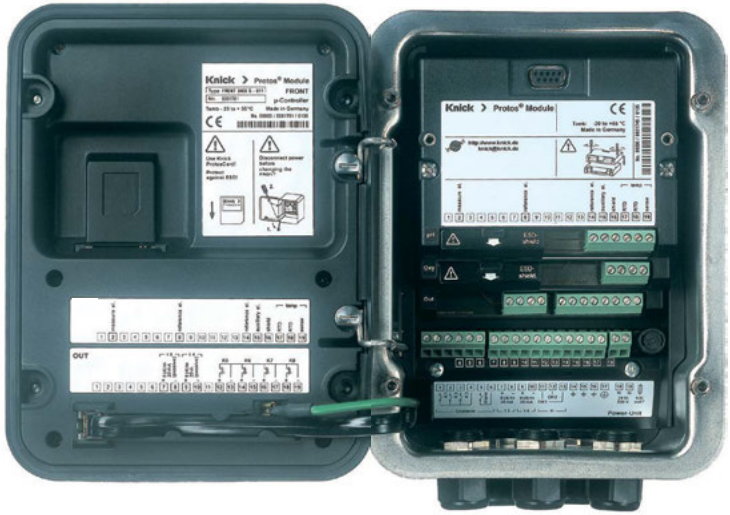
Knick

Protos II 4400(X) / Protos 3400(X)
Process Analysis System

User Manual

Protos PH 3400(X)-035 Measuring Module
For Simultaneous Measurement of
pH Values, ORP and Temperature



Latest Product Information: www.knick.de

Returns

Clean and securely package the product before returning it to Knick Elektronische Messgeräte GmbH & Co. KG if required.
If there has been contact with hazardous substances, the product must be decontaminated or disinfected prior to shipment. The consignment must always be accompanied by a corresponding return form to prevent service employees being exposed to potential hazards.
Further information can be found at www.knick.de.

Disposal

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

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Protos PH 3400(X)-035 Module

Intended Use

The module is used for the simultaneous measurement of pH, ORP, and temperature with analog glass electrodes or ISM sensors[1)] (Intelligent Sensor Management).

The PH 3400X-035 module is intended for operation in locations subject to explosion hazards which require equipment of Group II, device category 2(1), gas/dust.

1) With Protos II 4400(X) from FRONT firmware version 01.01.00

Safety Instructions

Operation in Explosive Atmospheres: PH 3400X-035 Module
The module is approved for operation in explosive atmospheres.
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 explosive atmospheres. 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!** Possible impairment of explosion protection.

- Modules which have already been used shall be subjected to a professional routine test before they may be operated in another type of protection.
- Prior to commissioning, the operating company must verify the intrinsic safety in accordance with the installation regulations of IEC 60079-14 for the complete interconnection of all equipment involved, including the connecting cables.
- The interconnection of Ex and non-Ex modules (mixed assembly) is not permitted.
- In hazardous locations the device shall only be cleaned with a damp cloth to prevent electrostatic charging.

Maintenance
The 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.

Firmware Version

Module Firmware PH 3400(X)-035: firmware version 3.x

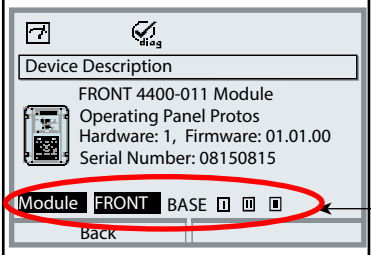
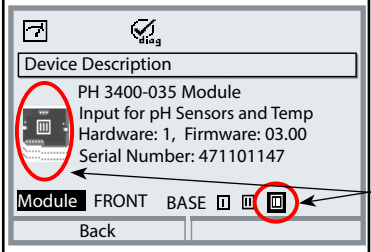
Module Compatibility	PH 3400-035	PH 3400X-035
Protos 3400 from FRONT firmware version 6.0	x	
Protos 3400X from FRONT firmware version 6.0		x
Protos II 4400 from FRONT firmware version 01.00.00	x	
Protos II 4400X from FRONT firmware version 01.00.00		x

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

Query device/module firmware

When the analyzer is in measuring mode:

Press **menu** key, open 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 version and device options. Select the different modules (FRONT, BASE, slots 1 - 3) using the arrow keys.
		**Query module firmware** Module PH 3400-035, hardware and firmware version, serial number – here installed in slot 3.

Note: The display may vary depending on the device version.

ISM – Intelligent Sensor Management

The module allows the connection of ISM sensors.
During pH measurement it is still possible to continuously monitor the glass and reference electrode.
ISM sensors have an "electronic datasheet" which allows the storage of additional operating parameters such as calibration date and settings directly in the sensor.
Afer being connected to the measuiring module, the ISM sensor is recognized and is ready for measurement.

Information Available in the ISM Sensor
The following information is stored in the sensor: manufacturer, production date, sensor description, application data and original calibration data, as well as information on predictive maintenance such as the load index and number of CIP/SIP cycles.
Statistical data inform on the product life cycle of the sensor: data of the last 3 calibrations/adjustments, calibration/adjustment record, buffer values, voltages, temperature, response time, glass and reference impedance.

Diagnostics Features
- Load diagram [1)]
- Wear indication
- Adaptive calibration timer
- Statistics

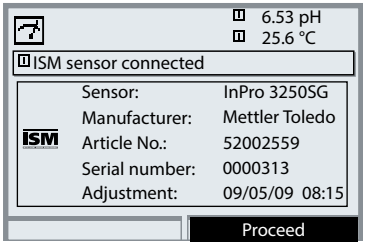
Taking over the minimum/maximum temperature
The maximum temperature range is stored in the ISM sensor. When "Sensor monitoring Auto" has been selected, the value pair for the maximum + minimum temperature is automatically taken over from the sensor.

1) With Protos 3400(X)

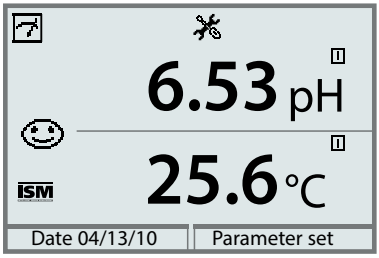
ISM

Plug and Measure

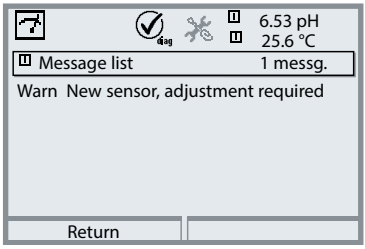
Thanks to the "Plug & Measure" method, an ISM sensor is immediately identified after being connected:



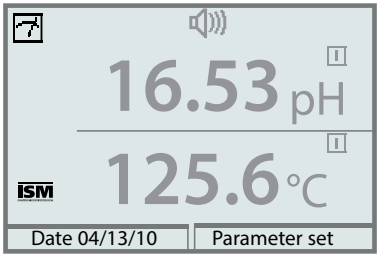
All sensor-typical parameters are automatically sent to the analyzer.
These are, for example, the measurement range, zero and slope of the sensor, but also the type of temperature probe. Without any further parameter setting, measurement starts at once, the measuring temperature is simultaneously detected.
With "Plug&Measure", premeasured ISM sensors can immediately be used for measurement without previous calibration.



The ISM icon is displayed as long as an ISM sensor is connected.
When the ISM sensor has not been adjusted, the "maintenance request" icon is displayed.



A new entry is added to the message list of the Diagnostics menu:
Warn New sensor, adjustment required

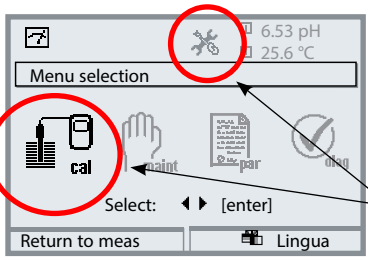


Failure message (incorrect meas. values)
Measured value, alarm icon, and module slot identifier are flashing.
The flashing means:
NOTICE! The displayed value is no "valid" measured value!

Note: The display may vary depending on the device version.

1) With Protos 3400(X)

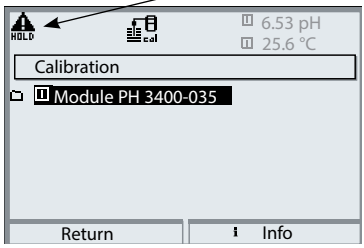
Prior to first use, an ISM sensor must be calibrated:



To open calibration
Press **menu** key to select menu.
The measured values (upper right corner) and the "alarm" and "calibration" icons are flashing. (The analyzer classifies the values as "invalid" because of the missing calibration).

Select calibration using arrow keys, confirm with **enter**. Passcode: 1147.
(To change passcode, select: Parameter setting > System control > Passcode entry).
After passcode entry, the system is in "function check (HOLD) mode: Current outputs and relay contacts behave as configured [1)] and supply either the last measured value or a fixed value until the Calibration menu is exited.

The function check (HOLD) mode is indicated by the "Hold" icon (upper left of display).

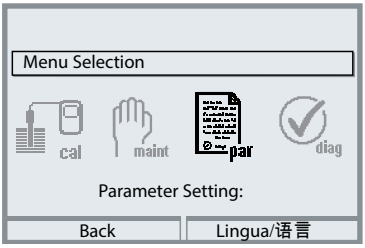


Select module using arrow keys, confirm with **enter**.

Note: The display may vary depending on the device version.

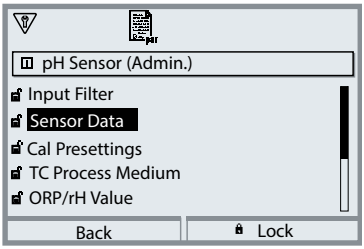
1) The current outputs / relay contacts are configured in the BASE module or the communication modules (OUT).

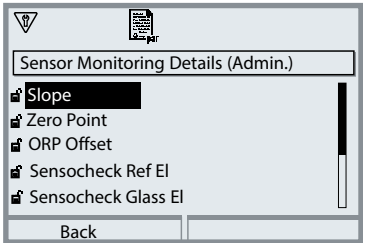
Note: The display may vary depending on the device version.



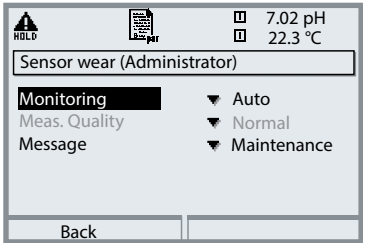
Since ISM sensors have an "electronic datasheet", many parameters are already provided by the sensor and automatically taken over by the analyzer.

The process-related parameters are specified in the menu
Parameter Setting > PH 3400(X)-035 Module > ISM pH > Sensor Data



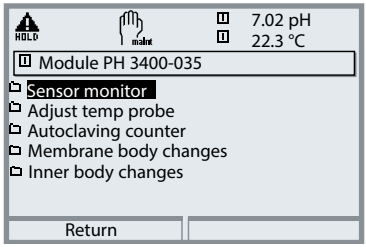


Sensor Monitoring Details
When an ISM sensor is connected, the values for slope, zero, reference and glass impedance, response time, and max./min. temperatures are automatically read by the module. Individual specifications are not overwritten by the ISM data. Additional specifications are required for CIP/SIP counter, autoclaving counter, and sensor operating time. The tolerance limits are displayed in gray.

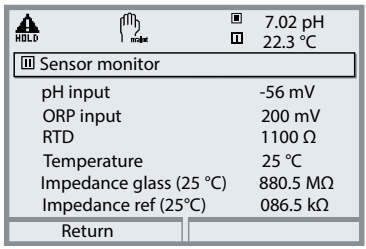


Sensor Wear
Mit Protos 3400(X) and Sensor monitoring details > Load matrix selected, additional specifications can be set here.

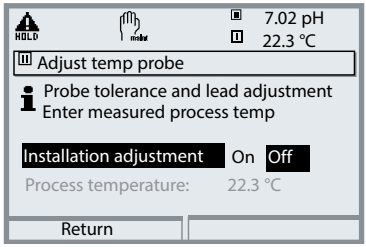
Note: The display may vary depending on the device version.



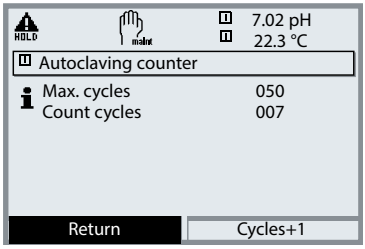
ISM sensors provide important tools for predictive maintenance.
The settings are made in the Maintenance menu > PH 3400(X)-035 Module > ISM pH.



Sensor Monitor
for validation of sensor and complete measured-value processing.

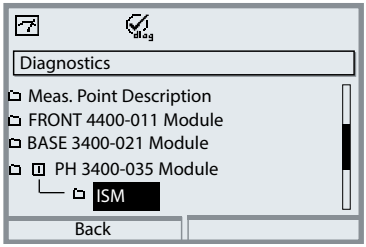


Temp Probe Adjustment [1)]
This function is used for compensating for the individual tolerance of the temperature probe and the influence of the lead resistances. Adjustment may only be carried out after the process temperature is precisely measured using a calibrated reference thermometer. The measurement error of the reference thermometer should be less than 0.1 °C. Adjustment without precise measurement might result in considerable deviations of the measured value display!

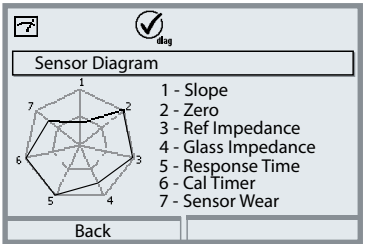


Autoclaving Counter
When setting the sensor data, the maximum number of autoclaving procedures permitted must be specified. Then, each cycle can be recorded in the Maintenance menu. This shows how many autoclaving cycles are still permitted.

1) With Protos II 4400(X) in the Calibration menu, with Protos 3400(X) in the Maintenance menu.

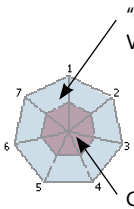


Diagnostics menu > PH 3400(X)-035 Module > ISM pH



Sensor Diagram

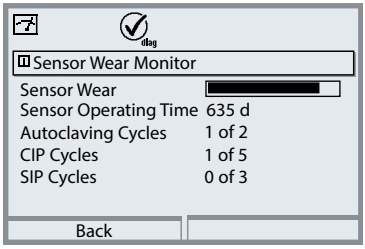
- Slope
- Zero
- Reference impedance
- Glass impedance
- Response time
- Calibration timer
- Sensor wear



"Outer circle"
Value within tolerance

Critical range –
"inner circle"
Value out of tolerance
The tolerance can be modified as required!

The measured values are continuously monitored during the measurement process. The sensor diagram provides at-a-glance information about critical parameters. If a tolerance limit has been exceeded, the respective parameter is flashing.
Values in gray: Monitoring switched off.



Sensor Wear Monitor

The sensor wear monitor shows the current sensor wear.
In addition, the sensor operating time as well as the number of executed autoclaving, CIP, or SIP cycles are indicated.

Note: The display may vary depending on the device version.

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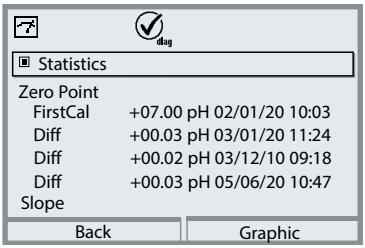
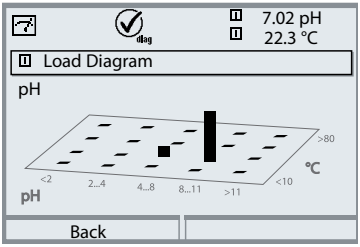


Statistics

Statistical data inform on the product life cycle of the sensor: Indication of sensor data for the first adjustment and the last three calibrations/ adjustments compared to the first adjustment (date and time of first adjustment, zero and slope, impedance of glass and reference electrode, response time). These data can be used to evaluate the behavior of the sensor over the operating time.
With the right softkey, you can choose between graphical display and listing.



Load Diagram [1)]

The parameters with "stressing" effect on digital sensors are represented as a 3D matrix. The height of the bar indicates the duration of the load. This way you can see at a glance to what extent the sensor has been exposed to stress.
Prerequisite: The “Load matrix” mode has been selected in Parameter setting > Sensor monitoring details, see p. 47.

1) With Protos 3400(X)

CIP/SIP Cycles

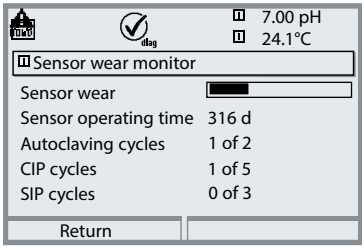
CIP (Cleaning in Place) / SIP (Sterilization in Place)

CIP/SIP cycles are used for cleaning or sterilizing the process-wetted parts in the process. They are performed for biotech applications, for example. Depending on the application, one (alkaline solution, water) or more chemicals (alkaline solution, water, acidic solution, water) are used.
The temperatures for CIP are around 80 °C/176 °F, for SIP around 110 °C/230 °F. These procedures extremely stress the sensors.
ISM sensors can release a message when a preset number of CIP/SIP cycles is exceeded. This allows replacing the sensor in time.

Example of CIP cycle:
The device automatically recognizes the CIP and SIP cycles and correspondingly increments the counter. The user can specify the max. number of cycles and decide whether a message is to be generated when this number is exceeded. These data are not overwritten even after sensor replacement.
The number of CIP cycles is shown in the sensor wear monitor of the Diagnostics menu when an individual max value has been specified.

