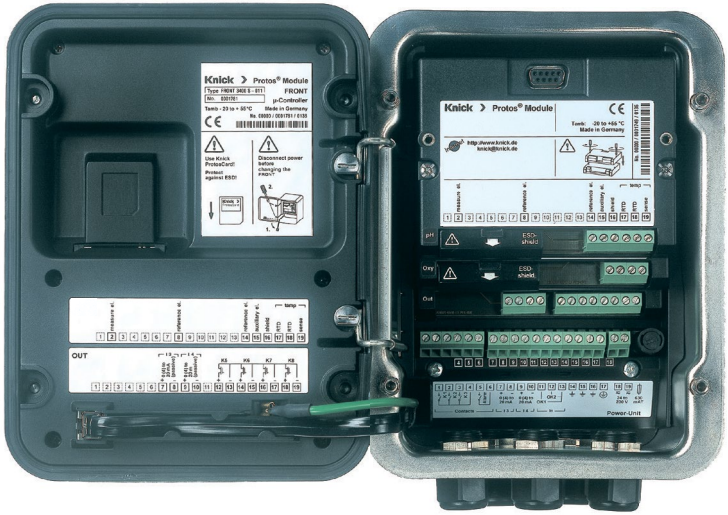
Knick

User Manual

Protos II 4400 (X) Process Analysis System

Protos MSU 4400(X)-180 Communication Module
for Memosens Sensors



MEMOSENS

Read before installation.
Keep for future use.

www.knick.de

Supplemental Directives

READ AND SAVE THIS DOCUMENT FOR FUTURE REFERENCE. BEFORE ATTEMPTING TO ASSEMBLE, INSTALL, OPERATE OR MAINTAIN THE PRODUCT, PLEASE ENSURE A COMPLETE UNDERSTANDING OF THE INSTRUCTIONS AND RISKS DESCRIBED HEREIN. ALWAYS OBSERVE ALL SAFETY INFORMATION. FAILURE TO COMPLY WITH INSTRUCTIONS IN THIS DOCUMENT COULD RESULT IN SERIOUS INJURY AND/OR PROPERTY DAMAGE. THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE.

These supplemental directives explain how safety information is laid out in this document and what content it covers.

Safety Chapter

This document's safety chapter is designed to give the reader a basic understanding of safety. It illustrates general hazards and gives strategies on how to avoid them.

Safety Guide

The separate safety guide is designed to give the reader a basic understanding of safety. It illustrates general hazards and gives strategies on how to avoid them.

Warnings

This document uses the following warnings to indicate hazardous situations:

Symbol	Category	Meaning	Remark
⚠	**WARNING**	Designates a situation that can lead to death or serious (irreversible) injury.	The warnings contain information on how to avoid the hazard.
⚠	**CAUTION**	Designates a situation that can lead to slight or moderate (reversible) injury.	
None	***NOTICE***	Designates a situation that can lead to property or environmental damage.	

Related Documents

- Protos II 4400(X) Safety Guide
- Protos II 4400(X) Basic Unit User Manual

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MSU 4400(X)-180 Module

Intended Use

The MSU4400(X)-180 multiparameter module is a multifunctional communication unit that provides up to three RS-485 interfaces for simultaneous use.
It enables the connection and operation of up to three Memosens sensors for simultaneous measurement of pH, oxidation-reduction potential (ORP), oxygen (add-on function FW4400-015), and conductivity (contacting, inductive) as well as the Unical 9000 electro-pneumatic controller.
An analog current input that supplies a pressure transmitter signal is used for oxygen sensor pressure correction during measurement and calibration.
The second and third sensor inputs (channels B and C) can be enabled via TAN.

- Channel B: add-on function FW4400-014
- Channels B+C: add-on function FW4400-018

Channel C is used for Unical actuation.

This user manual describes the use of the module in conjunction with Memosens sensors.
For a description of Unical actuation, see the Unical 9000/Protos II 4400 user manual.

The MSU4400X-180 module is intended for operation in hazardous locations that require equipment of Group II, device category 2(1), gas/dust.
The MSU4400-180 module may not be used in hazardous locations.

Package Contents

All devices:

- Measuring module
- Installation guide
- Test report 2.2 according to EN 10204
- Adhesive label with terminal assignments

Additionally for Ex version MSU4400X-180:

- Attachment to certificates (KEMA 03ATEX2530, IECEx DEK 11.0054)
- EU Declaration of Conformity
- Control drawings

Operation in Hazardous Locations – MSU4400X-180 Module
The module is approved for operation in hazardous locations.
When installing the product in a hazardous location, observe the information in the supplements to the certificates and, if applicable, the relevant control drawings.
Observe all applicable local and national codes and standards for the installation of electrical equipment in hazardous locations. For orientation, please refer to IEC 60079-14, EU directives 2014/34/EU and 1999/92/EC (ATEX), NFPA 70 (NEC), ANSI/ISA-RP12.06.01.

⚠ **WARNING!** Risk of impairment of explosion protection.
- Modules that have already been used must be subjected to a professional routine test before they may be operated in another type of protection.
- Before the product is commissioned, the operator must provide proof that the product is approved for connection to other equipment (including cables and wires).
- Connecting components designed for explosive atmospheres and those not designed for explosive atmospheres (mixed equipping) is not permitted.
- In hazardous locations, the device may only be cleaned with a damp cloth to prevent electrostatic charging.

Maintenance
Protos modules cannot be repaired by the user. For inquiries regarding module repair, please contact Knick Elektronische Messgeräte GmbH & Co. KG at www.knick.de.

Personnel Requirements
The operating company shall ensure that any personnel using or otherwise interacting with the product is adequately trained and has been properly instructed.
The operating company shall comply and cause its personnel to comply with all applicable laws, regulations, codes, ordinances and relevant industry qualification standards related to product. Failure to comply with the foregoing shall constitute a violation of operating company's obligations concerning the product, including but not limited to an unintended use as described in this document.

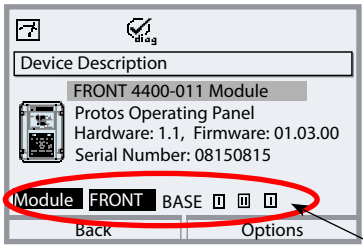
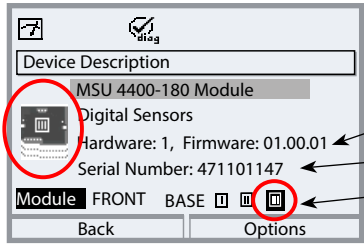
Firmware Version

MSU4400(X)-180 Module Firmware: Firmware version 01.xx.xx

Module Compatibility	MSU4400-180	MSU4400X-180
Protos II 4400 with FRONT firmware version 01.03.xx or higher	x	
Protos II 4400X with FRONT firmware version 01.03.xx or higher		x

Information on the firmware version history can be found at www.knick.de.

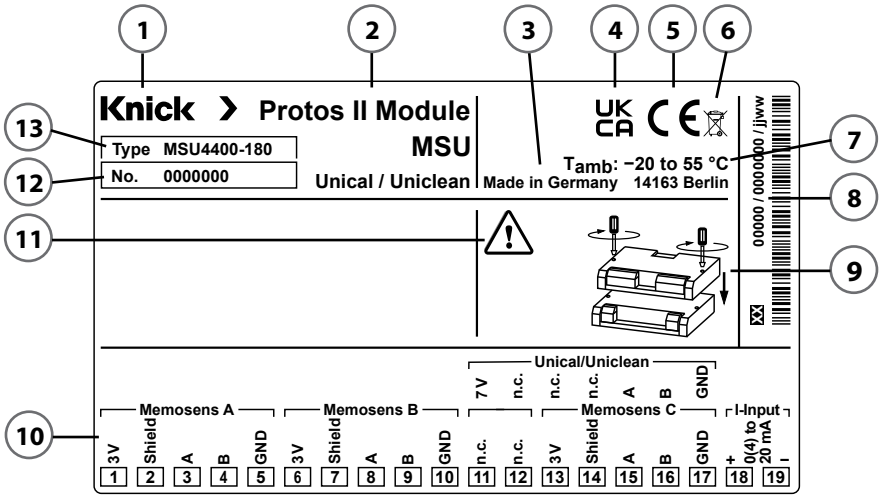
Query Current Device Firmware/Module Firmware
When the device is in measuring mode:
Press the **menu** key and open the Diagnostics menu: Device Description

Menu	Display	Action
diag		**Device Hardware and Firmware Version** Provides information on all modules installed: Module type and function, serial number, hardware and firmware versions, and device options. Select the modules (FRONT, BASE, slots 1-3) using the arrow keys.
		**Query Module Firmware** Here: MSU4400-180 module Hardware and firmware versions, serial number – here installed in slot 3.

Note: The display may vary depending on which sensors are connected.

Terminal Plate

MSU4400-180 Module Terminal Plate:

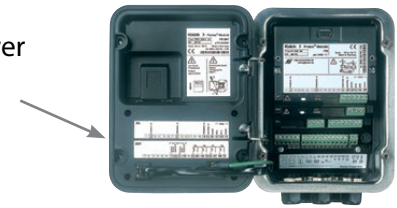


1	Name of manufacturer	**8**	Product number/serial number/ production year and week
2	Product name	**9**	Installation instructions
3	Designation of origin and address of the manufacturer	**10**	Terminal assignments
4	UKCA mark	**11**	Special conditions and danger points
5	CE mark	**12**	Serial number
6	WEEE mark	**13**	Model description
7	Permissible ambient temperature		

Note: The "Uniclean" function is currently unavailable.

Terminal Plate Adhesive Labels

The terminal plate adhesive labels for the lower modules can be attached to the inside door. This simplifies maintenance and service.



Terminal Assignments

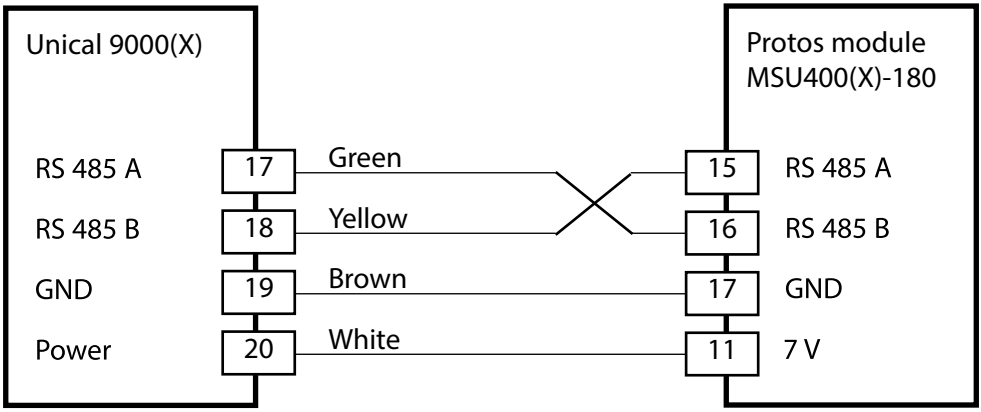
Terminal	Memosens Cable Wiring Wire Color			Wiring Unical	Terminal
1	Brown (BN)	Power supply +	Channel A: Memosens		
2	Transparent	Shield			
3	Green (GN)	RS485 (A)			
4	Yellow (YE)	RS485 (B)			
5	White (WH)	Power supply – (GND)			
6	Brown (BN)	Power supply +	Channel B: Memosens		
7	Transparent	Shield			
8	Green (GN)	RS485 (A)			
9	Yellow (YE)	RS485 (B)			
10	White (WH)	Power supply – (GND)			
11		N.C.	Channel C: Memosens/Unical	7 V (Power)	20
12		N.C.		N.C.	
13	Brown (BN)	Power supply +		N.C.	
14	Transparent	Shield		N.C.	
15	Green (GN)	RS485 (A)		RS 485 B	18
16	Yellow (YE)	RS485 (B)		RS 485 A	17
17	White (WH)	Power supply – (GND)		GND	19
18		+ Current input			
19		– 0(4) ... 20 mA			

The second and third sensor inputs (channels B and C) can be enabled via TAN.

- Channel B: Add-on function FW4400-014
- Channels B+C: Add-on function FW4400-018

Channel C (terminals 11 and 15 ... 17) is designed for Unical actuation.
For wiring, see also the next page.

Unical 9000(X) Connection



For a detailed description of the Unical 9000(X) electro-pneumatic control, see the Unical 9000/Protos II 4400 user manual.

Inserting the Module

⚠ **CAUTION!** Electrostatic discharge (ESD).
The modules' signal inputs are sensitive to electrostatic discharge.
Take measures to protect against ESD before inserting the module and wiring the inputs.

NOTICE! Strip the insulation from the wires using a suitable tool to prevent damage.

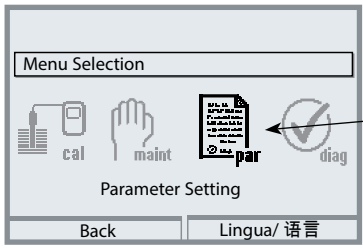
01. Switch off the power supply to the device.
02. Open the device (loosen the 4 screws on the front).
03. Plug the module into the slot (D-SUB connector), as in the image.
04. Tighten the module's fastening screws.
05. Connect the sensor cable.
06. Check whether all connections are correctly wired.
07. Close the device and tighten the screws on the front.
08. Switch on the power supply.

⚠ **CAUTION!** Risk of losing the specified ingress protection.
Fasten the cable glands and screw together the housing correctly.
Observe the permissible cable diameters and tightening torques (see basic unit specifications).
Insert blanking plugs or sealing inserts if necessary.

Parameter Setting

⚠ CAUTION! Incorrect parameter settings or adjustments can result in incorrect outputs.
Protos must therefore be commissioned by a system specialist, all its parameters must be set, and it must be fully adjusted.

NOTICE! The "function check" (HOLD) NAMUR contact is active during parameter setting. The behavior of the current outputs depends on the parameter setting, i.e., they may be frozen at the last measurement or set to a fixed value. The red "Alarm" LED blinks.
Measurement operations must not be carried out while Protos is in the function check (HOLD) mode, as this may put the user at risk due to unexpected system behavior.
For a description of NAMUR contacts, see the basic unit user manual.

Menu	Display	Action
		**Open Parameter Setting** From the measuring mode: Press ***menu*** key to select menu. Select Parameter Setting using arrow keys, press ***enter*** to confirm.

For a description of Unical actuation, see the Unical 9000/Protos II 4400 user manual.

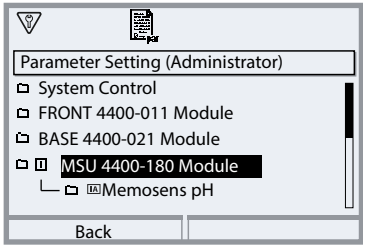
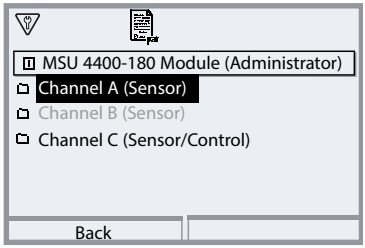
Module Configuration: Process Variable

Note: Function check (HOLD) active

The process variable, operating mode, and functionality are separately selected for each channel. If the Auto process variable is selected, the functionality settings are not shown.

Default: Process variable off

Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
par	 	Parameter Setting ▸ (Administrator Level): 01. Select the MSU module. 02. Press ***enter*** to confirm. 03. Select the channel. 04. Select the process variable, operating mode, and functionality. **See these pages for descriptions:** pH 20 ORP 46 O_2 (Oxy) 65 Cond 93 CondI 138 The second and third sensor inputs (channels B and C) can be enabled via TAN. Channel B: Add-on function FW4400-014 Channels B+C: Add-on function FW4400-018

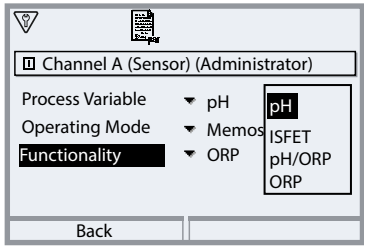
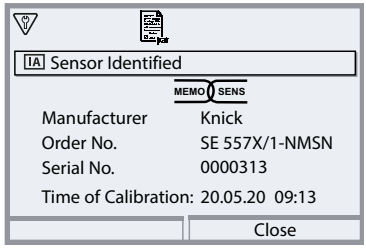
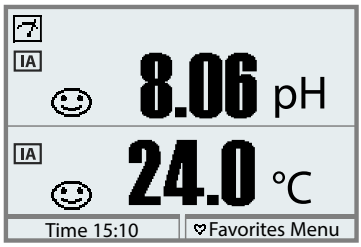
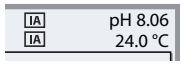
Module Configuration: Process Variable

Menu selection: Parameter Setting ▸ MSU ... Module ▸ Channel ...

Operating Mode: Memosens		
Process Variable	Auto	Automatic selection of process variables in the measurement display
	pH	Functionality: pH, ISFET, pH/ORP, ORP
	Conductivity	Functionality: 2-electrode / 4-electrode sensor
	Conductivity (ind.)	Functionality: CondI
	Oxygen	Functionality: Amperometric
Operating Mode: SE 670, SE680K		
Process Variable	Conductivity (Ind.)	For use with SE 670, SE680K

pH Parameter Setting

Note: Function check (HOLD) active

Menu	Display	Action
par		Parameter Setting ▸ MSU ... Module ▸ Channel ...: Process Variable: pH Operating Mode: Memosens Functionality: pH, ISFET, pH/ORP Then press the ***left softkey: Back***
A connected Memosens sensor is displayed immediately.		
	 	All typical sensor parameters are transferred to the measuring device automatically. These are, for example, the measuring range, zero point, and slope of the sensor. Measuring commences immediately and the measuring temperature is recorded simultaneously without any further parameters having to be set. With "Plug&Measure", premeasured Memosens sensors can immediately be used for measurement without prior calibration.
		In the menus assigned to a sensor channel, the respective channel, the primary measured value, and the measured temperature are always displayed in the upper right corner.

Note: The display may vary depending on which sensors are connected.

pH Parameter Setting

Menu selection: Parameter Setting ▸ MSU ... Module ▸ Memosens pH(/ORP)

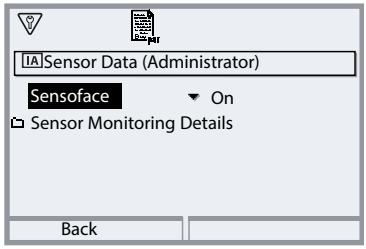
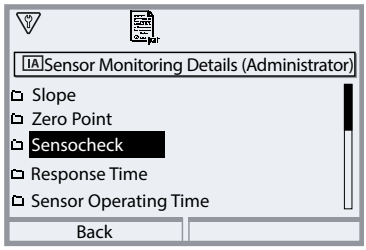
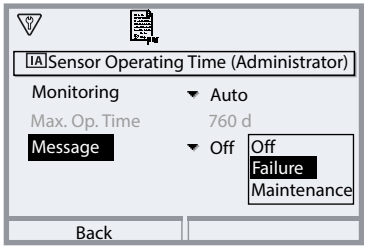
Parameter	Default	Description, Options
Input Filter		
Pulse Suppression	Off	Enable/disable suppression of interference pulses.
Sensor Data		
Sensoface	On	Enable/disable display of Sensoface messages and icons.
Sensor Monitoring Details (see page 20)		pH sensors: Slope, Zero Point, Sensocheck, Response Time, Sensor Operating Time, Sensor Wear, SIP Counter ISFET sensors: Slope, ISFET Operating Point, ISFET Leakage Current, Response Time, Sensor Operating Time, Sensor Wear, SIP Counter pH/ORP sensors: Slope, Zero Point, ORP Offset, Sensocheck Reference Electrode, Sensocheck Glass Electrode, Response Time, Sensor Operating Time, Sensor Wear, CIP Counter, SIP Counter, Autoclaving Counter
Cal Presettings (see page 22)		
Calibration Mode	Calimatic	Presetting for calibration mode pH sensors: Calimatic, Manual, Product, Data Entry, Temperature ISFET: Calimatic, Manual, Product, ISFET Zero Point, Data Entry, Temperature pH/ORP sensors: Calimatic, Manual, Product, Data entry, ORP Data Entry, ORP Adjustment, ORP Check, Temperature
Buffer Set	Knick CaliMat	For Calimatic: Select buffer set
Cal Points	Auto	For Calimatic and manual: Auto, 1-point, 2-point, 3-point
Drift Check	Standard	Fine: 1.2 mV/min (stop after 180 s) Standard: 2.4 mV/min (stop after 120 s) Coarse: 3.75 mV/min (stop after 90 s)
Cal Timer Monitoring	Off	Off, Auto: 0168h, Individual
Adaptive Cal Timer	Off	Off, On
TC Process Medium (see page 24)		
Temperature Comp.	Off	Off**,** Linear, Ultrapure Water, Table Linear: Enter Temp Factor +nn.nn%/K. Table: TC values specifiable, step size 5 °C / 9 °F

pH Parameter Setting

Menu selection: Parameter Setting ▸ MSU ... Module ▸ Memosens pH(/ORP)

Parameter	Default	Description, Options
ORP / rH Value (for pH/ORP sensors)		
Reference Electrode	Ag/AgCl, KCl 3mol	Ag/AgCl, KCl 1mol, Ag/AgCl, KCl 3mol, Hg, Tl/TlCl, KCl 3.5mol, Hg/Hg_2SO_4, K_2SO_4 sat.
ORP Conversion to SHE	No	Enable or disable ORP conversion to standard SHE hydrogen electrode.
Calculate rH with Factor	No	Calculate rH with or without factor.
Delta Function (see page 25)		
Delta Function	Off	pH sensors: Off, pH pH/ORP sensors: Off, pH, mV ORP, rH ISFET sensors: Off, pH
Messages (see page 26) pH sensors, ISFET sensors:		
pH Value Messages	Off	Off, Max. Device Limits, Variable Limits
Temperature Messages	Off	Off, Max. Device Limits, Variable Limits
pH Voltage Messages	Off	Off, Max. Device Limits, Variable Limits
pH/ORP sensors:		
pH Value Messages	Off	Off, Max. Device Limits, Variable Limits
ORP Messages	Off	Off, Max. Device Limits, Variable Limits
rH Value Messages	Off	Off, Max. Device Limits, Variable Limits
Temperature Messages	Off	Off, Max. Device Limits, Variable Limits
pH Voltage Messages	Off	Off, Max. Device Limits, Variable Limits

pH Parameter Setting

Menu	Display	Action
	 Example of pH sensor:  	**Parameter Setting** ▸ MSU ... Module ▸ Memosens pH(/ORP) ▸ Sensor Data: **Sensoface** The Sensoface icons provide the user with diagnostic information on wear and required maintenance of the sensor. In measuring mode, an icon (happy, neutral, or sad smiley) is shown on the display to reflect the continuous monitoring of the sensor parameters. **Sensor Monitoring Details** Enable/disable Sensocheck sensor monitoring. Set whether Sensocheck will generate Failure or Maint. Required messages. Option to enter individual limits before a message (options dependent on which sensor is connected) is triggered. Auto: The parameters are read out directly from the sensor or are adjusted by the system. They are displayed in gray and cannot be edited. Individual: The parameters must be specified by the user. **Messages** If the tolerance is exceeded, a message (“Failure” or “Maint. Required”) can be triggered.

Note: The display may vary depending on which sensors are connected.

CIP Counter[1)]/SIP Counter

CIP/SIP cycles are used to clean or sterilize process-wetted parts in the process. Depending on the application, either one chemical (alkaline solution, water) or several chemicals (alkaline solution, water, acidic solution, water) are used.

- CIP temperature > 55 °C/131 °F
- SIP temperature > 115 °C/239 °F

The cleaning (cleaning in place) and sterilization (sterilization in place) cycles are counted to measure the load on the sensor, e.g., in biotechnology applications.

Note: If measurements are generally taken at high temperatures (> 55 °C/131 °F), the counters should be switched off.

When a CIP/SIP counter is switched on, a maximum number of cycles can be entered. A message can be set to indicate when a counter has reached a specified value.

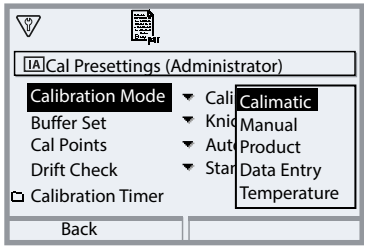
Note: A CIP or SIP cycle is only entered into the logbook 2 hours after the start to ensure that the cycle is complete.

Autoclaving Counter[1)]

Autoclaving cycles are counted to help measure the load on the sensor.

When the autoclaving counter is switched on, a maximum number of cycles can be entered. A message can be set to indicate when a counter has reached a specified value.

1) When using a pH/ORP combo sensor

Menu	Display	Action
par		**Presettings for Calibration** The calibration presettings can be defined in the parameter settings or adjusted directly in the Calibration menu prior to the calibration. Parameter Settings ▸ Memosens pH... ▸ Cal Presettings

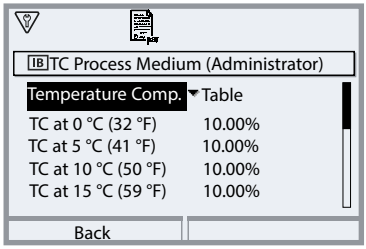
Calibration Mode: Presetting of calibration mode, e.g., Calimatic, Manual, Product, Data Entry, Temperature
If Calimatic automatic calibration is selected, the buffer set to be used must also be selected.
Cal Points: Selection of how many calibration points are to be used in the calibration (for Calimatic and manual calibration).
Selection: 1-, 2-, or 3-point
Drift Check: Setting of drift check sensitivity
Fine: 1.2 mV/min (stop after 180 s)
Standard: 2.4 mV/min (stop after 120 s)
Coarse: 3.75 mV/min (stop after 90 s)
Default: Standard

Calibration Timer
When a preset calibration interval expires, the calibration timer generates a message text to indicate the need for calibration.
"Auto": Interval is set to 168 h
"Individual": Any interval can be set
"Off": No monitoring of the calibration timer
Note: If Sensoface is enabled, 😐 (neutral) is displayed once 80 % of the time interval has expired. On expiry of the complete time interval, ☹ (sad) is displayed and a corresponding message is generated (see p. 20). The NAMUR icon ⊗ is displayed. If the current outputs are configured accordingly, a 22-mA error signal is generated (see basic unit user manual).

Note: The display may vary depending on which sensors are connected.

pH Parameter Setting

	**Adaptive Calibration Timer:** The time until the next calibration is automatically shortened depending on the temperature and pH value. Old sensor = timer expires faster. The following measuring conditions shorten the adaptive calibration timer interval: • Temperatures above 30 °C / 86 °F • pH ranges below pH 2 or above pH 12 The message test is displayed in the Diagnostics menu: Diagnostics ▸ Message List The calibration timer is reset after each calibration.

Menu	Display	Action
par		**TC Process Medium** You can select the following options: • Off • Linear (enter TC coefficient) • Ultrapure Water • Table

Linear Temperature Compensation of Process Medium

If the medium's pH value changes in linear fashion with the temperature, the temperature coefficient TC can be determined for temperature compensation in %/K as follows:

$TC = (pH_{25} - pH_T) \cdot 100 / (25\ °C - T)$ [%/K]

TC	Temperature coefficient [%/K]
pH_{25}	pH value at 25 °C
pH_T	pH value at measuring temperature T
T	Measuring temperature [°C]

Table

When using process media with a known pH value temperature response, the pH output value can be corrected using a table. The percentage deviation from the measured value in % can be entered for temperatures between 0 and 95 °C in steps of 5 °C. The pH output value is then corrected by the corresponding percentage deviation from the measured value in %, depending on the measuring temperature. Table values are linearly interpolated. If the temperature falls below or exceeds the specified value (< 0 °C or > 95 °C), the last value in the table is used for calculation.

The table must be completed with the following values in steps of 5 °C:

((pH25 / pHT) – 1) • 100 [%]

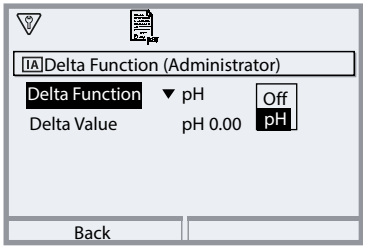
pH25 pH value at 25 °C

pHT pH value at measuring temperature T

Note: If TC correction for the process medium is enabled, "TC" is shown on the display in measuring mode.

