



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services

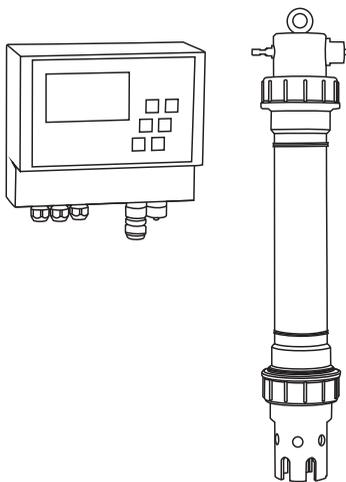


Solutions

Brief Operating Instructions

ISEmax CAM40/CAS40

Ion-selective electrode system



These instructions are Brief Operating Instructions.
For detailed information, please read the Operating Instructions and the special instructions on the supplied CD-ROM.

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Table of contents

1	Safety instructions	3
1.1	Designated use	3
1.2	Installation, commissioning and operation	3
1.3	Operational safety	4
2	Installation	4
2.1	Incoming acceptance, transport, storage	4
2.2	Installation instructions	5
2.3	Installation example	6
2.4	Post-installation check	7
3	Wiring	7
3.1	Electrical connection to the transmitter	7
3.2	Sensor connection	7
3.3	Optional cleaning unit connection	9
3.4	Post-connection check	10
4	Commissioning	11
4.1	Function check	11
4.2	Switching on the measuring system	11
4.3	Calibration	15

1 Safety instructions

1.1 Designated use

The ion-selective electrode system is designed for measuring tasks in the activated sludge basin and the inlet of the activated sludge basin of municipal sewage treatment plants.

The following parameters can be monitored depending on the device version:

- Nitrate
- Ammonium
- Potassium (to compensate ammonium)
- Chloride (to compensate nitrate)
- pH value

Any other use than the one described here compromises the safety of persons and the entire measuring system and is not permitted.

The manufacturer is not liable for damage caused by improper or non-designated use.

1.2 Installation, commissioning and operation

- The device/measuring system may only be installed, connected, operated and maintained by trained technical personnel (e.g. certified electrician). The technical personnel must strictly adhere to the Operating Instructions, prevailing standards, legal regulations and certificates (depending on application).
- If the Brief Operating Instructions do not provide sufficient information, you must read the Operating Instructions. There, you can find detailed information on the device.
- The operator may only perform modifications and repairs of the device/measuring system that are explicitly permitted in the Operating Instructions.
- Do not operate damaged products and secure them against unintentional commissioning. Mark the damaged product as being defective.
- If faults can not be rectified, the products must be taken out of service and secured against unintentional commissioning.

1.3 Operational safety

The assembly has been designed and tested in accordance with the latest industry standards and left the factory in perfect functioning order.

Relevant regulations and standards have been met.

As the user, you are responsible for complying with the following safety conditions:

- Guidelines for explosion protection
- Installation instructions
- Local prevailing standards and regulations.



Caution!

Pay attention to the technical data on the name plate!

2 Installation

2.1 Incoming acceptance, transport, storage

- Make sure the packaging is undamaged!
Inform the supplier about any damage to the packaging.
Keep the damaged packaging until the matter has been settled.
- Make sure the contents are undamaged!
Inform the supplier about damage to the contents. Keep the damaged products until the matter has been settled.
- Check that the order is complete and agrees with your shipping documents.
- The packaging material used to store or to transport the product must provide shock protection and humidity protection. The original packaging offers the best protection. Also, keep to the approved ambient conditions (see "Technical data").
- If you have any questions, please contact your supplier or your local sales center.

2.2 Installation instructions



Caution!

- The reference electrode or the optional pH electrode are supplied with a protection cap. If you remove the sensor from the medium for an extended period (> 20 min.), you have to put the protection cap, which is filled with 1-3 M KCl solution, back onto the reference electrode or pH electrode. In this way, you avoid irreparable damage resulting from the unit drying out.
- The ion-selective electrodes do not have a protection cap and should never be fitted with such a cap since removing the cap would damage the membrane.
- The compressed air supply should not exceed 3.5 bar (50 psi) as this could damage the relay.
- The compressed air must be supplied through an air filter (5 µm). This filter is already installed in the optional cleaning unit (→ Accessories).



Note!