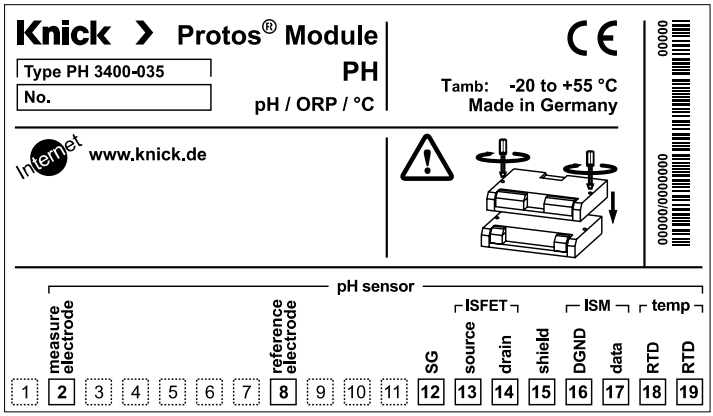
Default values for the counters (for evaluating the sensor wear):
CIP = 0
SIP = 300
Autoclaving counter = 500 hours for one cycle

Note: The display may vary depending on the device version.



Note:
The counters are incremented no earlier than 2 hours after start of the cycle, even if the cycle itself has already been terminated.

Terminal Plate PH 3400-035 Module



Attaching the terminal plates

The terminal plates of the lower modules can be sticked to the inner side of the door.
This facilitates maintenance and service.

Installing 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.

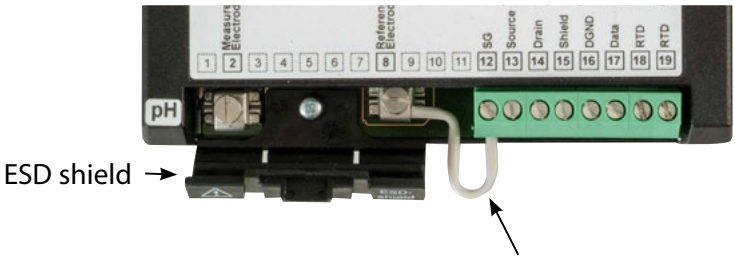
NOTICE! Strip the insulation from the wires using a suitable tool to prevent damage.

1) Switch off the power supply to the device.
2) Open the device (loosen the 4 screws on the front).
3) Plug the module into the slot (D-SUB connector), see figure.
4) Tighten the module's fastening screws.
5) Open the ESD shield (covering terminals 2 and 8).
6) Connect the sensor and separate temperature probe if necessary, see "Wiring Examples".
   Note: To avoid interferences, the cable shielding must be completely covered by the ESD shield.
7) Fit the ESD shield back into place (covering terminals 2 and 8).
8) Check whether all connections are correctly wired.
9) Close the device by tightening the screws on the front.
10) 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 the specifications of the basic unit).
Insert blanking plugs or sealing inserts if necessary.

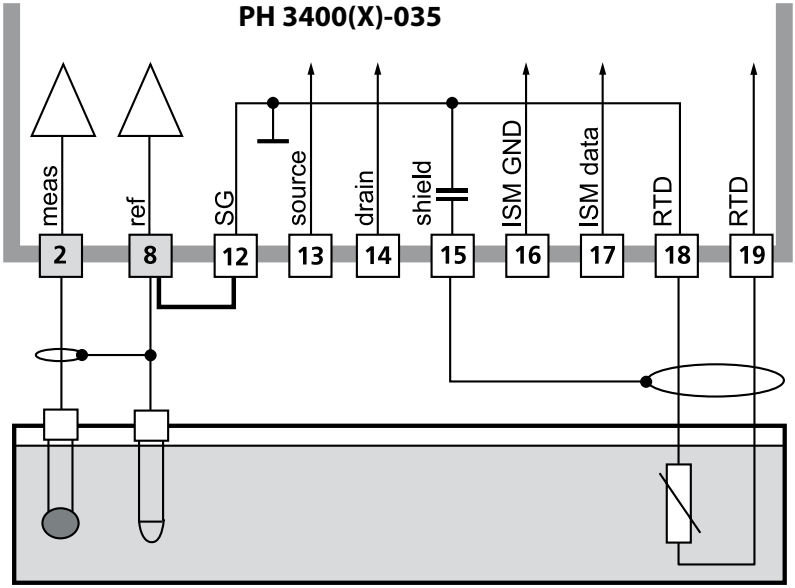
Wiring Examples

Note: Be sure to connect the shielding properly!



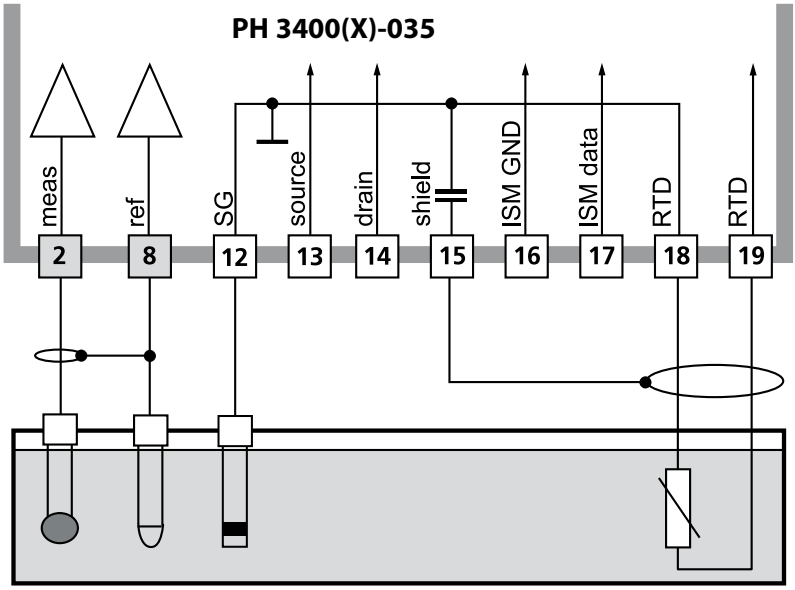
Note: Terminal 12 (Solution Ground SG) must always be wired. Otherwise set a jumper.

pH measurement with Sensocheck of glass electrode



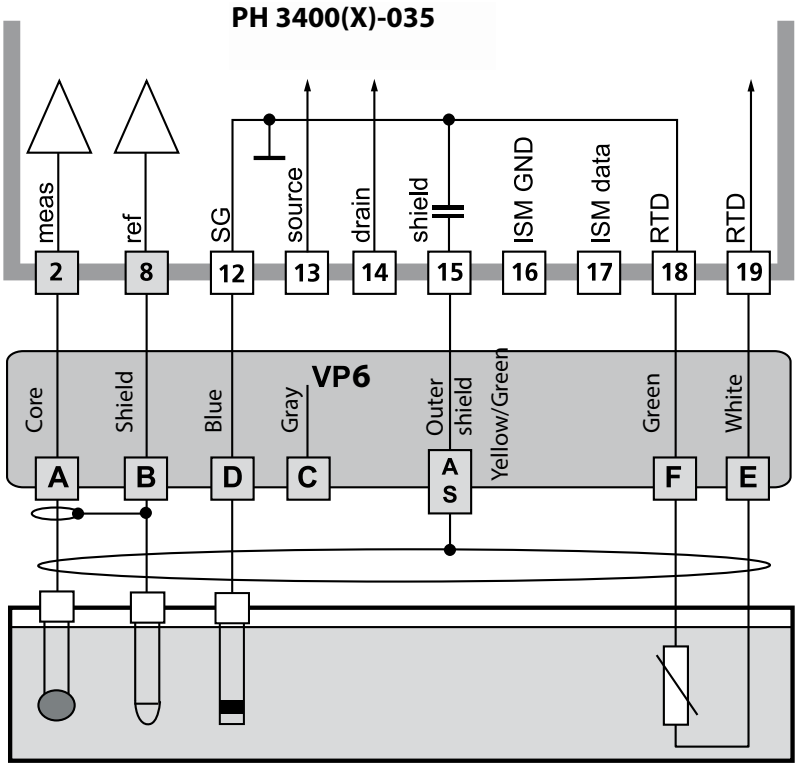
Wiring Examples

Simultaneous pH and ORP measurement with
Sensocheck of glass and reference electrode



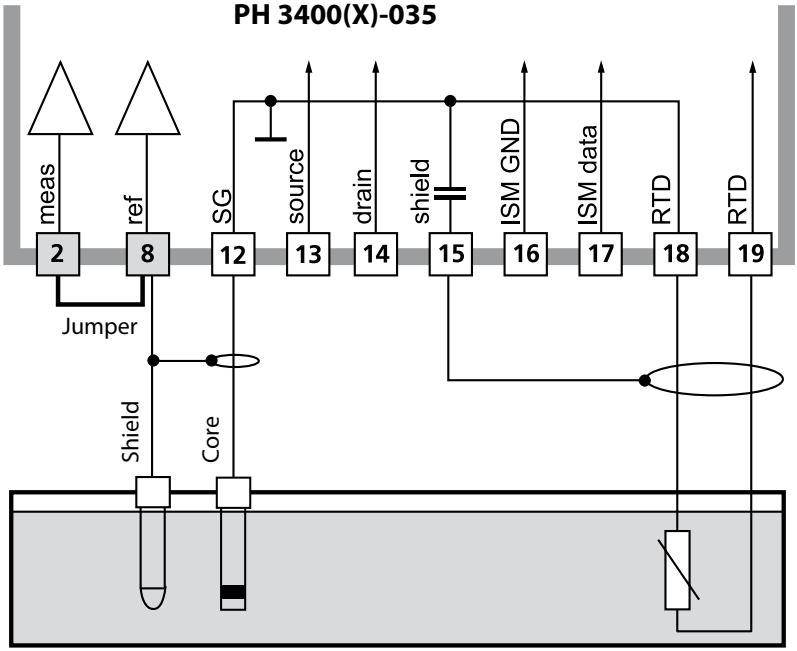
Wiring Examples

pH/ORP measurement with glass electrode
VP connection, Sensocheck of glass and reference electrode



Wiring Examples

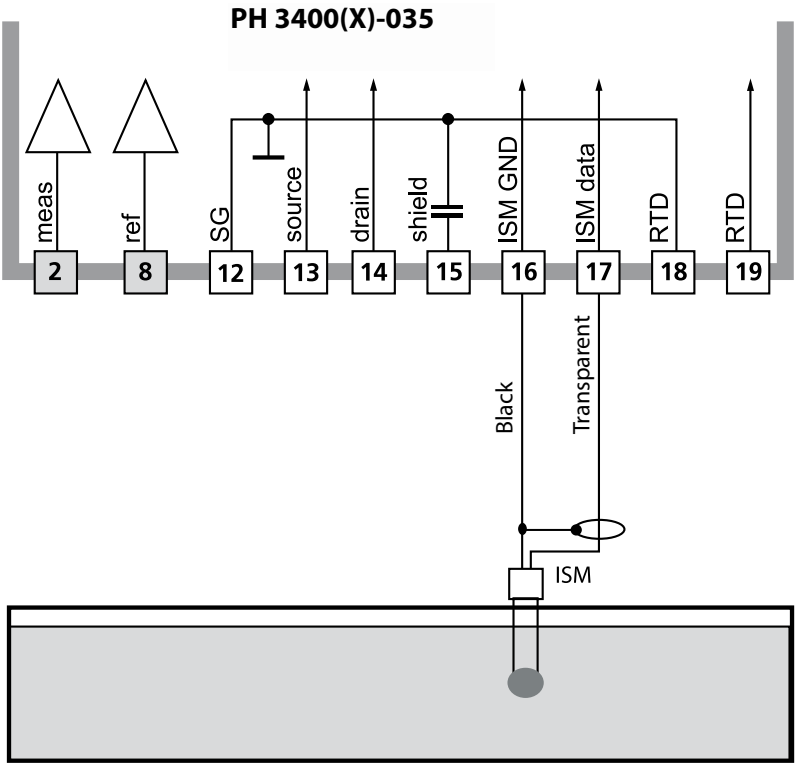
ORP measurement
with Sensocheck of reference electrode
Note: Switch off glass electrode messages!



Sensor SE 564X/1-NS8N

Wiring Examples

Connection of ISM sensor



Calibration / Adjustment

Note: Function check (HOLD) active for the currently calibrated module
Current outputs and relay contacts behave as configured

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

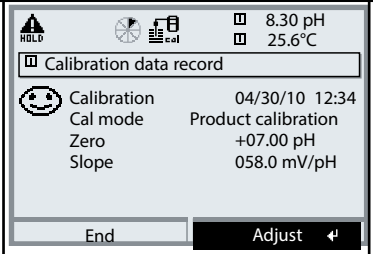
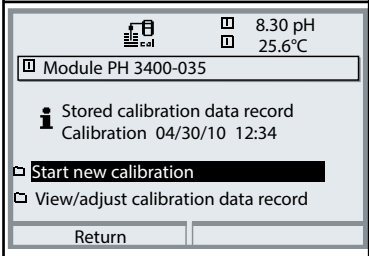
NOTICE!
Without adjustment every pH meter delivers an imprecise or wrong output value! Every pH electrode has its individual zero point and its individual slope. Both values are altered by aging and wear.
To determine the correct pH value, the pH meter must be adjusted to the electrode. The analyzer corrects the voltage delivered by the electrode with regard to electrode zero and slope and displays it as the pH value.
Be sure to perform an adjustment after having replaced the electrode!

Procedure
First, a calibration is performed to detect the deviations of the electrode (zero, slope). To do so, the electrode is immersed in buffer solutions whose pH value is exactly known. The measuring module measures the electrode voltages and the buffer solution temperature and automatically calculates the electrode zero and slope. These data are stored in a calibration record. By "Adjustment" the determined calibration data can be used for correction (see following page).

Parameters determined by calibration

Zero	is the pH value at which the pH electrode outputs the voltage 0 mV. It is different for each electrode and changes with age and wear.
Temperature	of the process solution must be detected since pH measurement is temperature-dependent. Many electrodes have an integrated temperature probe.
Slope	of an electrode is the voltage change per pH unit. For an ideal pH electrode, it lies at -59.2 mV/pH.

Adjustment
Adjustment means that the values determined by a calibration are taken over. The values determined for zero and slope are entered in the calibration record. (Cal record can be opened in the Diagnostics menu for the module). These values are only effective for calculating the measured variables when the calibration has been terminated with an adjustment. A passcode ensures that an adjustment can only be performed by an authorized person (Administrator). The Operator can check the current sensor data by a calibration and inform the Administrator when there are deviations. You can use the add-on function SW3400-107 [1)] for granting access rights (passcodes) and for AuditTrail (continuous data recording and backup according to FDA 21 CFR Part 11).

Menu	Display	Action
cal		**Administrator** With the corresponding access rights, the device can immediately be adjusted after calibration. The calibration values are taken over for calculating the measured variables.
		**Operator** (without administrator rights) After calibration, change to measuring mode. Inform Administrator. When opening the menu (Calibration, respective module), the Administrator sees all data of the last calibration and can take over the values or perform a new calibration.

Note: The display may vary depending on the device version.

1) with Protos 3400(X)

Calibration / Adjustment

Calibration Methods

One-Point Calibration
The electrode is calibrated with one buffer solution only.
Here, only the electrode zero point is detected and taken into account by the Protos. One-point calibration is appropriate and permissible whenever the measured values lie near the electrode zero point so that slope changes do not have much of an impact.

Two-Point Calibration
The electrode is calibrated with two buffer solutions.
In that case, zero point and slope of the electrode can be detected and taken into account by the Protos. Two-point calibration is required if

- the electrode has been replaced
- the measured pH values cover a wide range
- there is great difference between the measured pH value and the electrode zero
- the pH measurement must be very accurate
- the electrode is exposed to extreme wear.

Three-Point Calibration
The electrode is calibrated with three buffer solutions.
Zero and slope are calculated using a line of best fit according to DIN 19268.

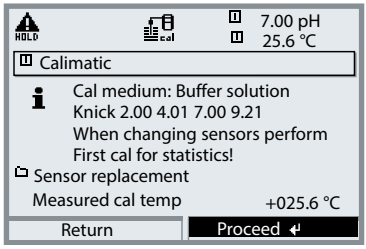
Replacing the Sensor – First Adjustment [1)]
Each time you replace the sensor, you should perform a "First Adjustment". With the first adjustment, the sensor data are stored as reference values for the sensor statistics. The "Statistics" menu of Diagnostics shows the deviations of zero, slope, glass and reference electrode impedance, and response time of the last three adjustments with respect to the reference values of the first adjustment. This allows evaluation of the drift behavior and aging of the sensor.

1) ISM with Protos II 4400(X)

Temperature Compensation During Calibration

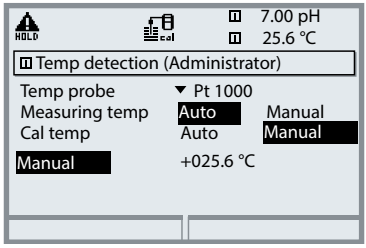
There are two important reasons for determining the temperature of the buffer solution:
The slope of the pH electrode is temperature-dependent. Therefore the measured voltage must be corrected by the temperature influence.
The pH value of the buffer solution is temperature-dependent. For calibration, the buffer solution temperature must therefore be known in order to choose the actual pH value from the buffer table.
During parameter setting you define whether cal temperature is measured automatically or must be entered manually:

Automatic Temperature Compensation



For automatic cal temp detection, the Protos measures the temperature of the buffer solution with a temperature probe (Pt 100/ Pt 1000/ NTC 30 kΩ/NTC 8.55 kΩ). If you work with automatic temperature compensation during calibration, a temperature probe connected to the temperature input of the Protos must be in the buffer solution! Otherwise, you must select manual entry of calibration temperature. When ”Cal temp automatic” is set, ”Measured cal temp” appears in the menu.