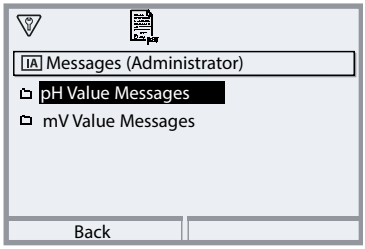
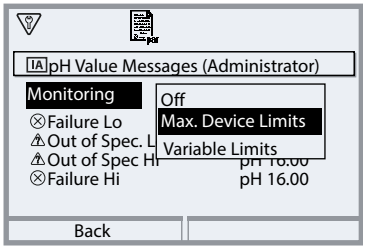
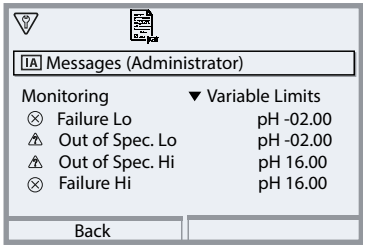
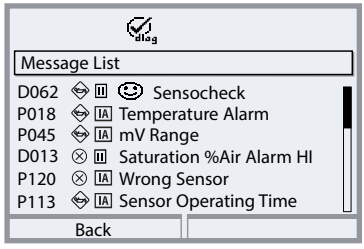
Note: The display may vary depending on which sensors are connected.

pH Parameter Setting

Menu	Display	Action
		**Delta Function** If a delta value is specified, the measuring system calculates the difference: Output value = measured value – delta value All outputs are controlled by the output value; the displays show the output value. If the delta function and TC correction are enabled at the same time, the TC correction is carried out first and the delta value is then deducted. **Note:** If the delta function is enabled, "Δ" is shown on the display in measuring mode.

Note: The display may vary depending on which sensors are connected.

pH Parameter Setting

Menu	Display	Action
par	  	**Messages** All parameters determined by the measuring module can generate messages. **Max. Device Limits** Messages are generated when the process variable is outside the measuring range. The "Failure" icon is displayed; the NAMUR failure contact is activated (BASE module, factory setting: Contact K4, N/C contact). The current outputs can signal a 22-mA message (user-defined); see the basic unit user manual. **Variable Limits** Upper and lower limits at which a message is generated can be defined for the "Failure" and "Out of Specification" messages. **Message Icons:** ⊗ Failure (Limit Hi/Lo) ⚠ Out of Specification (Hi/Lo)
diag		**Diagnostics Menu** Go to the Diagnostics menu if the "Maintenance" or "Failure" icons are blinking in the display. The messages are displayed in the "Message List".

Note: The display may vary depending on which sensors are connected.

pH Calibration / Adjustment

Note: During calibration, the function check (HOLD) operating state is active for the corresponding module channel. The assigned current outputs and relay contacts behave as configured (BASE module).

The calibration data is saved in the Memosens sensor. This means that Memosens sensors can be cleaned, reconditioned, calibrated, and adjusted away from the measurement location, e.g., in a laboratory. Sensors in the system are replaced on-site by adjusted sensors.

Calibration: Detecting deviations without readjustment
Adjustment: Detecting deviations with readjustment

pH Calibration / Adjustment

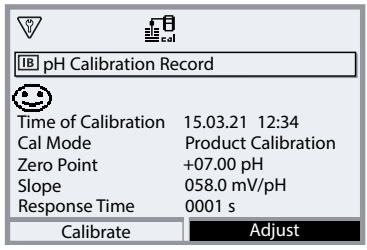
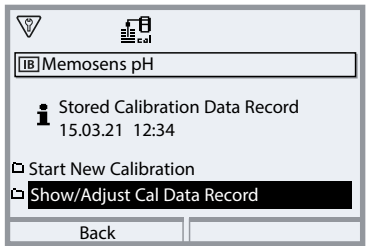
Adjustment

Adjustment means that the values determined by a calibration are applied to the sensor. The zero point and slope values determined during calibration are entered in the adjustment record:

Diagnostics ▸ MSU ... Module ▸ Memosens pH ▸ Cal/Adj Record

These values are not used to calculate the process variables until the calibration has been terminated with an adjustment.

Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
cal		**Administrator** With appropriate access rights, an adjustment can be carried out immediately after calibration: ***Right softkey: Adjust***. The calibration values are used to calculate the process variables.
		**Operator** (without administrator rights) After calibration, save the data by pressing the ***left softkey: Calibrate***, switch to measuring mode, and notify the administrator. The administrator can retrieve all the data of the last calibration (Calibration menu, selection module) and can accept the values or carry out a new calibration.

pH Calibration / Adjustment

pH Calibration / Adjustment Explanations

Each pH sensor has a separate zero point and a separate slope. Both values change as a result of aging and wear. The voltage supplied by the pH sensor is corrected by Protos for the zero point and the electrode slope of the pH sensor, and displayed as the pH value.

During calibration, the sensor's deviation is initially determined (zero point, slope).

The sensor is immersed in buffer solutions with a precisely known pH value for this purpose. Protos measures the voltages of the sensors and the temperature of the buffer solution, using this information to calculate the sensor's zero point and slope.

Note: Make sure that the temperature of the sensor and the temperature of the buffer solution are not too far apart. The ideal temperature is 25 °C/77 °F.

Calibration Values Determined During Calibration

Zero Point	The pH value at which the pH sensor supplies the voltage 0 mV. The zero point is different for each sensor and changes with age and wear.
Slope	The slope of a sensor is the voltage change per pH unit. With an ideal sensor, it is -59.2 mV/pH.
Temperature	The temperature of the process solution must be logged, since the pH measurement is temperature-dependent. Many sensors feature an integrated temperature detector.

There are limits that are calculated during calibration when monitoring glass and reference impedances. The following limits apply to standard glass electrodes:

- Temperature range: 0 ... 80 °C/32 ... 176 °F
- Impedance range: 50 ... 250 MΩ (at 25 °C/77 °F)

Note: With Memosens sensors, the calibration data is stored in the sensor. This allows the use of precalibrated sensors.

When Protos is used for precalibrating sensors in the lab, you can use the calibration routines described below.

Calibration Methods

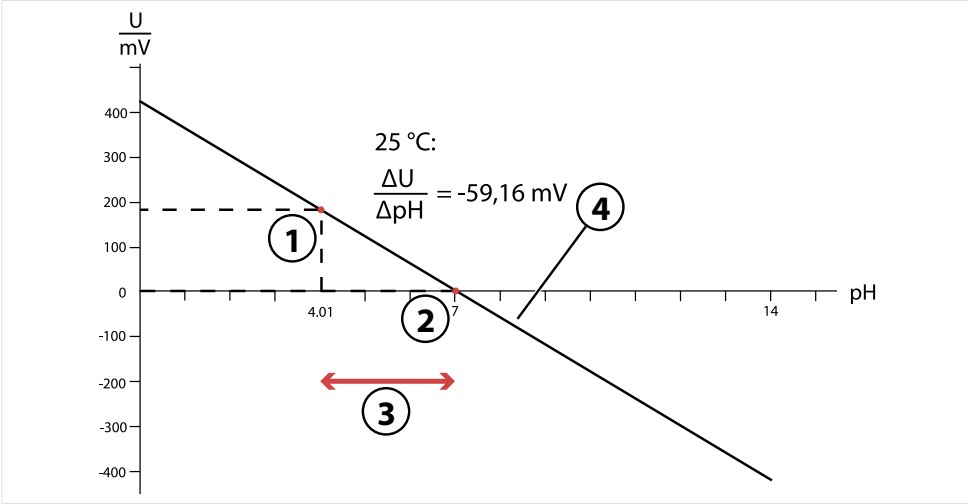
One-Point Calibration

The sensor is calibrated with just one buffer solution. A one-point calibration is useful and permissible if the measured values are close to the sensor zero point, such that the change in sensor slope is of negligible significance. The sensor's zero point is subsequently adjusted, while the slope remains unchanged.

Two-Point Calibration

The sensor is calibrated with two buffer solutions. This makes it possible to calculate the sensor's zero point and slope. The sensor's zero point and slope are subsequently adjusted. A two-point calibration is required in the following cases, for example:

- The sensor has been replaced.
- The pH measured value covers a large range.
- The pH measured value is far from the sensor zero point.
- The pH value needs to be determined with high precision.
- The sensor is subject to heavy wear.

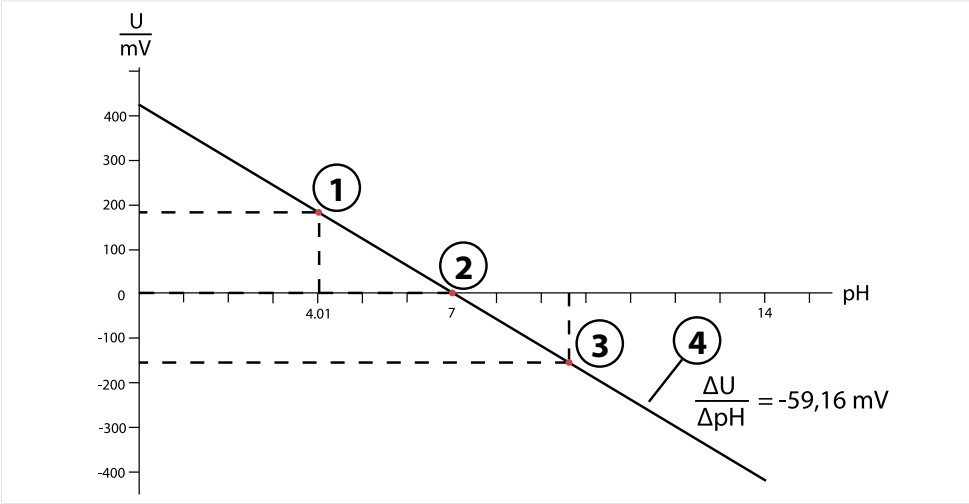


1	First point of first buffer solution	**3**	Recommended measuring range
2	Second point of second buffer solution	**4**	Result of ideal calibration at 25 °C/77 °F

pH Calibration / Adjustment

Three-Point Calibration

The sensor is calibrated with three buffer solutions.
The zero point and slope are calculated using a line of best fit in accordance with DIN 19268. The sensor's zero point and slope are subsequently adjusted.



1	Value of first buffer solution	**3**	Value of third buffer solution
2	Value of second buffer solution	**4**	Rise

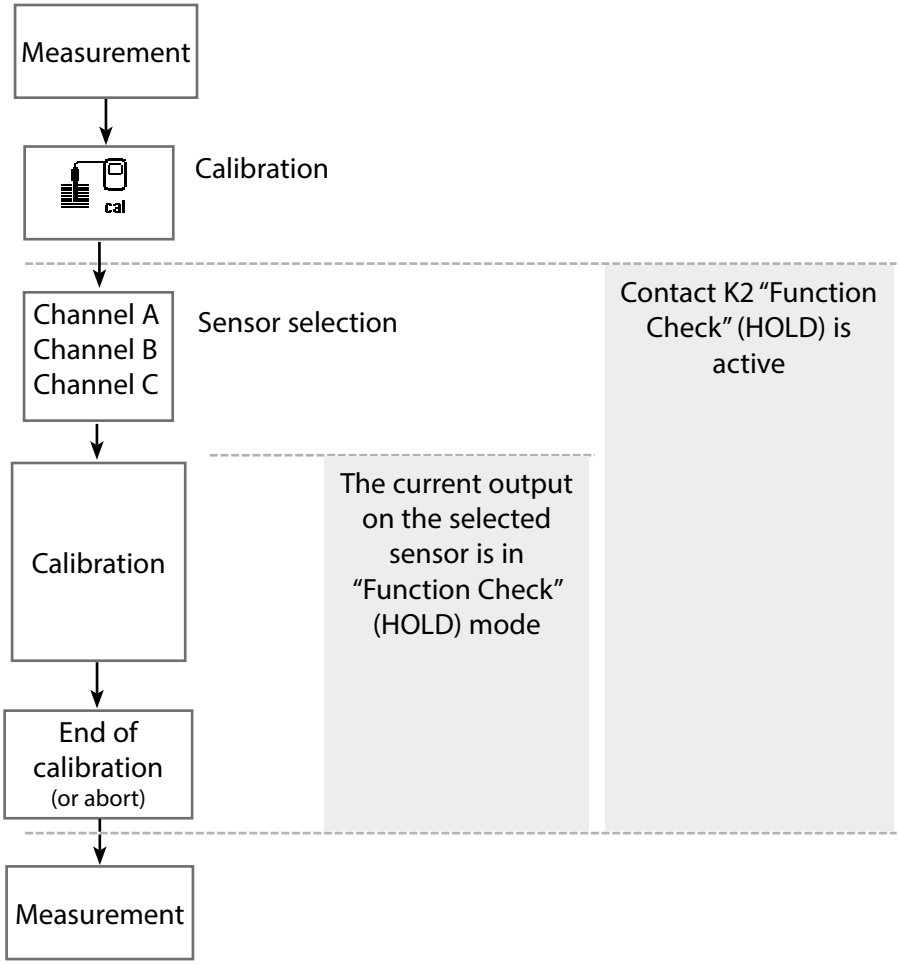
Temperature Compensation during Calibration

The pH sensor's slope is temperature-dependent. The measured voltage must therefore be corrected by the temperature influence.
The buffer solution's pH value is temperature-dependent. During calibration, the temperature of the buffer solution must therefore be known so that the actual pH value can be obtained from the buffer table.

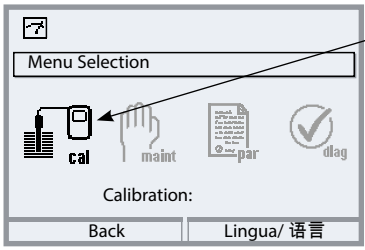
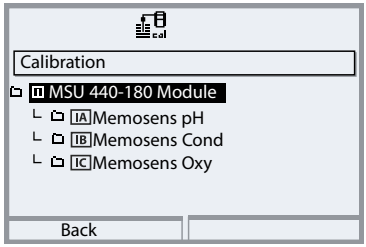
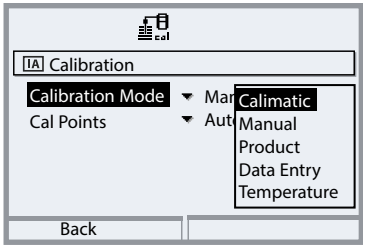
Automatic Temperature Compensation

Protos measures the temperature of the buffer solution using the temperature detector integrated in the Memosens sensor.

Function Check (HOLD) During Calibration / Adjustment
Behavior of the signal and switching outputs during calibration / adjustment



pH Calibration / Adjustment

Menu	Display	Action
		**Open the Calibration Menu** ***menu*** key: Menu Selection. Select calibration using arrow keys, confirm by pressing ***enter***, passcode 1147
cal	 	Select a sensor channel for the calibration. Menu selection: Calibration ▸ MSU ... Module ▸ Memosens pH(/ORP) ▸ Calibration Mode **Calibration / Adjustment Methods** • Calimatic (see page 34) • Manual (see page 36) • Product (see page 38) • Data Entry (see page 40) • ISFET Zero[1] (see page 41) • ORP Data Entry[2] (see page 53) • ORP Adjustment[2] (see page 54) • ORP Check[2] (see page 56) • Temperature (see page 42)

Note: The display may vary depending on which sensors are connected.

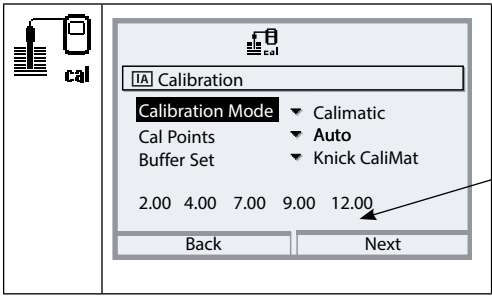
1) When using an ISFET sensor
2) When using a pH/ORP combo sensor

Calibration Mode: Calimatic

During automatic calibration with Knick Calimatic, the sensor is immersed in one, two, or three buffer solutions. On the basis of the sensor voltage and the measured temperature, Protos automatically detects the nominal buffer value. The buffer solutions can be used in any order, but they must be part of the buffer set defined during parameter setting.

Calimatic accounts for the temperature dependence of the buffer value.

All calibration data is converted to a reference temperature of 25 °C/77 °F.



Selection: Calimatic

Display the buffer set selected in Parameter Setting

Continue by pressing the softkey or ***enter***

Calibration Procedure

NOTICE! Use only new, undiluted buffer solutions that are part of the configured buffer set.

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Calimatic" calibration mode and press ***enter*** to confirm.
    Number of calibration points and buffer set are calibrated as in Cal Presettings; See Calibration Presettings, p. 22
02. If required, change the number of calibration points and the buffer set.
03. Take the sensor out of the medium and rinse it in deionized water.

⚠ **CAUTION! Risk of electrostatic discharge.**

Do not wipe the sensor or dab it dry.

04. Immerse the sensor in the first buffer solution.
05. Start calibration with the ***right softkey: Next***.
    ✓ Calibration with first buffer is carried out.
    The following parameters are displayed: Sensor Voltage, Calibration Temperature, Nominal Buffer Value, and Response Time.

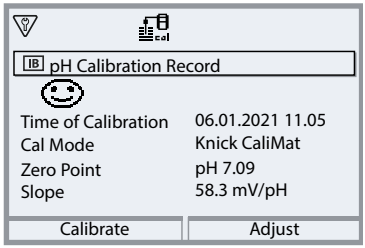
Note: The display may vary depending on which sensors are connected.

pH Calibration / Adjustment

The time for the measuring voltage to stabilize can be shortened with the ***left softkey: Exit*** (without drift check: reduced accuracy of calibration values). The response time indicates how long the sensor needs until the measuring voltage is stable. If the sensor voltage or the measured temperature fluctuate considerably, the calibration procedure is aborted after around 2 minutes. In this case, calibration needs to be restarted.

06. For one-point calibration: Exit calibration by pressing the softkey.
07. For two-point calibration: Rinse the sensor well with deionized water.
08. Immerse the sensor in the second buffer solution.
09. Start calibration with the ***right softkey: Next***.
    ✓ Calibration with second buffer is carried out.
10. Proceed as for one-point calibration.
11. For three-point calibration, the process uses the third buffer accordingly.

✓ By pressing the ***right softkey: Adjust***, the calculated calibration values are used to calculate the measured values in Protos and also saved in the Memosens sensor.



Note: The display may vary depending on which sensors are connected.

Calibration Mode: Manual

During calibration with manual entry of buffer values, the sensor is immersed in one, two, or three buffer solutions.

Protos displays the measured temperature. The temperature-corrected buffer values must then be manually entered. For this purpose, take the buffer value that goes with the displayed temperature from the buffer table (e.g., on the bottle). Intermediate values must be interpolated.

All calibration data is converted to a reference temperature of 25 °C/77 °F.

Calibration Procedure

NOTICE! Use only new, undiluted buffer solutions that are part of the configured buffer set.

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

Select "Manual" calibration mode and confirm by pressing ***enter***.

Number of calibration points are calibrated as in Cal Presettings;

See Calibration Presettings, p. 22

01. If required, change the number of calibration points.
02. Enter the first buffer value.
03. Continue with the ***right softkey: Next***.
04. Take the sensor out of the medium and rinse it well in deionized water.

⚠ **CAUTION! Risk of electrostatic discharge.**

Do not wipe the sensor or dab it dry.

05. Immerse the sensor in the first buffer solution.
06. Start calibration with the ***right softkey: Next***.
    ✓ Calibration with first buffer is carried out.
    The following parameters are displayed: Sensor Voltage, Calibration Temperature, Nominal Buffer Value, and Response Time.

pH Calibration / Adjustment

The time for the measuring voltage to stabilize can be shortened with the ***left softkey: Exit*** (without drift check: reduced accuracy of calibration values). The response time indicates how long the sensor needs until the measuring voltage is stable. If the sensor voltage or the measured temperature fluctuate considerably, the calibration procedure is aborted after around 2 minutes. In this case, calibration needs to be restarted.

07. For one-point calibration: Exit calibration by pressing the softkey.
08. For two-point calibration: Rinse the sensor well with deionized water.
09. Immerse the sensor in the second buffer solution.
10. Start calibration with the ***right softkey: Next***.
    ✓ Calibration with second buffer is carried out.
11. Proceed as for one-point calibration.
12. For three-point calibration, the process uses the third buffer accordingly.

✓ By pressing the ***right softkey: Adjust***, the calculated calibration values are used to calculate the measured values in Protos and also saved in the Memosens sensor.

Calibration Mode: Product
If the sensor cannot be removed – e.g., for sterility reasons – its zero point can be calibrated by "sampling". The currently measured value of the process is saved in the device for this purpose. A sample is taken directly afterward at the measuring point. The sample's pH value is measured in the laboratory.
The reference value is entered in the device.
Protos calculates the sensor's zero point from the difference between the measured and reference values. The slope is not changed in the process.

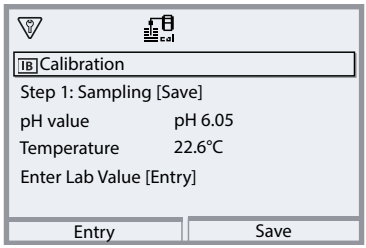
NOTICE! The sample's pH value is temperature-dependent. The reference measurement should be carried out at the sample temperature shown on the display. The sample should be transported in a vacuum flask.
The sample's pH value may also be falsified if volatile substances escape.

Calibration Procedure
When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Product" calibration mode and press ***enter*** to confirm.
02. Prepare for sampling.
03. Start with the right softkey: "Next".

Product calibration is performed in 2 steps.

Step 1:
04. Take sample.
    ✓ The measured value and temperature at the time of sampling are displayed.
05. Save with the ***right softkey: Save***.



Step 2: Lab value has been measured.

06. Open the Product Calibration menu again.
07. Enter reference value ("Lab value").
08. Confirm with the ***right softkey: Next*** or repeat calibration with the ***left softkey: Cancel***.

✓ By pressing the ***right softkey: Adjust***, the calculated calibration values are used to calculate the measured values in Protos and also saved in the Memosens sensor.

Exception: Sample value can be determined and entered on site: ***Left softkey: Entry*.**

Note: The display may vary depending on which sensors are connected.

Calibration Mode: Data Entry
Entry of values for the zero point and the slope of the sensor. The values must be known, e.g., determined beforehand in the laboratory.

Calibration Procedure
When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Data Entry" calibration mode and press ***enter*** to confirm.
02. Remove the sensor and install the premeasured sensor.
03. Continue with the ***right softkey: Next***.
04. Enter the zero point and slope measured values.

✓ By pressing the ***right softkey: Adjust***, the calculated calibration values are used to calculate the measured values in Protos and also saved in the Memosens sensor.

Calibration Mode: ISFET Zero
When using Memosens ISFET sensors for pH measurement, the individual operating point of the sensor first needs to be determined, and should be in the pH 6.5 ... pH 7.5 range. The sensor is immersed in a buffer solution with a pH value of 7.00 for this purpose.

Calibration Procedure
When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select the "ISFET Zero Point" calibration mode for setting the operating point for the first sensor calibration.
02. Continue with the ***right softkey: Next***.
03. Adjust the buffer value if necessary: Default pH 7.00
04. Take the sensor out of the medium and rinse it well in deionized water.

⚠ **CAUTION! Risk of electrostatic discharge.**
Do not wipe the sensor or dab it dry.

05. Immerse the sensor in buffer solution.
06. Start calibration with the ***right softkey: Next***.
    ✓ The ISFET operating point is calculated.
07. Finally, confirm the ISFET operating point with the ***right softkey: Adjust***.

A pH calibration, e.g., Calimatic 2-point calibration, can be performed afterward.

Note: The operating point only needs to be determined once for each ISFET sensor.

Calibration Mode: Temperature

This function is used to adjust the individual temperature detector tolerances or cable lengths for the purpose of increasing the accuracy of the temperature measurement. The adjustment requires an accurate measurement of the process temperature using a calibrated reference thermometer. The measurement error of the reference thermometer should be less than 0.1 K. Adjustment without an accurate measurement may result in falsification of the displayed measured value.

Calibration Procedure

01. Select "Temperature" calibration mode and press ***enter*** to confirm.
02. Enter the measured process temperature and press ***enter*** to confirm.
    ✓ The temperature offset is displayed.
03. Adjust the temperature detector with the ***right softkey: Save***.

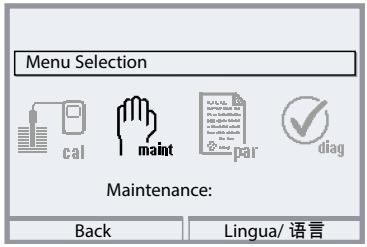
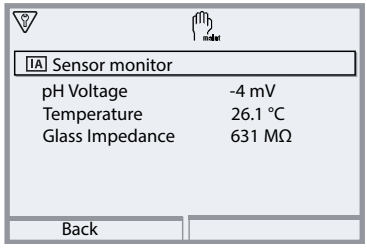
The current adjustment and temperature offset data can be displayed in the Diagnostics menu:
▸ MSU ... Module ▸ Memosens ... ▸ Temp. Offset Log

Note: The pH/ORP combo sensor can be calibrated as a pH sensor and/or as an ORP sensor.
See also "ORP Calibration / Adjustment"; p. 49

pH Maintenance Functions

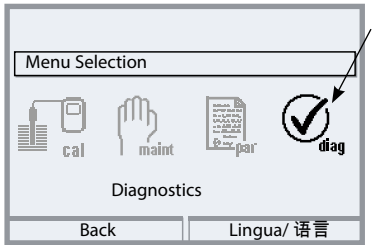
Note: Function check (HOLD) active

The current outputs and relay contacts behave in accordance with the parameter settings. Since the device is in function check (HOLD) mode, certain media can be used to validate the sensor and check the measured values without affecting the signal outputs.
To end the function check, return to measuring mode.

Menu	Display	Action
		**Open the Maintenance menu** From the measuring mode: ***menu*** key: Menu Selection. Select Maintenance (maint) using the arrow keys and confirm by pressing ***enter***. Passcode (factory setting): 2958 Then select the module and sensor.
		**Sensor Monitor** Display of the currently measured values (sensor monitor) with function check (HOLD mode activated) enabled.

Note: The display may vary depending on which sensors are connected.

pH Diagnostic Functions

Menu	Display	Action
diag		**Open the Diagnostics menu** From the measuring mode: ***menu*** key: Menu Selection. Select Diagnostics using arrow keys, press ***enter*** to confirm.

For a detailed description of general diagnostic functions, see the basic unit user manual.

Overview of pH Diagnostic Functions

In diagnostics mode, you can access the following submenus without interrupting the measurement:

Diagnostics ▸ MSU ... Module:

Module Diagnostics	Protos periodically performs a self-test in the background. The results can be displayed here.

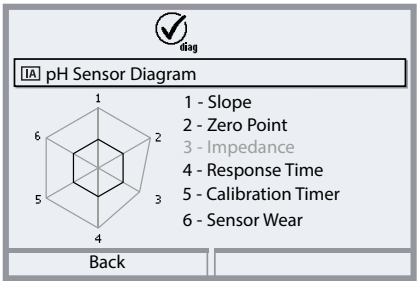
Diagnostics ▸ MSU ... Module ▸ Memosens pH:

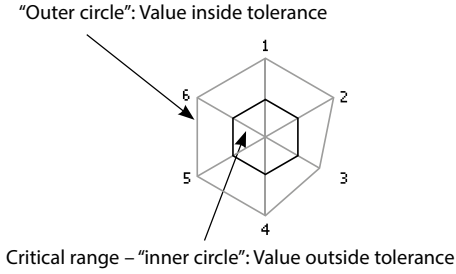
Submenus	**Description**
Sensor Information	The Sensor Information submenu shows data from the currently connected Memosens sensor, e.g., manufacturer, order no., serial no., firmware and hardware version, last calibration, operating time.
Sensor Monitor	The raw measured values, such as pH voltage, glass impedance, reference impedance, etc., are displayed for diagnostic purposes.

Note: The display may vary depending on which sensors are connected.

Note: The display may vary depending on which sensors are connected.

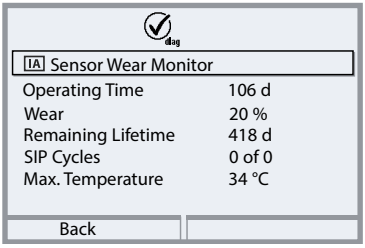
Submenus	Description
pH Sensor Diagram	The sensor diagram clearly indicates the status of the parameters in the connected sensor, including the calibration timer. Inactive parameters are shown in gray and set to 100 % (e.g., disabled calibration timer). The parameter values should lie between the outer (100 %) and inner (50 %) polygon. A warning signal flashes if a value drops below the inner polygon (< 50 %).