- Select a measuring place that is easily accessible so that no hazards for operating staff can occur.
- Select a measuring place with representative concentration levels and sufficient flow.
- If mounting the transmitter outdoors, you must use a weather protection cover which you can order as an accessory.

Installing at the measuring point

1. Secure the transmitter to an upright post, a railing or a wall.



2. **Air bubbles**

Air bubbles can form in the electrodes after transporting the sensor or if the sensor is stored in a horizontal position. These air bubbles cause measuring errors.

- a. Before installing the sensor, eliminate any air bubbles by gently shaking the unit for example.
 - b. Then make sure to only hold the sensor in an upright, vertical position (electrodes pointing downwards) until the sensor is installed at the measuring point.
3. Where necessary, install additional electrodes into the sensor and connect them to the suitable cable connector. → "Wiring"
In addition, adapt the sensor configuration (number of parameters, address of the measuring channel, electrode type, measuring unit). → "Commissioning/Addressing the sensor" and "Operation/Sensor data/Sensor menu"
 4. Mount the sensor using the optional bracket. The sensor has to be immersed in the medium up to the thread adapter nut and be at a distance of approx. 0.5 m (1.64 ft) from the basin rim. 
 5. Route the cables in such a way that no mechanical damage or interference influences can arise from other cables.
 6. Connect the optional cleaning unit to the transmitter and the pressurized hose (OD 8) to the sensor. 

2.3 Installation example

A complete measuring system comprises:

- CAM40 transmitter
- CAS40 sensor
 - Ion-selective electrode(s) for ammonium and/or nitrate
 - Reference electrode
 - Ion-selective electrode for compensating cross-interference
 - pH glass electrode

Optional

- Upright post with boom
- Wall retainer
- Weather protection cover - absolutely essential if mounting the transmitter outdoors!
- Compressed air generator (if no compressed air is available on site)

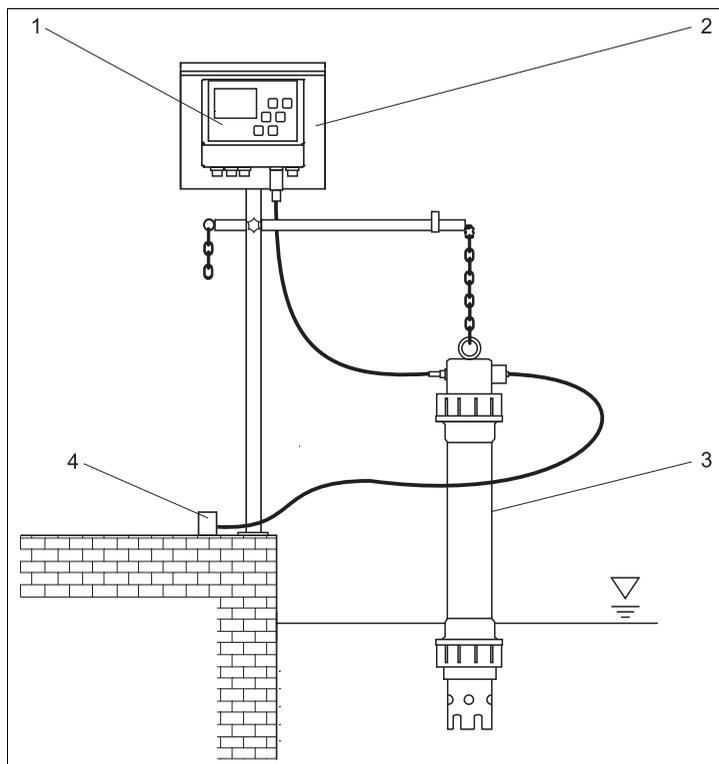


Fig. 1: Example: measuring system on basin rim

- | | | | |
|---|--|---|----------------------------------|
| 1 | CAM40 transmitter | 3 | CAS40 sensor |
| 2 | Upright post with weather protection cover | 4 | Compressed air supply (cleaning) |

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2.4 Post-installation check

- After mounting, check all the connections to ensure they are secure and leak-tight.
- Check all cables and hoses for damage.
- Check whether the cables are routed such that they are free from electromagnetic interference influences.

