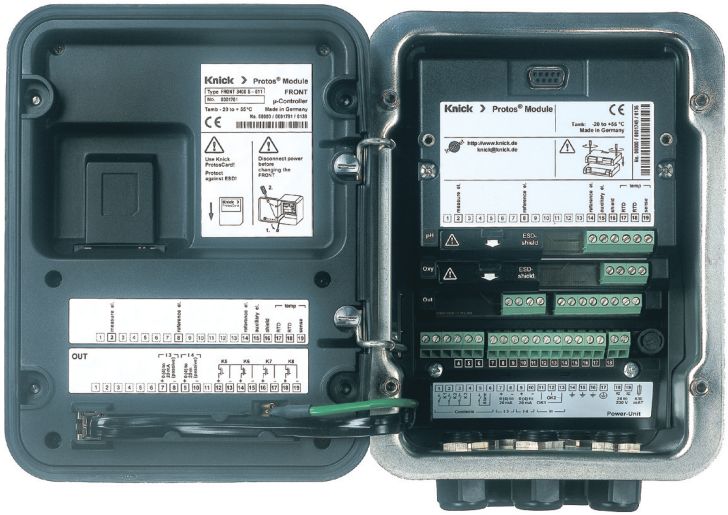
Knick

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

User Manual

Protos COND 3400(X)-041 Measuring Module

For Conductivity Measurement with
2- or 4-Electrode Sensors



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.

Table of Contents

Protos COND 3400(X)-041 Module

Returns 2
Disposal 2
Intended Use 5
Safety Instructions 6
Operation in Explosive Atmospheres: COND 3400X-041 Module 6
Firmware Version 7
Terminal Plate COND3400X-041-JP Module 9
Installing the Module 10
Wiring Examples 11
Calibration / Adjustment 19
Temperature Compensation 21
HOLD Function During Calibration 22
Automatic with Standard Calibration Solution 24
Manual Entry of Calibration Solution 26
Product Calibration (Calibration by Sampling) 28
Data Entry of Premeasured Sensors 30
Sensor Calibration 31
Temp Probe Adjustment 32
Parameter Setting 33
Parameter Setting: Operating Levels 34
Parameter Setting: Locking a Function 35
Default Settings and Selection Range 37
TC Process Medium 38
Parameter Setting: Concentration Curves 39
Concentration Table 43
USP Function 44
Calculation Blocks 45
pH Value Calculation 48
Logbook 50
Restore Factory Settings 50
Configuring the Current Output 53
Current Outputs: Characteristics 54
Current Outputs: Output Filter 56

Table of Contents

Protos COND 3400(X)-041 Module

Maintenance 57
Sensor Monitor 57
Temp Probe Adjustment 57
Diagnostic Functions 59
Point of Meas Description 59
Logbook 59
Module Diagnostics 60
Sensor Monitor 60
Calibration/Adjustment Record 60
Temp. Offset Log 60
Device Description 61
FRONT Module 61
BASE Module 61
Setting Diagnostic Messages as Favorite 62
Message list 64
Specifications 71
Appendix 75
Minimum Spans for Current Outputs 75
Overview 76
Overview of Parameter Setting 76

Intended Use

The module is an input module for conductivity measurement with commercially available 2- or 4-electrode sensors.

The COND 3400X-041 module is intended for operation in locations subject to explosion hazards which require equipment of Group II, device category 2(1), gas/dust.

Operation in Explosive Atmospheres: COND 3400X-041 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 further guidance, consult the following:

- IEC 60079-14
- EU directives 2014/34/EU and 1999/92/EC (ATEX)
- NFPA 70 (NEC)
- ANSI/ISA-RP12.06.01
- User's Guide to Explosion-Proof Equipment in Factories JNIOSH-TR-No.44

⚠ **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.

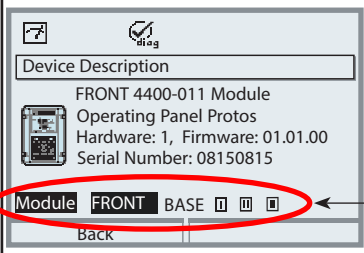
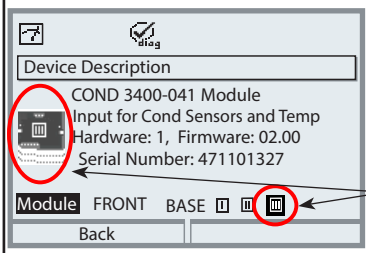
Firmware Version

COND 3400(X)-041 module firmware: Firmware version 2.x

Module compatibility	COND3400-041	COND3400X-041
Protos 3400 from FRONT firmware version 1.0	x	
Protos II 4400 from FRONT firmware version 01.00.00	x	
Protos II 4400X from FRONT firmware version 01.00.00		x

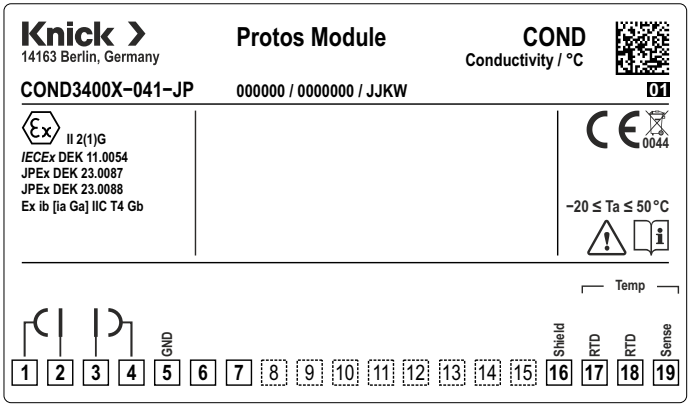
Further information on the firmware version history can be found at www.knick-international.com.