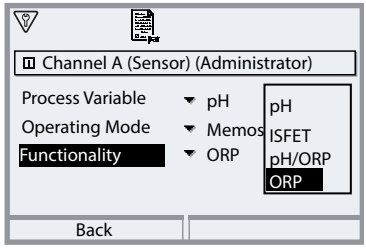
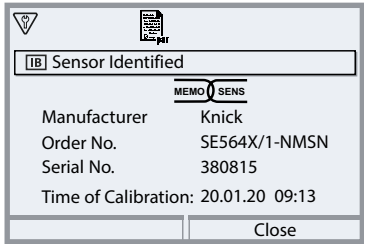
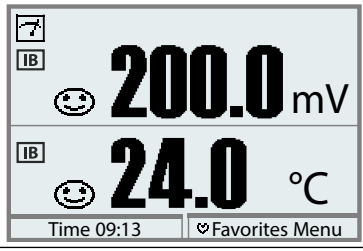
The tolerance limits (radius of the "inner circle") can be individually adjusted. See Parameter Setting ▸ Sensor Data ▸ Sensor Monitoring Details.

pH Cal/Adj Record	The calibration/adjustment record shows the data from the last calibration/adjustment performed on the currently connected sensor.
Temp. Offset Log	The temp. offset log shows the data from the last temperature equalization performed on the currently connected sensor.
Sensor Wear Monitor	The sensor wear monitor shows the sensor operating time and the maximum temperature during the operating time, as well as wear and the forecast remaining time.



ORP Parameter Setting

Note: Function check (HOLD) active

Menu	Display	Action
par		Parameter Setting ▸ MSU ... Module ▸ Channel ...: Process Variable: pH Operating Mode: Memosens Functionality: ORP Then press the ***left softkey: Back***
A connected Memosens sensor is displayed immediately.		
	 	All typical sensor parameters are transferred to the measuring device automatically. These are, for example, the measuring range, zero point, and slope of the sensor. Measuring commences immediately and the measuring temperature is recorded simultaneously without any further parameters having to be set. With "Plug&Measure", premeasured Memosens sensors can immediately be used for measurement without prior calibration.
		In the menus assigned to a sensor channel, the respective channel, the primary measured value, and the measured temperature are always displayed in the upper right corner.

Note: The display may vary depending on which sensors are connected.

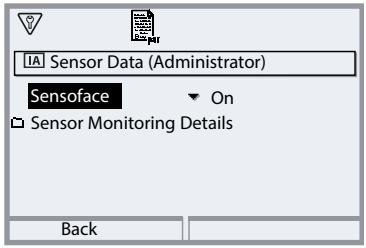
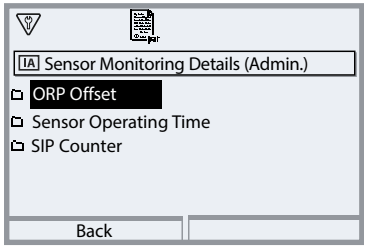
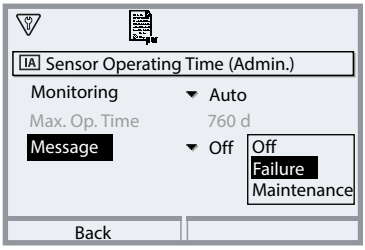
ORP Parameter Setting

Menu Selection: Parameter Setting ▸ MSU ... Module ▸ Memosens ORP

Parameter	Default	Description, Options
Input Filter		
Pulse Suppression	Off	Enable/disable suppression of interference pulses.
Sensor Data		
Sensoface	On	Enable/disable display of Sensoface messages and icons.
Sensor Monitoring Details (See next page)		Option to enter individual limits for monitoring ORP offset. Option to enter individual limits before a message for sensor operating time and SIP counter is triggered.
Cal Presettings		
Calibration Mode	ORP Data Entry	Presetting for calibration mode: ORP Data Entry, ORP Adjustment, ORP Check, Temperature
ORP Check	Test Period 10 s Test Difference 10 mV	Settings for test period in seconds and test difference in millivolts.
ORP / rH Value		
Ref El	Ag/AgCl, KCl 3 mol	Ag/AgCl, KCl 1 mol Ag/AgCl, KCl 3 mol Hg, Tl/TlCl, KCl 3.5 mol $Hg/HgSO_4$, $K2SO_4$ sat.
ORP Conversion to SHE	No	Enable or disable ORP conversion to standard SHE hydrogen electrode.
Calculate rH with Factor	No	When using a pH sensor connected via another module at the same time: Calculate rH with or without factor
Delta Function		
Delta Function	Off	Display deviations from a preset value (delta value); see page 25
Messages		
ORP Messages	Off	Off, Max. Device Limits, Variable Limits
Temperature Messages	Off	Off, Max. Device Limits, Variable Limits

ORP Parameter Setting

Menu Selection: Parameter Setting ▸ MSU ... Module ▸ Memosens ORP

Menu	Display	Action
	  	**Parameter Setting** ▸ MSU ... Module ▸ Memosens ORP ▸ Sensor Data: **Sensoface** The Sensoface icons provide the user with diagnostic information on wear and required maintenance of the sensor. In measuring mode, an icon (happy, neutral, or sad smiley) is shown on the display to reflect the continuous monitoring of the sensor parameters. **Sensor Monitoring Details** Enable/disable Sensocheck sensor monitoring. Set whether Sensocheck will generate Failure or Maint. Required messages. Option to enter individual values before a message is triggered. Auto: The parameters are read out directly from the sensor or are adjusted by the system. They are displayed in gray and cannot be edited. Individual: The parameters must be specified by the user. **Messages** If the tolerance is exceeded, a message ("Failure" or "Maint. Required") can be triggered.

Note: The display may vary depending on which sensors are connected.

ORP Calibration / Adjustment

Note: During calibration, the function check (HOLD) operating state is active for the corresponding module channel. The assigned current outputs and relay contacts behave as configured (BASE module).

The calibration and adjustment data is saved in the sensor. This means that Memosens sensors can be centrally calibrated, adjusted, reconditioned, and cleaned in a laboratory away from the measurement location. Only the sensors in the system are replaced on-site by calibrated / adjusted sensors.

Calibration: Detecting deviations without readjustment
Adjustment: Detecting deviations with readjustment

Note: Make sure that the temperature of the sensor and the temperature of the buffer solution are not too far apart. The ideal temperature is 25 °C/77 °F.

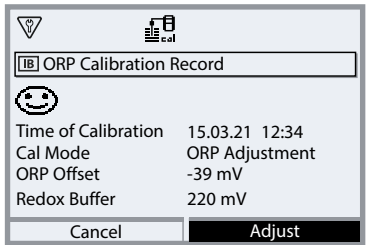
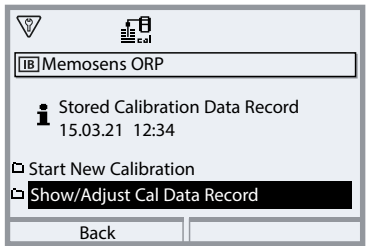
Adjustment

Adjustment means that the values determined by a calibration are applied to the sensor. The zero point and slope values determined during calibration are entered in the adjustment record:

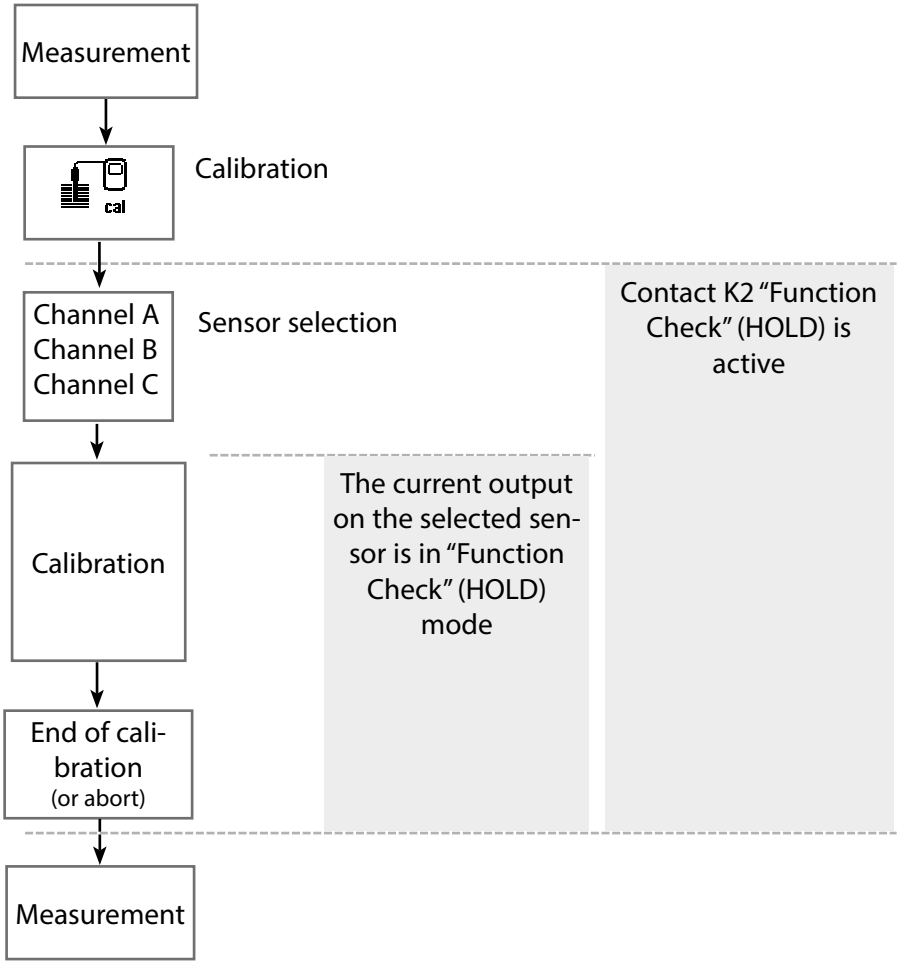
Diagnostics ▸ MSU ... Module ▸ Memosens ORP ▸ Cal/Adj Record

These values are not used to calculate the process variables until the calibration has been terminated with an adjustment.

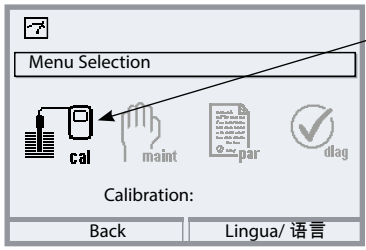
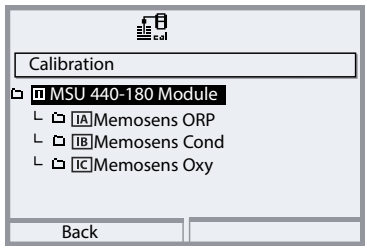
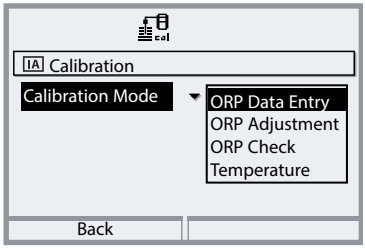
Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
cal		**Administrator** With appropriate access rights, an adjustment can be carried out immediately after calibration: ***Right softkey: Adjust***. The calibration values are used to calculate the process variables.
		**Operator** (without administrator rights) After calibration, save the data by pressing the ***left softkey: Calibrate***, switch to measuring mode, and notify the administrator. The administrator can retrieve all the data of the last calibration (Calibration menu, selection module) and can accept the values or carry out a new calibration.

Function Check (HOLD) During Calibration / Adjustment
Behavior of the signal and switching outputs during calibration / adjustment



ORP Calibration / Adjustment

Menu	Display	Action
		**Open the Calibration Menu** ***menu*** key: Menu Selection. Select calibration using arrow keys, confirm by pressing ***enter***, passcode 1147
cal	 	Select a sensor channel for the calibration. Menu selection: Calibration ▸ MSU ... Module ▸ Memosens ORP ▸ Calibration Mode **Calibration / Adjustment Methods** • ORP Data Entry (see page 53) • ORP Adjustment (see page 54) • ORP Check (see page 56) • Temperature (see page 57)

Note: The display may vary depending on which sensors are connected.

ORP Calibration / Adjustment

Calibration Mode: ORP Data Entry
Calibration by entering the ORP offset of a premeasured sensor.

Calibration Procedure
When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "ORP Data Entry" calibration mode and press ***enter*** to confirm.
02. Remove the sensor and install the premeasured sensor.
03. Continue with the ***right softkey: Next***.
04. Enter the ORP offset value.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calculated calibration values are used to calculate the measured values in Protos and also saved in the Memosens sensor.

ORP Calibration / Adjustment

Calibration Mode: ORP Adjustment
The sensor is immersed in an ORP buffer solution for ORP adjustment. Protos displays the measured temperature and the ORP. The temperature-corrected buffer values must then be manually entered. For this purpose, take the buffer value that goes with the displayed temperature from the buffer table (e.g., on the bottle). Intermediate values must be interpolated.
All calibration data is converted to a reference temperature of 25 °C/77 °F.

Calibration Procedure
When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "ORP Adjustment" calibration mode and press ***enter*** to confirm.
02. Continue with the ***right softkey: Next***.
03. Take the sensor out of the medium and rinse it well in deionized water.

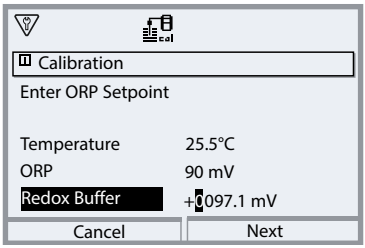
CAUTION! Risk of electrostatic discharge. Do not wipe the sensor or dab it dry.

04. Immerse the sensor in the ORP buffer solution and wait for the ORP measured value to stabilize.
05. Start calibration with the ***right softkey: Next***.

✓ When the drift check is complete, the measured temperature and ORP are displayed.

The time for the measuring voltage to stabilize can be shortened with the ***left softkey: Exit*** (without drift check: reduced accuracy of calibration values). The response time indicates how long the sensor needs until the measuring voltage is stable. If the sensor voltage or the measured temperature fluctuate considerably, the calibration procedure is aborted after around 2 minutes. In this case, calibration needs to be restarted.

06. Enter the ORP setpoint (printed on bottle) of the buffer solution in the Calibration Mode submenu ▸ ORP Adjustment ▸ and press ***enter*** to confirm.



07. Exit calibration with the ***right softkey: Next***.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calculated calibration values are used to calculate the measured values in Protos and also saved in the Memosens sensor.

Note: The display may vary depending on which sensors are connected.

Calibration Mode: ORP Check

The sensor is immersed in a solution with a known ORP value for the ORP check. The test period and the permissible test difference are specified during parameter setting:

Parameter Setting ▸ MSU ... Module ▸ Memosens ORP ▸ Cal Presettings

Calibration Procedure

01. Select "ORP Check" calibration mode and press ***enter*** to confirm.
02. Take the sensor out of the medium and rinse it well in deionized water.

CAUTION! Risk of electrostatic discharge. Do not wipe the sensor or dab it dry.

03. Immerse the sensor in the ORP solution and wait for the ORP measured value to stabilize.
04. Start the ORP check with the ***right softkey: Next***.

✓ When the drift check is complete, the measured temperature and ORP are displayed.

✓ If the specified test difference was not exceeded, the message "ORP Check Successful" appears.
If the specified test difference was exceeded, the message "ORP Check Unsuccessful" appears.

05. ORP adjustment should be carried out in the event of an unsuccessful ORP check.

Calibration Mode: Temperature

This function is used to adjust the individual temperature detector tolerances or cable lengths for the purpose of increasing the accuracy of the temperature measurement. The adjustment requires an accurate measurement of the process temperature using a calibrated reference thermometer. The measurement error of the reference thermometer should be less than 0.1 K. Adjustment without an accurate measurement may result in falsification of the displayed measured value.

Calibration Procedure

01. Select "Temperature" calibration mode and press ***enter*** to confirm.
02. Enter the measured process temperature and press ***enter*** to confirm.
    ✓ The temperature offset is displayed.
03. Adjust the temperature detector with the ***right softkey: Save***.

The current adjustment and temperature offset data can be displayed in the Diagnostics menu:

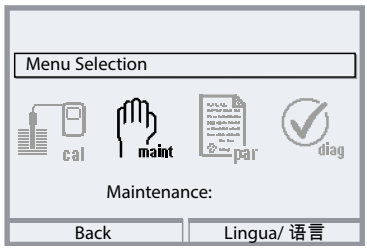
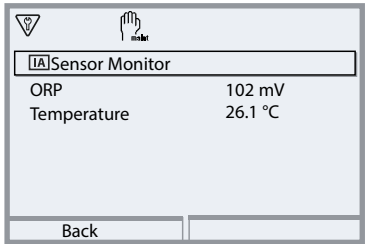
▸ MSU ... Module ▸ Memosens ORP ▸ Temp. Offset Log

ORP Maintenance Functions

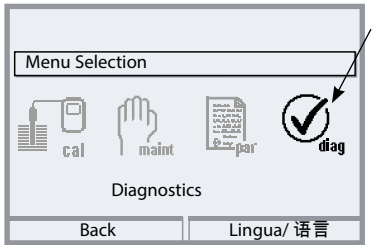
Note: Function check (HOLD) active

The current outputs and relay contacts behave in accordance with the parameter settings. Since the device is in function check (HOLD) mode, certain media can be used to validate the sensor and check the measured values without affecting the signal outputs.
To end the function check, return to measuring mode.

Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
maint		**Open the Maintenance menu** From the measuring mode: ***menu*** key: Menu Selection. Select Maintenance (maint) using the arrow keys and confirm by pressing ***enter***. Passcode (factory setting): 2958 Then select Memosens ORP.
		**Sensor Monitor** Display of the currently measured values (sensor monitor) with function check (HOLD mode activated) enabled:

ORP Diagnostic Functions

Menu	Display	Action
diag		**Open the Diagnostics menu** From the measuring mode: ***menu*** key: Menu Selection. Select Diagnostics using arrow keys, press ***enter*** to confirm.

The diagnostic functions are matched to NAMUR recommendation NE 107. For a detailed description of general diagnostic functions, see the basic unit user manual.

Overview of ORP Diagnostic Functions

In diagnostics mode, you can access the following submenus without interrupting the measurement:

Diagnostics ▸ MSU ... Module:

Module Diagnostics	Protos periodically performs a self-test in the background. The results can be displayed here.

Diagnostics ▸ MSU ... Module ▸ Memosens ORP:

Submenus	**Description**
Sensor Information	The Sensor Information submenu shows data from the currently connected Memosens sensor, e.g., manufacturer, order no., serial no., firmware and hardware version, last calibration, operating time.
Sensor Monitor	The raw measured values are displayed in the sensor monitor for diagnostic purposes.
ORP Cal/Adj Record	The calibration/adjustment record shows the data from the last calibration/adjustment performed on the currently connected sensor.

Submenus	Description
Temp. Offset Log	The temp. offset log shows the data from the last temperature equalization performed on the currently connected sensor.
Sensor Wear Monitor	The sensor wear monitor shows the sensor operating time and the maximum temperature during the operating time, as well as wear and the forecast remaining time.

pH, ORP Messages

pH, ORP Messages

⊗ Failure ⚠ Out of Specification ⚙ Maintenance Required

See also "Decommissioning"; p. 159

No.	Message Type	Message / Notes
P008	⊗	Factory Settings: Switch device off (approx. 10 s). If the message persists, send in the device.
P009	⊗	Firmware Error: Switch device off (approx. 10 s). Reload the firmware. If the message persists, send in the device.
P010	⊗	pH Range: Measuring range exceeded. Possible causes: Sensor not or incorrectly connected, sensor faulty, cable faulty, incorrect temperature detector selected, temperature detector faulty.
P011	⊗	pH LO_LO: Value below configured monitoring limit
P012	⚠	pH LO: Value below configured monitoring limit
P013	⚠	pH HI: Value above configured monitoring limit
P014	⊗	pH HI_HI: Value above configured monitoring limit
P015	⊗	Temperature Range: Measuring range exceeded. Possible causes: Sensor incorrectly or not connected, cable faulty.
P016	⊗	Temperature LO_LO: Value below configured monitoring limit
P017	⚠	Temperature LO: Value below configured monitoring limit
P018	⚠	Temperature HI: Value above configured monitoring limit
P019	⊗	Temperature HI_HI: Value above configured monitoring limit
P020	⊗	ORP Range: Measuring range exceeded. Possible causes: no ORP sensor connected, sensor incorrectly connected, sensor faulty, cable faulty.
P021	⊗	ORP LO_LO: Value below configured monitoring limit
P022	⚠	ORP LO: Value below configured monitoring limit
P023	⚠	ORP HI: Value above configured monitoring limit
P024	⊗	ORP HI_HI: Value above configured monitoring limit
P025	⚠	rH Range: Measuring range exceeded. Possible causes: no pH/ORP combo sensor connected, sensor incorrectly connected, cable faulty.
P026	⊗	rH LO_LO: Value below configured monitoring limit

pH, ORP Messages

No.	Message Type	Message / Notes
P027	⚠	rH LO: Value below configured monitoring limit
P028	⚠	rH HI: Value above configured monitoring limit
P029	⊗	rH HI_HI: Value above configured monitoring limit
P045	⊗	pH Voltage Range: Measuring range exceeded. Possible causes: Sensor not or incorrectly connected, sensor faulty, cable faulty.
P046	⊗	mV LO_LO: Value below configured monitoring limit
P047	⚠	mV LO: Value below configured monitoring limit
P048	⚠	mV HI: Value above configured monitoring limit
P049	⊗	mV HI_HI: Value above configured monitoring limit
P060	⊗ / ◇	Sad Sensoface: Slope
P061	⊗ / ◇	Sad Sensoface: Zero point
P062	User-defined	Sad Sensoface: Reference impedance
P063	User-defined	Sad Sensoface: Glass impedance
P064	User-defined	Sad Sensoface: Response time
P065	◇	Sad Sensoface: Calibration timer
P069	◇	Sad Sensoface: Calimatic (zero/slope)
P070	User-defined	Sad Sensoface: Sensor wear
P071	◇	Sad Sensoface: ISFET leakage current
P072	◇	Sad Sensoface: ISFET operating point
P074	◇	Sad Sensoface: ORP zero offset
P090	◇	Error in Buffer Table
P110	User-defined	CIP Counter: Configured number of CIP cycles exceeded: As required, calibrate/adjust sensor or replace.
P111	User-defined	SIP Counter: Configured number of SIP cycles exceeded: As required, calibrate/adjust sensor or replace.
P113	User-defined	Sensor Operating Time: Replace the sensor.
P120	⊗	Wrong Sensor (Sensor Check)
P121	⊗	Sensor Error (Factory Settings): Replace the sensor.
P122	◇	Sensor Memory (Cal Data): The calibration data is defective: Recalibrate/readjust sensor.
P123	◇	New Sensor, Adjustment Required

pH, ORP Messages

No.	Message Type	Message / Notes
P124	◈	Sensor Date: The sensor data is implausible. Check and, as necessary, adjust the configuration.
P130	Info	SIP Cycle Counted
P131	Info	CIP Cycle Counted
P200	⊗	Noise Level at pH Input
P201	◈	Cal Temperature: The calibration temperature is impermissible: Check the calibration temperature. Note the information in the Calibration chapter.
P202	Info	Cal: Buffer Unknown
P203	Info	Cal: Identical Buffers
P204	Info	Cal: Buffers Interchanged
P205	Info	Cal: Sensor Unstable: The drift criterion was not adhered to during calibration. Possible causes: improper calibration, sensor cable/connection faulty, sensor worn. Check the sensor and calibration and repeat as required. Otherwise, replace the sensor.
P206	◈	Cal: Slope: Slope out of permissible range: Repeat calibration/adjustment or replace sensor.
P207	◈	Cal: Zero Point: Zero point out of permissible range: Repeat calibration/adjustment or replace sensor.
P208	⊗	Cal: Sensor Failure (ORP Check): Replace the sensor.
P254	Info	Module Reset

pH, ORP Messages

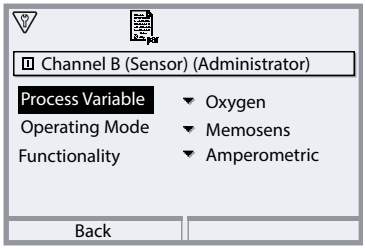
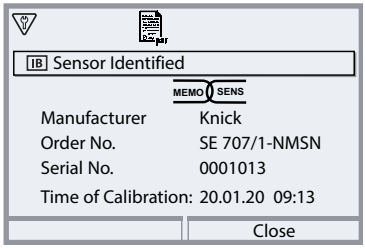
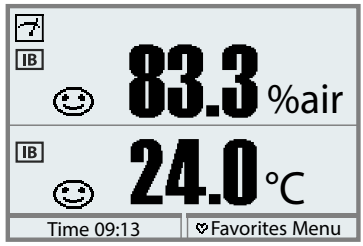
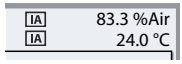
No.	Message Type	pH/pH Calculation Block Messages
A010	⊗	pH Diff Range: Max/min device limits exceeded: - Check both pH values. - Check sensor/cable connections.
A011	⊗	pH Diff LO_LO: Value below configured monitoring limit
A012	⚠	pH Diff LO: Value below configured monitoring limit
A013	⚠	pH Diff HI: Value above configured monitoring limit
A014	⊗	pH Diff HI_HI: Value above configured monitoring limit
A015	⊗	Temperature Diff Range: Max/min device limits exceeded: - Check both temperature values. - Check sensor/cable connections.
A016	⊗	Temperature Diff LO_LO: Value below configured monitoring limit
A017	⚠	Temperature Diff LO: Value below configured monitoring limit
A018	⚠	Temperature Diff HI: Value above configured monitoring limit
A019	⊗	Temperature Diff HI_HI: Value above configured monitoring limit
A020	⊗	ORP Diff Range: Max/min device limits exceeded: - Check both ORP values. - Check sensor/cable connections.
A021	⊗	ORP Diff LO_LO: Value below configured monitoring limit
A022	⚠	ORP Diff LO: Value below configured monitoring limit
A023	⚠	ORP Diff HI: Value above configured monitoring limit
A024	⊗	ORP Diff HI_HI: Value above configured monitoring limit
A045	⊗	pH Voltage Diff Range: Max/min device limits exceeded: - Check both pH voltage values. - Check sensor/cable connections.
A046	⊗	pH Voltage Diff LO_LO: Value below configured monitoring limit
A047	⚠	pH Voltage Diff LO: Value below configured monitoring limit
A048	⚠	pH Voltage Diff HI: Value above configured monitoring limit
A049	⊗	pH Voltage Diff HI_HI: Value above configured monitoring limit
A200	◇	Calculation Block Configuration

Oxy Parameter Setting

Note: Function check (HOLD) active

Note: The oxygen measurement requires TAN option FW4400-015: Oxygen Measurement in the Saturation and ppb Range

Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
par		Parameter Setting ▸ MSU ... Module ▸ Channel ...: Process Variable: Oxygen Operating Mode: Memosens Functionality: Amperometric
A connected Memosens sensor is displayed immediately.		
	 	All typical sensor parameters are transferred to the measuring device automatically. These are, for example, the measuring range, zero point, and slope of the sensor. Measuring commences immediately and the measuring temperature is recorded simultaneously without any further parameters having to be set. With "Plug&Measure", premeasured Memosens sensors can immediately be used for measurement without prior calibration.
		In the menus assigned to a sensor channel, the respective channel, the primary measured value, and the measured temperature are always displayed in the upper right corner.

Oxy Parameter Setting

Menu Selection: Parameter Setting ▸ MSU ... Module ▸ Memosens Oxy:

Parameter	Default	Selection / Range
Input Filter		
Pulse Suppression	Weak	Suppression of interference pulses: Off, Weak, Medium, Strong
Sensor Data		
Measure in	Liquids	Liquids, Gases
Relative Humidity	50.0 %	If measuring in gases
Sensoface	Off	Off, On
Sensor Monitoring Details (see page 68)		Slope, Zero Point, Sensocheck, Response Time, Sensor Operating Time, Sensor Wear, SIP Counter
Cal Presettings		
Calibration Mode	In Air	Presetting for calibration mode: In Air, In Water, Data Entry, Product, Zero Point, Temperature
Product Calibration	Sat. %Air	If "Product" is selected: Sat. %Air, Conc. (Liquid), Partial Pressure
Calibration Timer		
Monitoring	Off	Off, Auto: 720 h, Individual
Pressure Correction		
Ext. Pressure Transmitter		
Pressure Transmitter	Absolute	
Current Input	0 ... 20 mA	0 ... 20 mA / 4 ... 20 mA
Start 0(4) mA	0000 mbar	xxxx mbar
End 20 mA	2000 mbar	xxxx mbar
Pressure During Meas.		
Detection	Manual	Manual (default 1013 mbar), External, AO 1 if PROFINET is active [1)]
Pressure During Cal		
Detection	Manual	Manual (default 1013 mbar), External, AO 1 if PROFINET is active [1)]
Salinity Correction		
Entry	Salinity	Salinity, Chlorinity, Conductivity (0.00 g/kg or 0.000 µS/cm depending on selection) The calculated salinity is displayed if Chlorinity/ Conductivity are selected.