3 Wiring

3.1 Electrical connection to the transmitter

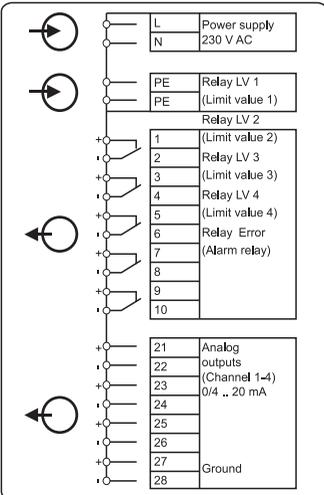
	Terminal	Assignment	
 <p>The diagram shows a terminal block with 28 terminals. It is divided into several sections: <ul style="list-style-type: none"> Power supply: Terminals L and N (230 V AC). Relays: Terminals PE (Relay LV 1), PE (Relay LV 2), 1 (Relay LV 3), 2 (Relay LV 3), 3 (Relay LV 3), 4 (Relay LV 4), 5 (Relay LV 4), 6 (Relay Error), 7 (Alarm relay), 8, 9, 10. Analog outputs: Terminals 21, 22, 23, 24, 25, 26, 27, 28. </p>	L, N	230 V AC power supply	
	1, 2	Relay 1, max. 230 V AC, 2 A	
	3, 4	Relay 2, max. 230 V AC, 2 A	
	5, 6	Relay 3, max. 230 V AC, 2 A	
	7, 8	Relay 4, max. 230 V AC, 2 A	
	9, 10	Relay 5, max. 230 V AC, 2 A	
	21, 22	Analog output 1	
	23, 24	Analog output 2	
	25, 26	Analog output 3	
	27, 28	Analog output 4	
	PE, PE	Protective earth	
			<p> Note! A compressor can optionally be controlled to terminals 9 and 10. In such instances, relay 5 is no longer available.</p>

Fig. 2: CAM40 wiring diagram a0009558-en

3.2 Sensor connection

Connect the sensor(s) directly to the transmitter via the cable connector.

- You can connect a maximum of 2 sensors to CAM40.
- You can install a maximum of 3 electrodes in every sensor. However, a maximum of only 4 measuring parameters can be displayed and output at the transmitter.
- Compressed air is supplied to two sensors by means of a common cleaning unit.

Sensor/parameter combinations when using two sensors (examples!):

Sensor	Version 1	Version 2	Version 3
Sensor 1	<ul style="list-style-type: none"> ■ Ammonium ■ Potassium (compensation) 	<ul style="list-style-type: none"> ■ Ammonium ■ Potassium (compensation) 	<ul style="list-style-type: none"> ■ Ammonium (no compensation) ■ pH
Sensor 2	<ul style="list-style-type: none"> ■ Nitrate ■ Chloride (compensation) 	<ul style="list-style-type: none"> ■ Ammonium (no compensation) ■ Nitrate (no compensation) 	<ul style="list-style-type: none"> ■ Nitrate ■ Chloride (compensation)

Electrode connection in the sensor:

Electrode	Color of the screw head	Color of the membrane cap	Cable label
Ammonium	RD	RD	1
Nitrate	BU	GY	2
Potassium	YE	BK	3
Chloride	BK	BK	3
Reference	-	-	GN/YE
pH	-	-	2 or 3 (depending on version)

**Caution!**

Free cable ends always have to be provided with a protection cap (→ "Spare parts"). Otherwise, moisture may cause short-circuits.

3.3 Optional cleaning unit connection

1. Connect the cleaning unit to the CAM40 transmitter by applying the voltage L1 to terminals 9 and 10 (relay 5).

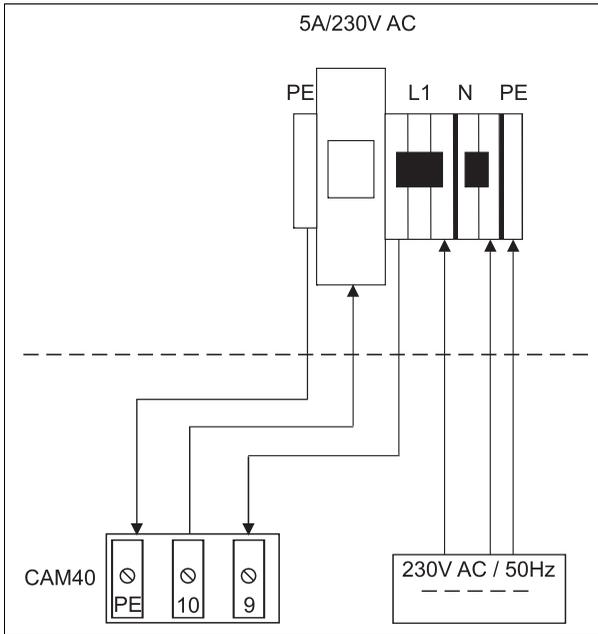


Fig. 3:

