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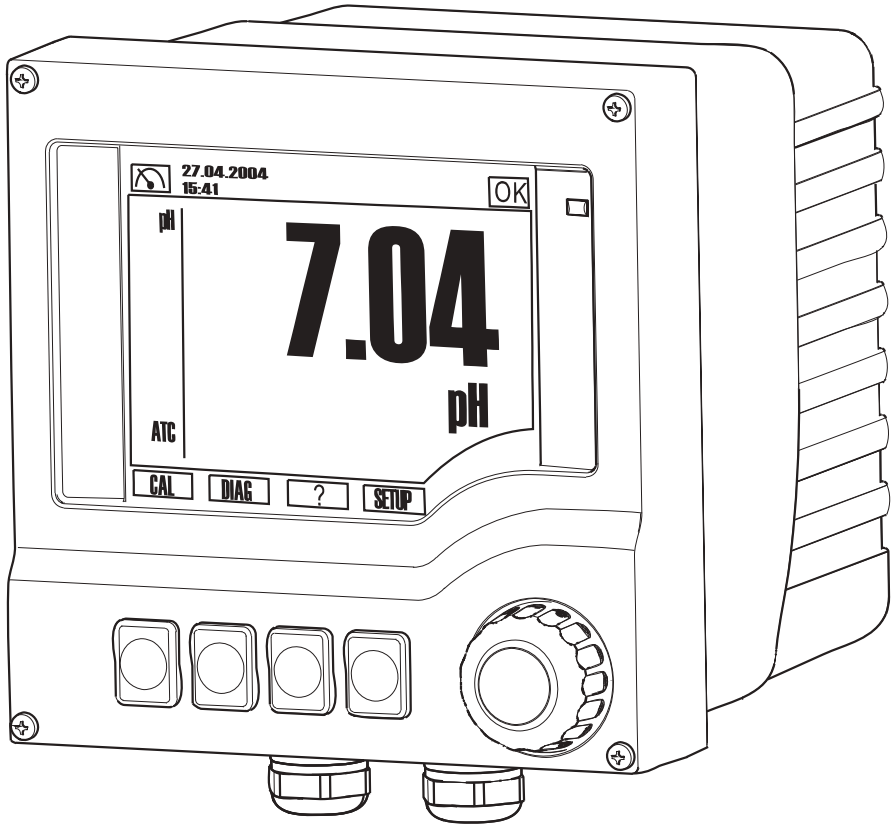
HAMILTON®

Operating Instructions
Transmitter H220X pH

Two-wire transmitter for pH/ORP measurement with analog sensors

Part 2



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1 Calibration and adjustment

The calibration provides important information on the condition of your sensor and the quality of the pH measurement.

pH glass electrodes
In addition to the slope that has an ideal value of approx. -59 mV/pH at 25 °C, the change in the zero point also provides important information to the user. It is an indicator of the condition of the gel-like layer of the pH glass and could point to a blockage in the reference system. Suitable maintenance would involve cleaning or regenerating the sensor.
To perform a quick test, simply immerse the sensor in a buffer solution with the same pH value as the internal buffer (e.g. pH 7). 0 mV would be an ideal value. The greater the deviation from the ideal value, the poorer the condition of the sensor (±20 mV is still acceptable in most situations).

pH-ISFET sensors
ISFET sensors use a control loop. The ISFET chip and reference must be immersed in the medium and the sensor must be connected. When commissioning, a certain settling time has to be taken into account until the control loop is established. The settling time depends on the type and duration of the interruption and generally takes 5-8 minutes.
The operating point of the sensor is between -200 mV and +200 mV and is primarily determined by the thickness of the sensitive layer on the chip. The operating point changes over the lifetime of the sensor as a result of wear and abrasion.
The slope of the sensor, which - like glass electrodes - has an ideal value of approx. -59 mV/pH (at 25 °C), changes primarily as a result of buildup forming on the chip.

1.1 Definitions

Calibration (as per DIN 1319):
A calibration is defined as a set of operations that establish the relationship between the measured value or expected value of the output variable and the related true or correct value of the measured variable (input variable) for a measuring system under specified conditions.
A calibration does not alter the performance of the measuring device.

Adjustment
An adjustment corrects the value displayed by a measuring device, in other words the measured/displayed value (the actual value) is corrected so that the reading agrees with the correct, set value.
The value determined during calibration is used to calculate the correct measured value and saved in the sensor.

1.2 Zero point and slope

Using a mathematical function, the transmitter converts the input signal of the sensor y (raw measured value) to the measured value x. In many cases, this function is a simple linear of the form $y = a + b \cdot x$.
The linear element "a" is usually equivalent to the zero point and the factor "b" is the slope of the line and is often known as the sensor slope.

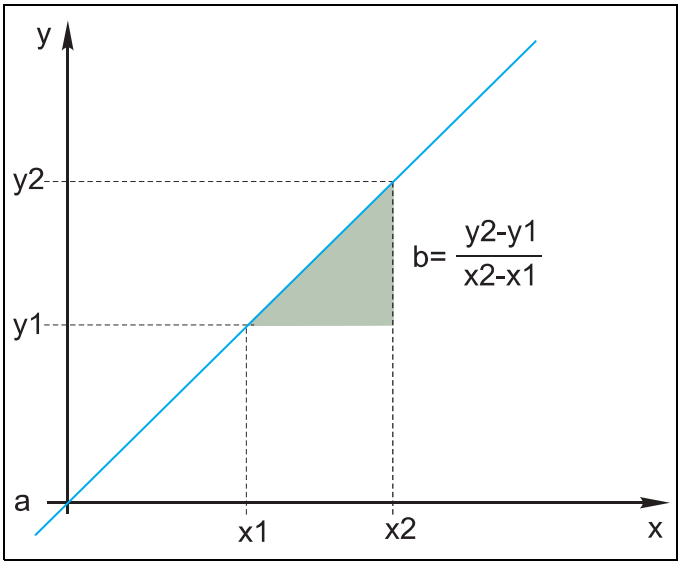

Fig. 1: Linear function

a *Zero point*
b *Slope*

The **Nernst equation**, which is used to calculate the pH value, is a typical linear relationship:

$$U_i = U_0 - \frac{2.303\ RT}{F}\ pH$$

$pH = -lg(a_{H+})$, a_{H+} ... activity of the hydrogen ions
U_i ... raw measured value in mV
U_0 ... zero point (=voltage at pH 7)
R ... universal gas constant (8.3143 J/molK)
T ... temperature [K]
F ... Faraday constant (26.803 Ah/mol)

The slope of the Nernst equation (-2.303RT/F) is known as the **Nernst factor** and has the value -59.16 mV/pH at 25 °C.