Query Device Firmware/Module Firmware
When the device 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 COND 3400-041, hardware and firmware version, serial number – here installed in slot 3.

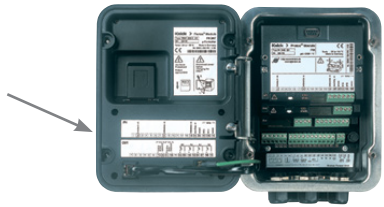
Note: The display may vary depending on the device version.

Terminal Plate COND3400X-041-JP 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) Connect the sensor and separate temperature probe if necessary, see "Wiring Examples".
6) Check whether all connections are correctly wired.
7) Close the device by tightening the screws on the front.
8) Switch on the power supply.

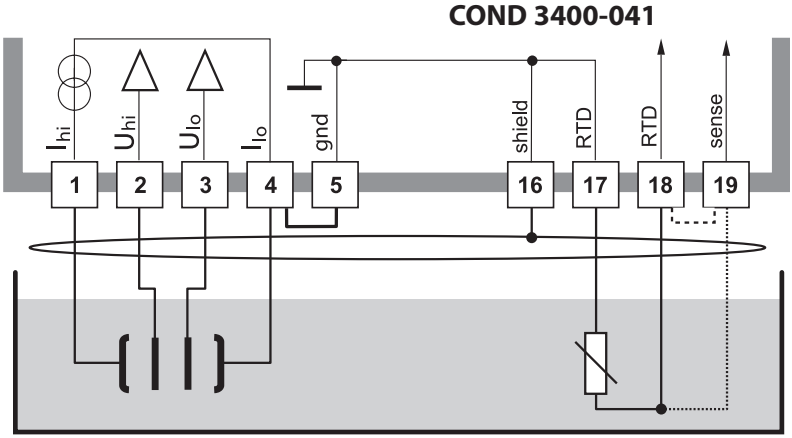
⚠ **CAUTION!** Risk of losing the specified ingress protection.
Fasten the cable glands and screw together the housing correctly.
Observe the permissible cable diameters and tightening torques (see the specifications of the basic unit).
Insert blanking plugs or sealing inserts if necessary.