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2. Go to the "General data" menu (→ "Operation/Operating structure").
3. Scroll to the third page with **MENU**.
If the cursor is disabled, enable it by pressing **←** + **MENU** simultaneously.
4. Scroll to the "Menue" item with **↓**.
5. Select the "ValveMnu" function (**←** → **↓** → **←**).
6. Under the "Water" function in the ValveMnu menu, configure the value **04096**.
7. Exit the ValveMnu by selecting "MainMnu" under "Menue" (**←** → **↓** → **←**).
8. From the main menu, you can go back to the "General data" display with **MENU**.

3.4 Post-connection check

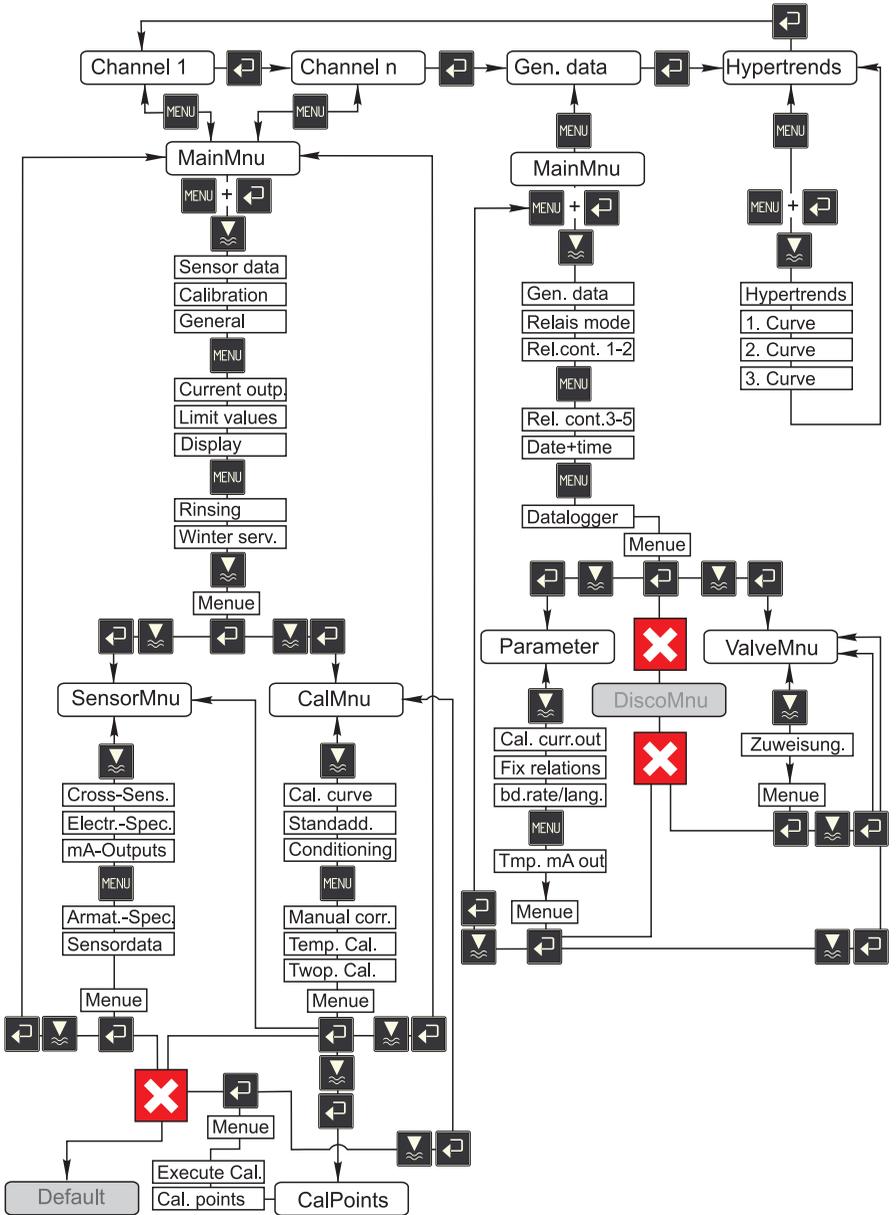
Checks	Notes
Is the supply voltage correct?	100 to 240 V DC
Are the installed cables strain-relieved and not twisted?	
Are all the cable entries installed, firmly tightened and leak-tight?	