1.3 Notes on the calibration

The following rules apply for all parameters:
- Calibrate in a way that reflects conditions in the process.
  - If the process medium is constantly moving, also move the calibration solution accordingly (e.g. use a magnetic stirrer if calibrating in the laboratory).
  - If your medium is relatively stationary, calibrate in solutions that are also stationary.
- Make sure that the samples are homogeneous for reference measurements, sample calibration etc.
- Use the same menu settings as those in the process to perform the calibration.
  Example: If you automatically compensate for the temperature effect during pH measurement, switch on automatic temperature compensation for the calibration also.

1.4 Calibration intervals

1.4.1 Specifying the intervals

The service life of a pH glass electrode is limited. This is due, in part, to the deterioration and aging of the pH-sensitive membrane glass. This aging causes the gel-like layer to change and become thicker over time.

Symptoms of aging include:
- Higher membrane resistance
- Slow response
- Decrease in the slope

A change in the reference system (e.g. due to contamination, i.e. unwanted redox reactions at the reference electrode) or electrolyte solution dissolving away in the reference half cell can change the reference potential, which, in turn, causes a zero point shift in the measuring electrode.
To ensure a high level of accuracy, it is important to readjust the pH sensors at set intervals. The calibration interval depends heavily on the area of application of the sensor, as well as the required level of accuracy and reproducibility. The calibration interval can vary between daily and once every few months.

Defining the calibration interval for the process

1. Check the sensor with a buffer solution, e.g. pH 7.

   ↳ Proceed as specified in Step 2 only if the value deviates from the set point. No calibration/adjustment is necessary if the value is within the defined deviation tolerance range (see the Technical Information for the sensor).

2. Calibrate and adjust the sensor.

3. After 24 hours, check again with the buffer solution.
   - If the deviation is within the permitted tolerance range, increase the checking interval by doubling it for example.
   - If the deviation is larger, you must shorten the interval.
4. Continue to proceed as defined in Steps 2 and 3 until you have identified the suitable interval.

1.4.2 Monitoring the calibration interval

If you have established calibration intervals for your process, you can also have the device monitor them.
(SETUP/Sensor pH/ORP/Sensor diagnostics/Diagnostic limits/Calibration timer)

1.5 Types of calibration

1.5.1 pH measurement

The following types of calibration are possible:
- Two-point calibration
  - With calibration buffers
  - Entry of data for the slope, zero point and temperature
- Single-point calibration
  - Entry of a reference value
  - Sample calibration with laboratory comparative value
- Temperature adjustment by entering a reference value

1.6 Two-point calibration

1.6.1 General information

Two-point calibration is the preferred method for pH sensors, particularly in the following applications:
- Municipal and industrial wastewater
- Natural waters and drinking water
- Boiler feedwater and condensates
- Beverages

Calibrating with buffers with pH 7.0 and 4.0 is recommended for most applications.
Alkaline buffer solutions have the disadvantage that carbon dioxide from the air can alter the pH value of the buffer on the long term. If calibrating with alkaline buffers it is best to do so in closed systems, such as flow assemblies or retractable assemblies with a rinse chamber, to minimize the effect of air.

1.6.2 With calibration buffers

Only use calibration buffers once.

1.6.3 Entering data for the zero point, slope and temperature(only pH)

You enter the slope, zero point and temperature manually. The function for determining the pH value is calculated from these values. Thus, the data entry returns the same result as two-point calibration.

▶ You must determine the slope, zero point and temperature alternatively.

1.7 Single-point calibration

1.7.1 Numeric input of a reference value (1-point cal.)

Single-point calibration is particularly useful if the deviation of the pH value from a reference value, and not the absolute pH value itself, is of interest to the user. Applications for single-point calibration include:
- Process control
- Quality assurance

Fluctuations in the process value should not exceed ±0.5 pH and the process temperature must remain relatively constant. As the measuring range is limited as a result, it is possible to set the slope to -59 mV/pH (at 25 °C).
Alternatively, you can also use the "sample calibration". Here, you take a sample from the process and determine the pH value in the laboratory. In the case of the laboratory sample, you must make sure that the pH value is determined at the process temperature.

1.7.2 Sample calibration (grab sample cal.)

With this type of calibration, you take a sample of the medium and determine its pH value (at process temperature) in the laboratory. You then use this laboratory value to adjust the sensor. This does not change the slope of the calibration function.

1.8 Temperature adjustment

The temperature sensor has to be calibrated at regular intervals to ensure the measured value is not falsified by incorrect temperature measurement.

1. Determine the temperature with a reference measurement.

2. Depending on the result, decide whether you want to align the temperature sensor of the sensor with the reference temperature.

If you do:

3. Go to the "CAL/Temperature" menu.
   ↳ The current offset is displayed. Mode is for information purposes only. You cannot select anything here.
4. Start the adjustment and follow the instructions.
   ↳ The transmitter shows the temperature currently measured by the temperature sensor of the sensor.
5. Enter the temperature of your reference measurement and select "Continue".
   ↳ The new offset is displayed.
6. Confirm acceptance of the new calibration data and finish the adjustment by clicking "OK".
   ↳ The transmitter automatically switches to the measuring mode and the new temperature offset is used.

