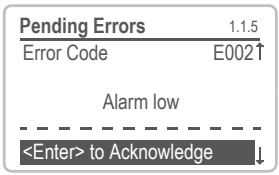
- Errors which disappear if correct measuring conditions are recovered (i.e. Sample Flow low).
  Such Errors are marked **E0xx** (bold and orange)
- Errors which indicate a hardware failure of the instrument.
  Such Errors are marked **E0xx** (bold and red)



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



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	Hydrogen Alarm high	– check process – check programmed value, see 5.3.1.1.1, p. 58
E002	Hydrogen Alarm low	– check process – check programmed value, see 5.3.1.1.22, p. 58
E003	Saturation Alarm high	– check process – check programmed value, see 5.3.1.4, p. 59
E004	Saturation Alarm low	– check process – check programmed value, see 5.3.1.4, p. 59
E007	Sample Temp. high	– check process – check programmed value, see 5.3.1.3.1, p. 59
E008	Sample Temp. low	– check process – check programmed value, see 5.3.1.3.22, p. 59
E009	Sample Flow high	– check sample flow – check programmed value, see 5.3.1.2.2, p. 59
E010	Sample Flow low	– establish sample flow – clean instrument – check programmed value, see 5.3.1.2.32, p. 59
E011	Temp. shorted	– Check wiring of sensor – Check sensor
E012	Temp. disconnected	– Check wiring of sensor – Check sensor

Error	Description	Corrective action
E013	Case Temp. high	– check case/environment temperature – check programmed value, see 5.3.1.5.1, p. 60
E014	Case Temp. low	– check case/environment temperature – check programmed value, see 5.3.1.5.2, p. 60
E017	Control Timeout	– check control device or programming in Installation, Relay contact, Relay 1/2 see 5.3.2 and 5.3.3, p. 60
E024	Input active	– See If Fault Yes is programmed in Menu see 5.3.4, p. 64
E026	IC LM75	– call service
E030	EEProm Frontend	– call service
E031	Calibration Recout	– call service
E032	Wrong Frontend	– call service
E033	Power-on	– none, normal status
E034	Power-down	– none, normal status

8. Program Overview

For explanations about each parameter of the menus see Program List and Explanations, p. 49.

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

8.1. Messages (Main Menu 1)

Pending Errors 1.1*	*Pending Errors*	1.1.5*	* Menu numbers
Maintenance List 1.2*	Maintenance List	1.2.5*	
Message List 1.3*	*Number*	1.3.1*	
	Date, Time		

8.2. Diagnostics (Main Menu 2)

Identification	Desig.	AMI Hydrogen		* Menu numbers
2.1*	Version	6.22-08/18		
	Factory Test	*Instrument*	2.1.3.1*	
	2.1.3*	*Motherboard*		
		Front End		
	Operating Time	*Years / Days / Hours / Minutes / Seconds*		2.1.4.1*
	2.1.4*			
Sensors	**Sensor**	*Current Value*		
2.2*	2.2.1*	*(Raw value tc)*		
		(Raw value)		
		Saturation		
		Cal. History	*Number*	2.2.1.5.1*
		2.2.1.5*	*Date, Time*	
			Sat. Current	
			Air pressure	
	Miscellaneous	*Case Temp.*	2.2.2.1*	
	2.2.2*	*Air pressure*		
Sample	*Sample ID*	2.3.1*		
2.3*	*Temperature °C*			
	Nt5K Ohm			
I/O State	*Alarm Relay*	2.4.1*		
2.4*	*Relay 1/2*	2.4.2*		
	Input			
	Signal Output 3			
Interface	*Protocol*	2.5.1*		
2.5*	*USB Stick*			

8.3. Maintenance (Main Menu 3)

Calibration 3.1*	*Calibration*	3.1.5		* Menu numbers
Sevice 3.2*	**Electrolyte** 3.2.1*	*Last filling*		
		Remaining amount		
		Remaining time		
		New Filling	3.2.1.5*	
Simulation 3.3*	*Alarm Relay*	3.3.1*		
	Relay 1	3.3.2*		
	Relay 2	3.3.3*		
	Signal Output 3	3.3.6*		
Set Time 3.4*	*(Date), (Time)*			