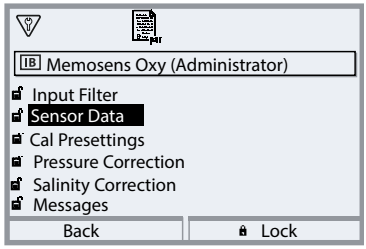
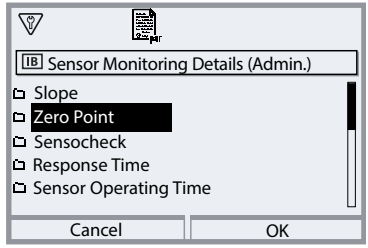
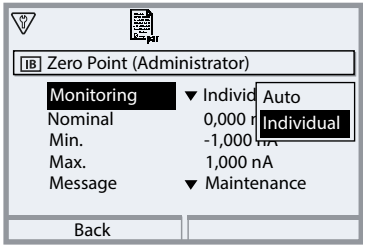
1) With PN4400-095 module

Oxy Parameter Setting

Parameter	Default	Selection / Range
Messages		
Saturation %Air Messages 1)	Off	Off, Max. Device Limits, Variable Limits
Saturation %O_2 Messages 1)	Off	Off, Max. Device Limits, Variable Limits
Concentration Messages	Off	Off, Max. Device Limits, Variable Limits
Partial Pressure Messages	Off	Off, Max. Device Limits, Variable Limits
Temperature Messages	Off	Off, Max. Device Limits, Variable Limits

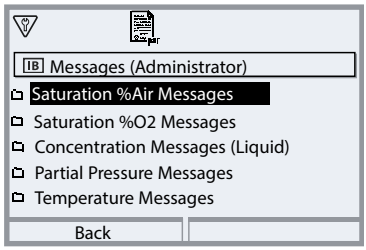
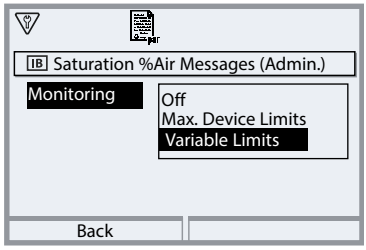
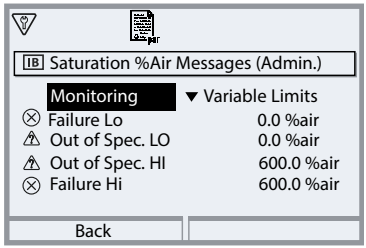
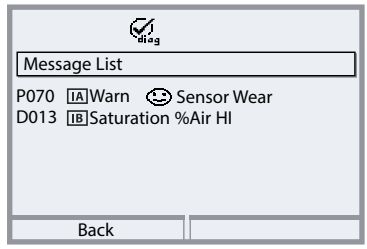
1) Only if Sensor Data ▸ Measure in Liquids is selected

Oxy Parameter Setting

Menu	Display	Action
	  	Parameter Setting ▸ MSU ... Module ▸ Memosens Oxy... ▸ Sensor Data: **Sensoface** The Sensoface icons provide the user with diagnostic information on wear and required maintenance of the sensor. In measuring mode, an icon (happy, neutral, or sad smiley) is shown on the display to reflect the continuous monitoring of the sensor parameters. **Sensor Monitoring Details** Enable/disable Sensocheck sensor monitoring. Set whether Sensocheck will generate Failure or Maint. Required messages. Option to enter individual values before a message is triggered. Auto: The parameters are read out directly from the sensor or are adjusted by the system. They are displayed in gray and cannot be edited. Individual: The parameters must be specified by the user. In addition, you can specify values for SIP counter and sensor operating time which will trigger a message.

Note: The display may vary depending on which sensors are connected.

Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
par	  	**Messages** All parameters determined by the measuring module can generate messages. **Max. Device Limits** Messages are generated when the process variable is outside the measuring range. The "Failure" icon is displayed, the NAMUR failure contact is activated (BASE module, factory setting: Contact K4, normally closed contact). The current outputs can signal a 22-mA message (user-defined); see the basic unit user manual. **Variable Limits** Upper and lower limits at which a message is generated can be defined for the "Failure" and "Out of Specification" messages. **Message Icons:** ⊗ Failure (Limit Hi/Lo) ⚠ Out of Specification (Hi/Lo)
diag		**Diagnostics Menu** When the "Maintenance" or "Failure" icons are blinking in the display, you should access the Diagnostics menu. The messages are displayed in the "Message list".

Oxy Calibration / Adjustment

Note: During calibration, the function check (HOLD) operating state is active for the corresponding module channel. The assigned current outputs and relay contacts behave as configured (BASE module).

The calibration data is saved in the Memosens sensor. This means that Memosens sensors can be cleaned, reconditioned, calibrated, and adjusted away from the measurement location, e.g., in a laboratory. Sensors in the system are replaced on-site by adjusted sensors.

Calibration: Detecting deviations without readjustment
Adjustment: Detecting deviations with readjustment

Oxy Calibration / Adjustment

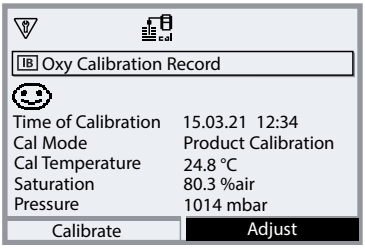
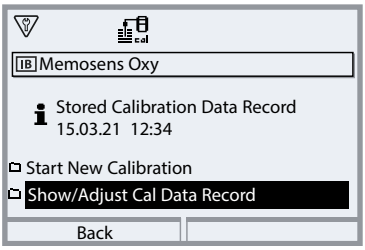
Adjustment

Adjustment means that the values determined by a calibration are applied to the sensor. The zero point and slope values determined during calibration are entered in the adjustment record:

Diagnostics ▸ MSU ... Module ▸ Memosens Oxy ▸ Cal/Adj Record

These values are not used to calculate the process variables until the calibration has been terminated with an adjustment.

Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
		**Administrator** With appropriate access rights, an adjustment can be carried out immediately after calibration: ***Right softkey: Adjust***. The calibration values are used to calculate the process variables.
		**Operator** (without administrator rights) After calibration, save the data by pressing the ***left softkey: Calibrate***, switch to measuring mode, and notify the administrator. The administrator can retrieve all the data of the last calibration (Calibration menu, selection module) and can accept the values or carry out a new calibration.

Oxy Calibration / Adjustment

Oxygen Calibration/Adjustment Explanations

Every oxygen sensor has an individual slope and an individual zero point. Both values are altered, for example, by aging. In order to achieve sufficient accuracy in the oxygen measurement, the meter must be regularly adjusted to reflect the sensor data (adjustment).

The "slope" is the sensor current value with atmospheric oxygen saturation, 25 °C/77 °F and 1013 mbar/14.69 psi: nA/100 %. Only the "nA" measurement symbol appears on the display.

This is technically not a "slope" but rather a calibration point. The value is provided with the intention of enabling the sensor to be compared with the data-sheet values.

If the electrolyte, the membrane body, or both are replaced during maintenance of amperometric sensors, this change must be confirmed manually in the Maintenance menu:

Maintenance ▸ MSU ... Module ▸ Memosens Oxy ▸ Membrane Body Replacement

Calibration is required after each membrane body replacement. This entry impacts on the accuracy of the calibration.

Oxy Calibration / Adjustment

Recommendations for Calibration
For best performance, you should always calibrate in air. Compared to water, air is a calibration medium that is easy to handle, stable, and thus safe. In the most cases, however, the sensor must be removed for a calibration in air. In some processes, the sensor cannot be removed for calibration. Here, calibration must be performed directly in the process medium (e.g., with aeration).

Common Combination: Process Variable / Calibration Mode

Measurement	Calibration
Saturation	Water
Concentration	Air

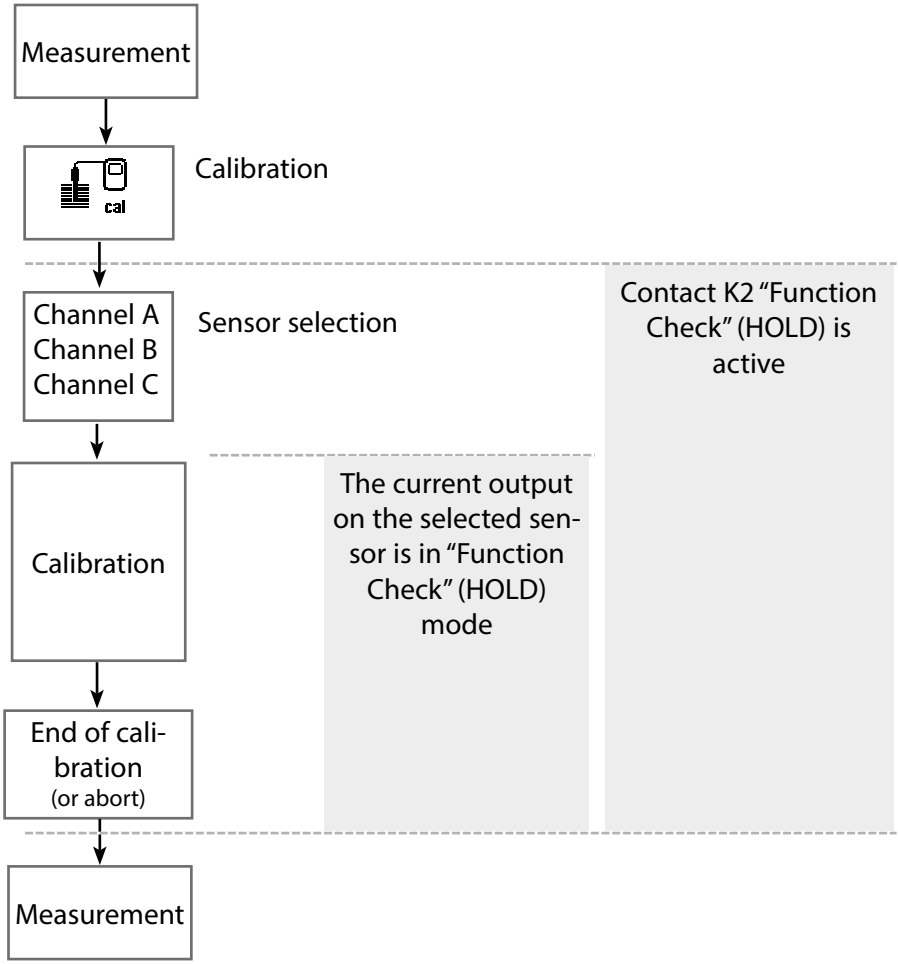
Note: Make sure that the temperature of the sensor and the temperature of the calibration solution are not too far apart. The ideal temperature is 25 °C/77 °F. If there is a temperature difference between the calibration medium and the measured medium, you must keep the sensor in the respective medium for several minutes before and after calibration in order to achieve stable measured values.

The type of calibration pressure detection is preset during parameter setting.

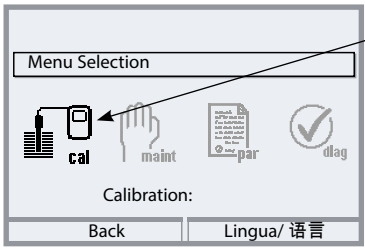
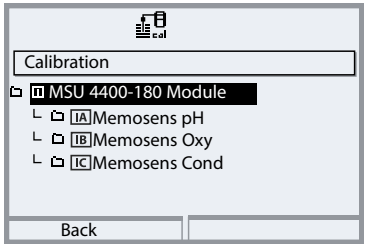
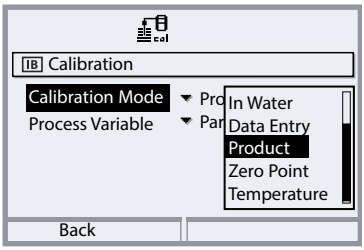
Parameter Setting ▸ MSU ... Module ▸ Memosens Oxy ▸ Pressure Correction ▸ Pressure During Cal

Note: Amperometric sensors must be sufficiently polarized prior to calibration/adjustment. Follow the information on the sensor in the sensor user manual to ensure that the calibration is neither falsified nor unstable.

Function Check (HOLD) During Calibration / Adjustment
Behavior of the signal and switching outputs during calibration / adjustment



Oxy Calibration / Adjustment

Menu	Display	Action
		**Open the Calibration Menu** ***menu*** key: Menu Selection. Select calibration using arrow keys, confirm by pressing ***enter***, passcode 1147
cal	 	Select a sensor channel for the calibration. **Calibration / Adjustment Methods** • In Air (see page 76) • In Water (see page 78) • Data Entry (see page 80) • Product (see page 81) • Zero Point (see page 83 • Temperature (see page 84)

Note: The display may vary depending on which sensors are connected.

Calibration Mode: In Air

The slope is corrected using the saturation value (100 % Air), similar to the air saturation of water. Since this analogy only applies to water-vapor saturated air (100 % relative humidity) and in many cases the calibration air is less humid, the relative humidity of the calibration air must also be specified. If you do not know the exact value of the relative humidity of the calibration air, you can take the following reference values for a sufficiently precise calibration:

- Ambient air: 50 % rel. humidity (average)
- Bottled gas (synthetic air): 0 % rel. humidity

Calibration Procedure

Notes: The sensor membrane must be dry. Be sure to keep temperature and pressure constant during calibration. If there is a temperature difference between calibration and measured media, the sensor requires some equalization time before and after calibration.

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "In Air" Calibration Mode and press ***enter*** to confirm.
02. Take the sensor out of the medium and clean it.
03. Carefully dab the membrane dry with a paper tissue.
04. Expose the sensor to air with a known water vapor saturation and press ***enter*** to confirm.
    ✓ Display of selected calibration medium (air)
05. Enter relative humidity, e.g.: Ambient air: 50 %, Bottled gas: 0 %
06. Enter Cal Pressure: Enter the calibration pressure if "Manual" was configured.
07. Start with the ***right softkey: Next***
    ✓ Drift check is carried out.

The following parameters are displayed: Sensor Current, Calibration Pressure, and Response Time.

08. Exit calibration with the ***right softkey: Next***.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calculated calibration values are used to calculate the measured values in Protos and also saved in the Memosens sensor.

Calibration Mode: In Water
The slope is corrected using the saturation value (100 %) related to saturation with air.

Calibration Procedure
Note: Ensure sufficient sensor incident flow (see the specifications of the oxygen sensor.)
The calibration medium must be in equilibrium with air. Oxygen exchange between water and air is very slow. Therefore, it takes a relatively long time until water is saturated with atmospheric oxygen. If there is a temperature difference between calibration medium and measured medium, you must keep the sensor in the respective medium for several minutes before and after calibration.
When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "In Water" Calibration Mode and press ***enter*** to confirm.
02. Take the sensor out of the medium and clean it.
03. Carefully dab the membrane dry with a paper tissue.
04. Expose the sensor to the calibration medium (air-saturated water), ensure sufficient incident flow, and press ***enter*** to confirm.
    ✓ Display of selected calibration medium (air-saturated water)
05. Enter Cal Pressure: Enter the calibration pressure if "Manual" was configured.
06. Start with the ***right softkey: Next***.
    ✓ Drift check is carried out.

The following parameters are displayed: Sensor Current, Calibration Pressure, and Response Time.

The time for the sensor signal to stabilize can be shortened with the ***left softkey: Exit*** (without drift check: reduced accuracy of calibration values). The response time indicates how long the sensor needs until the sensor signal is stable. If the sensor signal or the measured temperature fluctuate considerably

or the sensor is inadequately polarized, the calibration procedure is aborted after around 2 minutes. In this case, calibration needs to be restarted. Return the sensor to the process once this has been successfully completed. Make sure that the temperature of the sensor and the temperature of the calibration solution are not too far apart. The ideal temperature is 25 °C/77 °F.

07. Exit calibration with the ***right softkey: Next***.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calculated calibration values are used to calculate the measured values in Protos and also saved in the Memosens sensor.

Calibration Mode: Data Entry
Entry of values for slope and zero point of the sensor, related to 25 °C/77 °F, 1013 mbar/14.69 psi.
Slope = sensor current at 100 % atmospheric oxygen, 25 °C/77 °F, 1013 mbar/14.69 psi

Calibration Procedure
When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.
01. Select "Data Entry" calibration mode and press ***enter*** to confirm.
02. Remove the sensor and install the premeasured sensor.
03. Continue with the ***right softkey: Next***.
04. Enter the zero point and slope measured values.

✓ By pressing the ***right softkey: Adjust***, the calculated calibration values are used to calculate the measured values in Protos and also saved in the Memosens sensor.

Calibration Mode: Product

If the sensor cannot be removed – e.g., for sterility reasons – its slope can be determined by "sampling". The current measured value is saved in the device for this purpose. A sample is taken directly afterward at the measuring point. The reference value is entered in the device. Protos calculates the sensor's correction values from the difference between the measured and reference values, and corrects the zero point in the event of small saturation values, the slope in the event of large values.

Calibration Procedure

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Product" calibration mode and press ***enter*** to confirm.
    ✓ Process variable Saturation, Concentration, and Partial Pressure configured as in "Cal Presettings".
02. Change the process variable, if required.
03. Prepare for sampling.

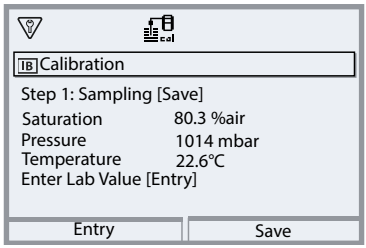
NOTICE! Measure the reference value at temperature and pressure conditions similar to those of the process.

04. Start with the ***right softkey: Next***.

Product calibration is performed in 2 steps.

Step 1:

05. Take sample.
    ✓ The measured value and temperature at the time of sampling are displayed.
06. Save with the ***right softkey: Save***.



Step 2: Lab value has been measured.

01. Open the Product Calibration menu again.
02. Enter reference value ("Lab value").
03. Confirm with the ***right softkey: Next*** or repeat calibration with the ***left softkey: Cancel***.

✓ By pressing the ***right softkey: Adjust***, the calibration values obtained during calibration for calculation of the process variables are applied to the device and saved in the sensor.

Exception: Sample value can be determined and entered on site:
***Left softkey: Entry*.**

Note: The display may vary depending on which sensors are connected.

Oxy Calibration / Adjustment

Calibration Mode: Zero Point

For trace measurements below 500 ppb, the zero point should be calibrated. If a zero correction is performed, the sensor should remain in the calibration medium (media containing CO_2: at least 120 min) for at least 10 to 60 minutes to obtain stable, non-drifting values. During zero correction, a drift check is not performed.

Calibration Procedure

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Zero Point" Calibration Mode and press ***enter*** to confirm.
02. Press the ***right softkey: Next***.
    ✓ Zero point correction is carried out.
    The measured sensor current is displayed.
03. Enter the input current for the zero point.
04. Press the ***right softkey: Next***.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calculated calibration values are used to calculate the measured values in Protos and also saved in the Memosens sensor.

Calibration Mode: Temperature

This function is used to adjust the individual temperature detector tolerances or cable lengths for the purpose of increasing the accuracy of the temperature measurement. The adjustment requires an accurate measurement of the process temperature using a calibrated reference thermometer. The measurement error of the reference thermometer should be less than 0.1 K. Adjustment without an accurate measurement may result in falsification of the displayed measured value.

Calibration Procedure

01. Select "Temperature" calibration mode and press ***enter*** to confirm.
02. Enter the measured process temperature and press ***enter*** to confirm
    ✓ The temperature offset is displayed..
03. Adjust the temperature detector with the ***right softkey: Save***.

The current adjustment and temperature offset data can be displayed in the Diagnostics menu:

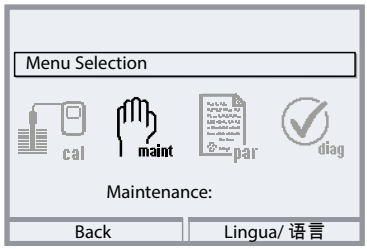
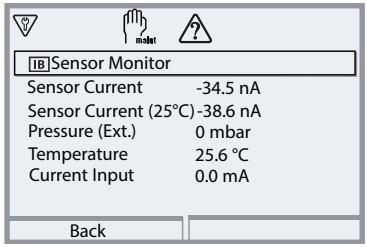
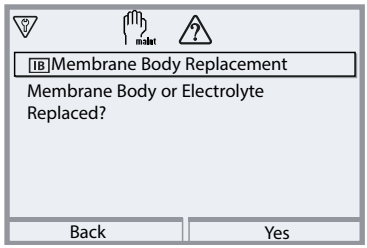
▸ MSU ... Module ▸ Memosens Oxy ▸ Temp. Offset Log

Oxy Maintenance Functions

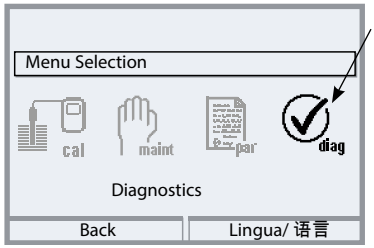
Note: Function check (HOLD) active

The current outputs and relay contacts behave in accordance with the parameter settings. Since the device is in function check (HOLD) mode, certain media can be used to validate the sensor and check the measured values without affecting the signal outputs.
To end the function check, return to measuring mode.

Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
maint		**Open the Maintenance menu** From the measuring mode: ***menu*** key: Menu Selection. Select Maintenance (maint) using the arrow keys and confirm by pressing ***enter***. Passcode (factory setting): 2958 Then select the module and sensor.
		**Sensor Monitor** During maintenance, the sensor monitor allows validation of the sensor by immersing it in a known solution, for example, and checking the values measured.
		**Membrane Body Replacement** If the electrolyte or the membrane body of a Memosens oxygen sensor are replaced during maintenance of a sensor, this must be confirmed with "Yes" in the Maintenance menu: After confirming the check, the calibration counter for the membrane body "Membrane Cals" is reset to "0". See the Sensor wear monitor figure on page 87.

Oxy Diagnostic Functions

Menu	Display	Action
diag		**Open the Diagnostics menu** From the measuring mode: ***menu*** key: Menu Selection. Select Diagnostics using arrow keys, press ***enter*** to confirm.

For a detailed description of general diagnostic functions, see the basic unit user manual.

Overview of Oxy Diagnostic Functions

In diagnostics mode, you can access the following submenus without interrupting the measurement:

Diagnostics ▸ MSU ... Module:

Module Diagnostics	Protos periodically performs a self-test in the background. The results can be displayed here.

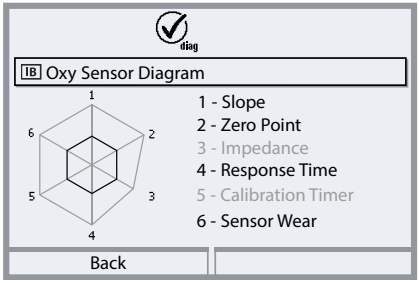
Diagnostics ▸ MSU ... Module ▸ Memosens Oxy:

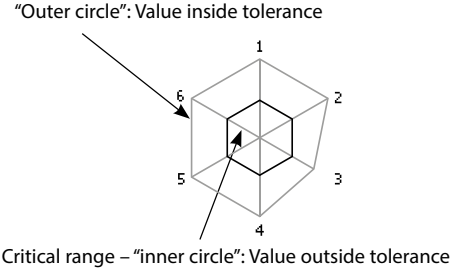
Submenus	**Description**
Sensor Information	The Sensor Information submenu shows data from the currently connected Memosens sensor, e.g., manufacturer, order no., serial no., firmware and hardware version, last calibration, operating time.
Sensor Monitor	The raw measured values are displayed in the sensor monitor for diagnostic purposes.

Note: The display may vary depending on which sensors are connected.

Note: The display may vary depending on which sensors are connected.

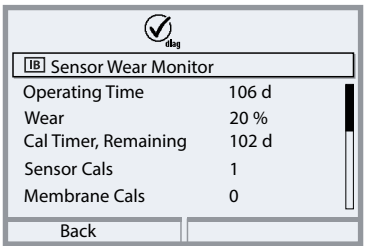
Submenus	Description
Oxy Sensor Diagram	The sensor diagram clearly indicates the status of the parameters in the connected sensor, including the calibration timer. Inactive parameters are shown in gray and set to 100 % (e.g., disabled response time). The parameter values should lie between the outer (100 %) and inner (50 %) polygon. A warning signal flashes if a value drops below the inner polygon (< 50 %).





The tolerance limits (radius of the "inner circle") can be individually adjusted. See Parameter Setting ▸ Sensor Data ▸ Sensor Monitoring Details.

Oxy Cal/Adj Record	The calibration/adjustment record shows the data from the last calibration/adjustment performed on the currently connected sensor.
Temp. Offset Log	The temp. offset log shows the data from the last temperature equalization performed on the currently connected sensor.
Sensor Wear Monitor	The sensor wear monitor shows the sensor operating time and the maximum temperature during the operating time, as well as wear and the forecast remaining time.



Oxy Messages

Oxy Messages

⊗ Failure ⚠ Out of Specification ◈ Maintenance Required

See also “Decommissioning”; p. 159

No.	Message Type	Message / Notes
D008	⊗	Factory Settings: Switch device off (approx. 10 s). If the message persists, send in the device.
D009	⊗	Firmware Error: Switch device off (approx. 10 s). Reload the firmware. If the message persists, send in the device.
D010	⊗	Saturation %Air Range: Max/min limits of range exceeded or sensor not/incorrectly connected, cable faulty.
D011	⊗	Saturation %Air LO_LO: Value below configured monitoring limit
D012	⚠	Saturation %Air LO: Value below configured monitoring limit
D013	⚠	Saturation %Air HI: Value above configured monitoring limit
D014	⊗	Saturation %Air HI_HI: Value above configured monitoring limit
D015	⊗	Temperature Range: Max/min limits of range exceeded or sensor not/incorrectly connected, cable faulty.
D016	⊗	Temperature LO_LO: Value below configured monitoring limit
D017	⚠	Temperature LO: Value below configured monitoring limit
D018	⚠	Temperature HI: Value above configured monitoring limit
D019	⊗	Temperature HI_HI: Value above configured monitoring limit
D020	⊗	Concentration Range: Max/min limits of range exceeded or sensor not/incorrectly connected, cable faulty.
D021	⊗	Concentration LO_LO: Value below configured monitoring limit
D022	⚠	Concentration LO: Value below configured monitoring limit
D023	⚠	Concentration HI: Value above configured monitoring limit
D024	⊗	Concentration HI_HI: Value above configured monitoring limit
D025	⊗	Partial Pressure Range: Max/min limits of range exceeded or sensor not/incorrectly connected, cable faulty.
D026	⊗	Part. Pressure LO_LO: Value below configured monitoring limit
D027	⚠	Part. Pressure LO: Value below configured monitoring limit

Oxy Messages

No.	Message Type	Message / Notes
D028	⚠	Part. pressure HI: Value above configured monitoring limit
D029	⊗	Part. Pressure HI_HI: Value above configured monitoring limit
D045	⊗	Saturation %O2 Range: Max/min limits of range exceeded or sensor not/incorrectly connected, cable faulty.
D046	⊗	Saturation %O2 LO_LO: Value below configured monitoring limit
D047	⚠	Saturation %O2 LO: Value below configured monitoring limit
D048	⚠	Saturation %O2 HI: Value above configured monitoring limit
D049	⊗	Saturation %O2 HI_HI: Value above configured monitoring limit
D060	⊗ / 🔧	Sad Sensoface: Slope - Readjust sensor. - Check/refill electrolyte. - Replace sensor.
D061	⊗ / 🔧	Sad Sensoface: Zero Point - Readjust sensor. - Check/refill electrolyte. - Replace sensor.
D062	User-defined	Sad Sensoface: Sensocheck - Readjust sensor. - Replace sensor.
D063	🔧	Sad Sensoface: Response Time - Check/refill electrolyte. - Replace sensor.
D064	🔧	Sad Sensoface: Calibration Timer
D070	User-defined	Sad Sensoface: Sensor Wear Sensor is Worn (100 %): - Readjust sensor. - Check/refill electrolyte. - Replace sensor.
D080	🔧	Sensor Current Range - Check polarization voltage: Parameter Setting ▸ MSU ... Module ▸ Memosens Oxy ▸ Sensor Data - Refill electrolyte. - Recalibrate/readjust.
D113	User-defined	Sensor Operating Time: Replace the sensor.
D120	⊗	Wrong Sensor (Sensor Check)
D121	⊗	Sensor Error (Factory Settings): Replace the sensor.
D122	🔧	Sensor Memory (Cal Data): The calibration data is defective: Recalibrate/readjust sensor.