You can cancel the calibration any time. No new data are then used to adjust the sensor.

1.9 Calibrate

1. Press the soft key for "CAL".
2. Select the type of calibration.
3. Enter the necessary parameters. (The parameters that have to be configured depend on the type of calibration selected.)
4. Start the calibration.
5. Follow the instructions in the menu.
6. Decide whether to use the calibration data captured, or to abort or repeat the calibration.
   ↳ After calibration, the transmitter automatically switches back to the measuring mode and your measuring point is now ready for operation.

- If calibration is aborted using ESC, or if the calibration is faulty, the system continues to use the original calibration data.
- A calibration error is shown as plain text on the display.
- Any offset set is automatically deleted after accepting the calibration.

2 Diagnostics, troubleshooting

In the DIAG menu you will find information about the device state, in particular detailed error and maintenance messages.
In addition to this, there are various service functions available[1)].

2.1 General troubleshooting

2.1.1 Troubleshooting

The transmitter continuously monitors its own functions.
If an error detected by the device occurs, the red alarm LED lights up and the error number with the related error message appears on the display.

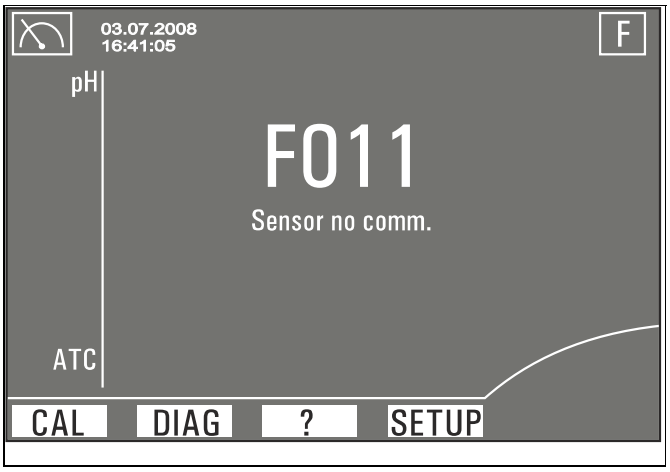

Fig. 2: Error messages (example)

Troubleshooting instructions
A diagnostics message is shown on the display, measured values are implausible or you discover an error.

1. See the Diagnostics menu (DIAG/Errors / Messages) for details on the diagnostics message.
2. Search for the diagnostic message under "Diagnostics information on the local display" (→ 13) in this manual. Use the message number as the search criterion. Ignore the letters indicating the Namur error category.
   ↳ Follow the troubleshooting instructions provided in the last column of the error tables.
3. In the event of implausible measured values, a malfunctioning local display or other errors, refer to "Process errors without messages" (→ 11) or "Device-specific errors" (→ 12).
   ↳ Follow the recommended measures.

1) Depending on the device version

4. Contact the Service Department if you cannot rectify the error yourself. Only cite the error number.

2.1.2 Process errors without messages

Problem	Possible cause	Tests and/or remedial measures
Display values deviate from reference measurement	Incorrect calibration	Repeat the calibration. Where necessary, check and repeat the calibration with the reference device.
	Sensor fouled	Clean the sensor.
	Temperature measurement	Check the temperature measured values of both devices.
	Temperature compensation	Check the settings for temperature compensation and adjustment for both devices.
Measuring chain zero-point cannot be adjusted	Contaminated reference system	Test with new sensor
	Junction clogged	Clean or grind junction
	Measuring line disconnected	Short-circuit pH input at device ?display pH 7
	Asymmetric sensor voltage too high	Clean junction or test with another sensor
	Potential matching (PA/PM) transmitter ? medium incorrect	Not symmetrical: no PML or PML at GND Symmetrical.: PML connection necessary
No change or subtle change in display	– Sensor fouled – Sensor old – Sensor defective (reference lead)	Clean the sensor.
	Reference has low level of KCl	Check KCl feed (0.8 bar above medium pressure).
Measuring chain slope: – Cannot be adjusted – Too low – No slope	Connection not high-impedance (moisture, dirt)	Check cables, connectors and junction boxes.
	Device input defective	Check device directly.
	– Sensor old – Hair-line crack in glass membrane	Replace sensor.
Constant, incorrect measured value	Sensor not immersing or protection cap not removed	Check installation position, remove protection cap.
	Air pockets in assembly	Check assembly and orientation.
	Ground connection at or in device	Carry out test measurement in isolated vessel, poss. with buffer solution.
	Hair-line crack in glass membrane	Replace sensor.
	Device has impermissible operating status (no reaction to keys being pressed)	Switch device off and then on again.

Problem	Possible cause	Tests and/or remedial measures
Incorrect temperature value	Temperature sensor wired incorrectly	Check connections using wiring diagram; three-wire connection always necessary.
	Measuring cable defective	Check cables for interruptions, short-circuit, shunt.
	Incorrect sensor type configured	Set correct temperature sensor type.
Measured value fluctuations	Interference on signal output cable	Check cable routing, route cable separately if necessary.
	Interference potential in medium	Eliminate source of interference or ground medium as close as possible to sensor.
Measured value fluctuations	Interference on measuring cable	Connect cable shield as per wiring diagram.
No current output signal	Cable disconnected or short-circuited	Disconnect cable and measure directly at device.
	Output defective	See "Device-specific errors" section.
Fixed current output signal	Current simulation active	Switch off simulation.
Incorrect current output signal	Total load in current loop too high	Measure the voltage directly at the device and compare to diagrams of the power supply and signal voltage (→ Technical data, Part 1).
	EMC (interference coupling)	Check wiring. Determine the reason for the EMC and eliminate it.