Manual Temperature Compensation

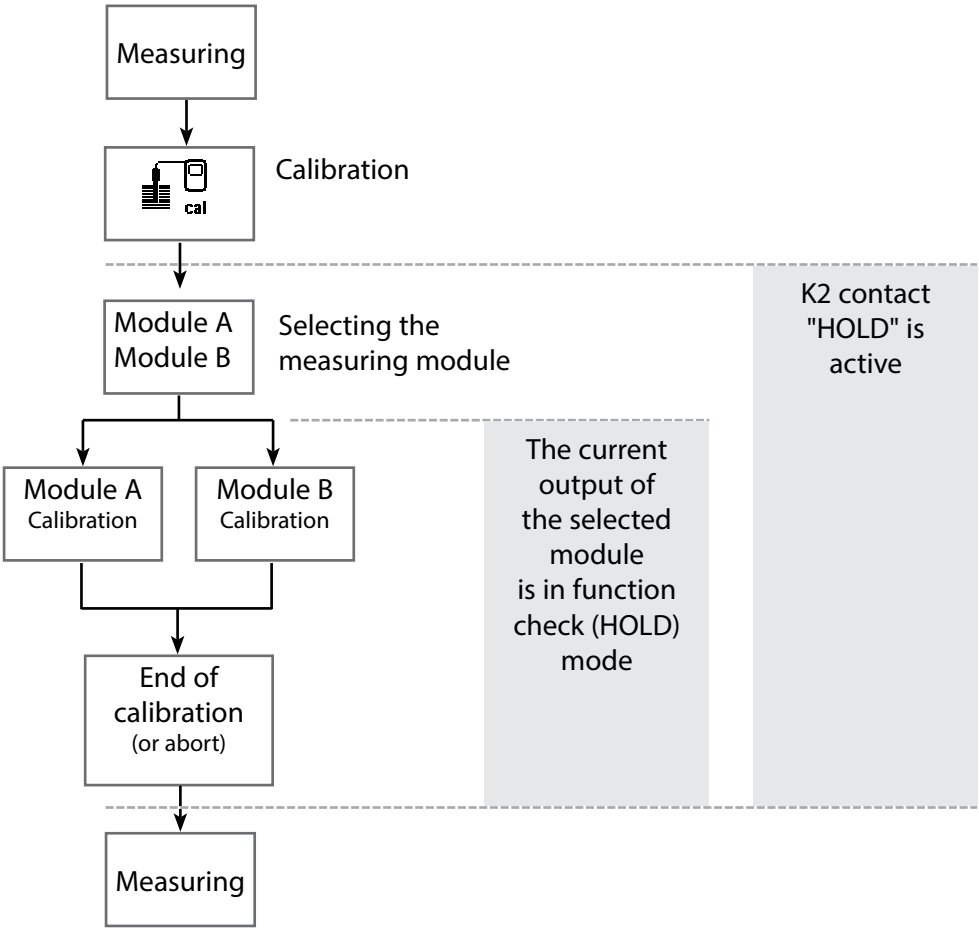


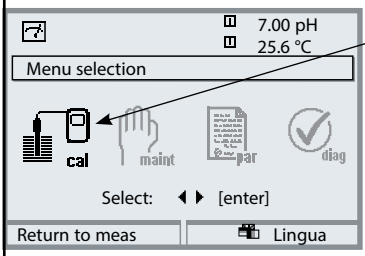
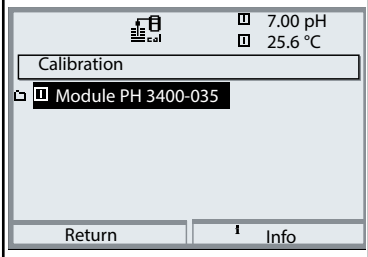
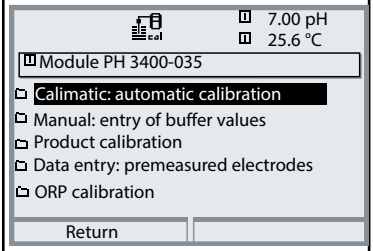
The temperature of the buffer solution must be entered manually in the Parameter setting menu at "Parameter setting > [PH module] > Sensor data > Temp detection >Cal temp > Manual". Temperature measurement is performed using a glass thermometer, for example.

Note: The display may vary depending on the device version.

HOLD Function During Calibration

Behavior of the signal and relay outputs during calibration



Menu	Display	Action
		**Open calibration** Press **menu** key to select menu. Select calibration using arrow keys, press **enter** to confirm, passcode 1147 (To change passcode, select: Parameter setting > System control > Passcode entry).
		Calibration: Select "Module PH"
		Select calibration method: • Automatic buffer recognition • Manual entry of buffer values • Product calibration (Calibration with sampling) • Entry of previously measured electrode data • ORP calbration/adjustment • Temp probe adjustment (with Protos II 4400(X))
		When you open the Calibration menu, the analyzer automatically proposes the previous calibration method. If you do not want to calibrate, press the "Return" softkey or the **meas** key. **During calibration the module is in function check (HOLD) mode.** Current outputs and relay contacts of the module behave as configured (Module BASE).

Note: The display may vary depending on the device version.

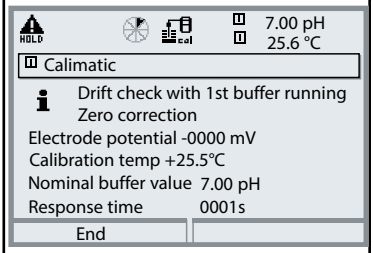
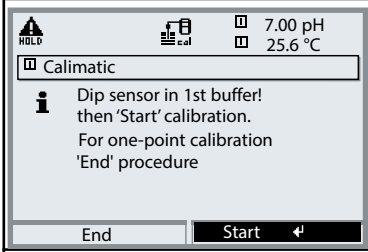
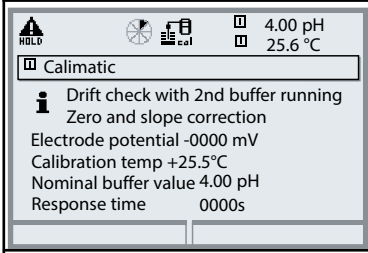
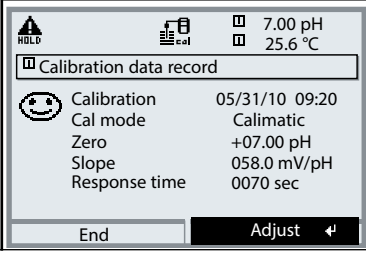
Automatic Buffer Recognition (Calimatic)
Automatic calibration using Knick Calimatic is performed with one, two, or three buffer solutions. Protos automatically detects the nominal buffer value on the basis of the electrode potential and the measured temperature. Any sequence of buffer solutions is possible, but they must belong to the buffer set defined during parameter setting.
The Calimatic takes the temperature dependence of the buffer value into account. All calibration data is converted using a reference temperature of 25 °C/77 °F.

During calibration the module is in function check (HOLD) mode.
Current outputs and relay contacts of the module behave as configured (Module BASE).

NOTICE!
Only ever use fresh, undiluted buffer solutions which belong to the selected buffer set!

Menu	Display	Action
cal	HOLD 7.00 pH 25.6 °C Calimatic Cal medium: Buffer solution Knick 2.00 4.01 7.00 9.21 When changing sensors perform First cal for statistics! Sensor replacement Enter cal temp +025.6 °C Return Proceed	**Select: Calimatic** Display of selected buffer set Select: Sensor replacement Enter: calibration temp Proceed by pressing softkey or **enter**.
	HOLD 7.00 pH 25.6 °C Calimatic Dip sensor in 1st buffer, then 'Start' calibration. Return Start	Remove and rinse the electrode (**CAUTION:** Electrostatic hazard. Do not rub.), then immerse it in the first buffer solution. Start by pressing softkey or **enter**.

Note: The display may vary depending on the device version.

Menu	Display	Action
cal		Display of nominal buffer value. You can press "End" to reduce the waiting time before stabilization of the electrode potential (reduced accuracy of calibration values). From the response time, you see how much time the electrode needs for the potential to stabilize. If the electrode potential or the measured temperature fluctuate greatly, the calibration procedure is aborted after 2 min.
		For a one-point calibration, press "End" softkey. For two-point calibration: Rinse electrode thoroughly! Immerse electrode in the second buffer solution. Start by pressing softkey or **enter**.
		Calibration is performed with the second buffer. Three-point calibration is performed correspondingly with the third buffer.
		**Adjustment** Press "Adjust" to take over the values determined during calibration for calculating the measured variables.

Note: The display may vary depending on the device version.

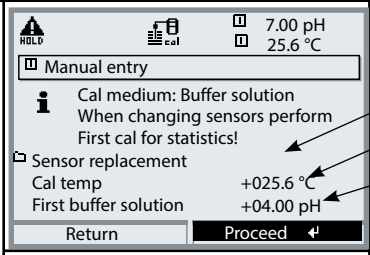
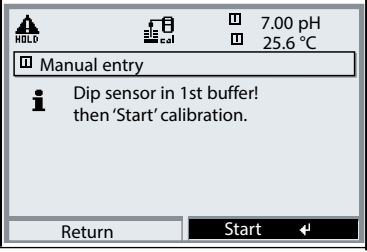
Calibration / Adjustment

Calibration with Manual Entry of Buffer Values

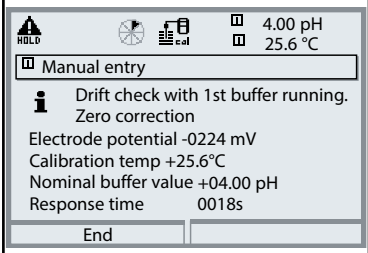
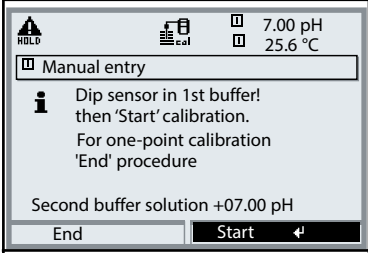
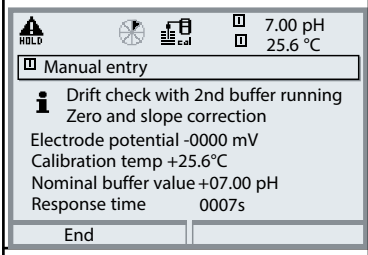
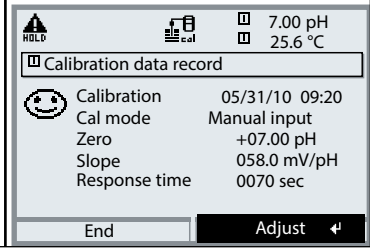
Calibration with Manual Entry of Buffer Values
Calibration with manual entry of buffer values is performed with one, two or three buffer solutions.
Protos displays the measured temperature.
You must then enter the temperature-corrected buffer values. To do so, refer to the buffer table (e.g. on the bottle) and enter the buffer value belonging to the displayed temperature.
Intermediate values must be interpolated.
All calibration data is converted using a reference temperature of 25 °C/77 °F.

During calibration the module is in function check (HOLD) mode.
Current outputs and relay contacts of the module behave as configured (Module BASE).

NOTICE!
Only ever use fresh, undiluted buffer solutions!

Menu	Display	Action
cal		**Select: Manual entry** Select: Sensor replacement Display: calibration temp Enter first buffer value Proceed by pressing softkey or **enter**
		Remove and rinse the electrode (**CAUTION:** Electrostatic hazard. Do not rub.), then immerse it in the first buffer solution. Start by pressing softkey or **enter**.

Note: The display may vary depending on the device version.

Menu	Display	Action
cal		Calibration with first buffer solution. You can press "End" to reduce the waiting time before stabilization of the electrode potential (reduced accuracy of calibration values). From the response time, you see how much time the electrode needs for the potential to stabilize. If the electrode potential or the measured temperature fluctuate greatly, the calibration procedure is aborted after 2 min.
		One-point calibration: "End". Two-point calibration: Rinse electrode thoroughly! Enter 2nd buffer value for correct temperature. Immerse electrode in the second buffer solution. Start by pressing softkey or **enter**
		Calibration is performed with the second buffer. Three-point calibration is performed correspondingly with the third buffer.
		**Adjustment** Press "Adjust" to take over the values determined during calibration for calculating the measured variables.

Note: The display may vary depending on the device version.

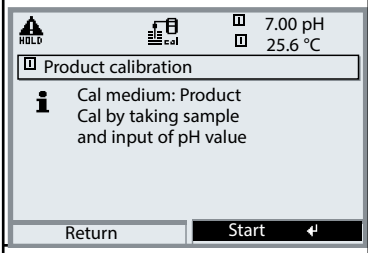
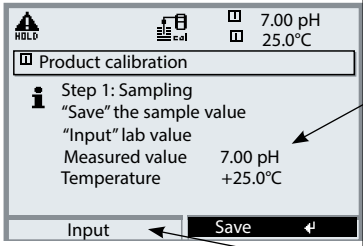
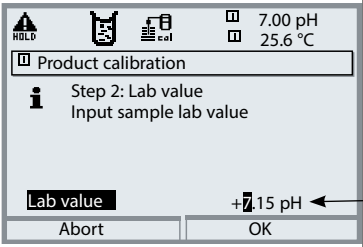
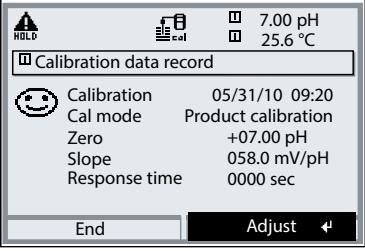
Product Calibration (Calibration with Sampling)
When the electrode cannot be removed – e.g. for sterility reasons – its zero point can be determined with "sampling". To do so, the currently measured process value is stored by the Protos. Immediately afterwards, you take a sample from the process. The pH value of the sample is measured in the lab or directly on the site using a portable pH meter. The reference value is entered into the measuring system. From the difference between measured value and reference value, the Protos calculates the electrode zero point (this method only allows one-point calibration).

During calibration the module is in function check (HOLD) mode. Current outputs and relay contacts of the module behave as configured (BASE).

NOTICE! The pH value of the sample is temperature-dependent. Therefore, the reference measurement should be performed at the sample temperature shown in the display. Transport the sample in an insulated container. The pH value may also be altered due to escaping of volatile substances.

Menu	Display	Action
cal	7.00 pH 25.6 °C Calibration Module PH 3400-035 Return Info	**Select module: PH 3400-035** The module is in function check (HOLD) mode. The assigned current outputs and relay contacts behave as configured (BASE). Press **enter** to confirm.
	7.00 pH 25.6 °C Module PH 3400-035 Calimatic: automatic calibration Manual: entry of buffer values Product calibration Data entry: premeasured electrodes ORP calibration Return	Select calibration mode "Product calibration" Press **enter** to confirm.

Note: The display may vary depending on the device version.

Menu	Display	Action
cal		**Product calibration** Product calibration is performed in 2 steps. Prepare sampling, start by pressing softkey or **enter**.
		**Step 1** Take sample. Save measured value and temperature at the moment of sampling ("Save" softkey or **enter**). Press **meas** to return to measurement. **Exception:** Sample value can be measured on the site and be entered immediately. To do so, press "Input" softkey.
		**Step 2** Lab value has been measured. When you open the Product calibration menu again, the display shown on the left appears: Enter reference value ("Lab value"). Confirm with OK or repeat calibration.
		**Adjustment** Press "Adjust" to take over the values determined during calibration for calculating the measured variables.

Note: The display may vary depending on the device version.

Calibration / Adjustment

Calibration by entering data from premeasured electrodes

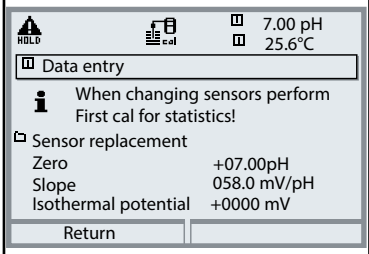
Data Entry of Premeasured Electrodes
Entry of values for zero point, slope and isothermal potential of a pH electrode. The values must be known, e.g. determined beforehand in the laboratory.

NOTICE! Input of an isothermal potential V_{is} also applies to the calibration methods

- Calimatic
- Manual input
- Product calibration

For an explanation of the isothermal potential, refer to p. 37.

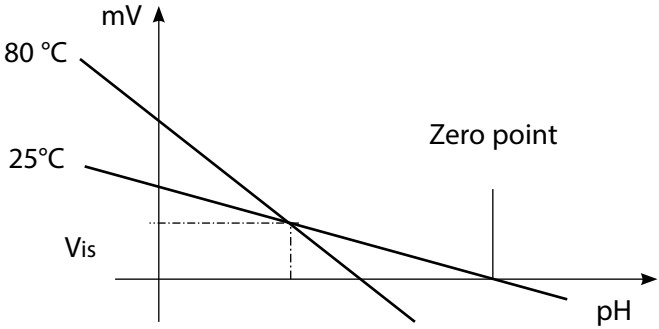
During calibration the module is in function check (HOLD) mode. Current outputs and relay contacts of the module behave as configured (BASE).

Menu	Display	Action
		**Select: Data entry of premeasured electrodes** Remove electrode and connect premeasured electrode. Open "Sensor replacement". Enter the values for • Zero • Slope • Isothermal potential Return using softkey or press **meas** to return to measurement.

Note: The display may vary depending on the device version.

Isothermal Potential
The isothermal intersection point is the point of intersection between two calibration lines at two different temperatures. The potential difference between the electrode zero point and this intersection point is the isothermal potential "Vis".
It may cause measurement errors depending on the temperature.
These errors can be compensated for by defining the"Vis" value.

- Measurement errors are avoided by calibrating at measuring temperature or at a controlled and stable temperature.



Monitoring Functions for Calibration
Protos provides comprehensive functions for monitoring proper calibration performance and the electrode condition. This allows documentation for quality management to ISO 9001 and GLP/GMP.