Oxy Messages

No.	Message Type	Message / Notes
D123	◈	New Sensor, Adjustment Required
D124	◈	Sensor Date: The sensor data is implausible. Check and, as necessary, adjust the configuration.
D200	◈	Temp O2 Conc/Sat: The temperature is outside the valid range for oxygen concentration/saturation.
D201	◈	Cal Temperature: The calibration temperature is impermissible: Check the calibration temperature. Note the information in the Calibration chapter.
D203	Info	Cal: Identical media
D204	Info	Cal: Media interchanged
D205	Info	Cal: Sensor Unstable: The drift criterion was not adhered to during calibration. Possible causes: improper calibration, sensor cable/connection faulty, sensor worn. Check the sensor and calibration and repeat as required. Otherwise, replace the sensor.
D254	Info	Module Reset

Oxy Messages

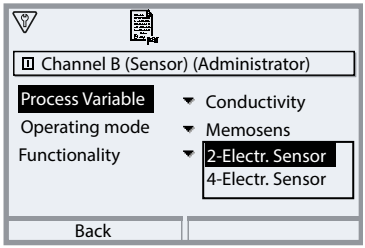
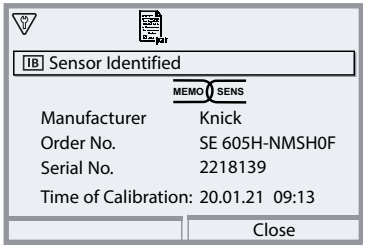
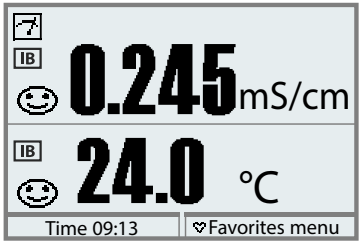
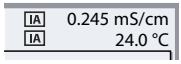
No.	Message Type	Oxy/Oxy Calculation Block Messages
H010	⊗	Saturation %AIR Diff Range: Max/min device limits exceeded: - Check both saturation values. - Check sensor/cable connections.
H011	⊗	Saturation %AIR Diff LO_LO: Value below configured monitoring limit
H012	⚠	Saturation %AIR Diff LO: Value below configured monitoring limit
H013	⚠	Saturation %AIR -Diff HI: Value above configured monitoring limit
H014	⊗	Saturation %AIR Diff HI_HI: Value above configured monitoring limit
H015	⊗	Temperature Diff Range: Max/min device limits exceeded: - Check both temperature values. - Check sensor/cable connections.
H016	⊗	Temperature Diff LO_LO: Value below configured monitoring limit
H017	⚠	Temperature Diff LO: Value below configured monitoring limit
H018	⚠	Temperature Diff HI: Value above configured monitoring limit
H019	⊗	Temperature Diff HI_HI: Value above configured monitoring limit
H020	⊗	Conc. (Liquid) Diff Range: Max/min device limits exceeded: - Check both concentration values. - Check sensor/cable connections.
H021	⊗	Conc. (Liquid) Diff LO_LO: Value below configured monitoring limit
H022	⚠	Conc. (Liquid) Diff LO: Value below configured monitoring limit
H023	⚠	Conc. (Liquid) Diff. HI: Value above configured monitoring limit
H024	⊗	Conc. (Liquid) Diff HI_HI: Value above configured monitoring limit
H045	⊗	Saturation %O2 Diff Range: Max/min device limits exceeded: - Check both saturation values. - Check sensor/cable connections.
H046	⊗	Saturation %O2 Diff LO_LO: Value below configured monitoring limit
H047	⚠	Saturation %O2 Diff LO: Value below configured monitoring limit
H048	⚠	Saturation %O2 Diff HI: Value above configured monitoring limit
H049	⊗	Saturation %O2 Diff HI_HI: Value above configured monitoring limit
H090	⊗	Conc. (Gas) Diff Range (Measurement in Gases): Max/min device limits exceeded: - Check both concentration values. - Check sensor/cable connections.

Oxy Messages

No.	Message Type	Oxy/Oxy Calculation Block Messages
H091	⊗	Conc. (Gas) Diff LO_LO: Value below configured monitoring limit.
H092	⚠	Conc. (Gas) Diff LO: Value below configured monitoring limit
H093	⚠	Conc. (Gas) Diff HI: Value above configured monitoring limit
H094	⊗	Conc. (Gas) Diff HI_HI: Value above configured monitoring limit
H200	◇	Calculation Block Configuration

Cond Parameter Setting

Note: Function check (HOLD) active

Menu	Display	Action
		Parameter Setting ▸ MSU ... Module ▸ Channel ...: Process Variable: Conductivity Operating Mode: Memosens Functionality: 2-electrode or 4-electrode sensor
A connected Memosens sensor is displayed immediately.		
	 	All typical sensor parameters are transferred to the measuring device automatically. Measuring commences immediately and the measuring temperature is recorded simultaneously without any further parameters having to be set. With "Plug&Measure", premeasured Memosens sensors can immediately be used for measurement without prior calibration.
		In the menus assigned to a sensor channel, the respective channel, the primary measured value, and the measured temperature are always displayed in the upper right corner.

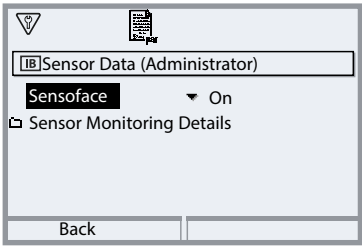
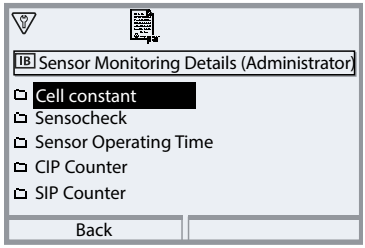
Note: The display may vary depending on which sensors are connected.

Cond Parameter Setting

Menu Selection: Parameter Setting ▸ MSU ... Module ▸ Memosens Cond:

Parameter	Default	Selection / Range
Input Filter		
Pulse suppression	Off	Enable/disable suppression of interference pulses.
Sensor Data		
Sensoface	On	On, Off
Sensor Monitoring Details (see page 95) • Cell Constant • Sensocheck • Sensor Operating Time • CIP Counter • SIP Counter	 Auto Off Off Off Off	 Auto, Individual Off, On Off, Individual (max. 9999 d) Off, Individual Off, Individual
Cal Presettings		
Calibration Mode	Automatic	Presetting for calibration mode: Automatic, Manual, Product, Installation Factor (4-Electrode Sensor), Data Entry, Temperature
Cal Solution	NaCl Sat	In Automatic mode: Selection of calibration solution: NaCl 0.01 m: 1183 µS/cm NaCl 0.1 m: 10.683 mS/cm NaCl Sat 251.3 mS/cm KCl 0.01 m: 1413 µS/cm KCl 0.1 m: 12.88 mS/cm KCl 1m: 111.80 mS/cm
Product Calibration	Conductivity	Conductivity, concentration (with TAN option FW4400-009)
Conductivity	Without TC	Without TC, With TC
TC Process Medium (see page 97)		
Temperature Compensation	Off	Off, Linear, EN27888, Ultrapure Water (with TAN option FW4400-008)
Concentration (see page 99)		
Concentration	Off	Off, On
TDS (see page 97)		
TDS Function	Off	Off, On (preset 1.00)
USP (see page 98)		
USP Function	Off	Off, On
Messages (see page 101)		
Messages	Temperature: Max. Device Limits	Conductivity, Resistivity, Concentration, Temperature, Salinity, TDS Can be adjusted for all types of monitoring: Off, Max. Device Limits, Variable Limits)

Cond Parameter Setting

Menu	Display	Action
	 	**Sensor Data** Memosens sensors provide relevant sensor data automatically. Parameter Setting ▸ MSU ... Module ▸ Memosens COND ▸ Sensor Data: **Sensoface** The Sensoface icons provide the user with diagnostic information on wear and required maintenance of the sensor. In measuring mode, an icon (happy, neutral, or sad smiley) is shown on the display to reflect the continuous monitoring of the sensor parameters. **Sensor Monitoring Details** Enable/disable Sensocheck sensor monitoring. Set whether Sensocheck will generate Failure or Maint. Required messages. Option to enter individual values before a message is triggered Auto: The parameters are read out directly from the sensor or are adjusted by the system. They are displayed in gray and cannot be edited. Individual: The parameters must be specified by the user.

Note: The display may vary depending on which sensors are connected.

CIP Counter/SIP Counter

CIP/SIP cycles are used to clean or sterilize process-wetted parts in the process. Depending on the application, either one chemical (alkaline solution, water) or several chemicals (alkaline solution, water, acidic solution, water) are used.

- CIP temperature > 55 °C / 131 °F
- SIP temperature > 115 °C / 239 °F

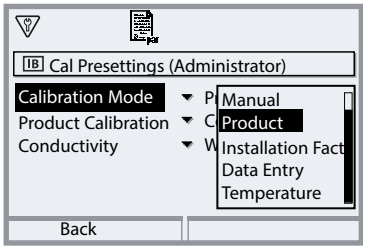
The cleaning (cleaning in place) and sterilization (sterilization in place) cycles are counted to measure the load on the sensor, e.g., in biotechnology applications.

Note: If measurements are generally taken at high temperatures (> 55 °C / 131 °F), the counters should be switched off.

When a CIP/SIP counter is switched on, a maximum number of cycles can be entered. A message can be set to indicate when a counter has reached a specified value.

Note: A CIP or SIP cycle is only entered into the logbook 2 hours after the start to ensure that the cycle is complete.

Presettings for Calibration

Menu	Display	Action
par		The calibration presettings can be defined in the Parameter Settings or adjusted directly in the Calibration menu prior to the calibration. Parameter Setting ▸ Memosens Cond... ▸ Cal Presettings
	Calibration Mode: Presetting of calibration mode, e.g., Automatic, Manual, Product, Installation Factor, Data Entry, Temperature Further options are available depending on the calibration mode. Automatic: Selection of calibration solution Product Calibration: Conductivity/concentration[1)] Conductivity: Selection with/without temperature compensation Concentration: Selection of medium	

Note: The display may vary depending on which sensors are connected.

1) First enable TAN option FW-E009.

Temperature Compensation of Process Medium

The following are available for temperature compensation:

- Off
- Linear (enter temperature coefficient TC)
- EN 27888 (natural waters)
- Ultrapure Water (with different trace impurities)

Trace Impurities in Ultrapure Water (with TAN option FW4400-008)

NaCl	Neutral ultrapure water, for conductivity measurement in water processing downstream of gravel bed filter
HCl	Acidic ultrapure water, for conductivity measurement downstream of cation filter
NH_3	Ammoniacal ultrapure water
NaOH	Alkaline ultrapure water

Note: If TC correction for the process medium is enabled, "TC" is shown on the display in measuring mode.

TDS Function

TDS (total dissolved solids) = weight of dissolved solids that influence conductivity

The TDS function provides a quick way of determining the evaporation residue of water. A TDS factor must be entered for this purpose.

The factor establishes a simple linear relationship between measured conductivity and evaporation residue. It is dependent on the composition of the medium and must be empirically determined by the user.

USP Function (Cond)

Monitoring Ultrapure Water in the Pharmaceutical Industry
The conductivity of ultrapure water in the pharmaceutical industry can be monitored online in accordance with the guideline "USP" (U.S. Pharmacopeia), Annex 5, Section 645 "Water Conductivity". The conductivity is measured without temperature compensation and is compared with limits. The water is usable without any further testing when the conductivity is below the USP limit.

Configuring the USP Function
The USP value can be configured as a process variable USP% for output (display, current output, limit, measurement recorder)
Settings can be changed in the USP submenu:
Parameter Setting ▸ MSU ... Module ▸ Memosens Cond ▸ USP

Reduced Limit Value: The USP limit can be reduced down to 10 %.
Monitoring: Select whether and how an exceeded limit is to be displayed.

Off	No message, but the parameter is still shown in the Diagnostics menu.
Failure	A failure message is shown in off-limit conditions; the corresponding NAMUR icon is displayed.
Maintenance	A Maint. Required message is shown in off-limit conditions; the corresponding NAMUR icon is displayed.

USP Function: Specify a Relay Contact
The USP function can also be assigned to a relay contact:
Parameter Setting ▸ BASE Module ... ▸ Contact K… ▸ Usage: USP Output

Display of the USP Function in the Diagnostics Menu
Diagnostics ▸ MSU ... Module ▸ Memosens Cond ▸ USP Function
Display of the USP limit, the reduced limit, and conductivity.

Concentration (Cond)

Note: Concentration determination requires the activation of TAN option FW4400-009.

The substance concentration in percent by weight (wt%) is determined for H_2SO_4, HNO_3, HCl, NaOH, NaCl, and Oleum. For concentration curves, see page 174.

Conditions for Concentration Determination
The following conditions must be met for a reliable concentration determination:

- For calculation of concentration, the medium to be measured must be a purely binary mixture (e.g., water-hydrochloric acid). Presence of other dissolved substances (e.g., salts) leads to incorrect concentration values.
- In the region of small slopes (e.g., at the range limits) small changes in conductivity can correspond to large changes in concentration. This may lead to an unsteady display of the concentration value.
- As the concentration value is calculated from the measured conductivity and temperature values, accurate temperature measurement is very important. Therefore, you should make sure that conductivity sensor and process medium are in thermal equilibrium.

Settings can be changed in the Concentration submenu:
Parameter Setting ▸ MSU ... Module ▸ Memosens Cond ▸ Concentration
01. Concentration: On
02. Select the medium:
    NaCl (0-28 %), HCl (0-18 %), NaOH (0-24 %), H_2SO_4 (0-37 %), HNO_3 (0-30 %), H_2SO_4 (89-99 %), HCl (22-39 %), HNO_3 (35-96 %), H_2SO_4 (28-88 %), NaOH (15-50 %), Oleum (12-45 %), table

You can define limits for warning and failure messages for the concentration value:
Parameter Setting ▸ MSU ... Module ▸ Memosens Cond ▸ Messages ▸ Concentration Messages

Specifying a Concentration Solution for Conductivity Measurement
To specify the customer-specific solution, 5 concentration values A-E are entered in a matrix together with 5 temperature values 1-5. First enter the 5 temperature values, then the corresponding conductivity values for each of the concentrations A-E.
These solutions are then available as "Table" in addition to the permanently set standard solutions.

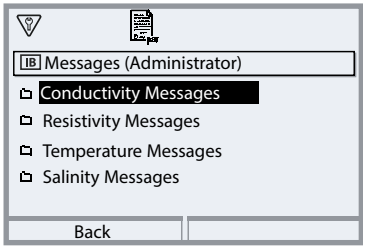
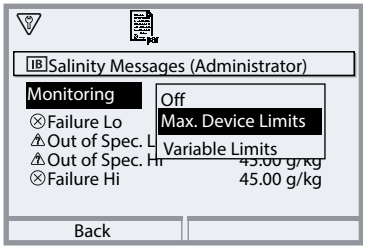
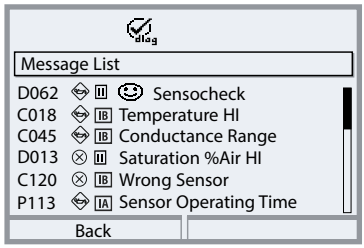
Settings can be changed in the System Control in the Concentration Table sub-menu:
Parameter Setting ▸ System Control ▸ Concentration Table:
01. Enter temperatures 1 to 5.
02. Enter values for concentrations A-E for the respective temperatures.

Notes: The temperature values must be rising (Temp. 1 is the lowest, Temp. 5 the highest temperature).
The concentration values must be rising (Conc. A is the lowest, conc. E the highest concentration).
The table values A1 ... E1, A2 ... E2, etc. must all be rising within the table or all falling.
Points of inflection are not allowed.
Incorrect table entries are indicated by an exclamation point in a red triangle.
The table is built up as 5x5 matrix:

	Conc. A	Conc. B	Conc. C	Conc. D	Conc. E
Temp 1	A1	B1	C1	D1	E1
Temp 2	A2	B2	C2	D2	E2
Temp 3	A3	B3	C3	D3	E3
Temp 4	A4	B4	C4	D4	E4
Temp 5	A5	B5	C5	D5	E5

The concentration table is selected in the menu:
Parameter Setting ▸ MSU ... Module ▸ Memosens Cond ▸ Cal Presettings
Calibration Mode: Automatic
Cal Solution: Table

Cond Parameter Setting

Menu	Display	Action
par	 	**Messages** All parameters determined by the measuring module can generate messages. **Max. Device Limits** Messages are generated when the process variable is outside the measuring range. The "Failure" icon is displayed; the NAMUR failure contact is activated (BASE module, factory setting: contact K4, N/C contact). The current outputs can signal a 22-mA message (user-defined); see the basic unit user manual. **Variable Limits** Upper and lower limits at which a message is generated can be defined for the "Failure" and "Out of Specification" messages. **Message Icons:** ⊗ Failure (Limit Hi/Lo) ⚠ Out of Specification (Hi/Lo)
diag		**Diagnostics Menu** Go to the Diagnostics menu if the "Maintenance" or "Failure" icons are blinking in the display. The messages are displayed in the "Message List".

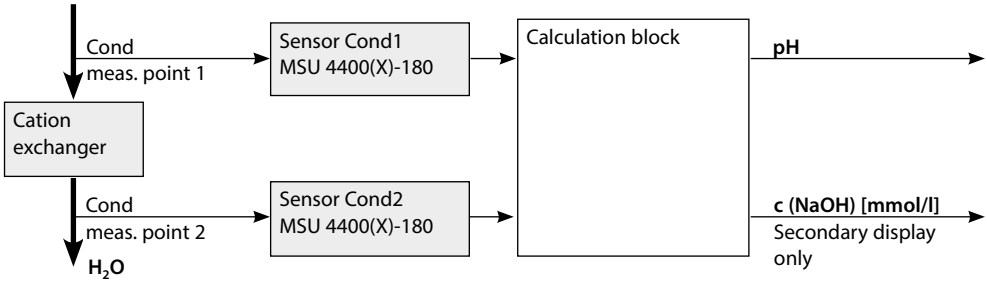
Note: The display may vary depending on which sensors are connected.

pH Value Calculation (Cond)

Note: Two conductivity sensors required

pH Value Calculation by Means of Dual Conductivity Measurement
When monitoring boiler feed water in power plants, the pH value can be calculated by means of a dual conductivity measurement. For that purpose, the boiler feedwater conductance is measured before and after the cation exchanger. This commonly used method of indirect pH value measurement does not require much maintenance and has the following advantage:
Normal pH measurement in ultrapure water is very critical. Boiler feedwater does not contain many ions. This requires the use of a special electrode, which must be calibrated constantly and the service life of which is generally rather short.

Function
Two conductivity sensors are used to measure the conductivity upstream and downstream of ion exchanger. The concentration of the sodium hydroxide and the pH value are determined from the two calculated conductivity values via a "calculation block" in accordance with the calculation formulas set out below:



Calculating the Concentration of Sodium Hydroxide / the pH Value

$$c(NaOH) = \frac{Cond1 - 1/3\ Cond2}{243}$$

$$pH = 11 + \log[c(NaOH)]$$

For a description of calculation blocks, see the basic unit user manual.

pH Value Calculation (Cond)

Recommended pH Ranges:

10 ± 0.2 for < 136 bar operating overpressure or

9.5 ± 0.2 for > 136 bar operating overpressure

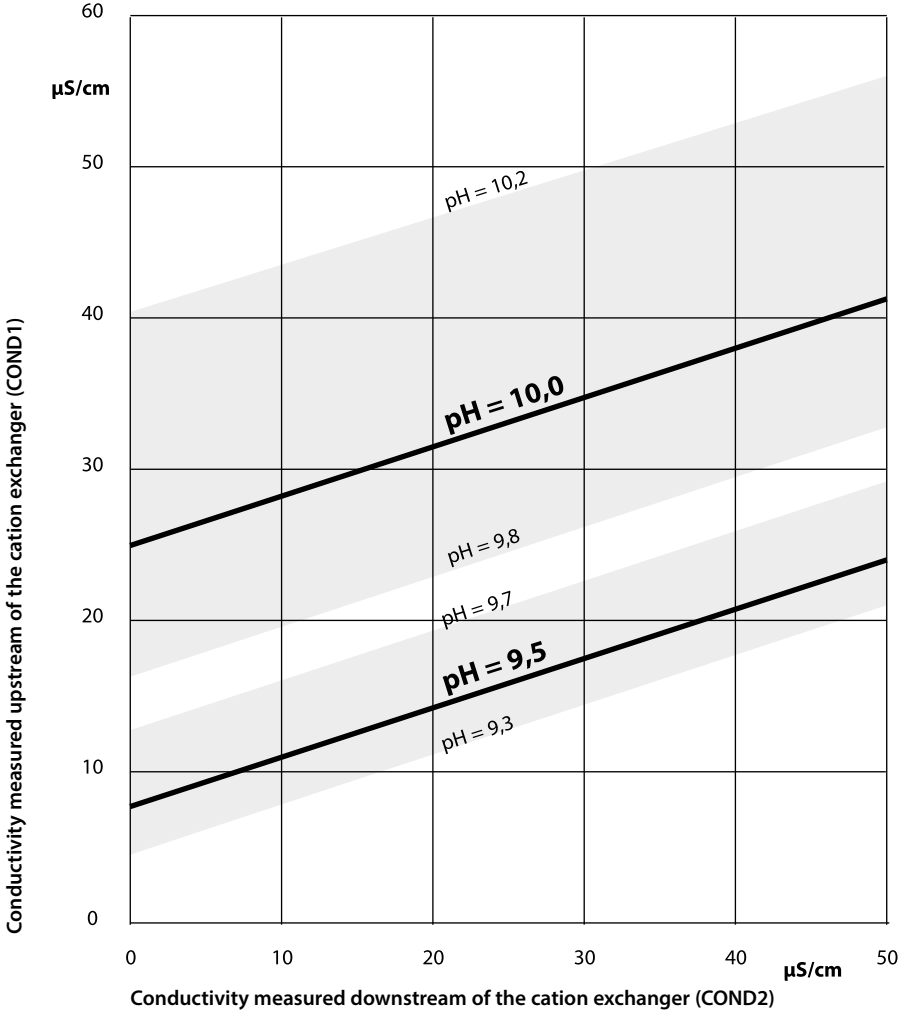


Figure:

Conditioning of water in natural circulation boilers with sodium hydroxide. Relationship between the pH value and the conductivity measured upstream and downstream of the cation exchanger.

Source: Appendix to VGB guideline for boiler feed water, boiler water, and steam of steam generators above 68 bar permissible operating overpressure (VGB-R 450 L, 1988 edition)

Cond Calibration / Adjustment

Note: During calibration, the function check (HOLD) operating state is active for the corresponding module channel. The assigned current outputs and relay contacts behave as configured (BASE module).

The calibration data is saved in the Memosens sensor. This means that Memosens sensors can be cleaned, reconditioned, calibrated, and adjusted away from the measurement location, e.g., in a laboratory. Sensors in the system are replaced on-site by adjusted sensors.

Calibration: Detecting deviations without readjustment
Adjustment: Detecting deviations with readjustment

Cond Calibration / Adjustment

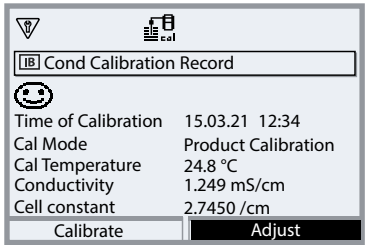
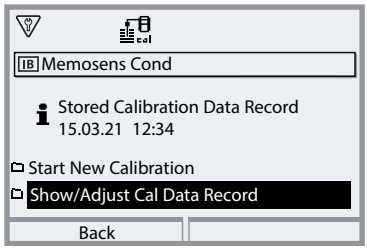
Adjustment

Adjustment means that the values determined by a calibration are applied to the sensor. The zero point and slope values determined during calibration are entered in the adjustment record:

Diagnostics ▸ MSU ... Module ▸ Memosens Cond ▸ Cal/Adj Record

These values are not used to calculate the process variables until the calibration has been terminated with an adjustment.

Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
cal		**Administrator** With appropriate access rights, an adjustment can be carried out immediately after calibration: ***Right softkey: Adjust***. The calibration values are used to calculate the process variables.
		**Operator** (without administrator rights) After calibration, save the data by pressing the ***left softkey: Calibrate***, switch to measuring mode, and notify the administrator. The administrator can retrieve all the data of the last calibration (Calibration menu, selection module) and can accept the values or carry out a new calibration.

Explanations Regarding Calibration/Adjustment with 2-/4-Electrode Sensors

Each conductivity sensor has an individual cell constant. Depending on the sensor design, the cell constant may vary over a wide range. Because the conductivity value is calculated from the measured conductance and the cell constant, the device must know the cell constant.
During calibration or sensor adjustment, either the known (printed) cell constant of the used conductivity sensor is entered in the device, or it is determined automatically by measuring a calibration solution with known conductivity.

Notes on Calibration

- Use only fresh calibration solutions.
- The used calibration solution must be configured.
- The accuracy of the calibration is crucially dependent on precise acquisition of the calibration solution temperature. On the basis of the measured or entered temperature, Protos calculates the setpoint of the calibration solution from a stored table.
- Note the response time of the temperature probe.
- To determine the exact cell constant, wait for temperature equalization of the temperature probe and calibration solution before calibration.

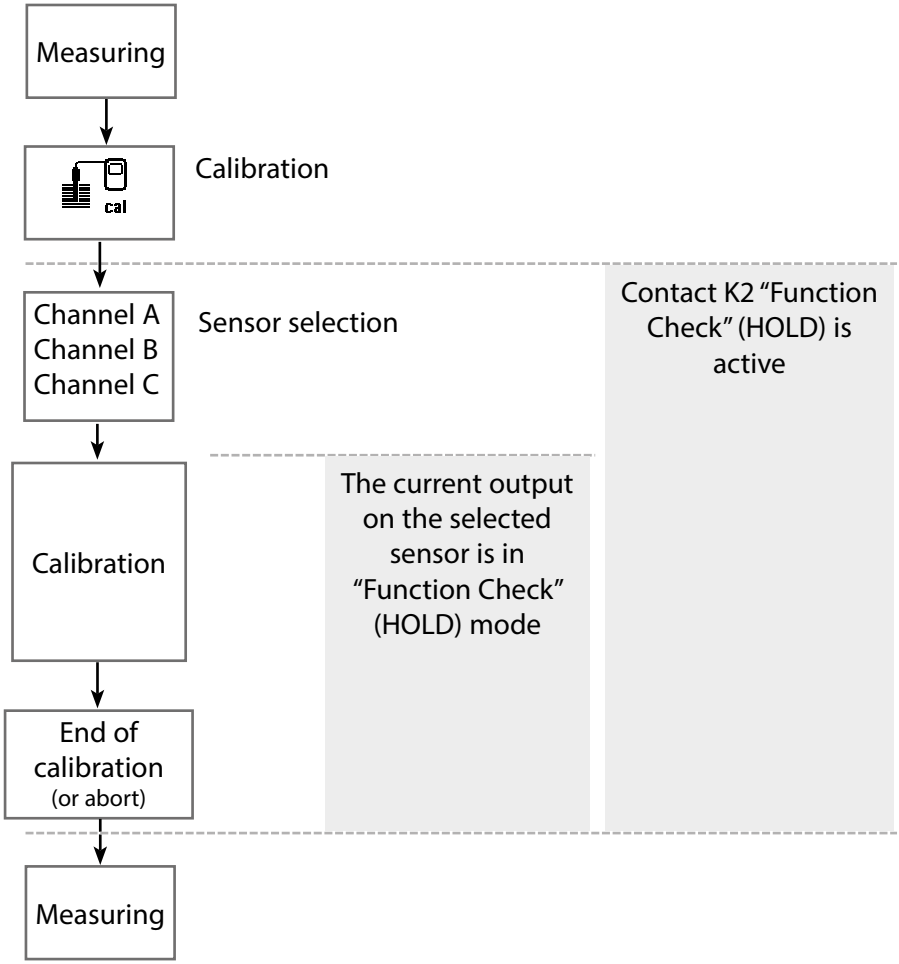
Since the cell constant is subject to production-related fluctuations, it is recommended that the removed sensor be calibrated with a calibration solution (e.g., saturated NaCl). The cell constants of the sensors are dependent on the installation geometry – especially in the case of fringe-field sensors:

- If the sensor is installed in a free space (minimum distances exceeded), the cell constant specified in the specifications can be entered directly. "Data Entry" Calibration Mode
- If the installation space is tight (minimum distances are not reached), the sensor must be adjusted in its installed state, as the resulting cell constant has changed. "Product" Calibration Mode

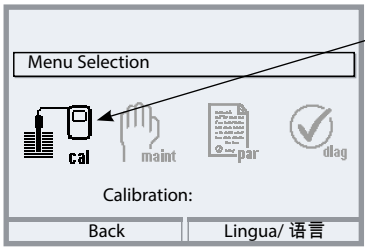
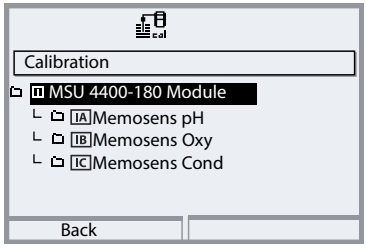
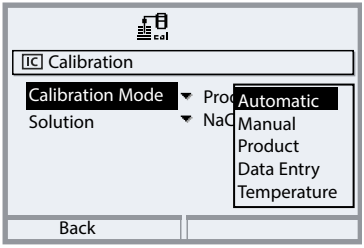
Temperature Compensation during Calibration
The conductivity value of the calibration solution is temperature-dependent. During calibration, the temperature of the calibration solution must therefore be known so that the actual value can be obtained from the conductivity table.