2.1.3 Device-specific errors

Problem	Possible cause	Tests and/or remedial measures
Dark display	No supply voltage	Check if supply voltage applied.
	CPU defective	Replace CPU, make sure correct version is used.
Values appear on display but: – Display does not change and / or – Device cannot be operated	Module not wired correctly	Check modules and wiring.
	Impermissible operating system condition	Switch device off and then on again.
Implausible measured values	Sensor module defective	First perform tests and take measures as outlined in "Process-specific errors" section
Current output, current value incorrect	Incorrect adjustment	Check with current simulation switched on, connect mA meter directly to current output .
	Load too large	
	Shunt / short to ground in current loop	

Problem	Possible cause	Tests and/or remedial measures
No current output signal	CPU defective	Check with current simulation switched on, connect mA meter directly to current output .

2.2 Diagnostic information on local display

The table of diagnostics messages is sorted by the message number. This number cannot be changed. The "Cat." column contains the error category which is assigned at the factory . Document all the changes you make for your measuring point in the diagnose list (→ SETUP/Sensor/Sensor diagnostics/Diagnostics list or SETUP/General settings/Device diagnostics/Diagnostics list).

No.	Display text	Cat.	Tests and/or remedial measures
003	Temp. sensor failure	F	– Check wiring
004	Scanning sensor	C	Establishing a connection to the sensor
010	Sensor initialization	C	Wait for the initialization to finish.
011	Sensor no communication	F	– Data processing interrupted due to user interaction with DAT module (F011) – Check the measuring chain with a new sensor – Check the settings for the sensor type used.
012	Sensor failure	F	
013	Wrong sensor type	F	
014	Invalid sensor data	C	
100	Glass impedance alarm	F	– Check glass electrode for breakage and hairline cracks – Check medium temperature – Check electrode plug-in head for moisture and dry if necessary
101	Ref. impedance alarm	F	– Check reference electrode for contamination and damage – Clean reference electrode
102	Glass imp. too low alarm	F	– Impedance of glass membrane too low – Check pH sensor, replace if necessary
103	Ref. imp. too low alarm	F	– Reference impedance too low – Check reference electrode for contamination/clogging – Replace reference or combined electrode
104	Sensor supply bad	F	– Sensor operating voltage fluctuating – Check connection – Replace sensor cable or sensor

No.	Display text	Cat.	Tests and/or remedial measures
106	Glass impedance warning	M	– Check glass electrode for breakage and hairline cracks – Check medium temperature – Check electrode plug-in head for moisture and dry if necessary
107	Ref. impedance warning	M	– Check reference electrode for contamination and damage – Clean reference electrode
111	Glass imp. too low warning	M	– Check glass electrode for breakage and hairline cracks – Check medium temperature – Check electrode plug-in head for moisture and dry if necessary
112	Ref. imp. too low warning	M	– Check reference electrode for contamination and damage – Clean reference electrode
119	Temp offset lower limit	F	– Check the temperature sensor of the sensor – Clean the sensor and recalibrate – Replace sensor
120	Temp offset lower limit	F	
127	Invalid TAG group	F	Use a sensor with a suitable sensor designation or sensor group.
128	Invalid TAG	F	
129	Sensor change aborted	C	Restart the sensor change
130	Calibration active	C	Wait for the calibration to finish.
131	PV not stable	M	– Sensor too old – Cable or connector defective
132	Temperature not stable	M	
134	Zero pnt. too high alarm	M	– Sensor old or defective – In the case of external reference: old or defective – Diaphragm blocked – Buffer solutions too old or contaminated – Potential matching missing (only for symmetrical measurement)
135	Zero pnt. too high warning	M	
136	Zero pnt. too low warning	M	
137	Zero pnt. too low alarm	M	
138	Slope too low alarm	M	
139	Slope too low warning	M	
140	Leakage current alarm	F	Sensor cannot be used. Replace the sensor.
142	SCC electrode cond. bad	M	– Glass membrane blocked or dry
148	SCC electrode sufficient	M	
145	Leakage current warn	M	Sensor is becoming unusable. Plan to replace the sensor.

No.	Display text	Cat.	Tests and/or remedial measures
153	Operating point too high alarm	M	– Sensor old or defective – Diaphragm blocked – Buffer solutions too old or contaminated – Potential matching missing (only for symmetrical measurement)
154	Operating point too high warning	M	
155	Operating point too low warning	M	
156	Operating point too low alarm	M	
203	Wrong transmitter type	F	Use a sensor module that suits the software. (Software version 10... for pH, 13... for conductivity, 20... for oxygen)
215	Simulation active	C	Active corresponding to your settings
218	Current output not available	F	Contact the Service Team!
318	Glass imp. too high alarm	M	Sensor check system warning – Check glass electrode for breakage and hairline cracks – Check medium temperature
319	Ref. imp. too high alarm	M	Sensor check system warning – Check reference electrode for contamination and damage – Clean reference electrode
320	Glass imp. too high warning	M	Sensor check system warning – Check glass electrode for breakage and hairline cracks – Check medium temperature
321	Ref. imp. too high warning	M	Sensor check system warning – Check reference electrode for contamination/clogging – Replace reference or combined electrode
322	Meas. value out of range	S	Process limit value undershot alarm Possible reasons: – Sensor in air – Air cushion in assembly – Sensor defective – Increase the process value – Check the measuring system – Change sensor type
380	Comm. module defect	F	
381	Comm. module incomp	F	
404	Lower limit current output	S	– Measured value outside the specified current range – Check plausibility – Adapt the current output limits (Setup/current output.../Low value (4mA) or Upper value (20mA))
405	Upper limit current output	S	
406	SETUP active	C	End parameter entry
407	DIAG active	C	End query of device and sensor information
408	Calibration aborted	M	Renew calibration solution, repeat calibration
501	Device open	M	Close the housing and tighten the screws.