- Sensocheck monitors the electrode condition by measuring the glass and reference electrode impedances.
- Regular calibration can be monitored by the cal timer.
- Adaptive cal timer - automatically reduces the calibration interval when the electrode is subjected to high stress
- The calibration record (GLP/GMP) provides all relevant data of the last calibration and adjustment.
- The statistics show the behavior of the electrode parameters during the last three calibrations compared to the First Calibration.
- The logbook shows the time and date of a performed calibration.

ORP Calbration/Adjustment
The potential of a redox electrode is calibrated using a redox (ORP) buffer solution. In the course of that, the difference between the measured potential and the potential of the calibration solution is determined. This potential difference is printed on the calibration solution bottle and is defined as the voltage across the redox electrode and a reference electrode.

Examples:	220 mV	Pt against Ag/AgCl, KCl 3 mol/l
	427 mV	Pt against SHE

During measurement this difference is added to the measured potential.

$mV_{ORP} = mV_{meas} + \Delta mV$

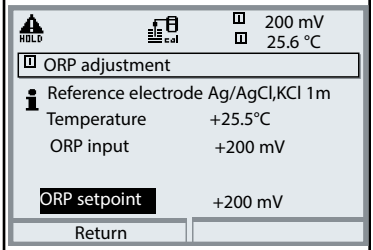
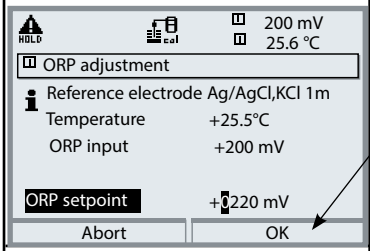
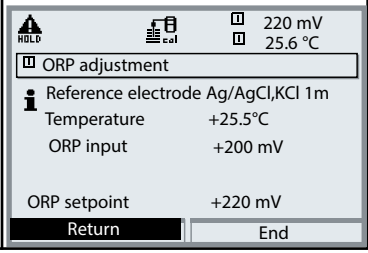
mV_{ORP} = displayed oxidation-reduction potential (measured ORP)
mV_{meas} = direct electrode potential (ORP input, see Sensor monitor)
ΔmV = delta value, determined during calibration

ORP related to the standard hydrogen electrode (SHE)
The oxidation-reduction potential can also be calibrated automatically with respect to the standard hydrogen electrode (SHE). To do so, you must first select the reference electrode used (see Parameter setting).
The temperature behavior of the reference electrode is automatically taken into account.

You can choose from the following types of reference electrodes:

Ag/AgCl, KCl 1 mol/l	(silver/silver chloride)
Ag/AgCl, KCl 3 mol/l	(silver/silver chloride)
Hg, Tl/TlCl, KCl 3.3 mol/l	(Thalamid)
Hg/Hg_2SO_4, K_2SO_4 saturated	(mercury sulfate)

Note: The display may vary depending on the device version.

Menu	Display	Action
cal		The type of reference electrode is selected during parameter setting. Immerse electrode in calibration medium and wait until the ORP value has stabilized. Enter the nominal ORP value (bottle). **Be sure to observe the correct reference!** (as configured) Press "**OK**" to confirm.
		
		End adjustment by pressing softkey or **enter**.

Temperature dependence of commonly used reference systems measured against SHE

Temperature [°C]	Ag/AgCl/KCl 1 mol/l [ΔmV]	Ag/AgCl/KCl 3 mol/l [ΔmV]	Thalamid [ΔmV]	Mercury sulfate [ΔmV]
0	249	224	-559	672
10	244	217	-564	664
20	240	211	-569	655
25	236	207	-571	651
30	233	203	-574	647
40	227	196	-580	639
50	221	188	-585	631
60	214	180	-592	623
70	207	172	-598	613
80	200	163	-605	603

Note: With Protos II 4400(X) in the Calibration menu,
with Protos 3400(X) in the Maintenance menu.

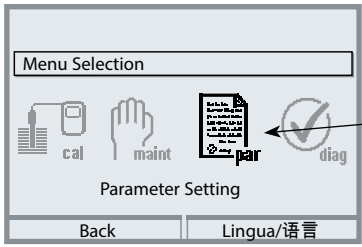
Temp Probe Adjustment
This function allows compensating for the individual temperature probe tolerance and the influence of the lead resistances to increase the accuracy of temperature measurement. Make sure that the process temperature is precisely measured using a calibrated reference thermometer when performing an adjustment. The measurement error of the reference thermometer should be less than 0.1 °C. Adjustment without precise measurement might result in considerable deviations of the measured value display!

With Protos II 4400(X), the data from the last adjustment and the temperature offset can be called from the Diagnostics menu, see p. 73.

Parameter Setting

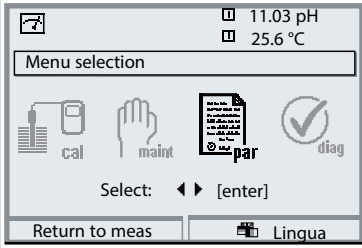
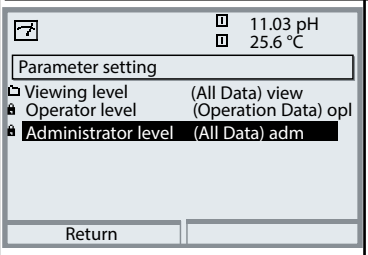
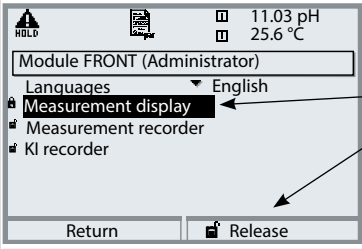
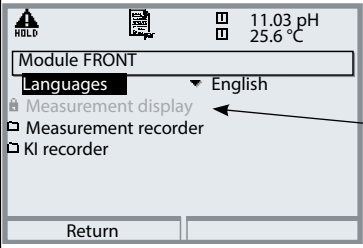
⚠ CAUTION! Incorrect parameter settings or adjustments can result in incorrect outputs.
The Protos II 4400(X) must therefore be commissioned by a system specialist, all its parameters must be set, and it must be fully adjusted.

NOTICE!
The "function check" (HOLD) mode 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 the Protos is in the function check (HOLD) mode, as this may put the user at risk due to unexpected system behavior.

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

Parameter Setting: Operating Levels

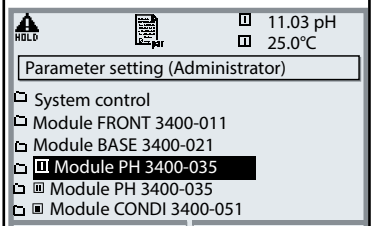
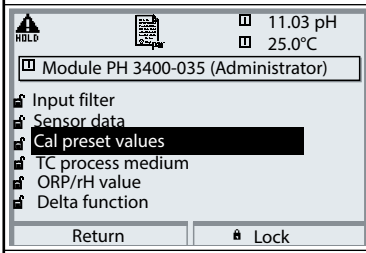
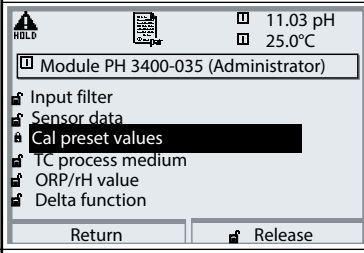
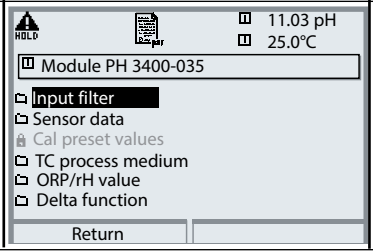
Viewing level, Operator level, Administrator level
Note: Function check (HOLD) mode active (Setting: BASE module)

Menu	Display	Action
par		**Open parameter setting** From the measuring mode: Press **menu** key to select menu. Select parameter setting using arrow keys, press **enter** to confirm.
		**Administrator level** Access to all functions, also passcode setting. Releasing or blocking a function for access from the Operator level.
		Functions which can be blocked for the Operator level are marked with the "lock" symbol. The functions are released or blocked using the softkey.
		**Operator level** Access to all functions which have been released at the Administrator level. Blocked functions are displayed in gray and cannot be edited (Fig.). **Viewing level** Display of all settings. No editing possible!

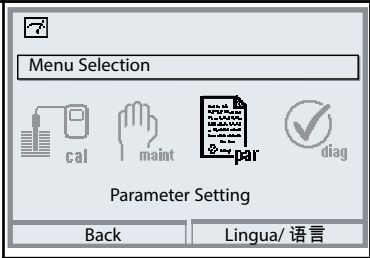
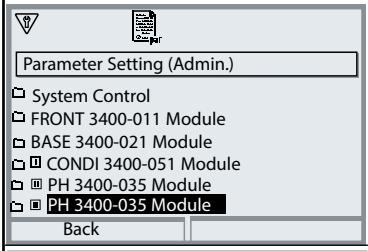
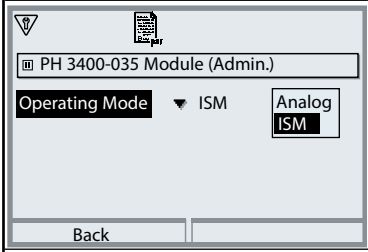
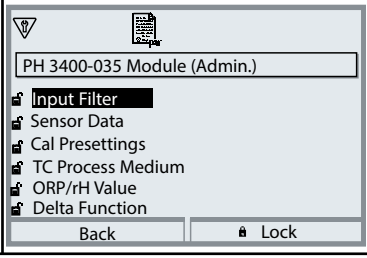
Note: The display may vary depending on the device version.

Parameter Setting: Locking a Function

Administrator level: Enabling/locking functions for Operator level
Note: Function check (HOLD) mode active (Setting: BASE module)

Menu	Display	Action
par		**Example:** Blocking access to the calibration adjustments from the Operator level **Open parameter setting** Select Administrator level. Enter passcode (1989). Select "Module PH" (e.g.) using arrow keys, press **enter** to confirm.
		Select "Cal preset values" using arrow keys. "Lock" with softkey.
		Now, the "Cal preset values" line is marked with the "lock" icon. This function cannot be accessed from the Operator level any more. The softkey function changes to "Release".
par		**Open parameter setting** Select Operator level, passcode (1246). Select "Module PH". Now, the locked function is displayed in gray and marked with the "lock" icon.

Note: The display may vary depending on the device version.

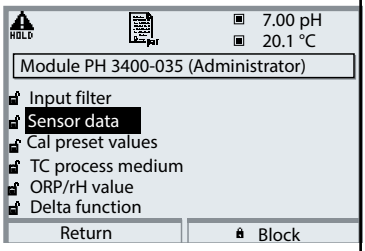
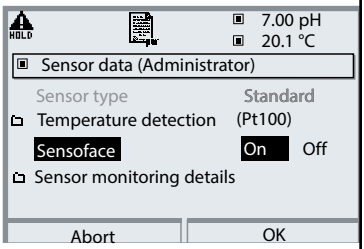
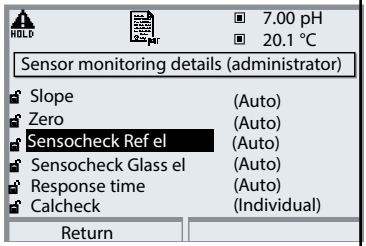
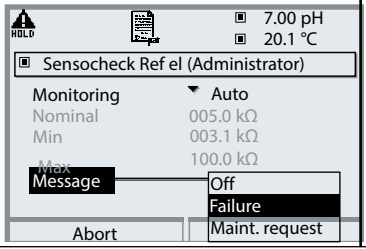
Menu	Display	Action
par		**Activating parameter setting** From the measuring mode: Press **menu** key to select menu. Select parameter setting using arrow keys, press **enter** to confirm.
		Select module, press **enter** to confirm.
		With Protos II 4400(X): Operating Mode: Analog / ISM Select using arrow keys, press **enter** to confirm. Press "Back" softkey to return to the parameter selection.
		Select parameter using arrow keys, press **enter** to confirm.

Note: The display may vary depending on the device version.

During parameter setting the analyzer is in function check (HOLD) mode:
Current outputs and relay contacts behave as configured (BASE module).

Parameter Setting

Sensor data. pH sensor monitoring adjustable
Note: Function check (HOLD) mode active

Menu	Display	Action
par		**Sensor data** (see also p. 47.) Sensor data are preset depending on the sensor type. Gray display lines cannot be edited.
		**Sensoface** provides information on the sensor condition (evaluating the sensor data). Great deviations are signaled. Sensoface can be switched off.
		**Sensor monitoring details** The following parameters are monitored: Slope, zero, reference impedance, glass impedance (pH electrodes), and response time, for ISM sensors also sensor wear[1)], CIP/SIP counter, autoclaving counter, and sensor operating time. For "Auto", the tolerance limits are displayed in gray. For "Individual", the settings can be specified by the user.
		ISM sensors automatically provide most of the default settings. Individual settings are not overwritten by the ISM. **Message:** See p. 47.

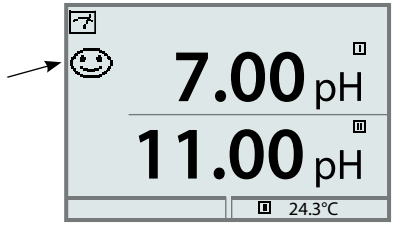
Note: The display may vary depending on the device version.

1) with Protos 3400(X)

Sensoface

Sensoface is a graphic indication of the sensor condition.

The “smileys” provide information on wear and required maintenance of the sensor (“friendly” - “neutral” - “sad”).



Sensoface Criteria

Parameter	Standard [1]	Critical range
Slope	59.2	< 53.3 or > 61
Zero	7.00	< 6.00 or > 8.00
Reference impedance	Rcal [2]	< 0.6 Rcal or > 100 kΩ+ 0.5 Rcal
Glass impedance	Rcal [2]	< 0.3 Rcal or > 3.5 Rcal
Response time Fine Standard Coarse		 120 sec 80 sec 60 sec
Calibration timer		when 80 % expired
Sensor wear [3]		as specified

Sensocheck
Automatic monitoring of glass and reference electrode

1) Applies to standard electrodes with pH = 7.00
2) Rcal is determined during calibration.
3) ISM with Protos 3400(X)

Parameter Setting: Sensor Data

With "Auto", the tolerance limits for the monitoring criteria are determined by the device. They are displayed in gray.
With "Individual", these tolerances can be adjusted.

Note:
Function check (HOLD) active. Gray values (display) cannot be edited.

Parameter	Default	Selection / Range / Notes
PH 3400-035 Module Operating Mode [1]	Analog	Analog, ISM
Analog pH or ISM pH [1]		
Input Filter • Pulse Suppression	Off	Off, On (suppression of fast transients at the input)
Sensor Data • Sensor Type	Standard	Standard, Other, ISM (automatically recognized)
• Temperature Detection Temperature Probe	Pt 1000	Pt100, Pt1000, NTC30 kΩ, NTC 8,55 kΩ, Balco 3 kΩ
Sensor Monitoring Details • Mode [2]	Load Matrix	Load Matrix. DLI Lifetime Indicator
• Slope Monitoring	Auto	Auto, Individual
Nominal	59.2 mV/pH	
Min	53.3 mV/pH	
Max	61.0 mV/pH	
Message	Maint. Required	Off, Failure, Maint. Required
• Zero Monitoring	Auto	Auto, Individual
Nominal	06.95 pH	
Min	05.95 pH	
Max	07.95 pH	
Message	Maint. Required	Off, Failure, Maint. Required
• ORP Offset Monitoring	Auto	Auto, Individual
Nominal	0 mV	
Min	-600 mV	
Max	600 mV	
Message	Maint. Required	Off, Failure, Maint. Required

Note: The menus may vary depending on the device version.

1) with Protos II 4400(X)
2) ISM with Protos 3400(X)

Parameter Setting: Sensor Data

Parameter	Default	Selection / Range / Notes
• Sensocheck Ref El		
Monitoring	Auto	Auto, Individual
Nominal	025.5 kΩ	
Min	015.9 kΩ	
Max	112.8 kΩ	
Message	Off	Off, Failure, Maint. Required
• Sensocheck Glass El		
Monitoring	Auto	Auto, Individual
Nominal	305.0 MΩ	
Min	087.1 MΩ	
Max	999.9 MΩ	
Message	Off	Off, Failure, Maint. Required
• Response Time		
Monitoring	Auto	Auto, Individual
Response Time Max.	0080 s	
Message	Off	Off, Failure, Maint. Required
• Sensor Operating Time 1)		
Monitoring	Off	Off, Individual
Max. operating time	0000 d	
Message	Maint. Required	Off, Failure, Maint. Required
• Sensor Wear 2)		
Monitoring	Off	Off, Auto, Individual
Meas. Quality	Normal	High, Normal, Low
Message	Maint. Required	Off, Failure, Maint. Required
• TTM Maintenance Timer 1)		
Monitoring	Auto	Off, Auto, Individual
TTM Interval	760 h	
Message	Maint. Required	Off, Failure, Maint. Required
• DLI LIfetime Indicator 1)		
Monitoring	Off	Off, Auto
Message	Maint. Required	Off, Failure, Maint. Required
• CIP Counter 1)		
Monitoring	Off	Off, Individual
Max. CIP Cycles	0	
Message	Maint. Required	Off, Failure, Maint. Required
• SIP Counter 1)		
Monitoring	Off	Off, Individual
Max. SIP Cycles	0	
Message	Maint. Required	Off, Failure, Maint. Required
• Autoclaving Counter 1)		
Monitoring	Off	Off, Individual
Max. AC Cycles	0	
Message	Maint. Required	Off, Failure, Maint. Required

Note: The menus may vary depending on the device version.

ISM sensors automatically provide most of the default settings.
Individual entries are not overwritten by the ISM sensor.