Automatic Temperature Compensation
Protos measures the temperature of the calibration solution using the temperature detector integrated in the Memosens sensor.

Function Check (HOLD) During Calibration / Adjustment
Behavior of the signal and switching outputs during calibration / adjustment



Cond Calibration / Adjustment

Menu	Display	Action
		**Opening the calibration menu** Press ***menu*** key to select menu. Select calibration using arrow keys, confirm by pressing ***enter***, passcode 1147
cal	 	Select a sensor channel for the calibration. **Calibration/Adjustment Methods** • Automatic (see page 110) • Manual (see page 112) • Product (see page 114) • Installation Factor (see page 116) • Data Entry (see page 117) • Temperature (see page 118)

Note: The display may vary depending on which sensors are connected.

1) When using a 4-electrode sensor

Calibration Mode: Automatic

During automatic calibration, the conductivity sensor is immersed in a standard calibration solution (NaCl or KCl, set during parameter setting in the "Cal Presettings" submenu). On the basis of the measured conductance and temperature, Protos automatically calculates the cell constant. The temperature dependence of the calibration solution is accounted for.

Notes on Calibration

- Use only fresh calibration solutions. The used calibration solution must be configured.
- The accuracy of the calibration is crucially dependent on a precise acquisition of the calibration solution temperature. On the basis of the measured or entered temperature, Protos calculates the setpoint of the calibration solution from a stored table.
- Note the response time of the temperature probe.
- To determine the exact cell constant, wait for temperature equalization of the temperature probe and calibration solution before calibration.
- If the measured conductance or temperature fluctuate greatly, the calibration procedure is aborted after approx. 2 min.
- Repeat calibration if an error message appears.

Calibration Procedure

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Automatic" calibration mode and press ***enter*** to confirm.
    ✓ Display of calibration solution as configured in Cal Presettings.
02. Change the calibration solution, if required.
03. Take the sensor out of the medium and rinse it well in deionized water.
04. Immerse the sensor in the calibration solution.
05. Start calibration with the ***right softkey: Next***.
    ✓ Calibration is performed.
    The following parameters are displayed: Calibration Temperature, Solution Table Value (conductivity depending on calibration temperature), and Response Time.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calculated calibration values are used to calculate the measured values in Protos and also saved in the Memosens sensor.

Calibration Mode: Manual

During calibration with manual entry of the conductivity value of the calibration solution, the sensor is immersed in a calibration solution. Protos determines a conductivity/calibration temperature pair value. The temperature-corrected conductivity value of the calibration solution must then be entered. For this purpose, take the conductivity value that goes with the displayed temperature from the calibration solution TC table. Conductivity intermediate values must be interpolated. Protos automatically calculates the cell constant.

Notes on Calibration

- Use only fresh calibration solutions. The used calibration solution must be configured.
- The accuracy of the calibration is dependent on precise acquisition of the calibration solution temperature. On the basis of the measured or entered temperature, Protos calculates the setpoint of the calibration solution from a stored table.
- Note the response time of the temperature probe.
- To determine the exact cell constant, wait for temperature equalization of the temperature probe and calibration solution before calibration.
- If the measured conductance or temperature fluctuate greatly, the calibration procedure is aborted after approx. 2 min.
- Repeat calibration if an error message appears.

Calibration Procedure

Calibration ▸ MSU ... Module ▸ Memosens Cond

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Manual" calibration mode and press ***enter*** to confirm.
02. Take the sensor out of the medium, rinse it well in deionized water, and dry it.
03. Immerse the sensor in the calibration solution.
04. Start calibration with the ***right softkey: Next***.
    ✓ Calibration is performed.
    The following parameters are displayed: Calibration Temperature and Response Time.
05. Enter conductivity.
06. Continue with the ***right softkey: Next***.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calibration values obtained during calibration for calculation of the measured values are applied to the device. The calibration values are also stored in the sensor.

Calibration Mode: Product

If the sensor cannot be removed – e.g., for sterility reasons – its cell constant can be determined by "sampling". The currently measured value (conductivity or concentration[1)]) in the process is stored by Protos for this purpose. Right after this, take a sample from the process. The value of this sample is separately determined under process conditions (same temperature!) wherever possible. The calculated value is entered in the measuring system. Protos calculates the conductivity sensor's cell constant from the deviation between the process measured value and the sample value.

Product Calibration without TC Compensation (With Conductivity)

A sample is taken from the process. The sample's measured value is determined in the laboratory at the temperature at which the sample was taken ("Sample Temperature", see display). It may be necessary to thermostat the sample in the laboratory accordingly. Temperature compensation of the reference measuring devices must be disabled (TC = 0 %/K).

Product Calibration with TC Compensation T_{ref} = 25 °C/77 °F (With Conductivity)

A sample is taken from the process. During measurement in the laboratory (TC linear), the same values for reference temperature and temperature coefficient must be set in both the reference measuring device and Protos. In addition, the measuring temperature should match the sample temperature (see display) as closely as possible. The sample should be transported in a vacuum flask (Dewar) to ensure this.

NOTICE! Product calibration is only possible if the process medium is stable (no chemical reactions that affect conductivity). At higher temperatures, evaporation may falsify results.

Calibration Procedure

Calibration ▸ MSU ... Module ▸ Memosens Cond

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Product" calibration mode and press ***enter*** to confirm.
02. Prepare for sampling.
03. Start with the ***right softkey: Next***.

1) First enable TAN option FW4400-009.

Cond Calibration / Adjustment

Product calibration is performed in 2 steps.

Step 1:

04. Take sample.
    ✓ The measured value and temperature at the time of sampling are displayed.
05. Save with the ***right softkey: Save***.
    ✓ An information window is shown.
06. ***Right softkey: Close***
07. As required, exit calibration by pressing the ***left softkey: Back***.

Note: The icon indicates that product calibration has not yet been completed.

Step 2: Lab value has been measured.

08. Open the Product Calibration menu again.
09. ***Right softkey: Next***
10. Enter the lab value and press ***enter*** to confirm.
11. Confirm with the ***right softkey: Next*** or repeat calibration with the ***left softkey: Cancel***.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calibration values obtained during calibration for calculation of the measured values are applied to the device. The calibration values are stored in the sensor.

Exception: Sample value can be determined and entered on site:

01. Take sample.
    ✓ The measured value and temperature at the time of sampling are displayed.
02. ***Left softkey: Entry***
03. Enter the lab value and press ***enter*** to confirm.
04. Confirm with the ***right softkey: Next*** or repeat calibration with the ***left softkey: Cancel***.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calibration values obtained during calibration for calculation of the measured values are applied to the device. The calibration values are stored in the sensor.

Calibration Mode: Installation Factor
When using a 4-electrode sensor in a tight space, an installation factor can be entered for calibration / adjustment.

Calibration Procedure
Calibration ▸ MSU ... Module ▸ Memosens Cond
When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

Make sure that the sensor is in normal mounting position in the medium.
01. Select "Install. Factor" calibration mode and press ***enter*** to confirm.
02. Enter the installation factor.
03. Press the ***right softkey: Next***.

✓ The calibration record is displayed. By pressing the ***right softkey: Save***, the calibration values obtained during calibration for calculation of the measured values are applied to the device. The calibration values are stored in the sensor.

Calibration Mode: Data Entry
Entry of values for the cell constant of a sensor, related to 25 °C/77 °F.

Calibration Procedure
Calibration ▸ MSU ... Module ▸ Memosens Cond
When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Data Entry" calibration mode and press ***enter*** to confirm.
02. Remove the sensor and install the premeasured sensor.
03. Continue with the ***right softkey: Next***.
04. Enter the cell constant of the premeasured sensor.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calibration values obtained during calibration for calculation of the measured values are applied to the device. The calibration values are stored in the sensor.

Calibration Mode: Temperature

This function is used to adjust the individual temperature probe tolerances or cable lengths for the purpose of increasing the accuracy of the temperature measurement. The adjustment requires an accurate measurement of the process temperature using a calibrated reference thermometer. The measurement error of the reference thermometer should be less than 0.1 K. Adjustment without an accurate measurement may result in falsification of the displayed measured value.
The adjustment value is stored in the sensor.

Calibration Procedure

Calibration ▸ MSU ... Module ▸ Memosens Cond
When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Temperature" calibration mode and press ***enter*** to confirm.
02. Enter the measured process temperature and press ***enter*** to confirm.
    ✓ The temperature offset is displayed.
03. Adjust the temperature detector with the ***right softkey: Save***.

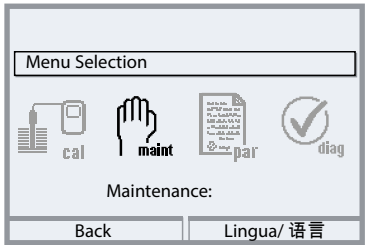
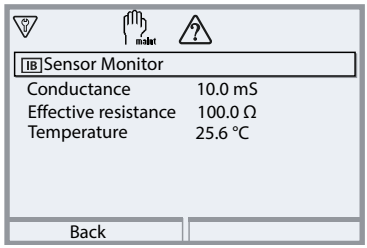
The current adjustment and temperature offset data can be displayed in the Diagnostics menu:
Diagnostics ▸ MSU ... Module ▸ Memosens Cond ▸ Temp. Offset Log

Cond Maintenance Functions

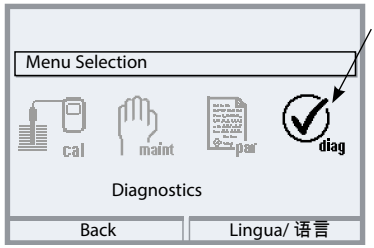
Note: Function check (HOLD) active

The current outputs and relay contacts behave in accordance with the parameter settings. Since the device is in function check (HOLD) mode, certain media can be used to validate the sensor and check the measured values without affecting the signal outputs.
To end the function check, return to measuring mode.

Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
maint	 	**Open the Maintenance menu** From the measuring mode: Press ***menu*** key to select menu. Select Maintenance (maint) using the arrow keys and confirm by pressing ***enter***. Passcode (factory setting): 2958 Then select the module and sensor. **Sensor Monitor** During maintenance, the sensor monitor allows validation of the sensor by immersing it in a known solution, for example, and checking the values measured.

Cond Diagnostic Functions

Menu	Display	Action
diag		**Open the Diagnostics menu** From the measuring mode: Press ***menu*** key to select menu. Select Diagnostics using arrow keys, press ***enter*** to confirm.

For a detailed description of general diagnostic functions, see the basic unit user manual.

Overview of Cond Diagnostic Functions

In diagnostics mode, you can access the following submenus without interrupting the measurement:

Diagnostics ▸ MSU ... Module:

Module Diagnostics	Protos periodically performs a self-test in the background. The results can be displayed here.

Diagnostics ▸ MSU ... Module ▸ Memosens Cond:

Submenus	**Description**
Sensor Information	The Sensor Information submenu shows data from the currently connected Memosens sensor, e.g., manufacturer, order no., serial no., firmware and hardware version, last calibration, operating time:
Sensor Monitor	The raw measured values, such as conductance, effective resistance, and temperature are displayed for diagnostic purposes.

Cond Diagnostic Functions

Submenus	Description
Cond Cal/Adj Record	The calibration/adjustment record shows the data from the last calibration/adjustment performed on the currently connected sensor.
Temp. Offset Log	The temp. offset log shows the data from the last temperature equalization performed on the currently connected sensor.
USP Function	If configured: Display of UPS Limit value, Reduced Limit Value, and Conductivity
Sensor Wear Monitor	The sensor wear monitor displays the sensor operating time and the maximum temperature during the operating time.

Cond Messages

Cond Messages

⊗ Failure ⚠ Out of Specification ◈ Maintenance Required

See also "Decommissioning"; p. 159

No.	Message Type	Cond Messages
C008	⊗	Factory Settings: Switch device off (approx. 10 s). If the message persists, send in the device.
C009	⊗	Firmware Error: Switch device off (approx. 10 s). Reload the firmware. If the message persists, send in the device.
C010	⊗	Conductivity Range: Measuring range exceeded. Possible causes: Sensor not/incorrectly connected, cable incorrectly connected/faulty, range incorrectly specified, incorrect cell constant set.
C011	⊗	Conductivity LO_LO: Value below configured monitoring limit
C012	⚠	Conductivity LO: Value below configured monitoring limit
C013	⚠	Conductivity HI: Value above configured monitoring limit
C014	⊗	Conductivity HI_HI: Value above configured monitoring limit
C015	⊗	Temperature Range: Measuring range exceeded. Possible causes: Sensor not/incorrectly connected, cable incorrectly connected/ faulty, range incorrectly specified
C016	⊗	Temperature LO_LO: Value below configured monitoring limit
C017	⚠	Temperature LO: Value below configured monitoring limit
C018	⚠	Temperature HI: Value above configured monitoring limit
C019	⊗	Temperature HI_HI: Value above configured monitoring limit
C020	⊗	Resistivity Range: Measuring range exceeded. Possible causes: Sensor not/incorrectly connected, cable incorrectly connected/ faulty, range incorrectly specified, incorrect cell constant set.
C021	⊗	Resistivity LO_LO: Value below configured monitoring limit
C022	⚠	Resistivity LO: Value below configured monitoring limit
C023	⚠	Resistivity HI: Value above configured monitoring limit
C024	⊗	Resistivity HI_HI: Value above configured monitoring limit
C025	⊗	Concentration Range: Measuring range exceeded. Possible causes: Sensor not/incorrectly connected, cable incorrectly connected/ faulty, range incorrectly specified, incorrect cell constant set.

Cond Messages

No.	Message Type	Cond Messages
C026	⊗	Concentration LO_LO: Value below configured monitoring limit
C027	⚠	Concentration LO: Value below configured monitoring limit
C028	⚠	Concentration HI: Value above configured monitoring limit
C029	⊗	Concentration HI_HI: Value above configured monitoring limit
C040	⊗	Salinity Range: Range exceeded. Possible causes: Sensor not/incorrectly connected, cable incorrectly connected/ faulty, incorrect cell constant set.
C041	⊗	Salinity LO_LO: Value below configured monitoring limit
C042	⚠	Salinity LO: Value below configured monitoring limit
C043	⚠	Salinity HI: Value above configured monitoring limit
C044	⊗	Salinity HI_HI: Value above configured monitoring limit
C045	⊗	Conductance Range: Value above range limit. Possible causes: Sensor not/incorrectly connected, incorrect sensor for range, cable faulty (short circuit).
C060	◇	Sad Sensoface: Polarization The sensor is polarized. Sensor is not suitable for the range or the process medium: Connect a suitable sensor.
C061	◇	Sad Sensoface: Cable
C062	User-defined	Sad Sensoface: Cell constant Incorrect cell constant set, incorrect adjustment: Repeat calibration/adjustment. Replace the sensor as required.
C070	⊗	TDS Range: Measuring range exceeded. Possible causes: Sensor not/incorrectly connected, cable incorrectly connected/ faulty, incorrect cell constant set.
C071	⊗	TDS LO_LO: Value below configured monitoring limit
C072	⚠	TDS LO: Value below configured monitoring limit
C073	⚠	TDS HI: Value above configured monitoring limit
C074	⊗	TDS HI_HI: Value above configured monitoring limit
C090	User-defined	USP Limit: The configured USP limit was exceeded.
C091	User-defined	Reduced USP Limit: The configured reduced USP limit was exceeded.
C110	User-defined	CIP Counter: Configured number of CIP cycles exceeded: As required, calibrate/adjust sensor or replace.
C111	User-defined	SIP counter: Configured number of SIP cycles exceeded: As required, calibrate/adjust sensor or replace.
C113	User-defined	Sensor Operating Time: Replace the sensor.

Cond Messages

No.	Message Type	Cond Messages
C120	⊗	Wrong Sensor (Sensor Check)
C121	⊗	Sensor Error (Factory Settings): Replace the sensor.
C122		Sensor Memory (Cal Data): The calibration data is defective: Recalibrate/readjust sensor.
C123		New Sensor, Adjustment Required
C124		Sensor Date: The sensor data is implausible. Check and, as necessary, adjust the configuration.
C130	Info	SIP Cycle Counted
C131	Info	CIP cycle counted
C200		Reference temperature The reference temperature for temperature compensation is invalid.
C201		Temperature compensation
C202		TC Range (Maintenance Required): The measured value is at the limit of the permissible compensation range (table).
C203	⊗	TC Range (Failure): The measured value is outside the permissible compensation range (table).
C204	Info	Cal: Sensor Unstable: The drift criterion was not adhered to during calibration. Possible causes: improper calibration, sensor cable/connection faulty, sensor worn. Check the sensor and calibration and repeat as required. Otherwise, replace the sensor.
C205	Info	Cal: Sensor Failure: Replace the sensor.
C254	Info	Module Reset

Cond Messages

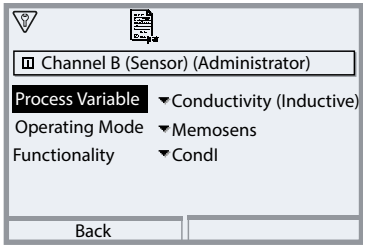
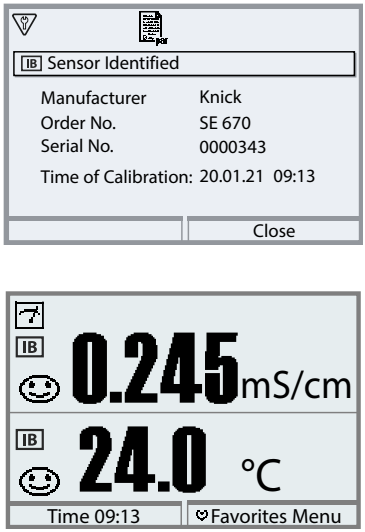
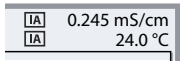
No.	Message Type	Cond / Cond Calculation Block Messages
E010	⊗	Conductivity Diff Range: Max/min device limits exceeded: - Check both conductivity values. - Check sensor/cable connections.
E011	⊗	Conductivity Diff LO_LO: Value below configured monitoring limit
E012	⚠	Conductivity Diff LO: Value below configured monitoring limit
E013	⚠	Conductivity Diff HI: Value above configured monitoring limit
E014	⊗	Conductivity Diff HI_HI: Value above configured monitoring limit
E015	⊗	Temperature Diff Range: Max/min device limits exceeded: - Check both temperature values. - Check sensor/cable connections.
E016	⊗	Temperature Diff LO_LO: Value below configured monitoring limit
E017	⚠	Temperature Diff LO: Value below configured monitoring limit
E018	⚠	Temperature Diff HI: Value above configured monitoring limit
E019	⊗	Temperature Diff HI_HI: Value above configured monitoring limit
E020	⊗	Resistivity Diff Range: Max/min device limits exceeded: - Check both resistance values. - Check sensor/cable connections.
E021	⊗	Resistivity Diff LO_LO: Value below configured monitoring limit
E022	⚠	Resistivity Diff LO: Value below configured monitoring limit
E023	⚠	Resistivity Diff HI: Value above configured monitoring limit
E024	⊗	Resistivity Diff HI_HI: Value above configured monitoring limit
E030	⊗	RATIO Range: Min/max device limits exceeded: - Check both conductivity values.
E031	⊗	RATIO LO_LO: Value below configured monitoring limit
E032	⚠	RATIO LO: Value below configured monitoring limit
E033	⚠	RATIO HI: Value above configured monitoring limit
E034	⊗	RATIO HI_HI: Value above configured monitoring limit
E035	⊗	PASSAGE Range: Min/max device limits exceeded: - Check both conductivity values.
E036	⊗	PASSAGE LO_LO: Value below configured monitoring limit
E037	⚠	PASSAGE LO: Value below configured monitoring limit
E038	⚠	PASSAGE HI: Value above configured monitoring limit

Cond Messages

No.	Message Type	Cond / Cond Calculation Block Messages
E039	⊗	PASSAGE HI_HI: Value above configured monitoring limit
E045	⊗	REJECTION Range: Min/max device limits exceeded: - Check both conductivity values.
E046	⊗	REJECTION LO_LO: Value below configured monitoring limit
E047	⚠	REJECTION LO: Value below configured monitoring limit
E048	⚠	REJECTION HI: Value above configured monitoring limit
E049	⊗	REJECTION HI_HI: Value above configured monitoring limit
E050	⊗	DEVIATION Range: Min/max device limits exceeded: - Check both conductivity values.
E051	⊗	DEVIATION LO_LO: Value below configured monitoring limit
E052	⚠	DEVIATION LO: Value below configured monitoring limit
E053	⚠	DEVIATION HI: Value above configured monitoring limit
E054	⊗	DEVIATION HI_HI: Value above configured monitoring limit
E060	⊗	pH Range: Range outside the permitted range of the VGB guideline: - Check both conductivity values. - Check choice of alkalizing agent. - Check ion exchanger. - Check both sensors/cables.
E061	⊗	pH LO_LO: Value below configured monitoring limit
E062	⚠	pH LO: Value below configured monitoring limit
E063	⚠	pH HI: Value above configured monitoring limit
E064	⊗	pH HI_HI: Value above configured monitoring limit
E200	◇	Calculation Block Configuration

CondI Parameter Setting

Note: Function check (HOLD) active

Menu	Display	Action
par		Parameter Setting ▸ MSU ... Module ▸ Channel ...: Process Variable: Conductivity (Induct.) Operating Mode: Memosens or SE670/SE680K Functionality: CondI There is no functionality selection on the SE670 and SE680K.
The connected digital inductive sensor is displayed immediately.		
		All typical sensor parameters are transferred to the measuring device automatically. Measuring commences immediately and the measuring temperature is recorded simultaneously without any further parameters having to be set.
		In the menus assigned to a sensor channel, the respective channel, the primary measured value, and the measured temperature are always displayed in the upper right corner.

Note: The display may vary depending on which sensors are connected.

CondI Parameter Setting

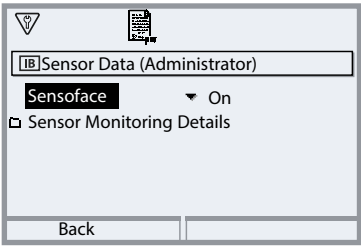
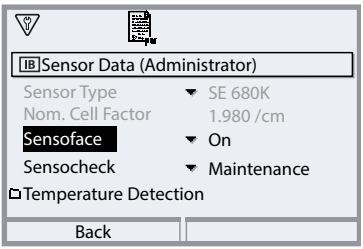
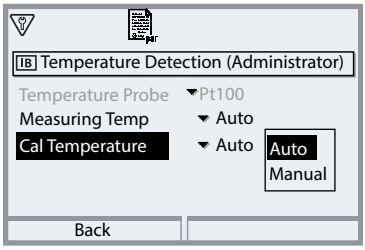
Menu Selection: Parameter Setting ▸ MSU ... Module ▸ ... CondI:

Parameter	Default	Selection / Range
Input Filter		
Pulse Suppression	Off	Enable/disable suppression of interference pulses.
Sensor Data (see page 130)		
Sensoface	On	On, Off
Sensocheck (Memosens: in "Sensor Monitoring Details")	Off	Off, Failure, Maintenance
Sensor Monitoring Details (Memosens only) • Cell Factor • Sensocheck • Sensor Operating Time • CIP Counter • SIP Counter	 Auto Off Off Off Off	 Auto, Individual Off, On Off, Individual (max. 9999 d) Off, Individual Off, Individual
Temperature Detection (SE670/SE680K only) Measuring Temp Cal Temperature	 Auto Auto	 Auto, Manual Auto, Manual
Cal Presettings		
Calibration Mode	Automatic	Automatic, Manual, Product, Zero Point, Installation Factor, Data Entry, Temperature
Cal Solution	NaCl Sat	NaCl 0.01 m: 1183 µS/cm NaCl 0.1 m: 10.683 mS/cm NaCl Sat 251.3 mS/cm KCl 0.01 m: 1413 µS/cm KCl 0.1 m: 12.88 mS/cm KCl 1m: 111.80 mS/cm
Product Calibration	Without TC	Without TC, With TC
TC Process Medium		
Temperature Compensation	Off	Off, Linear, EN27888, Ultrapure Water (with TAN option FW4400-008)
Concentration (see page 135)		
Concentration	Off	Off, On
TDS (see page 133)		
TDS Function	Off	Off, On (preset 1.00)
USP (see page 134)		
USP Function	Off	Off, On

Condl Parameter Setting

Menu Selection: Parameter Setting ▸ MSU ... Module ▸ ... Condl:

Parameter	Default	Selection / Range
Messages		
Messages	Temperature: Max. Device Limits	Conductivity, Resistivity, Concentration, Temperature, Salinity, TDS Can be adjusted for all types of monitoring: Off, Max. Device Limits, Variable Limits)

Menu	Display	Action
	Memosens:  SE670/SE680K:   	**Sensor Data** Memosens sensors and the SE670/ SE680K digital sensors automatically provide the required parameters. Parameters shown in gray are read directly from the sensor and cannot be changed. **Temperature Detection** (SE670/SE680K only) Auto: The temperature determined by the sensor is used for measurement or calibration. Manual: The manually specified temperature is used for measurement or calibration. Default: 25 °C / 77 °F

Note: The display may vary depending on which sensors are connected.

Sensoface

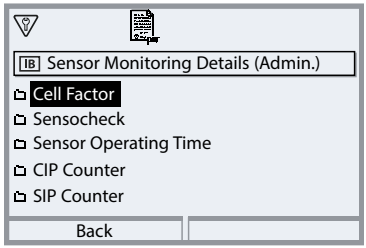
Parameter Setting ▸ MSU ... Module ▸ ... CondI ▸ Sensor Data:

The Sensoface icons provide the user with diagnostic information on wear and required maintenance of the sensor. In measuring mode, an icon (happy, neutral, or sad smiley) is shown on the display to reflect the continuous monitoring of the sensor parameters.

Sensoface monitors the toroidal conductivity sensor on the basis of the following parameters:

Cell Factor, Zero Point, and, if Sensocheck is enabled: Primary/Secondary Coil and Cables

Additionally with Memosens sensors: Number of CIP and SIP cycles compared to the specified "Sensor Monitoring Details".

Menu	Display	Action
par		**Sensor Monitoring Details** (Memosens only) Auto: The parameters are read out directly from the sensor or are adjusted by the system. They are displayed in gray and cannot be edited. Manual: The parameters must be specified by the user. In addition, you can specify values for Sensor Operating Time, CIP Counter, and SIP Counter that will trigger a message.

Note: The display may vary depending on which sensors are connected.

Sensocheck

Monitoring of primary and secondary coils. Additionally with Memosens sensors: Monitoring of the cell factor compared to the specified "Sensor Monitoring Details".

Enable or disable Sensocheck to generate Failure or Maint. Required messages.

Memosens: Parameter Setting ▸ MSU ... Module ▸ Memosens CondI ▸ Sensor Data ▸ Sensor Monitoring Details

SE670/SE680K: Parameter Setting ▸ MSU ... Module ▸ CondI Sensor ▸ Sensor Data

CIP Counter/SIP Counter

CIP/SIP cycles are used to clean or sterilize process-wetted parts in the process. Depending on the application, either one chemical (alkaline solution, water) or several chemicals (alkaline solution, water, acidic solution, water) are used.

- CIP temperature > 55 °C / 131 °F
- SIP temperature > 115 °C / 239 °F

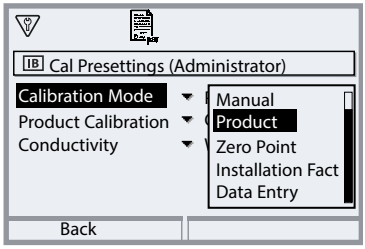
The cleaning (cleaning in place) and sterilization (sterilization in place) cycles are counted to measure the load on the sensor, e.g., in biotechnology applications.

Note: If measurements are generally taken at high temperatures (> 55 °C / 131 °F), the counters should be switched off.

When a CIP/SIP counter is switched on, a maximum number of cycles can be entered. A message can be set to indicate when a counter has reached a specified value.

Note: A CIP or SIP cycle is only entered into the logbook 2 hours after the start to ensure that the cycle is complete.

Presettings for Calibration

Menu	Display	Action
par		The calibration presettings can be defined in the parameter settings or adjusted directly in the Calibration menu prior to the calibration. Parameter Setting ▸ ... Condl... ▸ Cal Presettings:
	Calibration Mode: Presetting of calibration mode, e.g., Automatic, Manual, Product, Zero Point, Installation Factor, Data Entry, Temperature Further options are available depending on the calibration mode. Automatic: Selection of calibration solution Product Calibration: Conductivity/concentration[1)] Conductivity: Selection with/without temperature compensation Concentration: Selection of medium	

Note: The display may vary depending on which sensors are connected.