8.4. Operation (Main Menu 4)

Sensors	*Filter Time Const.*	4.1.1*		
4.1*	*Hold after Cal.*	4.1.2*		
Relay Contacts	**Alarm Relay**	**Alarm Hydrogene**	*Alarm High*	4.2.1.1.1*
4.2*	4.2.1*	4.2.1.1*	*Alarm Low*	4.2.1.1.22*
			Hysteresis	4.2.1.1.32*
			Delay	4.2.1.1.42*
		Alarm Saturation	*Alarm High*	4.2.1.2.1*
		4.2.1.2*	*Alarm Low*	4.2.1.2.22*
			Hysteresis	4.2.1.2.32*
			Delay	4.2.1.2.42*
	Relay 1/2	*Setpoint*	4.2.x.100*	
	4.2.2* - 4.2.3*	*Hysteresis*	4.2.x.200*	
		Delay	4.2.x.30*	
	Input	*Active*	4.2.4.1*	
	4.2.4*	*Signal Outputs*	4.2.4.2*	
		Output / Control	4.2.4.3*	
		Fault	4.2.4.4*	
		Delay	4.2.4.5*	
Logger	*Log Interval*	4.3.1*		
4.3*	*Clear Logger*	4.3.2*		* Menu numbers
	Eject USB Stick	4.3.3*		

8.5. Installation (Main Menu 5)

Sensors	**Miscellaneous**	*Flow*	5.1.1.1*	* Menu numbers
5.1*	5.1.1*	*Offset*	5.1.1.2*	
		Maintenance Int.	5.1.1.3*	
	Sensor parameters	Saturation current	5.1.3.1*	
	5.1.3*	Air pressure	5.1.3.2*	
Signal Outputs	**Signal Output 3**	*Parameter*	5.2.1.1*	
5.2*	5.2.1*	*Current Loop*	5.2.1.2*	
		Function	5.2.1.3*	
		Scaling	*Range Low*	5.2.x.40.10*
		5.2.x.40	*Range High*	5.2.x.40.20*
Relay Contacts	**Alarm Relay**	**Alarm Hydrogen**	*Alarm High*	5.3.1.1.1*
5.3*	5.3.1*	5.3.1.1*	*Alarm Low*	5.3.1.1.22
			Hysteresis	5.3.1.1.32
			Delay	5.3.1.1.42
		Sample Flow	*Flow Alarm*	5.3.1.2.1
		5.3.1.2*	*Alarm High*	5.3.1.2.2*
			Alarm Low	5.3.1.2.32*
		Sample Temp.	*Alarm High*	5.3.1.3.1*
		5.3.1.3*	*Alarm Low*	5.3.1.3.22*
		Alarm Saturation	*Alarm High*	5.3.1.4.1*
		5.3.1.4*	*Alarm Low*	5.3.1.4.22
			Hysteresis	5.3.1.4.32
			Delay	5.3.1.4.42
		Case Temp.	*Case Temp. high*	5.3.1.5.1*
		5.3.1.5*	*Case Temp. low*	5.3.1.5.2*
	Relay 1/2	*Function*	5.3.2.1–5.3.3.1*	
	5.3.2* - 5.3.3*	*Parameter*	5.3.2.20–5.3.3.20*	
		Setpoint	5.3.2.300–5.3.3.301*	
		Hysteresis	5.3.2.400–5.3.3.401*	
		Delay	5.3.2.50–5.3.3.50*	
	Input	*Active*	5.3.4.1*	
	5.3.4*	*Signal Outputs*	5.3.4.2*	
		Output/Control	5.3.4.3*	
		Fault	5.3.4.4*	
		Delay	5.3.4.5*	

Miscellaneous	*Language*	5.4.1*	
5.4*	*Set defaults*	5.4.2*	
	Load Firmware	5.4.3*	
	Password	*Messages*	5.4.4.1*
	5.4.4*	*Maintenance*	5.4.4.2*
		Operation	5.4.4.3*
		Installation	5.4.4.4*
	Sample ID	5.4.5*	
Interface	*Protocol*	USB Stick	
5.5*	5.5.1*		

* Menu numbers

9. Program List and Explanations

1 Messages

1.1 Pending Errors

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

1.2 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. 6.22-08/18)

2.1.3 **Factory Test**: Test date of the Instrument and Motherboard.