1) for ISM only
2) ISM with Protos 3400(X)

Parameter Setting

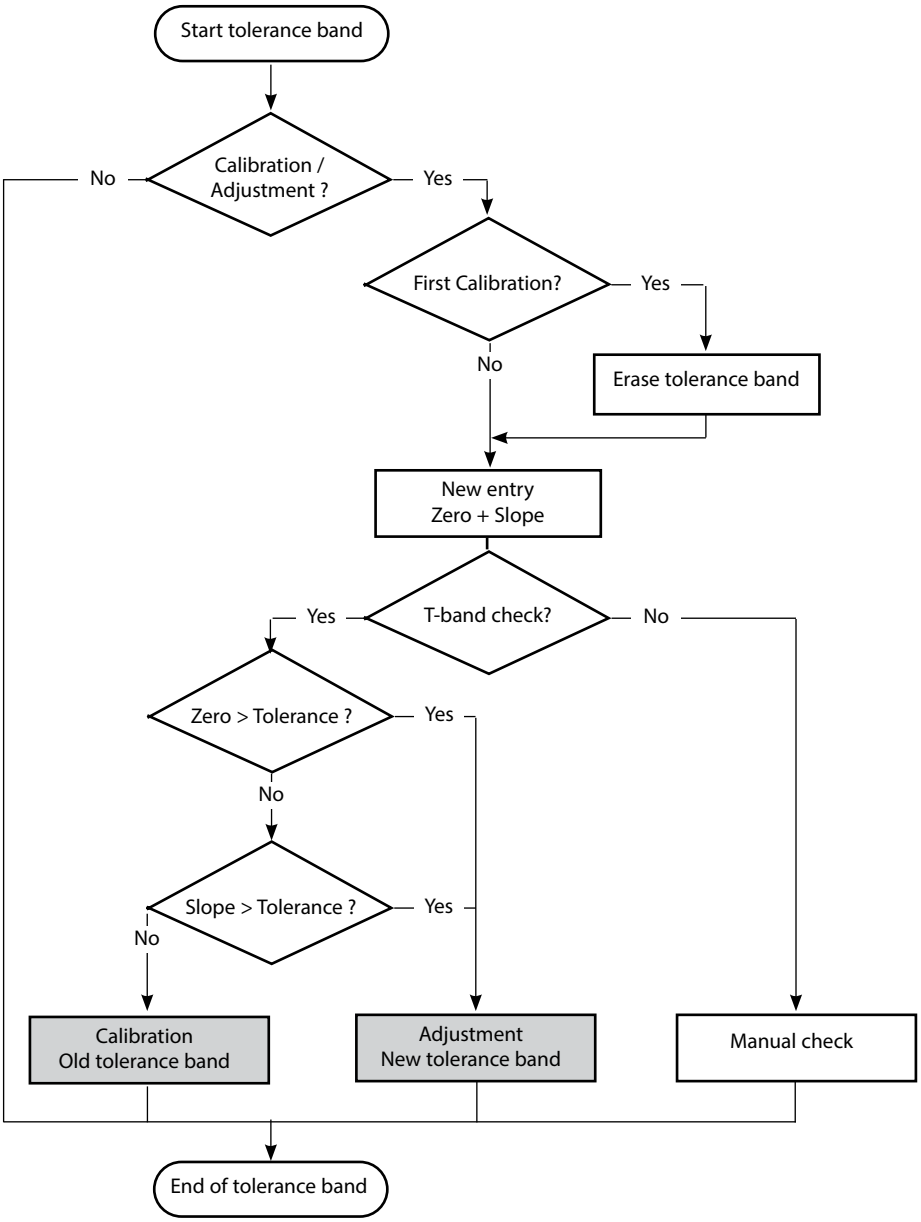
Cal preset values
Note: Function check (HOLD) mode active

Note: The menus may vary depending on the device version

Parameter	Default	Selection / Range
Cal preset values		
• Calimatic buffer	Knick CaliMat	Knick CaliMat: 2.00 4.00 7.00 9.00 12.00 (Merck/Riedel: 2.00 4.00 7.00 9.00 12.00) Mettler-Toledo: 2.00 4.01 7.00 9.21 DIN 19267: 1.09 4.65 6.79 9.23 12.75 NIST Standard: 4.006 6.865 9.180 NIST Technical: 1.68 4.00 7.00 10.01 12.46 Hamilton: 2.00 4.01 7.00 10.01 12.00 Kraft: 2.00 4.00 7.00 9.00 11.00 Hamilton A: 2.00 4.01 7.00 9.00 11.00 Hamilton B: 2.00 4.01 6.00 9.00 11.00 HACH: 4.01 7.00 10.00 Ciba: 2.06 4.00 7.00 10.00 Reagecon: 2.00 4.00 7.00 9.00 12.00 Table
• Drift check	Standard	Fine: 1.2 mV/min (Abort after 180 sec) Standard: 2.4 mV/min (Abort after 120 sec) Coarse: 3.75 mV/min (Abort after 90 sec)
• Cal timer		
Monitoring	Auto	Auto
Calibration timer	0000h (Off)	Off, entry
Adaptive cal timer	Off	Off, On
• Tolerance band check (SW 3400-005)	Off	Tolerance adjustment: Off, On Tolerance band zero +00.20 pH (entry) Tolerance band slope +002.0 mV/pH (entry)

Tolerance adjustment
(add-on function SW3400-005, with Protos 3400(X))
During calibration this function checks the zero and slope values and automatically performs an adjustment when the tolerance band is exceeded.
The parameters are stored in the tolerance band recorder (Diagnostics menu).
The add-on function SW3400-005 is device-specific. When ordering this function, you therefore have to specify the serial number of your FRONT module in addition to the respective order number.
(The FRONT module contains the Protos system control).
The manufacturer then supplies a TAN (transaction number) to release the add-on function in the system control menu.

Tolerance Adjustment[1)]: Program Flow

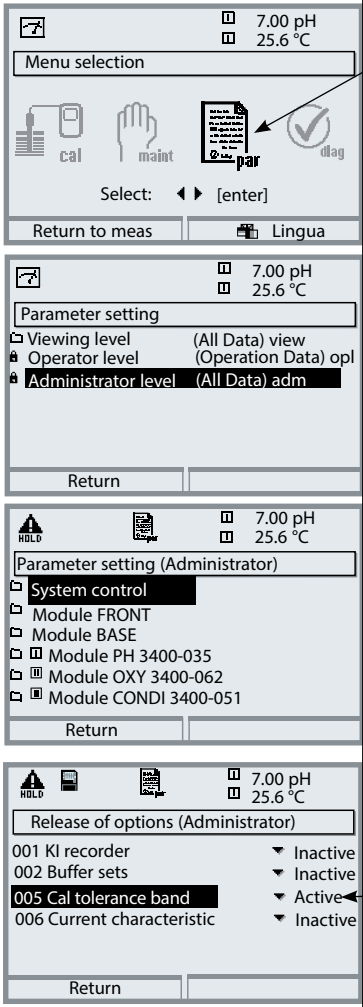


1) add-on function SW3400-005, with Protos 3400(X)

Activating the Tolerance Adjustment

Select menu: Parameter setting > System control > Release of options

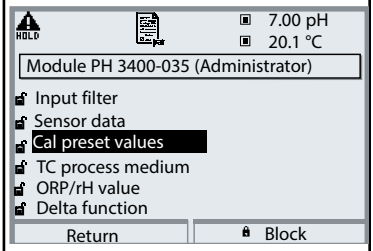
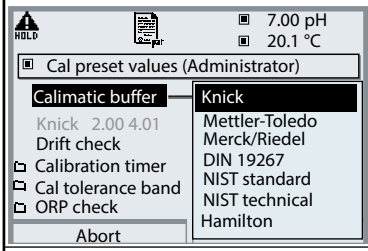
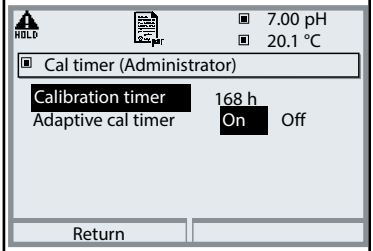
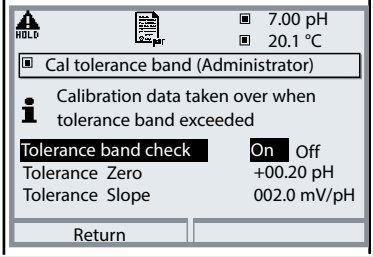
Note: The TAN for releasing an add-on function is only valid for the device with the corresponding serial number!

Menu	Display	Action
par		**Menu selection** Open parameter setting. From the measuring mode: Press **menu** key to select menu. Select parameter setting using arrow keys, confirm with **enter**. **Parameter setting** Select Administrator level using arrow keys, confirm with **enter**. Enter passcode and confirm (Passcode as delivered: 1989). Select system control using arrow keys, confirm with **enter**. Then select Release of options using arrow keys, confirm with **enter**. **Release of options** Select the add-on function to be released ("Cal tolerance band"). Set option to "active". Enter the TAN at the prompt. (**Note:** The TAN is only valid for the device with the corresponding serial number, see page 49.) The option is available after the TAN has been entered.

Note: The display may vary depending on the device version.

Parameter Setting

Cal preset values: Calimatic buffer, Cal timer, Cal tolerance band
Note: Function check (HOLD) mode active

Menu	Display	Action
par		**Calimatic buffer** For automatic calibration, you must define the buffer set you want to use. For calibration, you must then use buffer solutions from this buffer set in any order. The selected buffer set with the nominal values of the individual buffer solutions is displayed in gray. The "Calimatic buffer" menu shows all buffer sets available. Select buffer set with **enter.**
		
		**Calibration timer** Entry of the time interval until the next due calibration. **Adaptive cal timer** Automatically reduces the time until the next due calibration when the electrode is exposed to high stress (temperature, extreme pH values).
		**Cal tolerance band** If the measured value leaves the tolerance band specified here for zero and slope, an adjustment is automatically performed during calibration.

Note: The display may vary depending on the device version.

Parameter Setting

Default settings and selection range
Note: Function check (HOLD) mode active

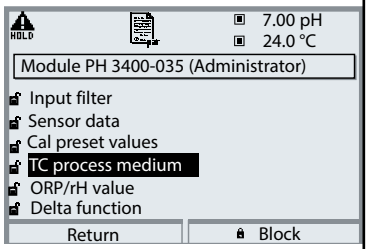
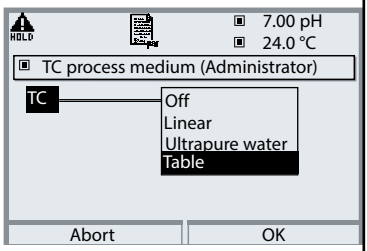
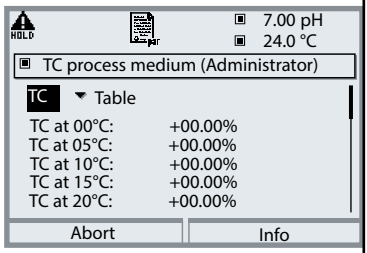
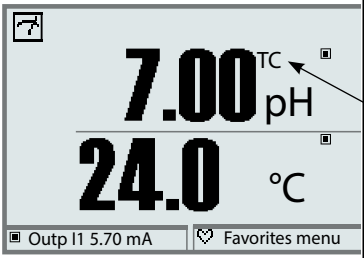
Note: The menus may vary depending on the device version.

Parameter	Default	Selection / Range
TC process medium • TC correction	Off	Off, linear, ultrapure water, table, Linear: enter temperature factor +XX.XX %/K
ORP/rH value • Reference electrode	Ag/AgCl,KCl 1mol/l	Ag/AgCl,KCl 3mol/l Hg, Tl/TlCl, KCl 3.3 mol/l Hg/Hg_2SO_4, K_2SO_4 sat
• ORP conversion to SHE	No	No, Yes
• Calculate rH with factor	No	No, Yes, entry of factor
Delta function • Delta function	Off	Off, pH, mV+ORP or rH: entry of delta value

Parameter Setting

TC process medium

Note: Function check (HOLD) mode active

Menu	Display	Action
par		**TC Process Medium** You can choose from: • Linear (entry of TC coefficient) • Ultrapure water • Table
		
		
		When the TC correction for process medium is switched on, "TC" appears in the display in measuring mode.

Note: The display may vary depending on the device version.

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:
$((pH_{25} / pH_T) - 1) \bullet 100$ [%]

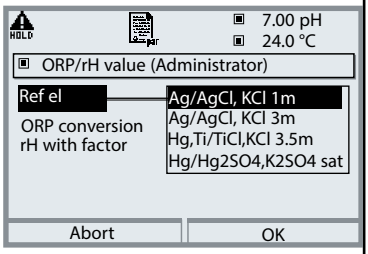
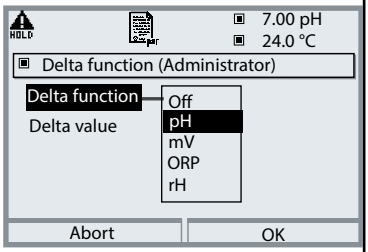
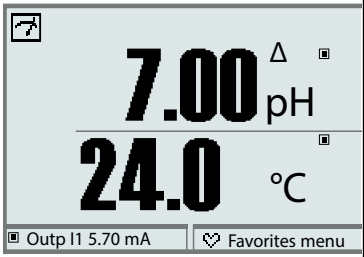
pH_{25}	pH value at 25 °C
pH_T	pH value at measuring temperature T

Note: 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,
see p. 56.

Parameter Setting

ORP/rH value, delta function

Note: Function check (HOLD) mode active

Menu	Display	Action
par		**ORP/rH Value** • Select type of reference electrode: Ag/AgCl, KCl 1 mol/l (silver/silver chloride) Ag/AgCl, KCl 3 mol/l (silver/silver chloride) Hg, Tl/TlCl, KCl 3.3 mol/l (Thalamid) Hg/Hg_2SO_4, K_2SO_4 saturated (mercury sulfate) • ORP conversion to SHE • Calculate rH with factor
		**Delta Function** When a delta value is entered, the system calculates the difference Output value = measured value – delta value The output value controls all outputs and is shown on the display. When the delta function has been activated simultaneously with temperature compensation, the temperature is compensated first and then the delta value is subtracted. When delta function is switched on, "Δ" appears in the display in measuring mode.
		

Note: The display may vary depending on the device version.

Calculation Blocks

Menu selection: Parameter setting > System control > Calculation Blocks
Calculation of new variables from measured variables

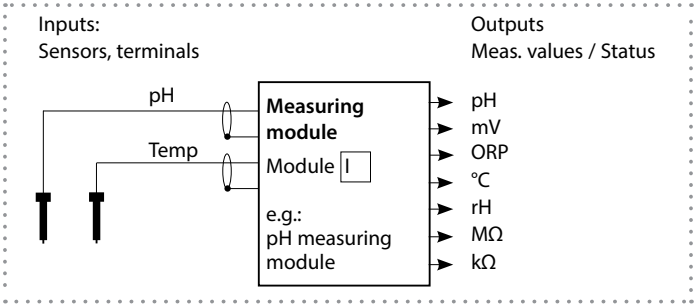
Calculation Blocks
Two measuring modules with all their measured values serve as input for the calculation block. In addition, the general device status (NAMUR signals) is taken into account. The difference between the existing values is calculated:

Current outputs
All current outputs can be set to output the new process variables formed by the Calculation Blocks.

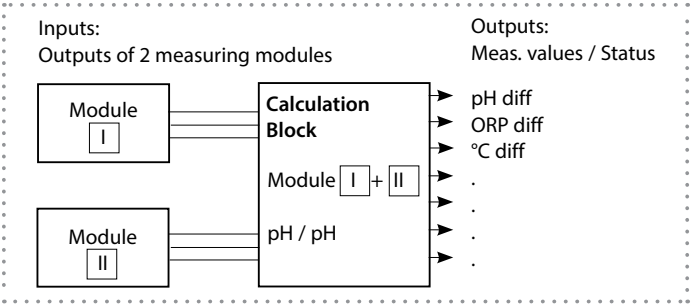
Measurement display
All new process variables can be displayed as primary or as secondary value.

Controller
Controller functions are not supported.

Functionality of measuring module



Functionality of Calculation Block



Activating Calculation Blocks

Menu selection: Parameter setting > System control > Calculation Blocks
Combining measuring modules to Calculation Blocks

Combining measuring modules
With three measuring modules the following Calculation Block combinations are possible: I + II , I + III , II + III

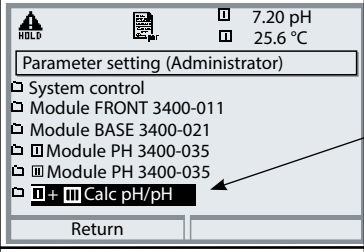
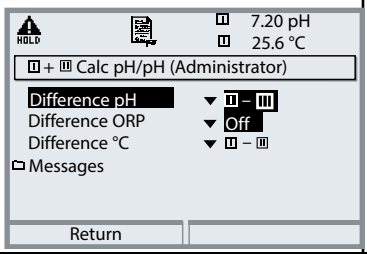
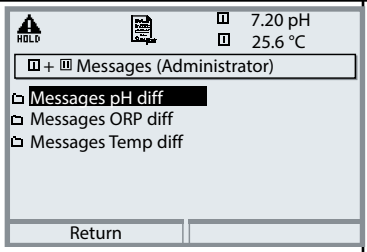
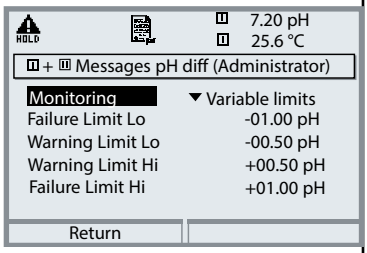
Two Calculation Blocks can be activated.