1) First enable TAN option FW-E009.

Temperature Compensation of Process Medium

The following are available for temperature compensation:

- Off
- Linear (enter temperature coefficient TC)
- EN 27888 (natural waters)
- Ultrapure water (with different trace impurities)

Trace Impurities in Ultrapure Water (with TAN option FW4400-008)

NaCl	Neutral ultrapure water, for conductivity measurement in water processing downstream of gravel bed filter
HCl	Acidic ultrapure water, for conductivity measurement downstream of cation filter
NH_3	Ammoniacal ultrapure water
NaOH	Alkaline ultrapure water

Note: If TC correction for the process medium is enabled, "TC" is shown on the display in measuring mode.

TDS Function

TDS (total dissolved solids) = weight of dissolved solids that influence conductivity

The TDS function provides a quick way of determining the evaporation residue of water. A TDS factor must be entered for this purpose.

The factor establishes a simple linear relationship between measured conductivity and evaporation residue. It is dependent on the composition of the medium and must be empirically determined by the user.

USP Function (CondI)

Monitoring Ultrapure Water in the Pharmaceutical Industry
The conductivity of ultrapure water in the pharmaceutical industry can be monitored online in accordance with the guideline "USP" (U.S. Pharmacopeia), Annex 5, Section 645 "Water Conductivity". The conductivity is measured without temperature compensation and is compared with limits. The water is usable without any further testing when the conductivity is below the USP limit.

Configuring the USP Function
The USP value can be configured as a process variable USP% for output (display, current output, limit, measurement recorder)
Settings can be changed in the USP submenu:
Parameter Setting ▸ MSU ... Module ▸ ... CondI ▸ USP

Reduced Limit Value: The USP limit can be reduced down to 10 %.
Monitoring: Select whether and how an exceeded limit is to be displayed.

Off	No message, but the parameter is still shown in the Diagnostics menu.
Failure	A failure message is shown in off-limit conditions; the corresponding NAMUR icon is displayed.
Maintenance	A Maint. Required message is shown in off-limit conditions; the corresponding NAMUR icon is displayed.

USP Function: Specify a Relay Contact
The USP function can also be assigned to a relay contact:
Parameter Setting ▸ BASE Module ... ▸ Contact K… ▸ Usage: USP Output

Display of the USP Function in the Diagnostics Menu
Diagnostics ▸ MSU ... Module ▸ ... CondI ▸ USP Function
Display of the USP limit, the reduced limit, and conductivity.

Concentration (CondI)

Note: Concentration determination requires the activation of TAN option FW4400-009.

The substance concentration in percent by weight (wt%) is determined for H_2SO_4, HNO_3, HCl, NaOH, NaCl, and Oleum (see page 174ff).

Conditions for Concentration Determination

The following conditions must be met for a reliable concentration determination:

- For calculation of concentration, the medium to be measured must be a purely binary mixture (e.g., water-hydrochloric acid). Presence of other dissolved substances (e.g., salts) leads to incorrect concentration values.
- In the region of small slopes (e.g., at the range limits) small changes in conductivity can correspond to large changes in concentration. This may lead to an unsteady display of the concentration value.
- As the concentration value is calculated from the measured conductivity and temperature values, accurate temperature measurement is very important. Therefore, you should make sure that conductivity sensor and process medium are in thermal equilibrium.

Settings can be changed in the Concentration submenu:
Parameter Setting ▸ MSU ... Module ▸ ... CondI ▸ Concentration

01. Concentration: On
02. Select the medium:
    NaCl (0-28 %), HCl (0-18 %), NaOH (0-24 %), H_2SO_4 (0-37 %), HNO_3 (0-30 %), H_2SO_4 (89-99 %), HCl (22-39 %), HNO_3 (35-96 %), H_2SO_4 (28-88 %), NaOH (15-50 %), Oleum (12-45 %), table

You can define limits for warning and failure messages for the concentration value:
Parameter Setting ▸ MSU ... Module ▸ ... CondI ▸ Messages ▸ Concentration Messages

Specifying a Concentration Solution for Conductivity Measurement
To specify the customer-specific solution, 5 concentration values A-E are entered in a matrix together with 5 temperature values 1-5. First enter the 5 temperature values, then the corresponding conductivity values for each of the concentrations A-E.
These solutions are then available as "Table" in addition to the permanently set standard solutions.

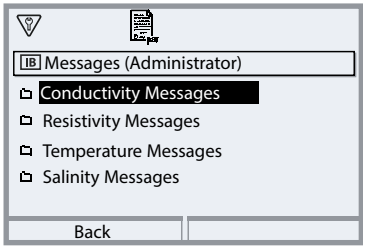
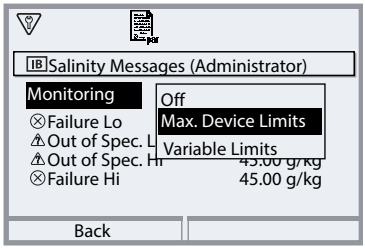
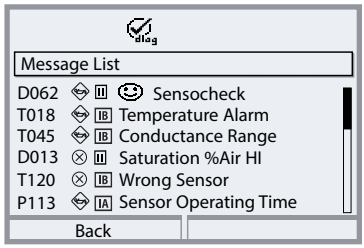
Settings can be changed in the System Control in the Concentration Table submenu:
Parameter Setting ▸ System Control ▸ Concentration Table:
01. Enter temperatures 1 to 5.
02. Enter values for concentrations A-E for the respective temperatures.

Notes: The temperature values must be rising (Temp. 1 is the lowest, Temp. 5 the highest temperature).
The concentration values must be rising (Conc. A is the lowest, conc. E the highest concentration).
The table values A1 ... E1, A2 ... E2, etc. must all be rising within the table or all falling.
Points of inflection are not allowed.
Incorrect table entries are indicated by an exclamation point in a red triangle.
The table is built up as 5x5 matrix:

	Conc. A	Conc. B	Conc. C	Conc. D	Conc. E
Temp 1	A1	B1	C1	D1	E1
Temp 2	A2	B2	C2	D2	E2
Temp 3	A3	B3	C3	D3	E3
Temp 4	A4	B4	C4	D4	E4
Temp 5	A5	B5	C5	D5	E5

The concentration table is selected in the menu:
Parameter Setting ▸ MSU ... Module ▸ ... CondI ▸ Cal Presettings
Calibration Mode: Automatic
Cal Solution: Table

Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
par	 	**Messages** All parameters determined by the measuring module can generate messages. **Max. Device Limits** Messages are generated when the process variable is outside the measuring range. The "Failure" icon is displayed; the NAMUR failure contact is activated (BASE module, factory setting: Contact K4, normally closed contact). The current outputs can signal a 22-mA message (user-defined); see the basic unit user manual. **Variable Limits** Upper and lower limits at which a message is generated can be defined for the "Failure" and "Out of Specification" messages. **Message Icons:** ⊗ Failure (Limit Hi/Lo) ⚠ Out of Specification (Hi/Lo)
diag		**Diagnostics Menu** Go to the Diagnostics menu if the "Maintenance" or "Failure" icons are blinking in the display. The messages are displayed in the "Message List".

CondI Calibration / Adjustment

Note: During calibration, the function check (HOLD) operating state is active for the corresponding module channel. The assigned current outputs and relay contacts behave as configured (BASE module).

The calibration data is saved in the Memosens sensor. This means that Memosens sensors can be cleaned, reconditioned, calibrated, and adjusted away from the measurement location, e.g., in a laboratory. Sensors in the system are replaced on-site by adjusted sensors.

Calibration: Detecting deviations without readjustment
Adjustment: Detecting deviations with readjustment

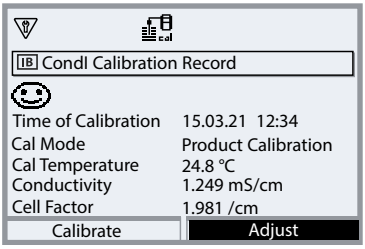
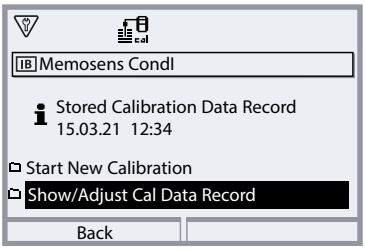
Adjustment

Adjustment means that the values determined by a calibration are applied to the sensor. The zero point and slope values determined during calibration are entered in the adjustment record:

Diagnostics ▸ MSU ... Module ▸ ... CondI ▸ Cal/Adj Record

These values are not used to calculate the process variables until the calibration has been terminated with an adjustment.

Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
		**Administrator** With appropriate access rights, an adjustment can be carried out immediately after calibration: ***Right softkey: Adjust***. The calibration values are used to calculate the process variables.
		**Operator** (without administrator rights) After calibration, save the data by pressing the ***left softkey: Calibrate***, switch to measuring mode, and notify the administrator. The administrator can retrieve all the data of the last calibration (Calibration menu, selection module) and can accept the values or carry out a new calibration.

Explanations Regarding Calibration/Adjustment with Toroidal Sensors
Each inductive (toroidal) conductivity sensor has an individual cell factor. The cell factor may vary depending on the sensor design. Because the conductivity value is calculated from the measured conductance and the cell factor, the measuring system must know the cell factor. During calibration or sensor adjustment, either the known (printed) cell factor of the used toroidal conductivity sensor is entered in the measuring system, or it is determined automatically by measuring a calibration solution with known conductivity.

Notes on Calibration
- Use only fresh calibration solutions.
- The used calibration solution must be configured.
- The accuracy of the calibration is crucially dependent on a precise acquisition of the calibration solution temperature. On the basis of the measured or entered temperature, Protos calculates the setpoint of the calibration solution from a stored table.
- Note the response time of the temperature probe.
- To determine the exact cell factor, wait for temperature equalization of the temperature probe and calibration solution before calibration.
- If the measured conductance or temperature fluctuate greatly, the calibration procedure is aborted after approx. 2 min. Repeat calibration if an error message appears.

Since the cell factor is subject to production-related fluctuations, it is recommended that the removed sensor be calibrated with a calibration solution (e.g., saturated NaCl).
- If the installation space is tight (minimum distances are not reached), the sensor must be adjusted in its installed state, as the resulting cell factor has changed.
  Calibration Mode: "Product Calibration".

Temperature Compensation during Calibration

The conductivity value of the calibration solution is temperature-dependent. During calibration, the temperature of the calibration solution must therefore be known so that the actual value can be obtained from the conductivity table.

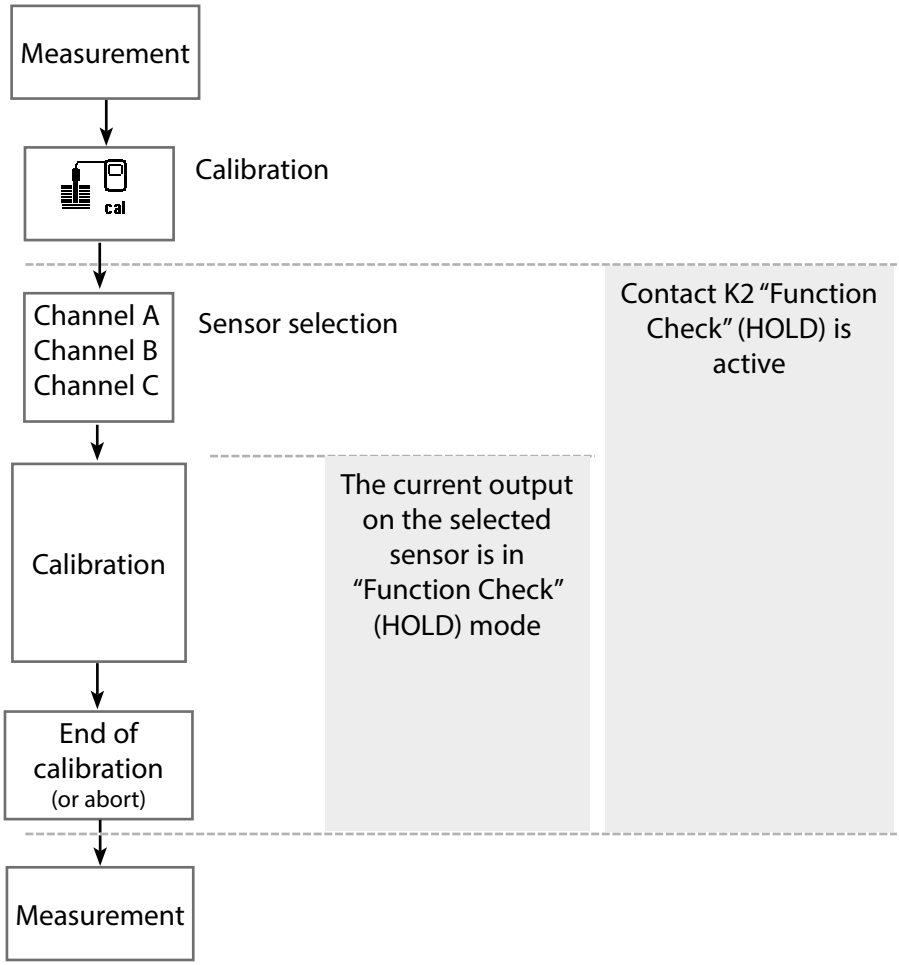
Automatic Temperature Compensation

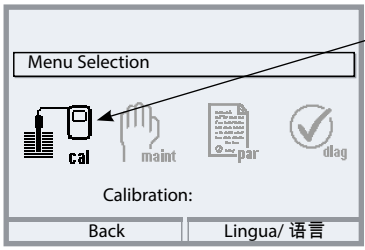
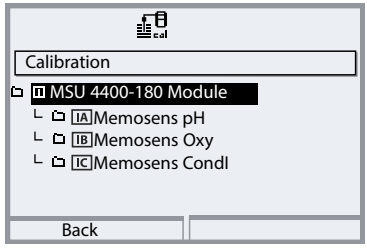
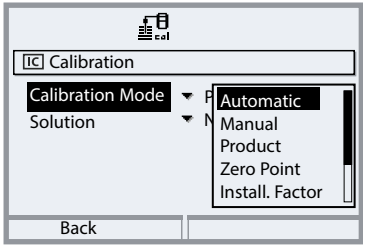
During automatic logging of the calibration temperature, Protos measures the temperature of the calibration solution using the temperature probe integrated in the Memosens sensor.

If the sensor does not have an integrated temperature detector:

- Connect an external temperature probe and select it in the Parameter Setting menu.
- Set the manual temperature for calibration.

Function Check (HOLD) During Calibration / Adjustment
Behavior of the signal and switching outputs during calibration / adjustment



Menu	Display	Action
		**Open the Calibration Menu** ***menu*** key: Menu Selection. Select calibration using arrow keys, confirm by pressing ***enter***, passcode 1147
cal	 	Select a sensor channel for the calibration. **Calibration / Adjustment Methods** • Automatic (see page 144) • Manual (see page 146) • Product (see page 148) • Zero Point (see page 150) • Installation Factor (Memosens only, see page 151) • Data Entry (see page 152) • Temperature (see page 153)

Note: The display may vary depending on which sensors are connected.

Calibration Mode: Automatic

During automatic calibration:, the conductivity sensor is immersed in a standard calibration solution (NaCl or KCl, set during parameter setting). On the basis of the measured conductance and temperature, Protos automatically calculates the cell factor.

The temperature dependence of the calibration solution is accounted for.

Notes on Calibration

- Use only fresh calibration solutions. The used calibration solution must be configured.
- The accuracy of the calibration is crucially dependent on a precise acquisition of the calibration solution temperature. On the basis of the measured or entered temperature, Protos calculates the setpoint of the calibration solution from a stored table.
- Note the response time of the temperature probe.
- To determine the exact cell factor, wait for temperature equalization of the temperature probe and calibration solution before calibration.
- If the measured conductance or temperature fluctuate greatly, the calibration procedure is aborted after approx. 2 min.
- Repeat calibration if an error message appears.

Calibration Procedure

Calibration ▸ MSU ... Module ▸ ... CondI

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Automatic" calibration mode and press ***enter*** to confirm.
    ✓ Display of calibration solution as configured in Cal Presettings.
02. Change the calibration solution, if required.
03. Take the sensor out of the medium, rinse it well in deionized water, and dry it.
04. Immerse the sensor in the calibration solution.
05. Start calibration with the ***right softkey: Next***.
    ✓ Calibration is performed.

The following parameters are displayed: Calibration Temperature, Solution Table Value (conductivity depending on calibration temperature), and Response Time.

✓ By pressing the ***right softkey: Adjust***, the calibration values obtained during calibration for calculation of the process variables are applied to the device.

Calibration Mode: Manual

During calibration with manual entry of the conductivity value of the calibration solution, the sensor is immersed in a calibration solution. Protos determines a conductivity / calibration temperature pair value. The temperature-corrected conductivity value of the calibration solution must then be entered. For this purpose, take the conductivity value that goes with the displayed temperature from the calibration solution TC table. Conductivity intermediate values must be interpolated.
Protos automatically calculates the cell factor.

Notes on Calibration

- Use only fresh calibration solutions. The used calibration solution must be configured.
- The accuracy of the calibration is crucially dependent on a precise acquisition of the calibration solution temperature. On the basis of the measured or entered temperature, Protos calculates the setpoint of the calibration solution from a stored table.
- Note the response time of the temperature probe.
- To determine the exact cell factor, wait for temperature equalization of the temperature probe and calibration solution before calibration.
- If the measured conductance or temperature fluctuate greatly, the calibration procedure is aborted after approx. 2 min.
- Repeat calibration if an error message appears.

Calibration Procedure

Calibration ▸ MSU ... Module ▸ ... CondI

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Manual" calibration mode and press ***enter*** to confirm.
02. Take the sensor out of the medium and rinse it well in deionized water.
03. Immerse the sensor in the calibration solution.
04. Start calibration with the ***right softkey: Next***.
    ✓ Calibration is performed.
    The following parameters are displayed: Calibration Temperature and Response Time.
05. Enter conductivity.
06. Continue with the ***right softkey: Next***.

✓ By pressing the ***right softkey: Adjust***, the calibration values obtained during calibration for calculation of the process variables are applied to the device.

Calibration Mode: Product

If the sensor cannot be removed – e.g., for sterility reasons – its cell factor can be determined by "sampling". The currently measured value (conductivity or concentration[1)]) in the process is stored by Protos for this purpose. Right after this, take a sample from the process. The value of this sample is separately determined under process conditions (same temperature!) wherever possible. The calculated value is entered in the measuring system. Protos calculates the conductivity sensor's cell factor from the deviation between the process measured value and the sample value.

Product Calibration without TC Compensation (With Conductivity)

A sample is taken from the process. The sample's measured value is determined in the laboratory at the temperature at which the sample was taken ("Sample Temperature", see display). It may be necessary to thermostat the sample in the laboratory accordingly. Temperature compensation of the reference measuring devices must be disabled (TC = 0 %/K).

Product Calibration with TC Compensation T_{ref} = 25 °C/77 °F (With Conductivity)

A sample is taken from the process. During measurement in the laboratory (TC linear), the same values for reference temperature and temperature coefficient must be set in both the reference measuring device and Protos. In addition, the measuring temperature should match the sample temperature (see display) as closely as possible. The sample should be transported in a vacuum flask (Dewar) to ensure this.

NOTICE! Product calibration is only possible if the process medium is stable (no chemical reactions that affect conductivity). At higher temperatures, evaporation may falsify results.

Calibration Procedure

Calibration ▸ MSU ... Module ▸ Memosens CondI

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Product" calibration mode and press ***enter*** to confirm.
02. Prepare for sampling.
03. Start with the ***right softkey: Next***.

Product calibration is performed in 2 steps.

Step 1:

04. Take sample.
    ✓ The measured value and temperature at the time of sampling are displayed.
05. Save with the ***right softkey: Save***.
    ✓ An information window is shown.
06. ***Right softkey: Close***
07. As required, exit calibration by pressing the ***left softkey: Back***.

Note: The icon indicates that product calibration has not yet been completed.

Step 2: Lab value has been measured.

08. Open the Product Calibration menu again.
09. ***Right softkey: Next***
10. Enter the lab value and press ***enter*** to confirm.
11. Confirm with the ***right softkey: Next*** or repeat calibration with the ***left softkey: Cancel***.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calibration values obtained during calibration for calculation of the measured values are applied to the device. The calibration values are stored in the sensor.

Exception: Sample value can be determined and entered on site:

01. Take sample.
    ✓ The measured value and temperature at the time of sampling are displayed.
02. ***Left softkey: Entry***
03. Enter the lab value and press ***enter*** to confirm.
04. Confirm with the ***right softkey: Next*** or repeat calibration with the ***left softkey: Cancel***.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calibration values obtained during calibration for calculation of the measured values are applied to the device. The calibration values are stored in the sensor.

Calibration Mode: Zero Point
Zero point correction

Calibration Procedure
Calibration ▸ MSU ... Module ▸ ... CondI
When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Zero Point" calibration mode.
02. Take the sensor out of the medium, rinse it in deionized water, and dry it. The sensor should be dry, since zero calibration is performed in air.
03. Press the ***right softkey: Next***.
    ✓ Zero point correction is carried out. The permissible zero deviation is model-dependent; on the SE 670 sensor, for example, it is ± 0.050 mS/cm.
04. Press the ***right softkey: Next***.

✓ The calibration record is displayed. By pressing the ***right softkey: Adjust***, the calibration values obtained during calibration for calculation of the measured values are applied to the device. The calibration values are stored in the sensor.

Calibration Mode: Installation Factor

When using a Memosens sensor in a tight space, an installation factor can be entered for calibration / adjustment.

Calibration Procedure

Calibration ▸ MSU ... Module ▸ Memosens CondI

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

Make sure that the sensor is in normal mounting position in the medium.

01. Select "Install. Factor" calibration mode and press ***enter*** to confirm.
02. Enter the installation factor.
03. Press the ***right softkey: Next***.

✓ The calibration record is displayed. By pressing the ***right softkey: Save***, the calibration values obtained during calibration for calculation of the measured values are applied to the device. The calibration values are stored in the sensor.

Calibration Mode: Data Entry

Entry of values for the cell factor and zero point of a sensor, related to 25 °C/77 °F.

If concentration measurement is activated (TAN option FW-E009), the concentration is also shown in this menu and directly adjusted with the cell factor. This makes direct calibration to the concentration value possible.

Calibration Procedure

Calibration ▸ MSU ... Module ▸ ... CondI

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Data Entry" calibration mode and press ***enter*** to confirm.
02. Remove the sensor and install the premeasured sensor.
03. Continue with the ***right softkey: Next***.
04. Enter the cell factor of the premeasured sensor.

✓ By pressing the ***right softkey: Adjust***, the calibration values obtained during calibration for calculation of the process variables are applied to the device. The calibration values are stored in the sensor.

Calibration Mode: Temperature

This function is used to adjust the individual temperature detector tolerances or cable lengths for the purpose of increasing the accuracy of the temperature measurement. The adjustment requires an accurate measurement of the process temperature using a calibrated reference thermometer. The measurement error of the reference thermometer should be less than 0.1 K. Adjustment without an accurate measurement may result in falsification of the displayed measured value.

Calibration Procedure

Calibration ▸ MSU ... Module ▸ ... CondI

When you access calibration, the calibration values selected in the calibration presettings are used. These settings can still be changed in the Calibration menu. If you do not want to perform calibration, use the left softkey to go back one level and abort the calibration.

01. Select "Temperature" calibration mode and press ***enter*** to confirm.
02. Enter the measured process temperature and press ***enter*** to confirm.
    ✓ The temperature offset is displayed.
03. Adjust the temperature detector with the ***right softkey: Save***.

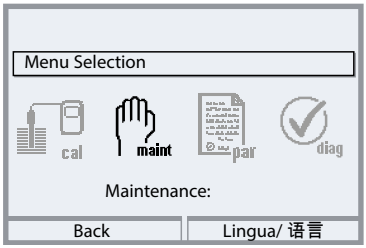
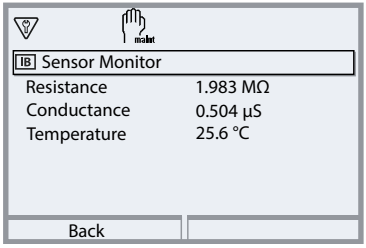
When using the SE670 or SE680K sensors, the current adjustment and temperature offset data can be displayed in the Diagnostics menu:
Diagnostics ▸ MSU ... Module ▸ Sensor CondI ▸ Temp. Offset Log

CondI Maintenance Functions

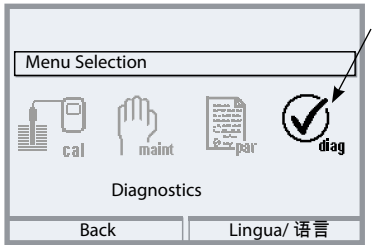
Note: Function check (HOLD) active

The current outputs and relay contacts behave in accordance with the parameter settings. Since the device is in function check (HOLD) mode, certain media can be used to validate the sensor and check the measured values without affecting the signal outputs.
To end the function check, return to measuring mode.

Note: The display may vary depending on which sensors are connected.

Menu	Display	Action
maint		**Open the Maintenance menu** From the measuring mode: ***menu*** key: Menu Selection. Select Maintenance (maint) using the arrow keys and confirm by pressing ***enter***. Passcode (factory setting): 2958 Then select the module and sensor.
		**Sensor Monitor** Display of the currently measured values (sensor monitor) with function check (HOLD mode activated) enabled:

CondI Diagnostic Functions

Menu	Display	Action
diag		**Open the Diagnostics menu** From the measuring mode: ***menu*** key: Menu Selection. Select Diagnostics using arrow keys, press ***enter*** to confirm.

For a detailed description of general diagnostic functions, see the basic unit user manual.

Overview of CondI Diagnostic Functions

In diagnostics mode, you can access the following submenus without interrupting the measurement:

Diagnostics ▸ MSU ... Module:

Module Diagnostics Protos periodically performs a self-test in the background. The results can be displayed here.

Diagnostics ▸ MSU ... Module ▸ ...CondI:

Submenus	Description
Sensor Information	The Sensor Information submenu shows data from the currently connected Memosens sensor, e.g., manufacturer, order no., serial no., firmware and hardware version, last calibration, operating time.
Sensor Monitor	The raw measured values are displayed in the sensor monitor for diagnostic purposes.
CondI Cal/Adj Record	The calibration/adjustment record shows the data from the last calibration/adjustment performed on the currently connected sensor.
Temp. Offset Log (SE670/SE680K only)	The temp. offset log shows the data from the last temperature equalization performed on the currently connected sensor.

CondI Messages

CondI Messages

⊗ Failure ⚠ Out of Specification ⚙ Maintenance Required

See also "Decommissioning"; p. 159

No.	Message Type	CondI Messages
T008	⊗	Factory Settings: Switch device off (approx. 10 s). If the message persists, send in the device.
T009	⊗	Firmware Error: Switch device off (approx. 10 s). Reload the firmware. If the message persists, send in the device.
T010	⊗	Conductivity Range: Measuring range exceeded. Possible causes: Sensor not/incorrectly connected, cable incorrectly connected/faulty, range incorrectly specified, incorrect cell factor set.
T011	⊗	Conductivity LO_LO: Value below configured monitoring limit
T012	⚠	Conductivity LO: Value below configured monitoring limit
T013	⚠	Conductivity HI: Value above configured monitoring limit
T014	⊗	Conductivity HI_HI: Value above configured monitoring limit
T015	⊗	Temperature Range: Measuring range exceeded. Possible causes: Sensor not/incorrectly connected, cable incorrectly connected/ faulty, range incorrectly specified
T016	⊗	Temperature LO_LO: Value below configured monitoring limit
T017	⚠	Temperature LO: Value below configured monitoring limit
T018	⚠	Temperature HI: Value above configured monitoring limit
T019	⊗	Temperature HI_HI: Value above configured monitoring limit
T020	⊗	Resistivity Range: Measuring range exceeded. Possible causes: Sensor not/incorrectly connected, cable incorrectly connected/ faulty, range incorrectly specified, incorrect cell factor set.
T021	⊗	Resistivity LO_LO: Value below configured monitoring limit
T022	⚠	Resistivity LO: Value below configured monitoring limit
T023	⚠	Resistivity HI: Value above configured monitoring limit
T024	⊗	Resistivity HI_HI: Value above configured monitoring limit
T025	⊗	Concentration Range: Measuring range exceeded. Possible causes: Sensor not/incorrectly connected, cable incorrectly connected/ faulty, range incorrectly specified, incorrect cell factor set.