2.1.4 **Operating Time:** Shows the operating time in Years, Days, Hours, Minutes and Seconds.

2.2 Sensors

2.2.1 **Sensor**

Current value:	Shows the actual measuring value in ppb.
Raw value tc:	Shows the actual temperature compensated measuring value in mA.
Raw value:	Shows the actual uncompensated measuring value in mA.
Saturation:	Shows the actual saturation in %

2.2.1.5 **Cal. History**
Review the diagnostic values of the last calibration of the hydrogen sensor. Max. 64 data records are memorized.
Number: Counter of calibrations.
Date, Time: Date and time of the calibration.
Sat. Current: Saturation current at the time of the calibration.
Air pressure: Air pressure at the time of the calibration.

2.2.2 **Miscellaneous**:

2.2.2.1 *Case Temp:* Shows the actual temperature in °C inside the transmitter.
Air pressure: Shows the actual air pressure in hPa

2.3 Sample

2.3.301 *Sample ID***:** Shows the assigned sample identification. This identification is defined by the user to identify the location of the sample
Temperature: Shows temperature in °C.
(Nt5K): Shows raw value of the temperature in Ω.
Sample Flow: Shows the sample flow in l/h
(Raw value) Shows the sample flow in Hz

2.4 I/O State

Shows actual status of all in- and outputs.

2.4.1

Alarm Relay:	Active or inactive.
Relay 1 and 2:	Active or inactive.
Input:	Open or closed.
Signal Output 3:	Actual current in mA

2.5 Interface

2.5.1 Protocol USB Stick.

3 Maintenance

3.1 Calibration

3.1.1 Start a calibration and follow the instructions on the screen. Displayed values are saturation in % and the saturation current in mA. The indication bar shows the progress. Detailed explanation see Calibration, p. 29.

3.2 Service

3.2.1 Electrolyte

Not applicable.

3.3 Simulation

In this menu the following relays and signal outputs can be tested:

- Alarm relay
- Relay 1 and 2
- Signal output 3

Select a relay or signal output with the [▲] or [▼] keys, press the [Enter]> key to confirm. Then change the value with the [▲] or [▼] keys. After confirming the setting with the [Enter] key, the value is simulated by the relay/signal output.

Alarm Relay:	Active or inactive.
Relay 1 and 2:	Active or inactive.
Input:	Open or closed.
Signal Output 3:	Current in mA

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

3.4 Set Time

Adjust date and time.

4 Operation

4.1 Sensors

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

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

4.2 Relay Contacts

See Relay Contacts, p. 19.

4.3 Logger

The instrument is equipped with an internal logger. The data can be copied to the USB stick installed in the transmitter.
The logger can save approx. 1500 data records. The Records consists of: Date, time, alarms, measuring values, raw values, case temperature, flow.

4.3.1 *Log Interval:* Select a convenient log interval. Consult the table below to estimate the max logging time. When the logging buffer is full, the oldest data record is erased to make room for the newest one (circular buffer).
Range: 1 Second to 1 hour

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

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

4.3.3 *Eject USB Stick*
Press [ENTER] to copy all logger data to the USB Stick.

5 Installation

5.1 Sensors

5.1.1 Miscellaneous

5.1.1.1 *Flow:* Select the installed flow meter:

- none
- Q-Flow

5.1.1.2 *Offset*: Manual, small correction of the offset. Range 0–3 ppb.

5.1.1.3 *Maintenance Int.:* Select the interval of the automatic sensor regeneration:

- Off
- 3 hours
- 6 hours
- 12 hours

5.1.2 Quality Assurance

Not applicable.