No.	Display text	Cat.	Tests and/or remedial measures
513	Device alarm ([%V%S])	F	Contact the Service Team! Quote the error number and the text displayed. ([%V%S]) here stands for the text actually displayed.
514	Device warning ([%V%S])	M	
530	[%V%S] : 20 % remain[1)]	S	The ring memory of the logbook is almost full.
531	[%V%S] : full	S	The ring memory of the logbook is full. From now on, new events will overwrite the oldest entries.
532	Calibration timer expired	M	The counter for the Cal Timer has reached its limit. Perform a calibration. This resets the counter.
810	PV upper limit alarm	F	– Sensor in air – Air cushion in assembly – Check the measuring chain – Potential matching missing for symmetrical measurement PV = primary value (main value)
811	PV lower limit alarm	F	
812	Temperature out of range	F	
840	PV upper limit warning	M	– Sensor in air – Air cushion in assembly – Check the measuring chain
841	PV lower limit warning	M	

1) Variable text [%V%S]: the relevant logbook is named.

2.3 Adapting the diagnostic information

2.3.1 Classification of diagnostics messages

More detailed information on the current errors displayed is provided in the "DIAG/Errors / Messages" menu. The red LED flashes if a diagnostic message assigned to error category F has occurred. Furthermore, the error category of every diagnostic message is indicated in the status bar of the display by the appropriate error letter.

In accordance with Namur specification NE 107, the diagnostics messages are characterized by:
- Message number
- Error category (letter in front of the message number)
  - **F** = Failure. A malfunction has been detected.
    The cause of the malfunction is to be found in the measuring point.
  - **C** = Function check, no error
    Maintenance work is being performed on the device. Wait until the work has been completed.
  - **S** = Out of specification. The measuring point is being operated outside specifications. Operation is still possible. However, you run the risk of increased wear, shorter operating life or lower accuracy levels. The cause of the problem is to be found outside the measuring point.

  - **M** = Maintenance required. Action must be taken as soon as possible
    The device stills measures correctly. Immediate measures must not be taken. However, proper maintenance efforts would prevent a possible malfunction in the future.
- Message text

If you contact the Service Department, please cite the message number only. Since you can individually change the assignment of an error to an error category, the Service Department cannot use this information.

2.3.2 Adapting the diagnostic information

All the diagnostics messages are assigned to specific error categories at the factory. Since other settings might be preferred depending on the application, error categories and the effect errors have on the measuring point can be configured individually. Furthermore, every diagnostic message can be disabled.

Example
The device displays diagnostic message 011 "Sensor no communication". You want to change this message so that no error is shown on the display, for example.

1. Go to SETUP/Sensor pH/ORP/Sensor diagnostics/Diagnostics list or SETUP/General settings/Device diagnostics/Diagnostics list
   ↳ The list of all the diagnostic messages is displayed. Here it does not matter which of the two paths you used to open the list. The list is the same either way.
2. Select diagnostic message 011 and press the navigator button.
   ↳ The details on the diagnostic message and the current message category are displayed.
3. Select the category and decide whether to change the category or deactivate the message.
4. Deactivate the message, for example (Disabled) and press "OK" to confirm your change.
   ↳ The message without the letter of the Namur category is displayed in the diagnostic list. The message is deactivated.

Proceed in a similar fashion if you want to change the category. You then see the change directly in the list.

2.4 Pending diagnostic messages

The Diagnostics menu contains all the information on the device status.
Furthermore, various service functions are available.

The following messages are directly displayed every time you enter the menu:
- "Most important msg."
  Diagnostic message recorded with the highest (most critical) Namur category
- "Past message"
  Diagnostic message whose cause was the most recent to be remedied.

2.5 Diagnostic list

All the diagnostic messages currently pending are listed under DIAG/Errors / Messages.
The Namur category along with the number of the diagnostic message and a message description are displayed.

2.6 Logbooks

The logbook memories are "ring memories". They are filled with data while storage space is available. As soon as the memory is full, each new entry overwrites the oldest entry in the memory.

To ensure data are recorded in the logbooks, you must activate the function in the **SETUP/General settings/Logbooks** menu.
Logbooks cannot be saved to external memories or transferred to other transmitters.
The logbook entries are in chronological order. The most recent entry always appears at the top of the list.

The following logbooks are available:

- Calibration logbook
  - Log of calibrations and adjustments
  - It is possible to call up the following details on every entry: time stamp, calibration method and sensor type used
  - Max. 15 entries
- Event logbook
  - Log of the warnings and error messages
  - It is possible to call up the following details on every entry: time stamp, event (diagnostic message number), description, device status and event state
  - Max. 50 entries
- Parameter logbook
  - Log of changes in the configuration
  - Every modified setting in the SETUP menu is recorded and displayed.
  - Max. 50 entries
- User logbook
  - Log of logins and logouts
  - Each login and logout is recorded and displayed with a time stamp and the user name.
  - The data are only recorded if user administration is enabled.
  - Max. 50 entries
- Audit trail
  - Chronological log of all logbook entries without the data logbook but with the device history (see DIAG/Device information)
  - Here, you can navigate to each individual logbook entry, regardless of the type of logbook, and display the details.
  - Max. 200 entries

You can also define and activate a data logbook:
- SETUP/General settings/Logbooks/Data logbook
- The data logbook consists of the recorded measured values in the scan rate you defined including the associated time stamp.
- Max. 500 entries

2.7 Simulation, Resetting the measuring device

2.7.1 Simulation

You can output a simulated current value at the current output for test purposes.
The symbol for the simulation appears in the status bar of the display when the function is switched on: SIMU

Path: DIAG/Service/Simulation

Function	Display	Info
Current output 1		
Simulation	Options ▪ on ▪ off **Factory setting** off	▪ **on**: The simulation value is output at current output 1. The simulation value continues to be output even if you exit the DIAG menu. If you want to switch back to having the system output the measured value, you have to set the "Simulation" to "Off". ▪ **off**: The measured value, and not the simulation value, is output at current output 1.
Simulation value	3.60 to 21.50 mA **Factory setting** 10.00 mA	
Current output 2		
Simulation	Options ▪ on ▪ off **Factory setting** off	▪ **on**: The simulation value is output at current output 2. The simulation value continues to be output even if you exit the DIAG menu. If you want to switch back to having the system output the measured value, you have to set the "Simulation" to "Off". ▪ **off**: The measured value, and not the simulation value, is output at current output 2.
Simulation value	3.60 to 21.50 mA **Factory setting** 10.00 mA	

2.7.2 Reset and factory settings

Each of the following functions causes the device to be restarted.