CondI Messages

No.	Message Type	CondI Messages
T026	⊗	Concentration LO_LO: Value below configured monitoring limit
T027	⚠	Concentration LO: Value below configured monitoring limit
T028	⚠	Concentration HI: Value above configured monitoring limit
T029	⊗	Concentration HI_HI: Value above configured monitoring limit
T040	⊗	Salinity Range: Range exceeded. Possible causes: Sensor not/incorrectly connected, cable incorrectly connected/ faulty, incorrect cell factor set.
T041	⊗	Salinity LO_LO: Value below configured monitoring limit
T042	⚠	Salinity LO: Value below configured monitoring limit
T043	⚠	Salinity HI: Value above configured monitoring limit
T044	⊗	Salinity HI_HI: Value above configured monitoring limit
T045	⊗	Conductance Range: Value above range limit. Possible causes: Sensor not/incorrectly connected, incorrect sensor for range, cable faulty (short circuit).
T060	◈	Sad Sensoface: Primary Coil Sensor faulty: Replace the sensor.
T061	◈	Sad Sensoface: Secondary Coil Sensor faulty: Replace the sensor.
T063	◈	Sad Sensoface: Zero Point Adjust the sensor zero point.
T064	User-defined	Sad Sensoface: Cell Factor Incorrect cell factor set, incorrect adjustment: Repeat calibration/adjustment. Replace the sensor as required.
T070	⊗	TDS Range: Measuring range exceeded. Possible causes: Sensor not/incorrectly connected, cable incorrectly connected/ faulty, range incorrectly specified, incorrect cell factor set.
T071	⊗	TDS LO_LO: Value below configured monitoring limit
T072	⚠	TDS LO: Value below configured monitoring limit
T073	⚠	TDS HI: Value above configured monitoring limit
T074	⊗	TDS HI_HI: Value above configured monitoring limit
T090	User-defined	USP Limit: The configured USP limit was exceeded.
T091	User-defined	Reduced USP Limit: The configured reduced USP limit was exceeded.
T110	User-defined	CIP Counter: Configured number of CIP cycles exceeded: As required, calibrate/adjust sensor or replace.
T111	User-defined	SIP Counter: Configured number of SIP cycles exceeded: As required, calibrate/adjust sensor or replace.

CondI Messages

No.	Message Type	CondI Messages
T113	User-defined	Sensor Operating Time: Replace the sensor.
T120	⊗	Wrong Sensor (Sensor Check)
T121	⊗	Sensor Error (Factory Settings): Replace the sensor.
T122	◈	Sensor Memory (Cal Data): The calibration data is defective: Recalibrate/readjust sensor.
T123	◈	New Sensor, Adjustment Required
T124	◈	Sensor Date: The sensor data is implausible. Check and, as necessary, adjust the configuration.
T130	Info	SIP Cycle Counted
T131	Info	CIP Cycle Counted
T200	⚠	Reference temperature The reference temperature for temperature compensation is invalid.
T201	⚠	Temperature compensation
T202	⚠	TC Range (Maintenance Required): The measured value is at the limit of the permissible compensation range (table).
T203	⊗	TC Range (Failure): The measured value is outside the permissible compensation range (table).
T204	◈	Sensor Coding
T205	Info	Cal: Sensor Unstable: The drift criterion was not adhered to during calibration. Possible causes: improper calibration, sensor cable/connection faulty, sensor worn. Check the sensor and calibration and repeat as required. Otherwise, replace the sensor.
T254	Info	Module Reset

Decommissioning

Returns
If required, send the product in a clean condition and securely packed to your local contact, see www.knick.de.

Disposal
The local codes and regulations must be observed when disposing of the product.

Specifications

Sensor input	Interface for Memosens I, II, III (channels A, B, C) Channel B: Add-on function FW4400-014 Channels B+C: Add-on function FW4400-018
Power supply	U = 2.99 … 3.22 V, I_{max} = 6 mA
Explosion protection (MSU 4400X-180)	For entity parameters, see attachment to certificates or control drawings.
Interface	RS-485
Transfer rate	9,600 Bd
Max. cable length	100 m

Current input	0/4 ... 20 mA / 100 Ω e.g., for external pressure signal with OXY
Start/end of scale	Can be configured within range
Characteristic curve	Linear
Measurement error	< 1% current value + 0.1 mA (± 1 count, plus sensor error)

General data

RoHS conformity	According to EU directive 2011/65/EU

EMC	EN 61326-1, EN 61326-2-3, NAMUR NE 21
Emitted interference	Industrial applications[1)] (EN 55011 Group 1 Class A)
Immunity to interference	Industrial applications
Lightning protection	to EN 61000-4-5, Installation class 2

Rated operating conditions (module installed)	
Ambient temperature	Safe area: –20 ... 55 °C/-4 ... 131 °F Ex: –20 ... 50 °C/-4 ... 122 °F
Relative humidity	5 ... 95 %
Climatic class	3K5 according to EN 60721-3-3
Location class	C1 according to EN 60654-1

1) This equipment is not designed for domestic use, and is unable to guarantee adequate protection of the radio reception in such environments.

Specifications

Transport / storage temperature	–20 ... 70 °C / -4 ... 158 °F
Screw clamp connectors	Tightening torque 0.5 ... 0.6 Nm
	Single or stranded wires 0.2 ... 2.5 mm^2
Wiring	Stripping length max. 7 mm
	Temperature resistance > 75 °C / 167 °F
Power supply (KBUS)	6.8 … 8.0 V / ≤ 75 mA

Buffer Tables

Mettler-Toledo Buffer Table

°C	pH			
0	2,03	4,01	7,12	9,52
5	2,02	4,01	7,09	9,45
10	2,01	4,00	7,06	9,38
15	2,00	4,00	7,04	9,32
20	2,00	4,00	7,02	9,26
25	**2,00**	**4,01**	**7,00**	**9,21**
30	1,99	4,01	6,99	9,16
35	1,99	4,02	6,98	9,11
40	1,98	4,03	6,97	9,06
45	1,98	4,04	6,97	9,03
50	1,98	4,06	6,97	8,99
55	1,98	4,08	6,98	8,96
60	1,98	4,10	6,98	8,93
65	1,99	4,13	6,99	8,90
70	1,99	4,16	7,00	8,88
75	2,00	4,19	7,02	8,85
80	2,00	4,22	7,04	8,83
85	2,00	4,26	7,06	8,81
90	2,00	4,30	7,09	8,79
95	2,00	4,35	7,12	8,77

Buffer Tables

Buffer Table, Knick CaliMat

°C	pH				
Order No.	CS-P0200A/...	CS-P0400A/...	CS-P0700A/...	CS-P0900A/...	CS-P1200A/...
0	2.01	4.05	7.09	9.24	12.58
5	2.01	4.04	7.07	9.16	12.39
10	2.01	4.02	7.04	9.11	12.26
15	2.00	4.01	7.02	9.05	12.13
20	**2.00**	**4.00**	**7.00**	**9.00**	**12.00**
25	2.00	4.01	6.99	8.95	11.87
30	2.00	4.01	6.98	8.91	11.75
35	2.00	4.01	6.96	8.88	11.64
40	2.00	4.01	6.96	8.85	11.53
50	2.00	4.01	6.96	8.79	11.31
60	2.00	4.00	6.96	8.73	11.09
70	2.00	4.00	6.96	8.70	10.88
80	2.00	4.00	6.98	8.66	10.68
90	2.00	4.00	7.00	8.64	10.48

Buffer Table, DIN 19267

°C	pH				
0	1,08	4,67	6,89	9,48	13,95*
5	1,08	4,67	6,87	9,43	13,63*
10	1,09	4,66	6,84	9,37	13,37
15	1,09	4,66	6,82	9,32	13,16
20	1,09	4,65	6,80	3,27	12,96
25	**1,09**	**4,65**	**6,79**	**9,23**	**12,75**
30	1,10	4,65	6,78	9,18	12,61
35	1,10	4,65	6,77	9,13	12,45
40	1,10	4,66	6,76	9,09	12,29
45	1,10	4,67	6,76	9,04	12,09
50	1,11	4,68	6,76	9,00	11,98
55	1,11	4,69	6,76	8,96	11,79
60	1,11	4,70	6,76	8,92	11,69
65	1,11	4,71	6,76	8,90	11,56
70	1,11	4,72	6,76	8,88	11,43
75	1,11	4,73	6,77	8,86	11,31
80	1,12	4,75	6,78	8,85	11,19
85	1,12	4,77	6,79	8,83	11,09
90	1,13	4,79	6,80	8,82	10,99
95	1,13*	4,82*	6,81*	8,81*	10,89*

* extrapoliert / extrapolated / extrapolée

Buffer Tables

NIST Standard Buffer Table (DIN 19266: 2000-01)

°C	pH			
0				
5	1.668	4.004	6.950	9.392
10	1.670	4.001	6.922	9.331
15	1.672	4.001	6.900	9.277
20	1.676	4.003	6.880	9.228
25	**1.680**	**4.008**	**6.865**	**9.184**
30	1,685	4.015	6.853	9.144
37	1,694	4.028	6.841	9.095
40	1.697	4.036	6.837	9.076
45	1.704	4.049	6.834	9.046
50	1.712	4.064	6.833	9.018
55	1.715	4.075	6.834	9.985
60	1.723	4.091	6.836	8.962
70	1.743	4.126	6.845	8.921
80	1.766	4.164	6.859	8.885
90	1.792	4.205	6.877	8.850
95	1.806	4.227	6.886	8.833

Note:
The actual pH(S) values of the individual batches of the reference materials are documented in a certificate of an accredited laboratory. This certificate is supplied with the respective buffers. Only these pH(S) values shall be used as standard values for the secondary reference buffer materials. Correspondingly, this standard does not include a table with standard pH values for practical use. The table above only provides examples of pH(PS) values for orientation.

Buffer Tables

Buffer Table, NIST Technical Buffers

°C	pH		
0	4.00	7.14	10.30
5	4.00	7.10	10.23
10	4.00	7.04	10.11
15	4.00	7.04	10.11
20	4.00	7.02	10.05
25	4.01	7.00	10.00
30	4.01	6.99	9.96
35	4.02	6.98	9.92
40	4.03	6.98	9.88
45	4.05	6.98	9.85
50	4.06	6.98	9.82
55	4.07	6.98	9.79
60	4.09	6.99	9.76
65	4.09 *	6.99 *	9.76 *
70	4.09 *	6.99 *	9.76 *
75	4.09 *	6.99 *	9.76 *
80	4.09 *	6.99 *	9.76 *
85	4.09 *	6.99 *	9.76 *
90	4.09 *	6.99 *	9.76 *
95	4.09 *	6.99 *	9.76 *

* Values complemented

Buffer Tables

Buffer Table, Hamilton

°C	pH				
0	1,99	4,01	7,12	10,19	12,46
5	1,99	4,01	7,09	10,19	12,46
10	2,00	4,00	7,06	10,15	12,34
15	2,00	4,00	7,04	10,11	12,23
20	2,00	4,00	7,02	10,06	12,11
25	**2,00**	**4,01**	**7,00**	**10,01**	**12,00**
30	1,99	4,01	6,99	9,97	11,90
35	1,98	4,02	6,98	9,92	11,80
40	1,98	4,03	6,97	9,86	11,70
45	1,97	4,04	6,97	9,83	11,60
50	1,97	4,06	6,97	9,79	11,51
55	1,97	4,08	6,98	9,77	11,51
60	1,97	4,10	6,98	9,75	11,51
65	1,97	4,13	6,99	9,74	11,51
70	1,97	4,16	7,00	9,73	11,51
75	1,97	4,19	7,02	9,73	11,51
80	1,97	4,22	7,04	9,73	11,51
85	1,97	4,26	7,06	9,74	11,51
90	1,97	4,30	7,09	9,75	11,51
95	1,97	4,35	7,09	9,75	11,51

Buffer Tables

Buffer Table, Kraft

℃	pH				
0	2.01	4.05	7.13	9.24	11.47*
5	2.01	4.04	7.07	9.16	11.47
10	2.01	4.02	7.05	9.11	11.31
15	2.00	4.01	7.02	9.05	11.15
20	**2.00**	**4.00**	**7.00**	**9.00**	**11.00**
25	2.00	4.01	6.98	8.95	10.85
30	2.00	4.01	6.98	8.91	10.71
35	2.00	4.01	6.96	8.88	10.57
40	2.00	4.01	6.95	8.85	10.44
45	2.00	4.01	6.95	8.82	10.31
50	2.00	4.00	6.95	8.79	10.18
55	2.00	4.00	6.95	8.76	10.18*
60	2.00	4.00	6.96	8.73	10.18*
65	2.00	4.00	6.96	8.72	10.18*
70	2.01	4.00	6.96	8.70	10.18*
75	2.01	4.00	6.96	8.68	10.18*
80	2.01	4.00	6.97	8.66	10.18*
85	2.01	4.00	6.98	8.65	10.18*
90	2.01	4.00	7.00	8.64	10.18*
95	2.01	4.00	7.02	8.64	10.18*

* Values complemented

Buffer Tables

Buffer Table, Hamilton A

°C	pH				
0	1.99	4.01	7.12	9.31	11.42
5	1.99	4.01	7.09	9.24	11.33
10	2.00	4.00	7.06	9.17	11.25
15	2.00	4.00	7.04	9.11	11.16
20	2.00	4.00	7.02	9.05	11.07
25	**2.00**	**4.01**	**7.00**	**9.00**	**11.00**
30	1.99	4.01	6.99	8.95	10.93
35	1.98	4.02	6.98	8.90	10.86
40	1.98	4.03	6.97	8.85	10.80
45	1.97	4.04	6.97	8.82	10.73
50	1.97	4.05	6.97	8.78	10.67
55	1.98	4.06	6.98	8.75	10.61
60	1.98	4.08	6.98	8.72	10.55
65	1.98	4.10	6.99	8.70	10.49
70	1.99	4.12	7.00	8.67	10.43
75	1.99	4.14	7.02	8.64	10.38
80	2.00	4.16	7.04	8.62	10.33
85	2.00	4.18	7.06	8.60	10.28
90	2.00	4.21	7.09	8.58	10.23
95	2.00	4.24	7.12	8.56	10.18

Buffer Tables

Buffer Table, Hamilton B

℃	pH				
0	1.99	4.01	6.03	9.31	11.42
5	1.99	4.01	6.02	9.24	11.33
10	2.00	4.00	6.01	9.17	11.25
15	2.00	4.00	6.00	9.11	11.16
20	2.00	4.00	6.00	9.05	11.07
25	**2.00**	**4.01**	**6.00**	**9.00**	**11.00**
30	1.99	4.01	6.00	8.95	10.93
35	1.98	4.02	6.00	8.90	10.86
40	1.98	4.03	6.01	8.85	10.80
45	1.97	4.04	6.02	8.82	10.73
50	1.97	4.05	6.04	8.78	10.67
55	1.98	4.06	6.06	8.75	10.61
60	1.98	4.08	6.09	8.72	10.55
65	1.98	4.10	6.11	8.70	10.49
70	1.99	4.12	6.13	8.67	10.43
75	1.99	4.14	6.15	8.64	10.38
80	2.00	4.16	6.18	8.62	10.33
85	2.00	4.18	6.21	8.60	10.28
90	2.00	4.21	6.24	8.58	10.23
95	2.00	4.24	6.27	8.56	10.18

Buffer Tables

Buffer Table, HACH

°C	pH		
0	4,00	7,118	10,30
5	4,00	7,087	10,23
10	4,00	7,059	10,17
15	4,00	7,036	10,11
20	4,00	7,016	10,05
25	**4,01**	**7,000**	**10,00**
30	4,01	6,987	9,96
35	4,02	6,977	9,92
40	4,03	6,970	9,88
45	4,05	6,965	9,85
50	4,06	6,964	9,82
55	4,07	6,965	9,79
60	4,09	6,968	9,76
65	4,10	6,980	9,71
70	4,12	7,000	9,66
75	4,14	7,020	9,63
80	4,16	7,040	9,59
85	4,18	7,060	9,56
90	4,21	7,090	9,52
95	4,24	7,120	9,48

Buffer Table, Ciba

°C	pH			
0	2,04	4,00	7,10	10,30
5	2,09	4,02	7,08	10,21
10	2,07	4,00	7,05	10,14
15	2,08	4,00	7,02	10,06
20	2,09	4,01	6,98	9,99
25	2,08	4,02	6,98	9,95
30	2,06	4,00	6,96	9,89
35	2,06	4,01	6,95	9,85
40	2,07	4,02	6,94	9,81
45	2,06	4,03	6,93	9,77
50	2,06	4,04	6,93	9,73
55	2,05	4,05	6,91	9,68
60	2,08	4,10	6,93	9,66
65	2,07*	4,10*	6,92*	9,61*
70	2,07	4,11	6,92	9,57
75	2,04*	4,13*	6,92*	9,54*
80	2,02	4,15	6,93	9,52
85	2,03*	4,17*	6,95*	9,47*
90	2,04	4,20	6,97	9,43
95	2,05*	4,22*	6,99*	9,38*

* extrapolated

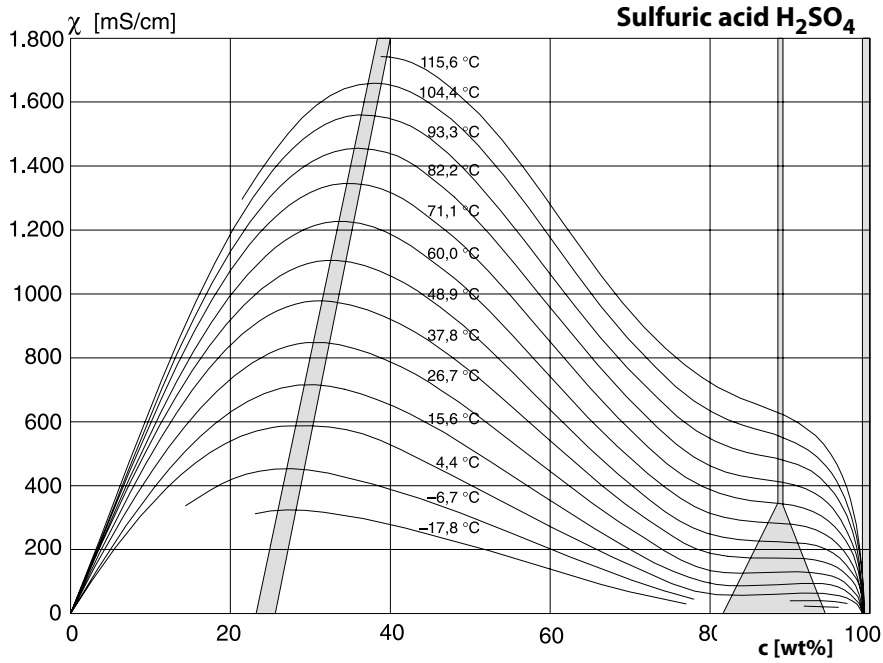
Buffer Tables

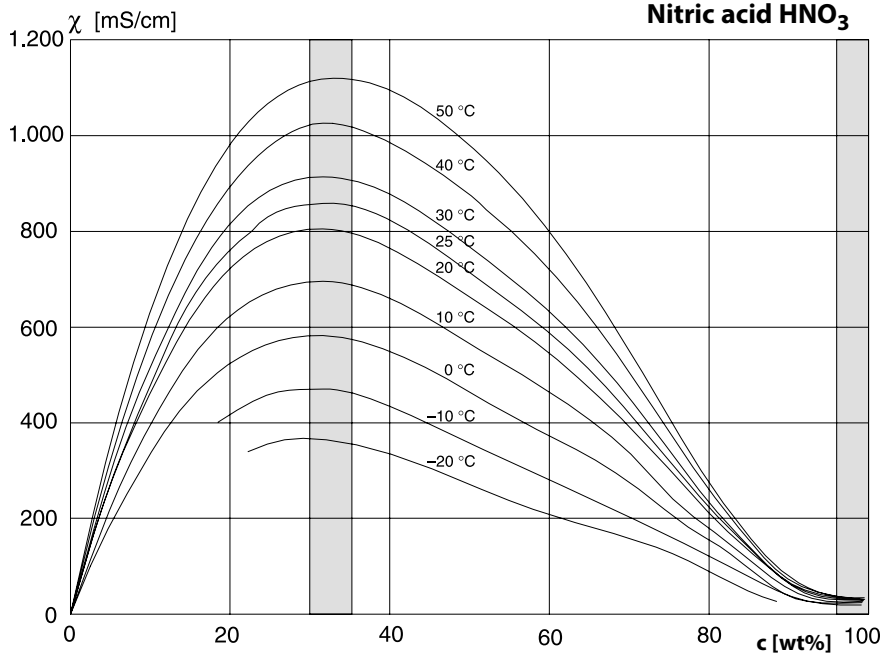
Buffer Table, Reagecon

°C	pH				
0°C	*2,01	*4,01	*7,07	*9,18	*12,54
5°C	*2,01	*4,01	*7,07	*9,18	*12,54
10°C	2,01	4,00	7,07	9,18	12,54
15°C	2,01	4,00	7,04	9,12	12,36
20°C	2,01	4,00	7,02	9,06	12,17
25°C	**2,00**	**4,00**	**7,00**	**9,00**	**12,00**
30°C	1,99	4,01	6,99	8,95	11,81
35°C	2,00	4,02	6,98	8,90	11,63
40°C	2,01	4,03	6,97	8,86	11,47
45°C	2,01	4,04	6,97	8,83	11,39
50°C	2,00	4,05	6,96	8,79	11,30
55°C	2,00	4,07	6,96	8,77	11,13
60°C	2,00	4,08	6,96	8,74	10,95
65°C	*2,00	*4,10	*6,99	*8,70	*10,95
70°C	*2,00	*4,12	*7,00	*8,67	*10,95
75°C	*2,00	*4,14	*7,02	*8,64	*10,95
80°C	*2,00	*4,16	*7,04	*8,62	*10,95
85°C	*2,00	*4,18	*7,06	*8,60	*10,95
90°C	*2,00	*4,21	*7,09	*8,58	*10,95
95°C	*2,00	*4,24	*7,12	*8,56	*10,95

* Values complemented

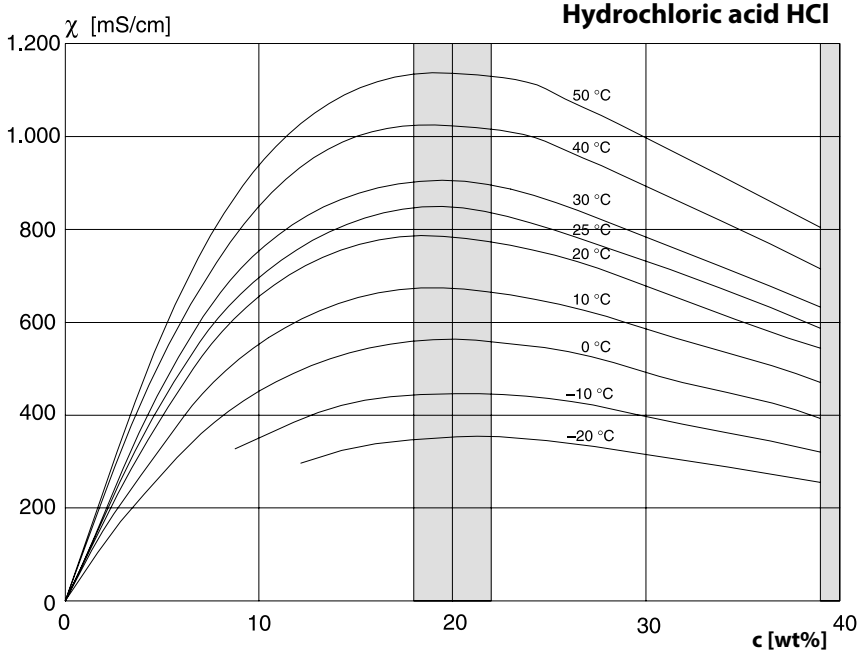
Conductivity Concentration Curves



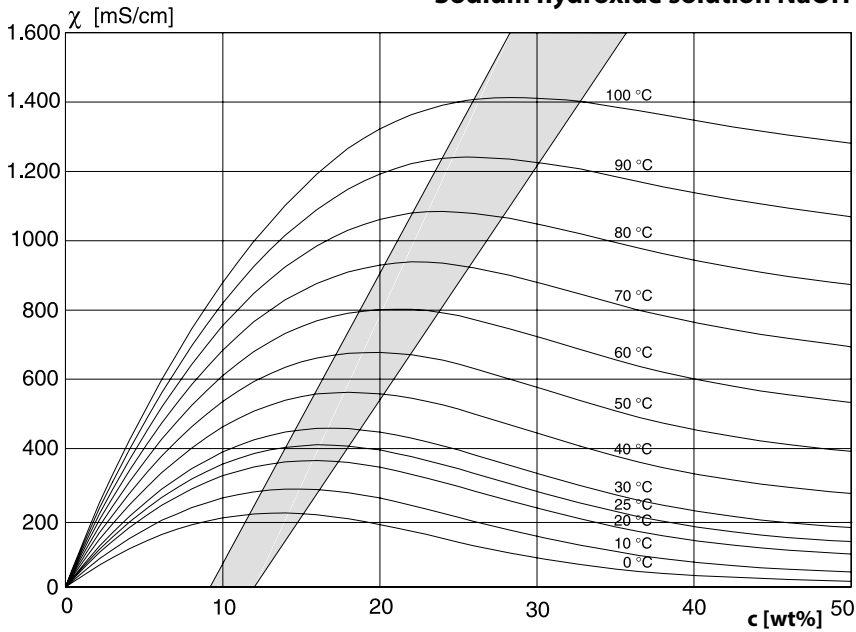


Conductivity Concentration Curves

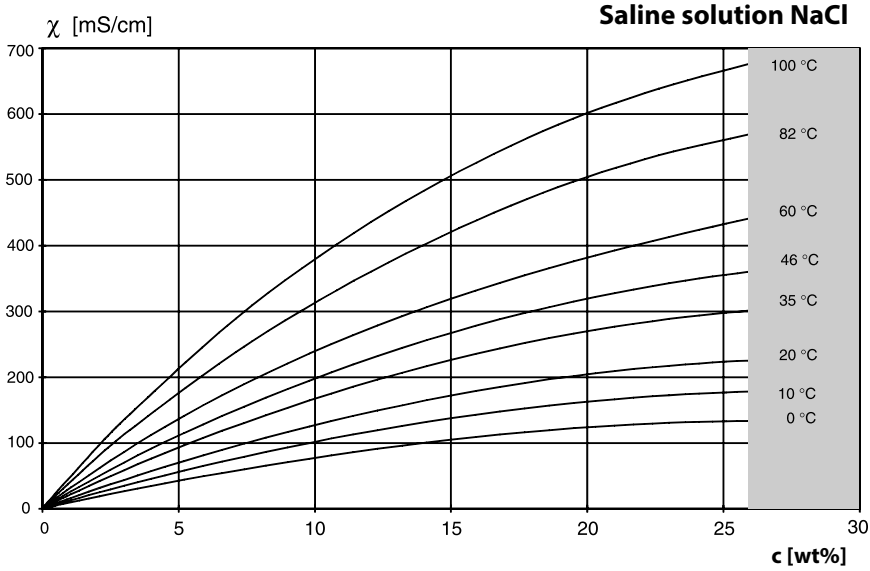
Hydrochloric acid HCl

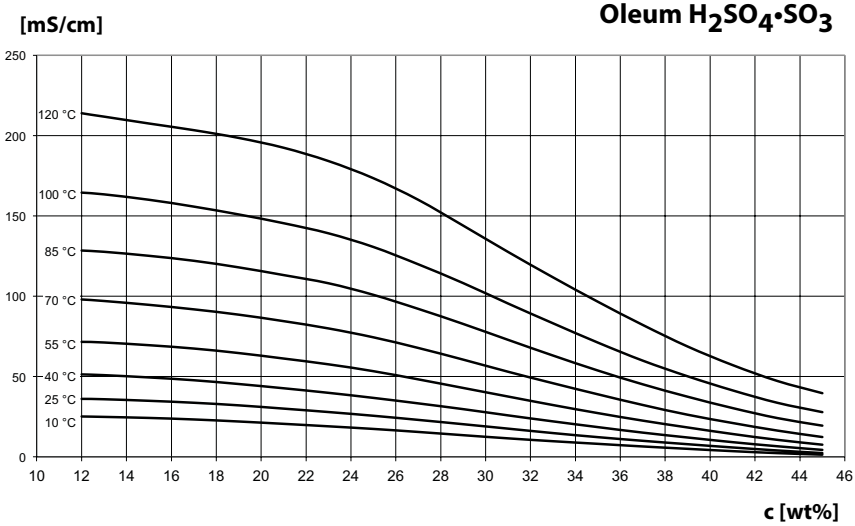


Sodium hydroxide solution NaOH



Conductivity Concentration Curves





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MSU 4400(X)-180 Module

MSU 4400(X)-180 Module

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Translation of the original instructions

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under the corresponding product description.

100772 TA-201.180-KNEN02