5.1.3 Sensor parameters

5.1.3.1 *Saturation current:* Enter the saturation current printed on the sensor label.
Range: 2.000–4.500 µA

5.1.3.2 *Air pressure:* Enter the air pressure printed on the sensor label.
Range: 900–1100 hPa

5.2 Signal Outputs

5.2.1 Signal Output 3 (signal outputs 1 and 2 are deactivated)

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

- Hydrogen
- Temperature
- Sample Flow (if a flow sensor is selected)
- Saturation

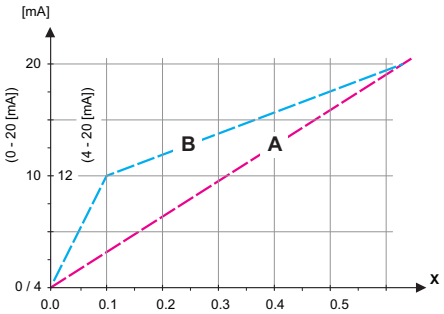
5.2.1.2 *Current Loop:* Select the current range of the signal output. Make sure the connected device works with the same current range.
Available ranges: 0–20 mA or 4–20 mA

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:

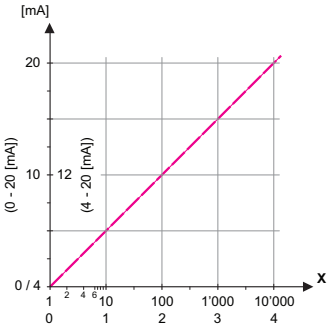
- Linear, bilinear or logarithmic for process values.
  See As process values, p. 54
- Control upwards or control downwards for controllers.
  See As control output, p. 56

As process values

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



A linear
B bilinear
X Measured value



X Measured value (logarithmic)

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

Parameter: Hydrogen.

Range low: 0.00 ppb – 20.00 ppm
Range high: 0.00 ppb – 20.00 ppm

Parameter: Temperature

Range low: -30 to + 130 °C
Range high: 30 to + 130 °C

Parameter: Sample flow

Range low: 0 – 50 l/h
Range high: 0 – 50 l/h

Parameter: Saturation

Range low: 0 – 200 %
Range high: 0 – 200 %

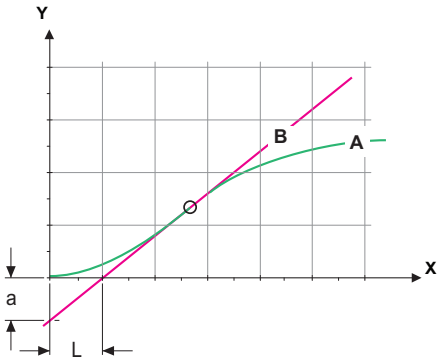
As control output

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.

Setpoint: User defined precess value for the selected parameter.
P-Band: Range below (upwards control) or above (downwards control) the set-point, within which the dosing intensity is reduced from 100% to 0% to reach the set-point without overshooting.

5.2.1.43 **Control Parameters**: if Parameter = Hydrogen
5.2.1.43.10 Setopint:
Range: 0.00 ppb – 20.00 ppm
5.2.1.43.20 P-Band:
Range: 0.00 ppb – 20.00 ppm

5.2.1.43 **Control Parameters**: if Parameter = Temperature
5.2.1.43.11 Setopint:
Range: -30 to + 130 °C
5.2.1.43.21 P-Band:
Range: 0 to + 100 °C

5.2.1.43 **Control Parameters**: if Parameter = Sample flow
5.2.1.43.12 Setopint:
Range: 0 – 50 l/h
5.2.1.43.22 P-Band:
Range: 0 – 50 l/h

5.2.1.43 **Control Parameters**: if Parameter = Saturation
5.2.1.43.13 Setopint:
Range: 0 – 200 %
5.2.1.43.23 P-Band:
Range: 0 – 200 %

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

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

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

5.3 Relay Contacts

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

The contact is inactive at:

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

Program alarm levels for the following parameters:

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

5.3.1.1 Alarm Hydrogen

5.3.1.1.1 *Alarm High:* If the measured value rises above the alarm high value, the alarm relay is activated and E001, is displayed in the message list.
Range: 0.00 ppb – 20.00 ppm

5.3.1.1.22 *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 – 20.00 ppm

5.3.1.1.32 *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 – 20.00 ppm

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

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

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

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

5.3.1.2.2 *Alarm High:* If the measuring values rises above the programmed value E009 will be issued.
Range: 12–20 l/h

5.3.1.2.32 *Alarm Low:* If the measuring values falls below the programmed value E010 will be issued.
Range: 5–20 l/h

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

5.3.1.3.1 *Alarm High:* If the measured value rises above the alarm high value, the alarm relay is activated and E007 is issued.
Range: 30–100 °C

5.3.1.3.22 *Alarm Low:* If the measured value rises above the alarm high value, the alarm relay is activated and E008 is issued.
Range: -10 to +20 °C

5.3.1.4 Alarm Saturation

5.3.1.4.1 *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: 0.00–200 %

5.3.1.4.22 *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: 0.00–200 %

5.3.1.4.32 *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. 0.00–200 %

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

5.3.1.5 Case Temp.

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

5.3.1.5.2 *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 function of relay contacts 1 or 2 are defined by the user

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

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

2 Then enter the necessary data depending on the selected function. The same values may also be entered in menu 4.2 Relay Contacts, p. 52

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:* choose one of the following process values
- Hydrogen
- Temperature
- Sample Flow
- Saturation

5.3.2.300 *Setpoint*: If the measured value rises above respectively falls below the set-point, the relay is activated.
- Parameter Hydrogen: Range: 0.00 ppb–20.00 ppm
- Parameter Temperature: Range: -30 to + 130 °C
- Parameter Sample flow: Range: 0–50 l/h
- Parameter Saturation: Range: 0–200 %

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 Hydrogen; Range: 0.00 ppb – 20.00 ppm
- Parameter Temperature; Range: 0 – 100 °C
- Parameter Sample flow; Range: 0 – 50 l/h
- Parameter Saturation; Range: 0 – 200 %

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

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

5.3.2.22 *Parameter:* choose one of the following process values

- Hydrogen
- Temperature
- Sample Flow
- Saturation

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 sec.

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

5.3.2.32.4 Control Parameters:
Range for each Parameter same as 5.2.1.43, p. 57

	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. 57
	Actuator = Motor valve
	Dosing is controlled by the position of a motor driven mixing valve.
5.3.2.32.22	*Run time:* Time needed to open a completely closed valve Range: 5–300 Sec.
5.3.2.32.32	*Neutral zone:* Minimal response time in % of the runtime. If the requested dosing output is smaller than the response time, no change will take place. Range: 1–20 %
5.3.2.32.4	**Control Parameters:** Range for each Parameter same as 5.2.1.43, p. 57
5.3.2.1	Function = Timer
	The relay will be activated repetitively depending on the programmed time scheme.
5.3.2.24	*Mode:* Operating mode (interval, daily, weekly)
5.3.2.24	*Interval*
5.3.2.340	*Interval:* The interval can be programmed within a range of 1–1'440 min.
5.3.2.44	*Run Time*: Enter the time the relay stays active. Range: 5–32'400 Sec.
5.3.2.54	*Delay*: during run time plus the delay time the signal and control outputs are held in the operating mode programmed below. Range: 0–6'000 Sec.
5.3.2.24	*daily*
	The relay contact can be activated daily, at any time of a day.
5.3.2.341	*Start time*: to set the start time proceed as follows:
	1 Press [Enter], to set the hours.
	2 Set the hour with the [▲] or [▼] keys.