Menu	Display	Action
par	HOLD 7.20 pH 25.6 °C System control (Administrator) Calculation Blocks Point of measurement Release of options Logbook Buffer table Concentration table Return	**Calculation Blocks** • Open parameter setting • System control • Select "Calculation Blocks"
	HOLD 7.10 pH 25.6 °C Calculation Blocks (Administrator) Block 1 Off Block 2 Calc pH/pH Return	• Depending on the modules installed, the possible combinations for Calculation Blocks are offered.
	HOLD 7.20 pH 25.6 °C Parameter setting (Administrator) System control Module FRONT 3400-011 Module BASE 3400-021 Module PH 3400-035 Module PH 3400-035 I + II Calc pH/pH Return	During parameter setting the Calculation Blocks are displayed like modules.

Note: The display may vary depending on the device version.

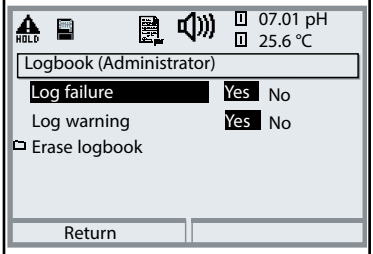
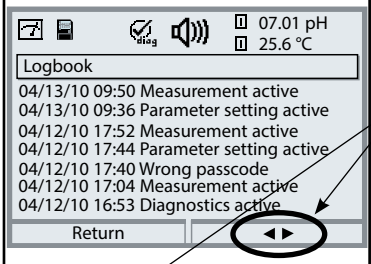
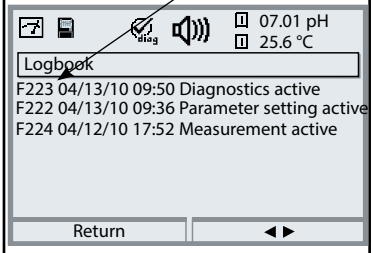
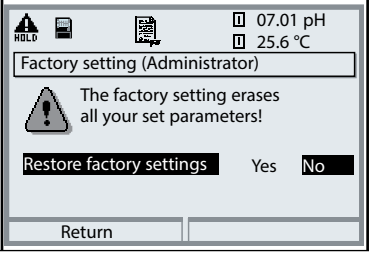
Configuring a Calculation Block

Menu selection: Parameter setting > System control > Calculation Blocks
Setting the process variable to be calculated

Menu	Display	Action
		**To select a Calculation Block** • Open parameter setting • System control • Select module
		• Depending on the modules installed, the possible combinations for Calculation Blocks are offered.
	 	**Messages** You can activate messages for the selected variables. Variables which have been set as "Off" cannot be processed further. Set the measured values which shall release a message using the arrow keys (left/right: select position, up/down: edit number) and confirm with **enter**.

Note: The display may vary depending on the device version.

Parameter setting > System control
Note: Function check (HOLD) mode active

Menu	Display	Action
par		**Logbook** Select which messages are to be recorded in the logbook. The logbook directly displays the last events with date and time (Protos 3400(X): 50, Protos II 4400(X): 100 events).
		The logbook entries can be called from the Diagnostics menu (Fig.). Pressing the right softkey displays the message identifier.
		SW3400-104: Extended logbook / FW4400-104: Logbook With SmartMedia Card and Protos 3400(X) or Data Card and Protos II 4400(X), max. 50,000 entries (Protos 3400(X)) or min. 20,000 entries (Protos II 4400(X)) can be saved on a memory card.
		**Restore Factory Settings** Allows resetting the parameters to their factory setting.

Note: The display may vary depending on the device version.

Parameter Setting

Messages: Default settings and selection range
Note: Function check (HOLD) mode active

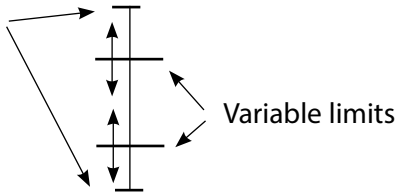
Parameter	Default	Selection / Range
Messages		
• pH value	Limits max	Off, device limits max., variable limits*
• ORP value	Off	Off, device limits max., variable limits*
• rH value	Off	Off, device limits max., variable limits*
• Temperature	Limits max	Off, device limits max., variable limits*
• mV value	Off	Off, device limits max., variable limits*
		* With "Variable limits" selected, the following parameters can be edited: • Failure Limit Lo • Warning Limit Lo • Warning Limit Hi • Failure Limit Hi

Note: The menus may vary depending on the device version

Device limits

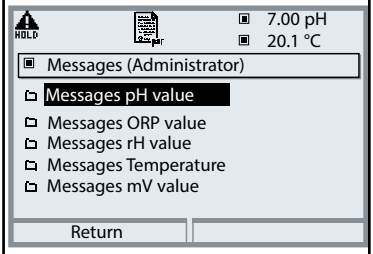
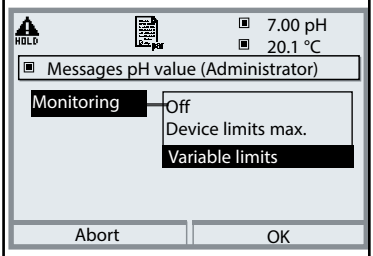
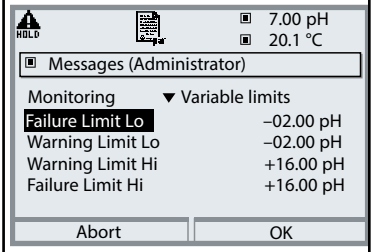
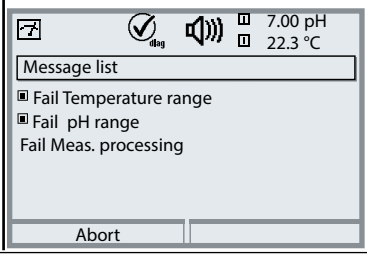
- Device limits max. Maximum measuring range of device
- Variable limits: Range limits specified

Max. device limits



Parameter Setting

Messages
Note: Function check (HOLD) mode active

Menu	Display	Action
par		**Messages** All parameters determined by the measuring module can generate messages. • **Device limits max:** Messages are generated when the process variable (e.g. pH) 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).
		• **Variable limits:** For the "failure" and "warning" messages you can define upper and lower limits for message generation.
		• **Message icons:** Failure (Failure limit HiHi/LoLo) Maintenance (Warning limit Hi/Lo)
diag		**Diagnostics menu** When the "Maintenance" or "Failure" icons are flashing in the display, you should call up the Diagnostics menu. The messages are displayed in the "Message list".

Note: The display may vary depending on the device version.

Parameter Setting: BASE Module

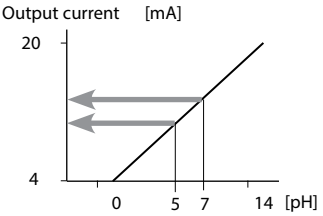
Menu selection: Parameter Setting > BASE Module
Note: Function check (HOLD) active

Menu	Display	Action
par	HOLD 7.00 pH 19.2°C Module BASE (Administrator) Output current I2 Contact K4 (NAMUR Failure) Contact K3 (NAMUR maintenance) Contact K2 (NAMUR HOLD) Contact K1 (Limit) Inputs OK1, OK2 Return / Block	**Configuring a Current Output** • Open parameter setting • Enter passcode • Select "Module BASE" • Select "Output current ..."
	HOLD 7.00 pH 19.0 °C Output current I1 (Administrator) Variable Curve Output Start End Behavior during messages Off / pH / °C / rH / S/cm / °C / g/kg Abort / OK	• Select process variable
	HOLD 7.00 pH 19.0 °C Output current I1 (Administrator) Variable °C Curve Linear Output Start End Output filter Trilinear Function Table Abort / OK	• Select Curve, e.g. "linear": The measured variable is represented by a linear output current curve. The desired range of the measured variable is specified by the values for "Start" and "End".

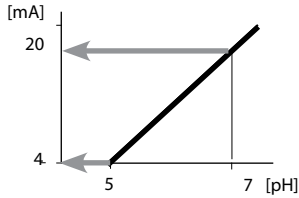
Note: The display may vary depending on the device version.

Assigning measured values: Start (4 mA) and End (20 mA)

Example 1: Range pH 0 - 14



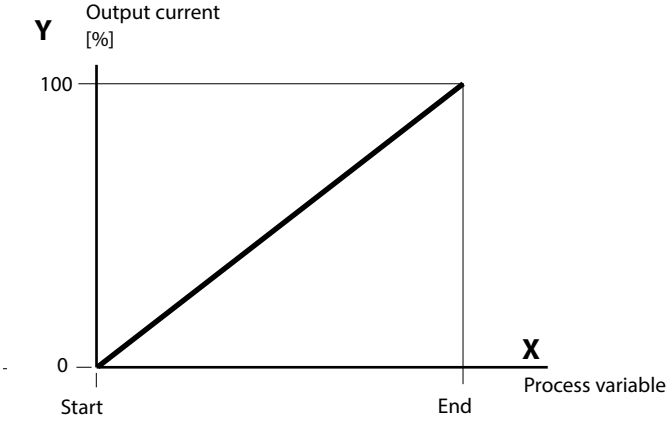
Example 2: Range pH 5 - 7
Advantage: Higher resolution in range of interest



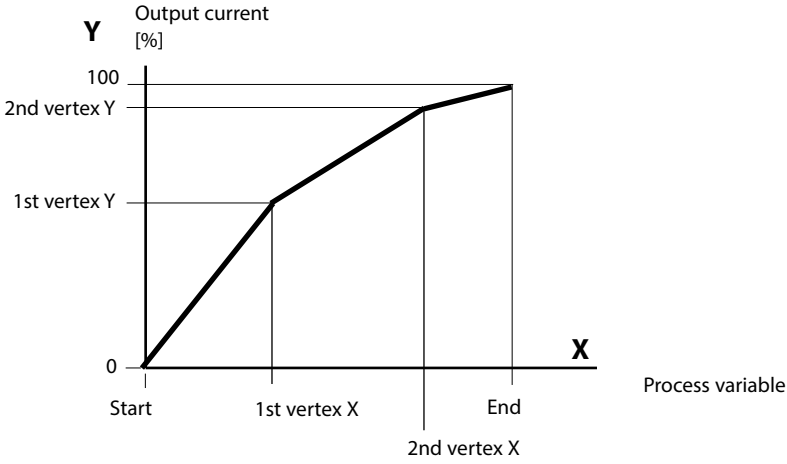
Current Outputs: Characteristics

Menu selection: Parameter setting > BASE module
Note: Function check (HOLD) mode active

- **Linear characteristic**
  The process variable is represented by a linear output current curve.



- **Trilinear characteristic**
  Two additional vertices must be entered:

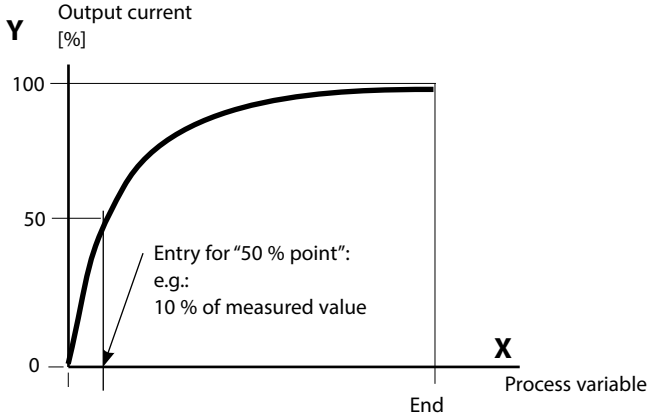


- **Note: Bilinear characteristic**
  For a bilinear characteristic, identical parameters are entered for the two vertices (1st vertex, 2nd vertex).

- **Function characteristic**

  Nonlinear output current characteristic: allows measurements over several decades, e.g. measuring very low values with a high resolution and high values with a low resolution.

  Required: Entering a value for 50 % output current.



Equation

$$\text{Output current (4 to 20 mA)} = \frac{(1+K)x}{1+Kx} 16\text{ mA} + 4\text{ mA}$$

$$K = \frac{E + S - 2 * X50\%}{X50\% - S} \qquad x = \frac{M - S}{E - S}$$

S: Start value at 4 mA
X50%: 50% value at 12 mA (output current range 4 to 20 mA)
E: End value at 20 mA
M: Measured value

Logarithmic output curve over one decade:
S: 10 % of maximum value
X50%: 31.6 % of maximum value
E: Maximum value

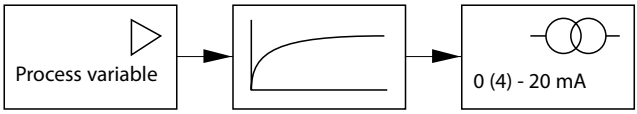
Logarithmic output curve over two decades:
S: 1 % of maximum value
X50%: 10 % of maximum value
E: Maximum value

Current Outputs: Output Filter

Parameter setting > BASE module > Output current I... > Output filter
Note: Function check (HOLD) mode active

Time Averaging Filter
To smoothen the current output, a low-pass filter with adjustable time interval can be switched on. When there is a jump at the input (100 %), the output level is at 63 % after the time interval has been reached.
The time interval can be set from 0 to 120 sec. If the time interval is set to 0 sec, the current output follows the input.

Note:
The filter only acts on the current output and the current value of the secondary display, not on the measurement display, the limit values or the controller!

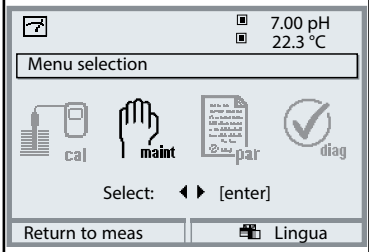
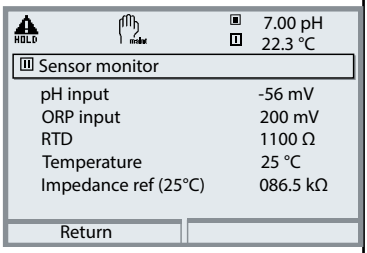
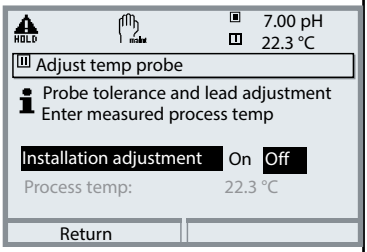


Time interval 0 ... 120 sec

Note:
For further BASE module settings (behavior during messages, contacts, optocoupler inputs) refer to the user manual of the basic device.

Maintenance

Sensor monitor, temp probe adjustment
Note: Function check (HOLD) mode active

Menu	Display	Action
maint		**Open Maintenance** From the measuring mode: Press **menu** key to select menu. Select maintenance using arrow keys, confirm by pressing **enter**. Passcode as delivered: 2958 Then select "Module PH".
		**Sensor monitor** for validation of sensor and complete measured-value processing.
		**Temp probe adjustment** [1] This function allows compensating for the individual temperature probe tolerance and the influence of the lead resistances to increase the accuracy of temperature measurement. Make sure that the process temperature is precisely measured using a calibrated reference thermometer when performing an adjustment! The measurement error of the reference thermometer should be less than 0.1 °C. Adjustment without precise measurement might result in considerable deviations of the measured value display!

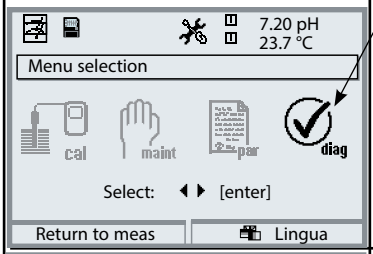
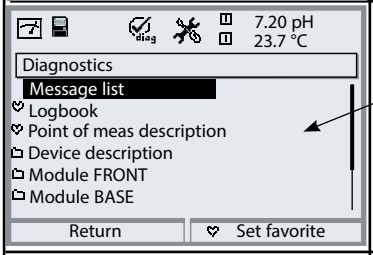
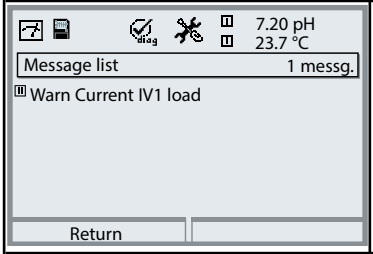
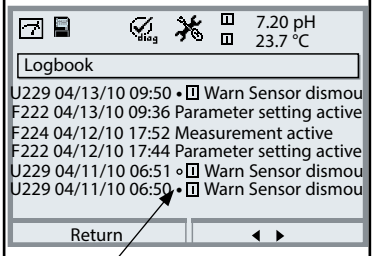
Note: The display may vary depending on the device version.

1) With Protos II 4400(X) in the Calibration menu

Diagnostic Functions

General status information of the measuring system
Menu selection: Diagnostics

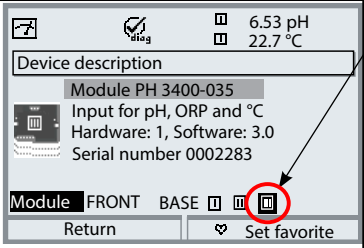
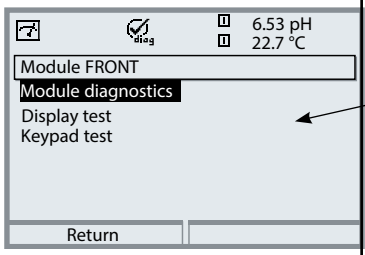
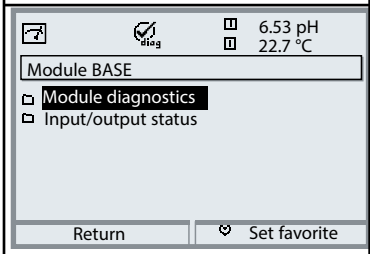
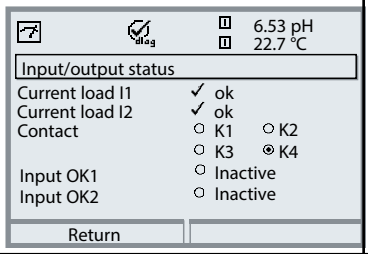
Note: The display may vary depending on the device version.