NOTICE

Factory default or customer factory default

All user-specific changes in the configuration are lost

▶ Make a backup of your configuration on an optional CopyDAT (CY42-C1).

▶ Only select "Factory default" or "Customer factory default" if you do not need the modified settings with user-specific changes or have saved them beforehand.

Path: DIAG / Service

Function	Display	Info
Device restart	Options ▪ Abort action ▪ Device restart **Factory setting** Abort action	Restart the device and keep all the settings
Factory default	Options ▪ Abort action ▪ Factory default **Factory setting** Abort action	The device is restarted and all the customer-specific settings are reset to the factory default values.
Cust. fact. default	Options ▪ Abort action ▪ Cust. fact. default **Factory setting** Abort action	The device is restarted and all the settings are reset to the original, **optionally** ordered settings

2.8 Sensor status

The device displays calculation variables of the calibration function, such as the zero point and slope, and the related quality, i.e. to what extent they deviate from the ideal values.
You also see the sensor operating time.
From the information displayed, you can see whether and when you must schedule maintenance measures for the sensor, whether the sensor has to be calibrated shortly or whether you will have to replace the sensor soon.

You can display the values graphically (as a bar graph) or numerically (selection using soft keys).

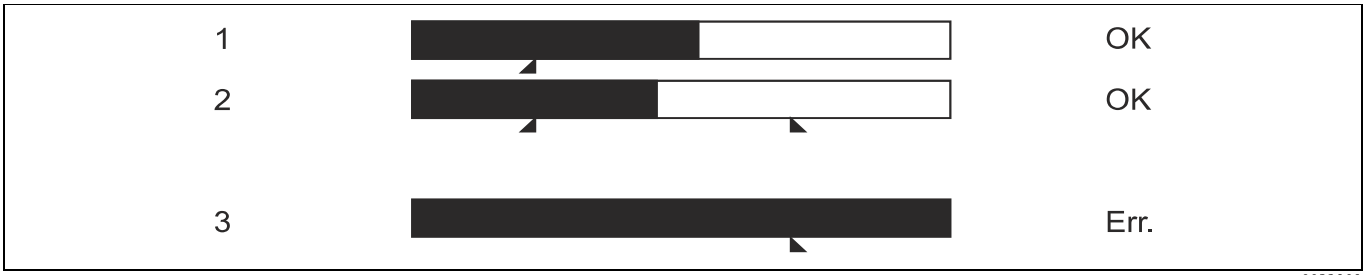

Abb. 3: Graphic display of the sensor status (example)

1 Calibration date, e.g. slope: value is within an acceptable range
2 Calibration date, e.g. zero point: value is within an acceptable range
3 Operating time: specified duration exceeded: error is displayed

You can set warning and alarm limits in the "SETUP/Sensor pH/ORP/Sensor diagnostics" menu.

2.9 Output state

The current value and the output variable are displayed for each current output.
You can select the output variable to be displayed in the "SETUP/Current output" menu.

The current output range is displayed for information purposes only. It is fixed at 4 to 20 mA.

2.10 Device information

Information in the following categories is displayed:

- Identification
  Information on the device identifier, e.g. serial number, order code, device version and bus address
- CPU
  Identification of the installed CPU module, e.g. serial number, order code, hardware and firmware versions
- Sensor module
  Identification of the installed sensor module, e.g. serial number, order code, hardware and firmware version
- Current output
  Identification of the current output, e.g. serial number, order code, hardware and firmware version
- Display
  Identification of the installed display module, e.g. serial number, order code, hardware and firmware version

- Device history
  "Hardware logbook"
  All the hardware and software changes made to the device can be read out with a time stamp and with detailed information on every entry.
  – Max. 10 entries concerning changes to the software version
  – Max. 25 entries concerning changes to the hardware, e.g. sensor change, module replacement etc.

3 Maintenance

Only clean the front of the housing with commercially available cleaning agents.

The front is resistant to the following as per DIN 42 115:
- Ethanol (short periods)
- Diluted acids (max. 2% HCl)
- Diluted bases (max. 3% NaOH)
- Soap-based household cleaners

NOTICE

Prohibited cleaning agents

Danger of damaging the housing surface or housing sealing.
- ▶ Never use concentrated mineral acids or bases for cleaning purposes.
- ▶ Never use organic cleaners such as acetone, benzyl alcohol, methanol, methylene chloride, xylene or concentrated glycerol cleaner.
- ▶ Never use high-pressure steam for cleaning purposes.

3.1 Maintenance of certified devices

Please note the following:
- Ex-certified devices may only be altered, maintained or repaired by qualified personnel or by the Service Team of the manufacturer.
- Make sure applicable standards, national Ex-area regulations and the safety instructions in the Operating Instructions and certificates are observed.
- Only use genuine spare parts from the manufacturer.
- When ordering spare parts, note the device designation on the nameplate. Parts can only be replaced by like parts.
- Only the manufacturer's Service Team may convert a certified device to another certified version.
- Document every repair and every conversion.

4 Repair

4.1 Spare parts

Contact your local sales center.

4.2 Replacing modules

You change modules if you must replace defective modules or if you want to change the hardware configuration of your device.