3 Press [Enter], to set the minutes.

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

5 Press [Enter], to set the seconds.

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

Range: 00:00:00–23:59:59

5.3.2.44 *Run Time*: see Interval

5.3.2.54 *Delay*: see Interval

5.3.2.6 *Signal Outputs*: see Interval

5.3.2.7 *Output/Control*: see Interval

5.3.2.24 *weekly*

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

5.3.2.342 Calendar:

5.3.2.342.1 *Start time*: The programmed start time is valid for each of the programmed days. To set the start time see 5.3.2.341, p. 62.
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.

5.3.2.6 *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.

5.3.4 **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:

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

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

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

5.3.4.4 *Fault:*

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

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

5.4 Miscellaneous

5.4.1 *Language:* Set the desired language.
Available settings: German / English / French / Spanish

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

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

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

5.4.4 **Password:** Select a password different from 0000 to prevent unauthorized access to the menus “Messages”, “Maintenance”, “Operation” and “Installation”.

Each menu may be protected by a *different* password.

If you forgot the passwords, contact the closest SWAN representative.

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

5.5 Interface

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

5.5.1 *Protocol:* **Profibus**

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

5.5.1 *Protocol:* **Modbus RTU**

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

5.5.1 *Protocol:* **USB-Stick**

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

10. Default Values

Operation:

Sensors:	Filter Time Const.: ..... 10 s Hold after Cal.:..... 300 s
Alarm Relay	..... same as in Installation
Relay 1/2	..... same as in Installation
Input	..... same as in Installation
Logger:	Logger Interval:..... 30 min Clear Logger:..... no

Installation:

Sensors	Miscellaneous; Flow: ..... None Miscellaneous; Offset: ..... 0.0 ppb Miscellaneous; Maintenance Int. ..... 3 h Quality Assurance; Level: ..... 0: Off Sensor parameters; Saturation current: .....3.500 µA Sensor parameters; Air pressure:.....1013 hPa
Signal Output	Parameter:..... Hydrogen Current loop:..... 4 –20 mA Function:..... linear Scaling: Range low:..... 0.00 ppb Scaling: Range high: ..... 10.00 ppm
Alarm Relay:	Alarm Hydrogen; Alarm high:..... 10.00 ppm Alarm Hydrogen; Alarm low: ..... 0.00 ppb Alarm Hydrogen; Hysteresis:..... 100 ppb Alarm Hydrogen; Delay: ..... 30 s If Flow = Q-Flow Sample Flow, Flow Alarm: ..... yes Sample Flow, Alarm high:.....14.0 l/h Sample Flow, Alarm low: .....6.0 l/h Sample Temp., Alarm High:.....50 °C Sample Temp., Alarm Low:.....0 °C Alarm Saturation; Alarm high.....120 % Alarm Saturation; Alarm low .....0.0 % Alarm Saturation; Hysteresis .....2 % Alarm Saturation; Delay..... 30 s Case temp. high: .....65 °C Case temp. low:.....0 °C

Relay 1	Function:	limit upper
	Parameter:	Hydrogen
	Setpoint:	10.00 ppm
	Hysteresis:	100 ppb
	Delay:	30 s
Relay 2	Function:	limit upper
	Parameter:	Temperature
	Setpoint:	50.0 °C
	Hysteresis:	1.0 °C
	Delay:	30 s
	If Function = Control upw. or dnw:	
	Parameter:	Meas. Value
	Settings: Actuator:	Frequency
	Settings: Pulse Frequency:	120/min
	Settings: Control Parameters: Setpoint:	10.00 ppm
	Settings: Control Parameters: P-band:	100 ppb
	Settings: Control Parameters: Reset time:	0 s
	Settings: Control Parameters: Derivative Time:	0 s
	Settings: Control Parameters: Control Timeout:	0 min
	Settings: Act. Time prop.: Cycle time:	60 s
	Settings: Act. Time prop.: Response time:	10 s
	Settings: Act. Motor valve: Run time:	60 s
	Settings: Act. Motor valve: Neutral zone:	5%
	If Function = Timer:	
	Mode:	Interval
	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:	- - - - - - - -
Interface	Protocol:	USB Stick

11. Index

12. Notes

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- Feedwater, Steam and Condensate
- Potable Water
- Pool and Sanitary Water
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