Menu	Display	Action
diag		**Opening the diagnostics menu** From the measuring mode: Press **menu** key to select menu. Select diagnostics using arrow keys, confirm by pressing **enter**.
		The "Diagnostics" menu gives an overview of all functions available. Functions which have been set as "Favorite" can be directly accessed from the measuring mode.
		**Message list** Shows the currently activated warning or failure messages in plain text.
		**Logbook** Shows the last events[1)] with date and time, e.g. calibrations, warning and failure messages, power failure. This permits quality management documentation as required by ISO 9001. For parameter setting, see p. 60.

1) Protos 3400(X): 50 events, Protos II 4400(X): 100 events

Diagnostic Functions

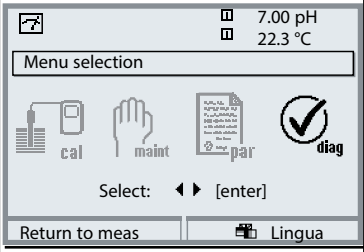
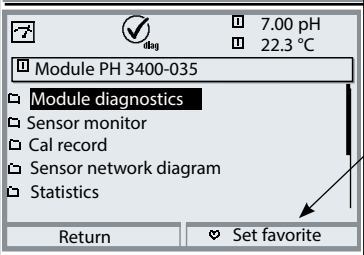
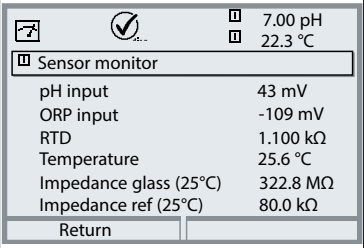
Device description, FRONT module, BASE module

Menu	Display	Action
diag		**Device description** Select module using arrow keys: Provides information about all modules installed: Function, serial number, hardware and firmware version and device options.
		**FRONT module** The module contains the display and keypad control. Test possibilities: • Module diagnostics • Display test • Keypad test
		**BASE module** The module generates the standard output signals. Test possibilities: • Module diagnostics • Input/output status
		Example: Module BASE, input/output status.

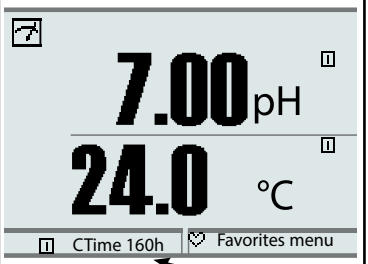
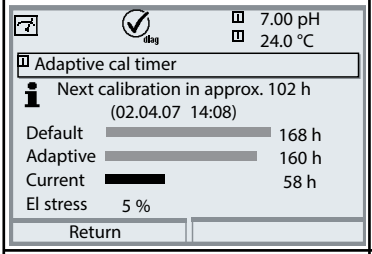
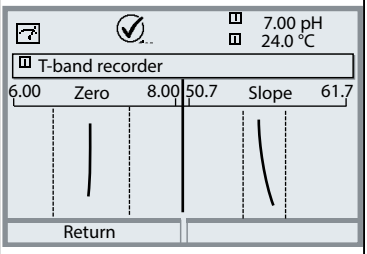
Note: The display may vary depending on the device version.

Diagnostic Functions

Menu selection: Diagnostics > PH … Module

Menu	Display	Action
diag		**Opening the diagnostics menu** From the measuring mode: Press **menu** key to select menu. Select diagnostics using arrow keys, confirm by pressing **enter**. Then select pH module.
		The Diagnostics menu gives an overview of all diagnostics functions available. Messages set as "Favorite" can be called up directly from the measuring mode using a softkey. To configure: Parameter setting > System control > Function control matrix.
		Module diagnostics Internal function test (without Fig.).
		For diagnostic functions for ISM sensors, see. p. 14 **Sensor monitor** Shows the values currently measured by the sensor. Important function for diagnostics and validation! (cf Maintenance)

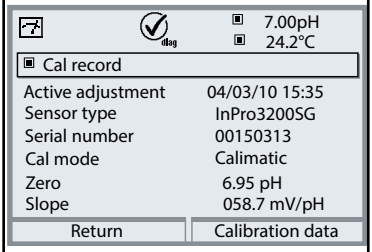
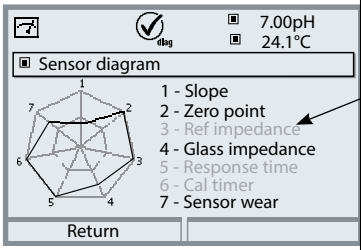
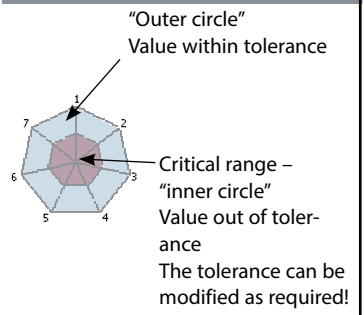
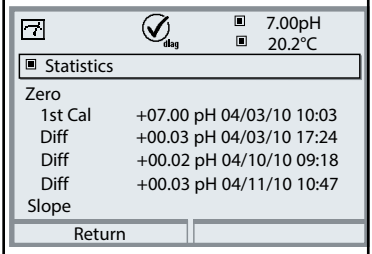
Note: The display may vary depending on the device version.

Menu	Display	Action
		**Calibration timer** After expiration of a presettable interval (Parameter Setting > PH Module > Cal Presettings), the calibration timer generates a warning message as a reminder that calibration is required. The remaining time can be indicated in the measuring mode by pressing a softkey (secondary display: "CTime").
diag		**Adaptive calibration timer** The time until the next due calibration is automatically reduced depending on the temperature and pH value, i.e. old electrode = timer expires sooner.
		**Tolerance adjustment** Add-on function SW3400-005 [1)] Records the tolerance ranges for zero and slope over the time. If the values determined by a calibration exceed the tolerance limits, the calibration is taken over as adjustment. Display can be graphical or as a listing. The tolerance band (zero, slope) is configured during parameter setting (Module PH, Cal preset values).

Note: The display may vary depending on the device version.

1) with Protos 3400(X)

Diagnostic Functions

Menu	Display	Action
diag		**Calibration/Adjustment Record** Data of the last adjustment/calibration (Date, time, calibration method, zero and slope, isothermal potential, information concerning calibration buffers and response times) **Temp. Offset Log** Shows the data from the last temperature adjustment performed on the currently connected sensor.[1)]
	 	**Sensor Diagram** Graphical representation of the sensor parameters. Tolerance limit violations can be seen at a glance. Critical parameters are flashing. Parameters displayed in gray have been disabled during parameter setting or do not apply to the currently selected sensor. The tolerance limits (radius of "inner circle") can be modified as desired. See Parameter Setting > Sensor Data > Sensor Monitoring Details.
		**Statistics** Indication of sensor data for the first adjustment and the last 3 adjustments compared to the first adjustment. (Date and time of First Calibration, zero and slope, impedance of glass and reference electrode, response time. For ISM, the data are stored in the sensor)

Note: The display may vary depending on the device version.

1) with Protos II 4400(X)

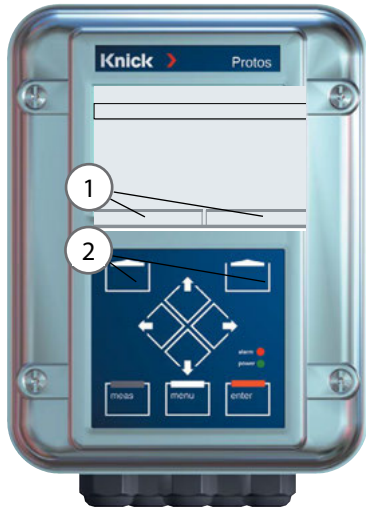
Setting Diagnostic Messages as Favorite

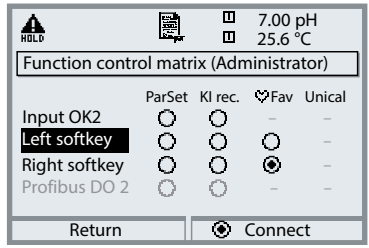
Menu selection: Parameter setting > System control > Function control matrix

Secondary displays (1)
Here, additional values are displayed in the measuring mode according to the factory setting. When the respective softkey (2) is pressed, the process variables measured by the modules plus date or time are displayed. In addition, you can use the **softkeys (2)** to control functions.
To assign a function to a softkey, select

Parameter setting > System control > Function control matrix
Function which can be controlled by softkeys:

- Parameter set selection
- KI recorder Start/Stop[1)]
- Favorites
- Unical (fully automated probe controller)[1)]





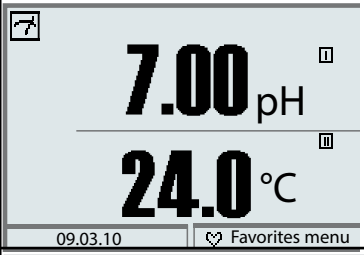
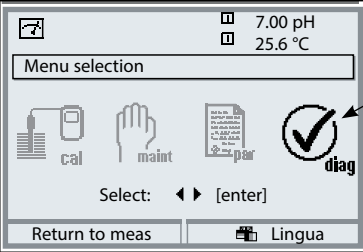
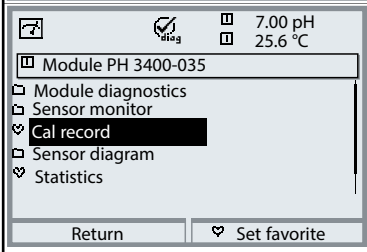
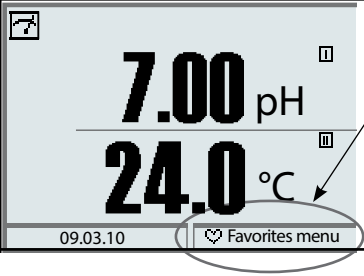
Example:
"Favorites" to be selected with "Right softkey"

To select a softkey function:
Select desired function using arrow keys,
press "Connect" softkey and confirm with **enter**.

To deselect a function:
Press "Disconnect" softkey, confirm with **enter**.

Favorites
Selected Diagnostic functions can be called directly from the measuring mode using a softkey.
The table on the next page explains how to select favorites.

1) with Protos 3400(X).

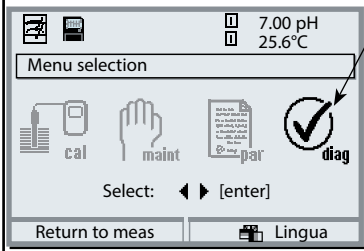
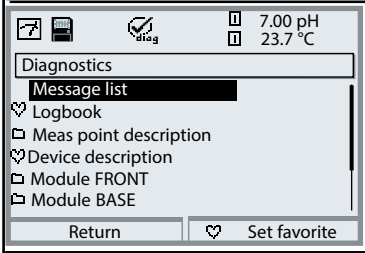
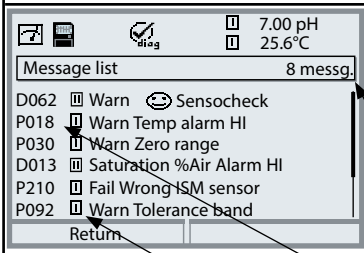
Menu	Display	Action
		**Favorites menu** Diagnostic functions can be called directly from the measuring mode using a softkey. The "Favorites" are selected in the Diagnostics menu.
diag		**Select favorites** Press **menu** key to select menu. Select diagnostics using arrow keys, confirm with **enter**. Then select module and confirm with **enter**.
		Set/delete favorite: "Set favorite" allows activation of the selected diagnostic function directly from the measuring mode via softkey. The menu line is marked with a heart icon.
		Pressing the **meas** key returns to measurement. When the softkey has been assigned to "Favorites", "Favorites menu" is read in the secondary display (see "Function control matrix").

Note: The display may vary depending on the device version.

Note:
When one of the softkeys has been assigned to the "Favorites menu" function, diagnostic functions which have been set as "Favorite" can be directly called from the measuring mode.

Diagnostic Functions

General status information of the measuring system
Menu Selection: Diagnostics > Message list

Menu	Display	Action
diag		**Opening the diagnostics menu** From the measuring mode: Press **menu** key to select menu. Select diagnostics using arrow keys, confirm by pressing **enter**.
		The "Diagnostics" menu gives an overview of all functions available. Functions which have been set as "Favorite" can be directly accessed from the measuring mode.
		**Message list** Shows the currently activated warning or failure messages in plain text. **Number of messages** When there are more than 7 messages, a vertical scrollbar appears. Scroll with the up/down arrow keys. **Message identifier** See message list for description. **Module identifier** Specifies the module that has generated the message.

Note: The display may vary depending on the device version.

Messages

Messages for PH 3400(X)-035 Module with Protos 3400(X)

No.	PH message	Message type
P008	Meas. processing (factory settings)	FAIL
P009	Module failure (Firmware Flash check sum)	FAIL
P010	pH range	FAIL
P011	pH Alarm LO_LO	FAIL
P012	pH Alarm LO	WARN
P013	pH Alarm HI	WARN
P014	pH Alarm HI_HI	FAIL
P015	Temperature range	FAIL
P016	Temperature Alarm LO_LO	FAIL
P017	Temperature Alarm LO	WARN
P018	Temperature Alarm HI	WARN
P019	Temperature Alarm HI_HI	FAIL
P020	ORP range	FAIL
P021	ORP Alarm LO_LO	FAIL
P022	ORP Alarm LO	WARN
P023	ORP Alarm HI	WARN
P024	ORP Alarm HI_HI	FAIL
P025	rH range	WARN
P026	rH Alarm LO_LO	FAIL
P027	rH Alarm LO	WARN
P028	rH Alarm HI	WARN
P029	rH Alarm HI_HI	FAIL
P030	Zero range	WARN
P035	Slope range	WARN
P040	Isotherm potential Uis range	WARN
P045	mV range	WARN

No.	PH message	Message type
P046	mV Alarm LO_LO	FAIL
P047	mV Alarm LO	WARN
P048	mV Alarm HI	WARN
P049	mV Alarm HI_HI	FAIL
P050	Man. temperature range	FAIL
P060	SAD SENSOFACE: Slope	User-defined
P061	SAD SENSOFACE: Zero	User-defined
P062	SAD SENSOFACE: Ref impedance (Sensocheck)	User-defined
P063	SAD SENSOFACE: Glass impedance (Sensocheck)	User-defined
P064	SAD SENSOFACE: Response time	User-defined
P065	SAD SENSOFACE: Calibration timer	WARN
P066	SAD SENSOFACE: Calcheck	User-defined
P069	SAD SENSOFACE: Calimatic (Zero/slope)	WARN
P070	SAD SENSOFACE: Sensor wear	User-defined
P071	SAD SENSOFACE: ISFET leakage current	User-defined
P090	Buffer offset (buffer table to be entered):	WARN
P091	Zero offset ORP	WARN
P092	Tolerance band	WARN
P110	CIP counter	User-defined
P111	SIP counter	User-defined
P112	Autoclaving counter	User-defined
P113	Sensor operating time (duration of use)	User-defined
P114	ISFET characteristic	User-defined
P115	Membrane body changes	User-defined
P120	Wrong ISM sensor	FAIL
P121	ISM sensor (error in factory settings/characteristics)	FAIL
P122	ISM sensor memory (error in cal data records)	WARN
P123	New sensor, adjustment required	WARN
P130	SIP cycle counted	Text
P131	CIP cycle counted	Text

No.	PH message	Message type
P200	Noise level at pH input	FAIL
P201	Cal temp	WARN
P202	Cal: Buffer unknown	Text
P203	Cal: Identical buffers	Text
P204	Cal: Buf interchanged	Text
P205	Cal: Sensor unstable	Text
P206	Cal: Slope	WARN
P207	Cal: Zero	WARN
P208	Cal: Sensor failure (ORP check)	FAIL
P254	Module reset	Text

No.	Calculation Block PH / PH messages	Message type
A010	pH-Diff Range	FAIL
A011	pH-Diff Alarm LO_LO	FAIL
A012	pH-Diff Alarm LO	WARN
A013	pH-Diff Alarm HI	WARN
A014	pH-Diff Alarm HI_HI	FAIL
A015	Temperature-Diff Range	FAIL
A016	Temperature-Diff Alarm LO_LO	FAIL
A017	Temperature-Diff Alarm LO	WARN
A018	Temperature-Diff Alarm HI	WARN
A019	Temperature-Diff Alarm HI_HI	FAIL
A020	ORP-Diff Range	FAIL
A021	ORP-Diff Alarm LO_LO	FAIL
A022	ORP-Diff Alarm LO	WARN
A023	ORP-Diff Alarm HI	WARN
A024	ORP-Diff Alarm HI_HI	FAIL

Messages for PH 3400(X)-035 Module with Protos II 4400(X)

⊗ Failure ⚠ Out of Specification ⟲ Maintenance Required

No.	Message Type	PH Message
P008	Failure	Meas. Processing (Factory Settings)
P009	Failure	Firmware Error
P010	Failure	pH Range
P011	Failure	pH Alarm LO_LO
P012	Out of Specification	pH Alarm LO
P013	Out of Specification	pH Alarm HI
P014	Failure	pH Alarm HI_HI
P015	Failure	Temperature Range
P016	Failure	Temperature Alarm LO_LO
P017	Out of Specification	Temperature Alarm LO
P018	Out of Specification	Temperature Alarm HI
P019	Failure	Temperature Alarm HI_HI
P020	Failure	ORP Range
P021	Failure	ORP Alarm LO_LO
P022	Out of Specification	ORP Alarm LO
P023	Out of Specification	ORP Alarm HI
P024	Failure	ORP Alarm HI_HI
P025	Out of Specification	rH Range
P026	Failure	rH Alarm LO_LO
P027	Out of Specification	rH Alarm LO
P028	Out of Specification	rH Alarm HI
P029	Failure	rH Alarm HI_HI
P045	Failure	mV Range
P046	Failure	mV Alarm LO_LO
P047	Out of Specification	mV Alarm LO
P048	Out of Specification	mV Alarm HI
P049	Failure	mV Alarm HI_HI
P060	Failure/Maintenance Required	Sad Sensoface: Slope
P061	Failure/Maintenance Required	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	Maintenance Required	Sad Sensoface: Calibration timer