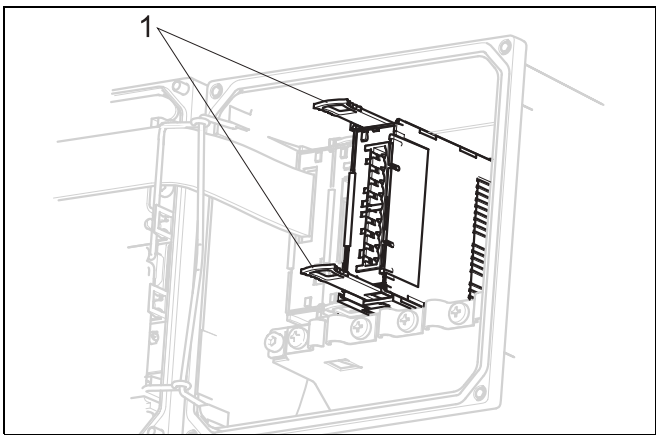

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Fig. 4: Removing module

1 Removal aids

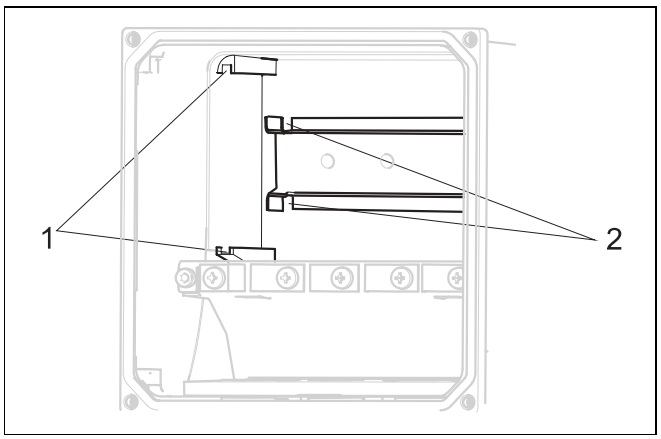

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Fig. 5: Housing guides

1 Guides on housing wall
2 Guides in DIN rail

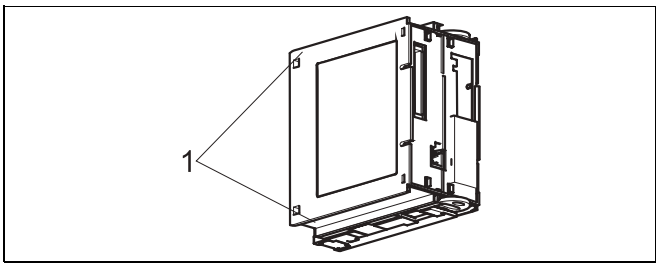

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Fig. 6: Module, left side (cable connections = front)

1 Guides (CPU module) to fit into the guides in housing

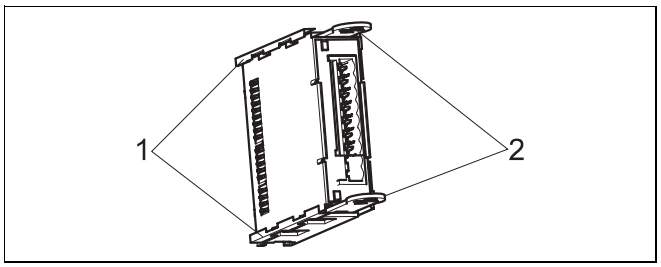

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Fig. 7: Module, right side (cable connection = front)

1 Guides (input module) to fit into the right-hand guides in the CPU module
2 Removal aids

1. Disconnect the transmitter from the power supply and open the housing.
2. Remove the cable connections from the module you want to replace.
3. Pull out the two removal aids on the module until the stop (→ 4).
   ↳ The module can now be easily removed from the DIN rail.
4. Slide the new module into the guides (→ 5, → 6, → 7).

5. Push the two removal aids on the module in the direction of the DIN rail until the stop. This locks the module onto the DIN rail.
6. Connect the cables in accordance with the wiring diagram (see "Wiring").
7. Connect the sensor, close the housing, and check that the entire measuring system is working correctly.

4.3 Return

The product must be returned if it is in need of repair or a factory calibration, or if the wrong product was ordered or delivered. Legal specifications require the manufacturer as an ISO-certified company, to follow certain procedures when handling products that are in contact with the medium.

4.4 Disposal

The device contains electronic components and must therefore be disposed of in accordance with regulations on the disposal of electronic waste.
Please observe local regulations.

5 Accessories

Contact your local sales center.

6 Technical data

6.1 Input

6.1.1 Measured variables

→ Documentation of the connected sensor

6.1.2 Measuring range

→ Documentation of the connected sensor

6.1.3 Cable specification

Without SCS	Max. cable length 50 m (160 ft)
With SCS	Max. cable length 20 m (65 ft)

6.1.4 Ex specification

Intrinsically safe sensor circuit with type of protection: Ex ia IIC		
	Glass	**ISFET**
Max. output voltage U_o Max. loop current I_o Max. output performance P_o Max. outer inductance L_o Max. outer capacitance C_o	10.08 V 4.1 mA 10.2 mW 1 mH 250 nF	10.08 V 50.7 mA 128 mW 1 mH 250 nF
Connection category according to NE116	SensISCO1X	-

When pH/ORP glass electrodes are connected to terminals 317, 318, 320, 111, 112 and 113, the device corresponds to connection class 1 as per NAMUR Recommendation NE116 (SensISCO). Terminals 315 and 316 may not be connected for this categorization.
The device is labeled SensISCO1X.

6.2 Output

6.2.1 Output signal

2x 4 to 20 mA, passive, potentially isolated from the sensor circuit and from one another

6.2.2 Signal on alarm

3.6 to 21.5 mA

6.2.3 Load

Max. load with supply voltage of 24 V: 500 Ω
Max. load with supply voltage of 30 V: 750 Ω

6.2.4 Ex specification

6.2.5 Current output, passive

Span

3.6 to 21.5 mA

Signal characteristics

Linear / table

Cable specification

Cable type: shielded cable, Ø 2.5 mm (14 AWG)