4 Commissioning

4.1 Operating concept

Call up a menu	
Call up the editing mode	 + 
Navigate in the menu	 , 
Scroll	
Select function/position	
Change position/value	 , 
Save the settings	Cursor on "Menu",  twice
<p> You have to wait 10 minutes before the settings are saved automatically to the EEPROM. If you want to save your changes immediately, you have to select "Save data" under "Display/change" in the "Sensor data" main menu. Otherwise, the changes are lost if you switch off the device before 10 minutes have elapsed.</p>	
Exit the menu	
Characters available for user-defined fields:	
	A B C D E F G H I J K L M N O P Q R S T U V
	W X Y Z a b c d e f g h i j k l m n o p q r
	s t u v w x y z ! " # \$ % & ' () * + , -
	. / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @

4.2 Operating matrix



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4.3 Switching on the measuring system

4.3.1 Switching on the unit

1. Remove the protection cap from the reference electrode or pH electrode.
Keep the protection cap in a safe place for later use.
2. Switch on the main switch of the transmitter (underneath the operating field, left).



Note!

CAM40 performs a self-test for approximately 20 seconds. In doing so, it recognizes all the electrodes connected. In addition, CAM40 starts the automatic cleaning function. The display is inactive during the self-test. The first channel is automatically displayed after the self-test.

During initial commissioning with factory settings, the display changes to the next measuring channel every 6 seconds.

4.3.2 Selecting a language

1. Use to navigate to the "General data" display and call up the main menu ().
2. Scroll to the third page with and call up the editing mode (flashing cursor, launch with +).
3. Under "Menue", select the "Parameter" submenu (, ,).
4. In the same way, select your preferred software language under the "Language" function.
5. Go back to the "General data" main menu using "Menue".
6. Save the language setting by selecting the "Save data" option under the "Modifications" function (, , ,).
7. Switch the CAM40 off and then on again. Only now is the language changed.

Software languages available:

- German
- English

4.3.3 Addressing the sensor



Note!

You do not have to change the settings here if you are only connecting one sensor with two electrodes. CAM40 detects the sensor values automatically. In this case, just check the settings.

1. Navigate with to the display for the first measuring channel (e.g. ammonium) and call up the main menu ():

```
Name Addr: 01  :> CAS40 - NH4
*****Sensor data*****
Slope          :> 094.8 %
Offset         :> -1.29 px
Electrode      :> Ammonium
Zero line      :> 00.00 mg/l
***** Calibration *****
Actual value   :> 07.00 mg/l
Method        :> Offset
***** General *****
Start position :> Measure
Check type    :> Off
Auto zero     :> Manual
```

2. Call up the editing mode (flashing cursor, launch with +).
3. Under "Name Addr" enter a name for this measuring channel (, ,). You can enter a maximum of 12 characters, e.g. "CAS40 - NH4".
4. Scroll to the third page with and select the "SensorMnu" under "Menue" (, ,).
5. Scroll to the second page with and enter the number of electrodes in the sensor, e.g. "2", under "No of parameter":

```
*** Armature-Specification ***
No of parameter :> 02
Base Address    :> 01
No of channels  :> 01
Second title    :> Ammonium

***** Sensordata *****
Softwareversion :> 0125
Hardwareversion :> 0104
Serial number   :> 08639462

Menue          :> SensorMnu
```

6. Under "Base address", enter the address for the measuring channel, e.g. "01" for the electrode of the first sensor that is connected to cable 1.
You can also specify a second title. This is displayed in the measuring channel under the name of the measuring channel ("Name Addr", see Point 3).
7. Go back to the measuring display.

**Note!**

- Your settings are accepted automatically after 10 minutes. Alternatively, you can choose "Save data" in the main menu under "Modification" and switch CAM40 off and then on again.
- Under "Name Addr" enter an individual name such that users can easily distinguish between the measuring channel displays. This is particularly important if you are connecting two sensors with the same electrode types.