No.	Message Type	PH Message
P069	Maintenance Required	Sad Sensoface: Calimatic (Zero/Slope)
P070	User-defined	Sad Sensoface: Sensor Wear
P071	Maintenance Required	Sad Sensoface: ISFET Leakage Current
P072	Maintenance Required	Sad Sensoface: ISFET Operating Point
P073	Maintenance Required	TTM Maintenance Timer (for ISM sensor only)
P074	Maintenance Required	Sad Sensoface: ORP Zero Offset
P090	Maintenance Required	Buffer Distance (User-Defined Buffer Table)
P092	Maintenance Required	Tolerance Band
P110	User-defined	CIP Counter
P111	User-defined	SIP Counter
P112	User-defined	Autoclaving Counter
P113	User-defined	Sensor Operating Time
P120	Failure	Wrong Sensor (Sensor Verification)
P121	Failure	Sensor Error (Factory/Characteristic Data)
P122	Maintenance Required	Sensor Memory Error (Cal Data)
P123	Maintenance Required	New Sensor, Adjustment Required
P124	Maintenance Required	Sensor Date
P130	Text	SIP Cycle Counted
P131	Text	CIP Cycle Counted
P200	Failure	Noise Level at pH Input
P201	Maintenance Required	Cal Temperature
P202	Text	Cal: Buffer Unknown
P203	Text	Cal: Identical Buffers
P204	Text	Cal: Buffers Interchanged
P205	Text	Cal: Sensor Unstable
P206	Maintenance Required	Cal: Slope
P207	Maintenance Required	Cal: Zero Point
P208	Failure	Cal: Sensor Failure (ORP Check)
P254	Text	Module Reset

No.	Message Type	Calculation Block PH / PH Messages
A010	Failure	pH Diff Range
A011	Failure	pH Diff Alarm LO_LO
A012	Out of Specification	pH Diff Alarm LO
A013	Out of Specification	pH Diff Alarm HI
A014	Failure	pH Diff Alarm HI_HI
A015	Failure	Temperature Diff Range
A016	Failure	Temperature Diff Alarm LO_LO
A017	Out of Specification	Temperature Diff Alarm LO
A018	Out of Specification	Temperature Diff Alarm HI
A019	Failure	Temperature Diff Alarm HI_HI
A020	Failure	ORP Diff Range
A021	Failure	ORP Diff Alarm LO_LO
A022	Out of Specification	ORP Diff Alarm LO
A023	Out of Specification	ORP Diff Alarm HI
A024	Failure	ORP Diff Alarm HI_HI
A045	Failure	mV Diff Range
A046	Failure	mV Diff Alarm LO_LO
A047	Out of Specification	mV Diff Alarm LO
A048	Out of Specification	mV Diff Alarm HI
A049	Failure	mV Diff Alarm HI_HI
A200	Maintenance Required	Calculation Block Configuration

Specifications

Specifications Protos PH 3400(X)-035

pH/ORP input	Analog glass electrode or ORP sensor, actuation of ISM sensors		
	Glass electrode input		
	Reference electrode input		
	SG input: ORP sensor or auxiliary electrode		
Measuring range	pH value	-2.00 ... 16.00	
	ORP value	-2000 ... 2000 mV	
	rH Value	0.0 ... 42.5	
Adm. voltage ORP + pH [mV]	2000 mV		
Adm. cable capacitance	< 2 nF (cable length max. 20 m)		
Glass electrode input[2)]	Input resistance	> 1 x 10^{12} Ω	
	Input current	< 1 x 10^{-12} A [4)]	
	Impedance range	0.5 ... 1000 MΩ	
Reference electrode input[2)]	Input resistance	> 1 x 10^{10} Ω	
	Input current	< 1 x 10^{-10} A [4)]	
	Impedance range	0.5 ... 200 kΩ	
Measurement error [3)]	pH value	< 0.02	TC < 0.001 pH/K
(display)	ORP value	< 1 mV	TC < 0.05 mV/K
Temperature input	Pt100/Pt1000/NTC 30 kΩ/NTC 8.55 kΩ [1)]		
	3-wire connection, adjustable		
Measuring range	-20 ... 150 °C / -4 ... 302 °F (Pt 100/Pt 1000/NTC 30 kΩ)		
	-10 ... 130 °C / 14 ... 266 °F (NTC 8.55 kΩ, Mitsubishi)		
Resolution	0.1 °C/°F		
Measurement error[3)]	0.2 % meas.val. + 0.5 K (< 1 K with NTC > 100 °C / 212 °F)		
Temp compensation, media-related	Reference temperature 25 °C/77 °F • Linear temperature coefficient, user-defined from -19.99 to 19.99 % / K • Ultrapure water 0 ... 150 °C / 32 ... 302 °F • Table 0 ... 95 °C / 32 ... 203 °F, user-defined in 5 K steps		

1) user-definable 2) at rated operating conditions
3) ± 1 count, plus sensor error 4) at 20 °C/68 °F, doubles every 10 K

Specifications

ORP [1]	Automatic conversion to standard hydrogen electrode SHE when type of reference electrode is entered	
Sensor standardization ORP [1]	Zero adjustable from -200 to 200 mV	
pH sensor standardization [1]	1-/2-/3-point calibration (best fit line)	
	Operating modes:	
	• Calimatic automatic buffer recognition	
	• Input of individual buffer values	
	• Product calibration	
	• Data entry of pre-measured electrodes	
Drift check [1]	Fine / standard / coarse	
Calimatic buffer sets [1]	• Fixed buffer sets:	
	Knick/Mettler-Toledo	2.00 / 4.01 / 7.00 / 9.21
	Merck/Riedel	2.00 / 4.00 / 7.00 / 9.00 / 12.00
	DIN 19267	1.09 / 4.65 / 6.79 / 9.23 / 12.75
	NIST Standard	4.006 / 6.865 / 9.180
	Techn. buffers to NIST	1.68 / 4.00 / 7.00 / 10.01 / 12.46
	Hamilton	2.00 / 4.01 / 7.00 / 10.01 / 12.00
	Kraft	2.00 / 4.00 / 7.00 / 9.00 / 11.00
	Hamilton buffer A	2.00 / 4.01 / 7.00 / 9.00 / 11.00
	Hamilton buffer B	2.00 / 4.01 / 6.00 / 9.00 / 11.00
	HACH	4.01 / 7.00 / 10.00
	Ciba	2.06 / 4.00 / 7.00 / 10.0
	Reagecon	2.00 / 4.00 / 7.00 / 9.00 / 12.00
	• Manually enterable buffer set with max. three buffer tables	
	(add-on function SW3400-002/ FW4400-002)	
Nom. zero [1]	pH 0 ... 14; calibration range ΔpH = ± 1	
Nom. slope (25 °C) [1]	25 ... 61 mV/pH; calibration range 80 ... 103 %	
Vis [1]	-1000 ... 1000 mV	

1) user-definable

Diagnostic functions	
Calibration/adjustment record	Recording of: zero point, slope, Vis, response time, calibration method with date and time
Temp. offset log [1]	Display of the current temperature probe adjustment and of the temperature offset.
Statistics	Recording of: zero, slope, Vis, response time, glass and reference impedance with date and time of the last three adjustments and the first adjustment
Sensocheck	Automatic monitoring of glass and reference electrode, message can be switched off
Sensoface	Provides information on the sensor condition: zero/slope, response time, calibration interval, Sensocheck, can be switched off
Sensor diagram	Graphical representation of current sensor parameters in a radar chart on the display: slope, zero, reference impedance, glass impedance, response time, cal timer
Sensor monitor	Direct display of measured values from sensor for validation: pH input / ORP input / glass el. impedance / ref. el. impedance / RTD / temperature
KI recorder [2] (SW3400-001)	Adaptive representation of process flow with monitoring and signaling of critical process parameters
Adaptive calibration timer [3]	Automatic adjustment of calibration interval (Sensoface signal), depending on measured values
Tolerance band recorder [2] (SW3400-005)	Tolerant calibration/adjustment, tolerance limits adjustable, graphical recording of zero point and slope of the last 40 calibrations
Sensor wear monitor (ISM)	Display of wear parameters: sensor wear / sensor operating time / autoclaving cycles / SIP cycles / CIP cycles
Load diagram [2] (ISM)	Graphical representation of sensor load

1) with Protos II 4400(X) 2) with Protos 3400(X)
3) user-definable

General Data

Explosion protection (Ex version of module only)	For entity parameters, see attachment to certificates or control drawings.
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)]
Interference immunity	(EN 55011 Group 1 Class A) 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
Transport/storage temperature	-20 ... 70 °C / -4 ... 158 °F
Screw clamp connectors	Single or stranded wires 0.2 ... 2.5 mm^2 Tightening torque 0.5 ... 0.6 Nm
Wiring	Stripping length max. 7 mm Temperature resistance > 75 °C / 167 °F

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

Appendix

Minimum Spans for Current Outputs

The PH 3400(X)-035 module is a measuring module.
It does not provide current outputs.
Current outputs are provided by the BASE module (basic device)
or by communication modules (e.g. OUT, PID).
The corresponding parameters must be set there.

The minimum current span shall prevent that the resolution limit of the measurement technology (± 1 count) is seen in the current.

PH 3400(X)-035 Module

pH	1.00
ORP	100.0
°C	10.0
mV	100.0
rH	1.00
°F	10.0

Calculation Block PH/PH

Diff pH	1.00
Diff ORP	100.0
Diff °C	10.0

Appendix

Buffer table "Mettler-Toledo"

°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

Appendix

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

Appendix

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

Appendix

Buffer table "NIST standard" (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 pH(S) values of the individual charges of the secondary reference materials are documented in a certificate of an accredited laboratory. This certificate is supplied with the respective buffer materials. 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 ony provides examples of pH(PS) values for orientation.

Appendix

Buffer table "Techn. buffers to NIST"

°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

Appendix

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

Appendix

Buffer table "Kraft"

°C	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

Appendix

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

Appendix

Buffer table "Hamilton B"

°C	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

Appendix

Buffer table "HACH"

T [°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

Appendix

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

Appendix

Buffer table "Reagecon"

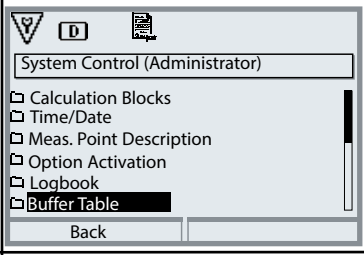
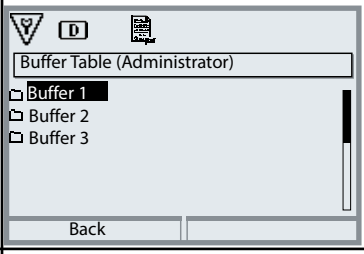
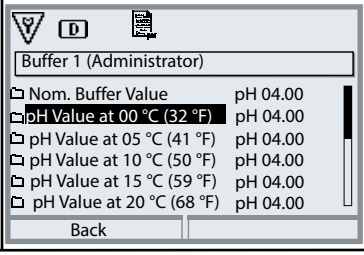
°C	pH				
0°C	*2,01	*4,01	*7,07	*9,18	*12,54
5°C	*2,01	*4,01	*7,07	*9,18	*12,54
10°C	2,01	4,00	7,07	9,18	12,54
15°C	2,01	4,00	7,04	9,12	12,36
20°C	2,01	4,00	7,02	9,06	12,17
25°C	**2,00**	**4,00**	**7,00**	**9,00**	**12,00**
30°C	1,99	4,01	6,99	8,95	11,81
35°C	2,00	4,02	6,98	8,90	11,63
40°C	2,01	4,03	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

Specifiable Buffer Sets

SW3400-002 / FW4400-002
Select menu: Parameter setting > System control > Buffer table

Specifying an Individual Buffer Set for pH Measurement
You can enter an individual buffer set with 3 buffer solutions. To do so, enter the nominal buffer values for the correct temperature (0 ... 95 °C / 32 ... 203 °F, 5 °C/9 °F step size). Then this buffer set is available as "Table" in addition to the permanently set standard buffer solutions.

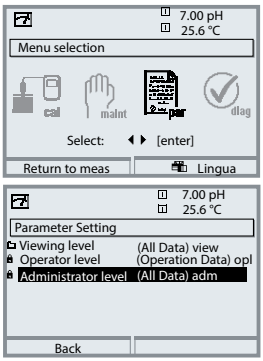
Menu	Display	Action
par		**Entering a Buffer Set** 1) Parameter Setting 2) System Control 3) Buffer Table
		Select buffer to be entered. Enter the values for 3 complete buffer solutions in ascending order (e.g. pH 4, 7, 10). Minimum distance: 2 pH units
		Enter nominal buffer value and all other values for the correct temperature (right/left arrow keys to select position, up/down arrow keys to edit number, press **enter** to confirm.)

Note: The display may vary depending on the device version.

The individual buffer set is selected in the menu:
Parameter Setting > PH Module > Cal Presettings:
Calibration Mode: Calimatic, Buffer Set: Table.

Parameter Setting Menu

Note: The menus may vary depending on the device version



Parameter Setting

From measuring mode: Press **menu** key to select menu.
Select parameter setting using arrow keys,
press **enter** to confirm.

Administrator level
Access to all functions, also passcode setting. Releasing or blocking functions for access from the Operator level.

Operator level
Access to all functions which have been released at the Administrator level. Blocked functions are displayed in gray and cannot be edited.

Viewing level
Only display, no editing possible!

System Control

Memory card (Option)	Menu only appears when a memory card is inserted and the corresponding add-on function has been enabled.
Transfer configuration	The complete configuration of a device can be written on a memory card. This allows transferring all device settings to other devices with identical equipment (exception: options and passcodes).
Parameter set	2 parameter sets (A, B) are available in the device. The currently active parameter set is shown in the display. Parameter sets contain all settings except: sensor type, options, system control settings Up to 5 parameter sets (1, 2, 3, 4, 5) are available when a memory card (Option) is used.
Function control	Select the functions to be controlled via softkeys and OK inputs
Time/date	Time, date, display format
Meas. point description	Free input of a tag number, can be called from the diagnostics menu
Release of options	Option activation via TAN
Reset to default	Reset all parameters to factory setting
Passcode entry	Change passcodes
Firmware update	Update the firmware using an Update Card
Logbook	Select the events to be recorded

Overview of Parameter Setting

Parameter Setting Menu

FRONT Module: Display Settings	
Language	Select the menu language
Units[1)]	Select the measurement units
Formats[1)]	Select the display format
Measurement display	Representation of measured values on the display
Display	Brightness/contrast, auto-off
BASE Module: Signal Outputs and Inputs, Contacts	
Output current I1, I2	Separately adjustable current outputs
Contact K4	Failure signaling
Contacts K3, K2, K1	Separately adjustable relay contacts
Inputs OK1, OK2	Optocoupler signal inputs

Note: The menus may vary depending on the device version

1) With Protos II 4400(X) only

Parameter Setting Menu

PH 3400(X)-035 module

Operating Mode [1]	Analog or ISM
Input Filter	Noise Suppression
Sensor Data • Sensor Type • Temperature Detection • Sensoface • Sensor Monitoring Details	Representation of measured values on the display: - Selection (automatic for ISM) - Selection (automatic for ISM) for meas / cal Slope, zero, ORP offset, Sensocheck ref./glass electrode, response time, sensor operating time [2], sensor wear [3], TTM maintenance timer [2], DLI Lifetime Indicator [2], CIP/SIP counter [2], autoclaving counter [2]
Cal preset values • Calimatic buffer - Mettler-Toledo - Knick CaliMat - DIN 19267 - NIST standard / technical - Hamilton - Kraft - Hamilton A/B - HACH - Ciba - Reagecon - Table • Drift check • Calibration timer • Tolerance adjustment	
TC process medium	Set the temperature compensation
ORP/rH value • Reference electrode • ORP conversion to SHE • Calculate rH with factor	
Delta function	(Output value = measurement - delta value)
Messages • pH value • ORP value • rH value • Temperature • mV value	Off, device limits max., variable limits
Devaluate ISM sensor	

Note: The menus may vary depending on the device version.

1) with Protos II 4400(X) 2) for ISM only 3) ISM with Protos 3400(X)

Note: The menus may vary depending on the device version.

Calibration Menu

PH 3400(X)-035 module

Calimatic	
Entry of buffer values	
Product calibration	
Data entry	
ORP calibration	
Temp probe adjustment [1]	Compensating for lead length

Maintenance Menu

BASE module

Current source	Output current definable 0 ... 22 mA

PH 3400(X)-035 module

Sensor monitor	pH / ORP input, RTD, Temp, Impedance glass + ref. el.
Temp probe adjustment [2]	Compensating for lead length)

Diagnostics Menu

Diagnostics messages	List of all messages
Meas. point description	Shows the tag number and annotation
Logbook	Shows the last events with date and time
Device description	Hardware version, Serial no., (Module) Firmware, Options

FRONT module

Module diagnostics	
Display test	
Keypad test	

BASE module

Module diagnostics	
Input/output status	

PH 3400(X)-035 module

Module diagnostics	Internal function test
Sensor diagnostics	Sensor monitor, sensor diagram, cal/adj record, temp. offset log[1], sensor wear monitor[3], load diagram [2, 3], statistics

1) with Protos II 4400(X) 2) with Protos 3400(X) 3) for ISM only

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097682 TA-201.035-KNEN09 Firmware version: 3.x