6.3 Electrical connection

6.3.1 Supply voltage and signal voltage

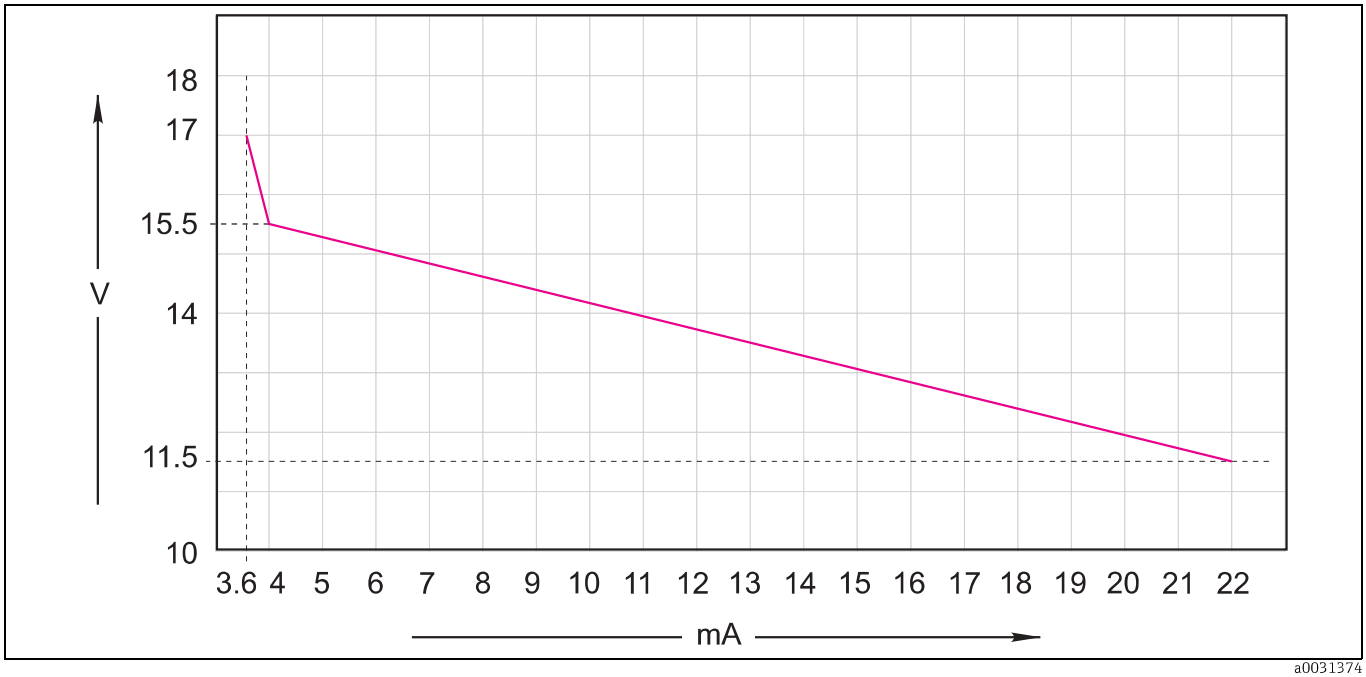

Fig. 8: Minimum supply voltage at the transmitter depending on the output current

6.3.2 Certified cable glands

Cable gland	Clamping area, permitted cable diameter
M16 x 1.5 mm	3 to 6 mm (0.12 to 0.24")
M20 x 1.5 mm	5 to 9 mm (0.20 to 0.35")
M20 x 1.5 mm	6 to 12 mm (0.24 to 0.47")
NPT 3/8"	3 to 6 mm (0.12 to 0.24")
NPT 1/2"	5 to 9 mm (0.20 to 0.35")
NPT 1/2"	6 to 12 mm (0.24 to 0.47")
G3/8	3 to 6 mm (0.12 to 0.24")
G1/2	5 to 9 mm (0.20 to 0.35")
G1/2	9 to 12 mm (0.35 to 0.47")
Dummy plug M16	-
Dummy plug M20	-

NOTICE

Housing not sealed correctly, lack of strain relief

Dust can enter, cables can become loose, IP protection no longer guaranteed

- ▶ Make sure that cable glands cannot become loose and that the seals are installed close to the housing.
- ▶ Once you have routed the cables through the glands, tighten the cable glands and the associated nuts with a torque of 2 Nm to ensure the cables are secure.
- ▶ Pay attention to strain relief for the cables. Route the cables so that they are securely in place.
- ▶ Make sure that the cable entries and glands are leak-tight.

6.3.3 Cable cross-section

Max. cable cross-section: 2.5 mm^2 (h 14 AWG), GND 4 mm^2 (h 12 AWG)

6.4 Performance characteristics

6.4.1 Reference temperature

25 °C (77 °F)

6.4.2 Current output response time

t_{90} = max. 500 ms for an increase from 4 to 20 mA

6.4.3 Measured value resolution

→ Documentation of the connected sensor

6.4.4 Maximum measured error

→ Documentation of the connected sensor

Current outputs, additional	25 µA

6.4.5 Tolerance of current outputs

Current outputs, additional	25 µA

6.4.6 Repeatability

→ Documentation of the connected sensor

6.5 Environment

6.5.1 Ambient temperature range

–20 to 50 °C (T6)
–20 to 55 °C (T4)

6.5.2 Storage temperature

–40 to 80 °C (–40 to 175 °F)

6.5.3 Electromagnetic compatibility

Interference emission and interference immunity to EN 61326-1: 2006, Category B (residential environments)

6.5.4 Degree of protection

IP66 / IP 67 / NEMA 4X

6.5.5 Relative humidity

10 to 95%, not condensing

6.5.6 Pollution degree

The product is suitable for pollution degree 3.

6.6 Mechanical construction

6.6.1 Weight

1.5 kg (3.3 lbs)

6.6.2 Material

Housing Housing seals	PC-FR (polycarbonate, flame-retardant) Foamed silicone, EPDM
Module housing Soft keys, Cable mounting rail Display panel Cable glands Dummy plugs M16 and M20	PC (polycarbonate) TPE Stainless steel 1.4301 (AISI 304) PC-FR (polycarbonate, flame-retardant) PA (polyamide) V0 as per UL94 PA (polyamide) V0 as per UL94

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