4.3.4 Working with two sensors (optional)**Note!**

The settings are accepted automatically after 10 minutes. Alternatively, you can choose "Save data" in the main menu under "Modification" and switch CAM40 off and then on again. The settings are then accepted immediately.

Addressing the second sensor

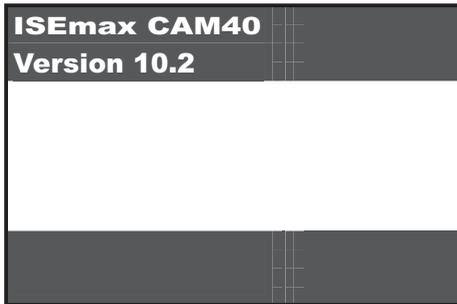
1. Switch the CAM40 off.
2. Disconnect the cable connector of the first sensor from the transmitter.
3. Connect the second sensor to the second plug-in jack that has not yet been used.
4. Switch on the CAM40 and wait for the self-test to be completed (approx. 20 seconds).
5. In the main menu of the first measuring channel (e.g. nitrate), assign a new name ("Name Addr") for this measuring channel.
6. Go to the sensor menu and configure the number of parameters and the base address of the first electrode (e.g. "03" if the first sensor is already using "01" and "02"). Also assign a second title.
7. For every additional measuring channel of the second sensor, also assign the base address and a second title. For this purpose, go to the main menu of the measuring channel and repeat steps 5 and 6 (base address e.g. "04").

Measuring with two sensors

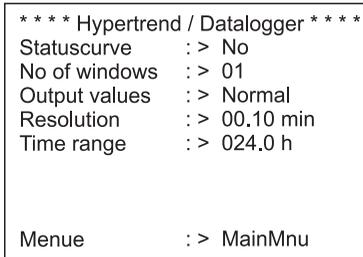
1. Switch the CAM40 off.
2. In addition to the second sensor, also reconnect the first sensor to the transmitter.
3. Switch the CAM40 on and wait for the self-test to be completed.
4. Navigate through all the measuring channels (max. 4). You should see the individual name and the address of every channel on the display.
5. Make the necessary settings for every measuring channel in the main menu in question (→ "Operation").

Displaying the hypertrends of all the measuring channels

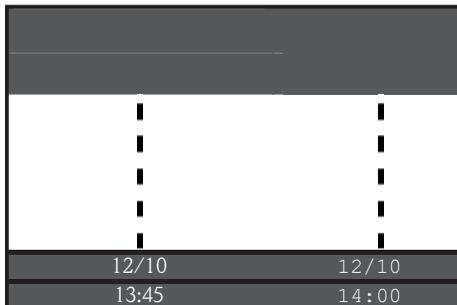
1. Switch to the display for "General settings":



2. Go to this menu and scroll to the 3rd page ("Hypertrend/Datalogger"):



3. Configure the value "02" for the "No of windows".
4. Go back to the measured value display.
5. Go to the display for "Hypertrends" (second screen):



6. In the "Hypertrends" menu, assign the address of the measuring channel for the first and, if applicable, for the second curve and specify the title which should be displayed for the curve:

```

***** Hypertrend *****
Range       : > 024.0 h
Scaling     : > 008.0 h
***** 1. Curve *****
Address     : > 03
Title       : > Ammonium
Start point : > 00.00 mg/l
End point   : > 20.00 mg/l
***** 2. Curve *****
Address     : > 04
Title       : > Potassium
Start point : > 00.00 mg/l
End point   : > 50.00 mg/l

```

7. Switch back to the measured value display.

Your measuring point is now working with two sensors.

4.4 Calibration

A calibration is necessary:

- During initial commissioning
- Each time an electrode or membrane cap is replaced
- In the event of implausible measured values



Note!

Condition the sensor for at least 1 hour in the medium before the first calibration and each time the membrane cap and electrode are replaced.

4.4.1 Calibration modes

The following calibration modes are available:

- Offset calibration
 - Standard method for all ion-selective electrodes
- Two-point calibration
 - Standard method for the pH electrode
 - Alternative for ion-selective electrodes (ammonium, nitrate) if the offset calibration does not return the desired result
- Standard addition
 - Alternative for compensation electrodes (potassium, chloride) if offset calibration is not possible since a laboratory value cannot be determined, for example

4.4.2 Offset calibration (ion-selective electrodes)



Note!

The section below describes the calibration if the activated sludge basin is the point where the sensor is being used. If you use the sensor in the inlet to the sludge activation, you have to use a higher standard concentration for the calibration, e.g. 50 mg/l.

Preparing to calibrate

1. Take 3 l (0.79 US gal.) of sample from the sewage treatment plant outlet.
2. Have some of the sample analyzed in the laboratory for the parameter to be calibrated.
3. Press to switch off rinsing.
4. Add 2 ml (0.068 fl.oz.) standard (1 mol/l \cong 14 g/l) to 2 l (0.52 US gal.) of the sample. Concentration of the sample with standard added [mg/l] = laboratory measured value [mg/l] + 14 mg/l.
5. Transfer the sample with the standard to a suitable container and immerse the sensor into it.
→ The measured value display increases.

Configuring the offset

1. Select the measuring channel of the parameter you want to calibrate.
2. Press the key.
3. Hold down and also press until the cursor appears.
4. Using , navigate to the "Calibration/actual value" menu item.
5. Enter the concentration of the sample with the standard.
6. Make sure that the "Offset" calibration mode is set under "Calibration/method".
7. Navigate to the "Menu" menu item, select "MainMnu" and press .

Calibration

1. During calibration, move the sensor in the container.
This ensures the necessary flow to the ion-selective electrode.
2. Press the key.
→ An electrode symbol is displayed in addition to other symbols. The transmitter measures and averages the current sensor signal.
3. Wait until the electrode symbol disappears. This can take several minutes in some circumstances.
4. Press the key again.
→ The "Actual value" set in the menu is displayed. After an internal delay period, all the symbols disappear and the display changes to the measuring channel.
5. Ammonium only:

Make sure that the value for "Slope" in the measuring channel display is > 90%.
If this is not the case, the electrode is used up and has to be replaced.

 The new calibration data are saved automatically after 10 minutes.

Checking the calibration

1. Immerse the sensor into a suitable container with drinking water.
2. Compare the measured value to the specifications for drinking water.
→ The measured value has to drop to the local concentration for drinking water (e.g. ammonium in Germany: < 0.5 mg/l.)
3. If the measured value does not meet expectations:
 - a. Repeat offset calibration.
 - b. If the repeated calibration is not successful, you have to record another calibration point using a sample with less standard added:
 - Add 0.2 ml (0.0068 fl.oz.) standard (1 mol/l \cong 14 g/l) to 2 l (0.52 US gal.) of a sample from the sewage treatment plant outlet.
Concentration of the sample with standard added [mg/l] = laboratory measured value [mg/l] + 1.4 mg/l.
 - In the menu, set the new, low concentration of the sample with the standard as the current value.
 - Rinse the sensor thoroughly with outlet water before transferring it from the sample with more standard added to the sample with less standard added. This prevents sample being carried over from one container to the next.
 - Perform the calibration as described.
 - In the calibration menu, navigate to the "Menue" item and select "CalMnu".
 - Navigate to "Menue" again and select "CalPoints".
 - In the list that follows, the high value and the low value have to be displayed at the top.
 - Under "Execute cal", select the "2-Point" value and go back to the measuring channel.

 Calibration with a second, low value is only required on rare occasions.

4.4.3 Two point calibration (pH electrode, ion-selective electrodes)

 This example describes two-point calibration for pH measurement.
The same process applies for ion-selective electrodes.

Preparing to calibrate

1. Prepare two Endress+Hauser pH quality buffers in a suitable vessel (min. 1 l) (or two standard solutions for ammonium or nitrate).
2. Go to the main menu of the measuring channel to be calibrated.

- On Page 1, configure "Two-point" as the method:

```

Name Addr: 03  :> CAS40 - pH
***** Sensor data *****
Slope          :> 094.8 %
Offset         :> -1.29 px
Electrode      :> pH
Zeroline       :> 00.00
***** Calibration *****
Actual value   :> 07.00
Method         :> 2-Point
***** General *****
Start position :> Measure
Check type     :> Off
Auto zero      :> Manual

```

- Scroll to Page 3 of the main menu and select "CalMnu" for menu.
- Scroll to Page 2 of this menu and configure the pH values of your buffer solutions under two-point calibration, e.g. 7 and 4 (or the concentrations of the standard solutions for ammonium or nitrate):

```

***** Manual correction *****
Value          :> +00.0 ppm

*** Temperature calibration ***
Temperatur     :> 025.0 C

***** Calibration *****
1. Buffer       :> 07.00
2. Buffer       :> 04.00

Measuring mode :> C-Curve
Menu           :> CalMnu

```

- Go back to the measured value display.

Calibration

1. Press  to switch off rinsing.
2. Immerse the sensor into the first buffer solution, e.g. pH 7 and wait until the measured value has stabilized.
3. Press the  key.
→ Wait until the electrode symbol disappears.
4. Immerse the sensor into the second buffer solution, e.g. pH 4 and wait until the measured value has stabilized.
5. Press the  key.
→ Wait until the electrode symbol disappears.
6. This concludes the calibration.

 The new calibration data are saved automatically after 10 minutes.

4.4.4 Standard addition (alternative for compensation electrodes)

 Standard addition is only necessary if offset calibration is not possible for compensation electrodes (potassium or chloride).

Preparing to calibrate

1. Place the sensor in a suitable vessel with 1 l (0.26 US gal.) of drinking water.
2. Press  to switch off rinsing.
3. Go to the main menu of the measuring channel (e.g. potassium) and configure "StdAdd" for the method on Page 1:

```

Name Addr: 03  : > CAS40 - K
***** Sensor data *****
Slope          : > 094.8 %
Offset         : > -1.29 px
Electrode      : > Potassium
Zeroline       : > 00.00 mg/l
***** Calibration *****
Actual value   : > 00.00 mg/l
Method        : > StdAdd
***** General *****
Start position : > Measure
Check type    : > Off
Auto zero     : > Manual

```

4. Scroll to Page 3 of the main menu and select "CalMnu" for menu.

5. Under Standardaddition on Page 1, enter the probe volume, the standard concentration, the standard volume and the number of steps (= number of calibration points):

```

Name Addr: 03  :> CAS40 - K
***** Calibration curve *****
Actual point   :> 00.00 mg/l
***** Standardaddition *****
Probe volume   :> 1000 ml
Flow rate      :> 01.00 ml
Standard       :> 1.000 M/l
Duration       :> 01.00 min
No of steps    :> 02 step
Automatic      :> no
***** Conditioning *****
Flow rate      :> 00.02 ml/min
Duration       :> 00.00 min
  
```

 "Flowrate" here means the volume of standard added per step.

6. Go back to the measured value display.

Calibration

1. Press the  key.
→ Wait until the electrode symbol disappears. The text "+1.0 ml" with a black background appears on the right of the display (if you entered 1.0 ml for the flowrate).
2. Add 1 ml standard solution to the sample. Move the sensor during the measurement to generate the necessary flow.
3. Press the  key.
→ Wait until the electrode symbol disappears. The text "+2.0 ml" appears on the display (if you entered "2" or more for the number of steps).
4. Add 1 ml standard solution to the sample again. Move the sensor during the measurement to generate the necessary flow.
→ Wait until the electrode symbol disappears.
5. If you selected more than 2 steps, repeat the process for adding standard and taking measurements until all the calibration points are recorded.
6. Press the  key to end the calibration.
→ The current value of the potassium or chloride concentration appears on the display.

 The new calibration data are saved automatically after 10 minutes.

4.4.5 Calibrating the temperature

 Here, enter a reference value that you determined with an external measurement.

1. Go to the main menu of the first measuring channel (e.g. ammonium).
2. Scroll to Page 3 and select "CalMnu" for menu.

3. Go to Page 2 of the CalMnu and specify the measured reference temperature for "Temperature calibration":

```
***** Manual correction *****  
Value           : > +00.0 ppm  
  
*** Temperature calibration ***  
Temperatur      : > 025.0 C  
  
***** Calibration *****  
1. Buffer        : > 07.00  
2. Buffer        : > 04.00  
  
Measuring mode : > C-Curve  
Menu           : > CalMnu
```

4. Go back to the measured value display ()
→ The electrode symbol and the hourglass appear on the display.
5. Once the electrode symbol has disappeared (the hourglass does not disappear), go back to Page 2 of the CalMnu.
6. Go to the "Temperature Calibration" menu item again and press  to confirm the value.
7. Go back to the measured value display ()
→ The hourglass disappears and the temperature value entered is accepted.

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