Wiring Examples

Note: Be sure to connect the shielding properly

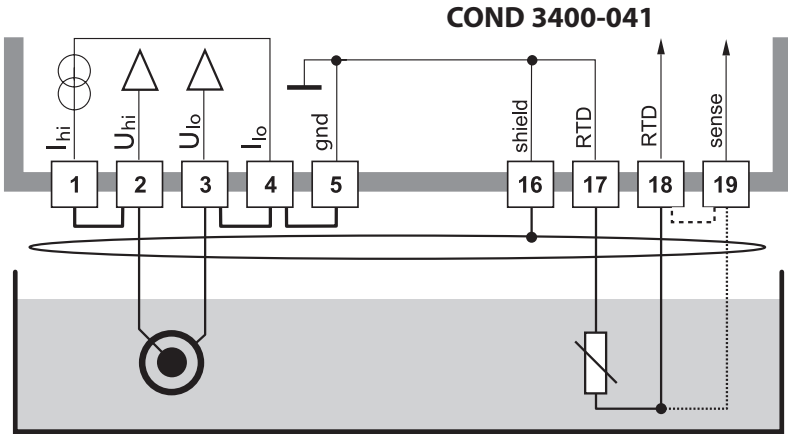
Wiring Example 1

Conductivity measurement with 4-electrode sensor



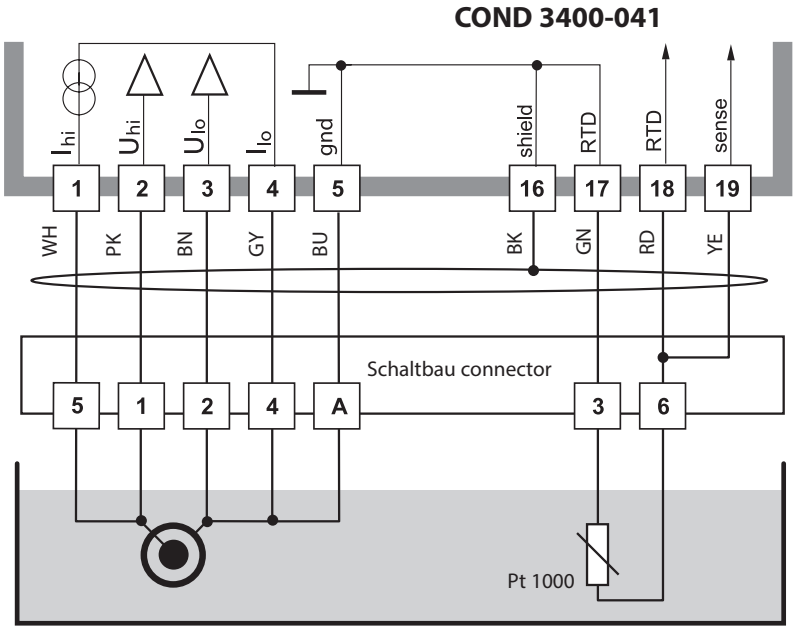
Wiring Example 2

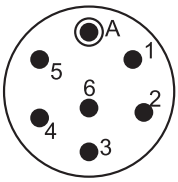
Conductivity measurement with 2-electrode coax sensor



Wiring Example 3

Conductivity measurement with SE 604 2-electrode coax sensor
Connection via Schaltbau cable





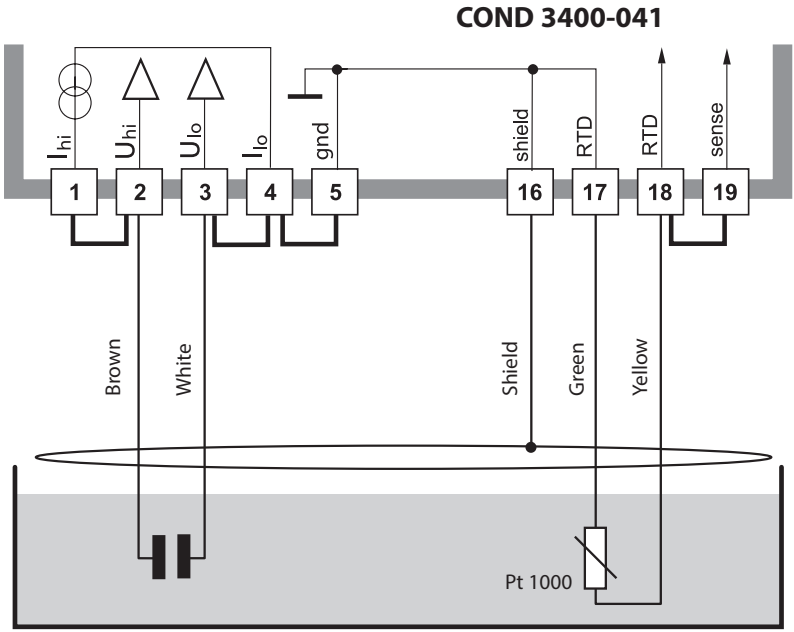
View on the sensor

Schaltbau connector

Pin	Wire color	Module terminal
1	White	2
2	Brown	3
3	Green	17
4	Gray	4
5	Pink	1
6	Red, yellow	18 and 19
A	Blue	5

Wiring Example 4

Conductivity measurement with SE 610 2-electrode sensor
Connection with pre-assembled cable with wire end ferrules

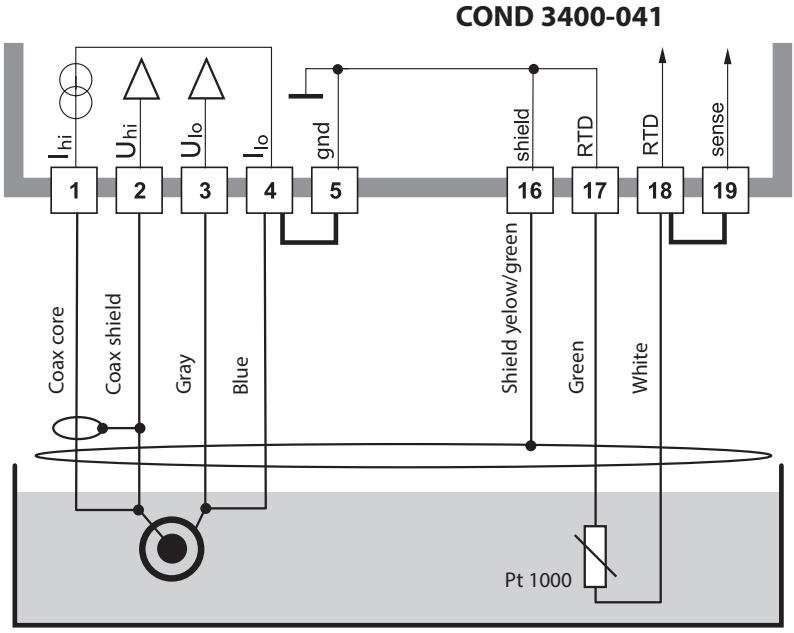


Screw clamp connection

Wire color	Module terminal
Brown	2 (jumper 1-2)
White	3 (jumper 3-4-5)
Shield	16
Green	17
Yellow	18 (jumper 18-19)

Wiring Example 5

Conductivity measurement with SE 620 2-electrode sensor
Connection with VP cable

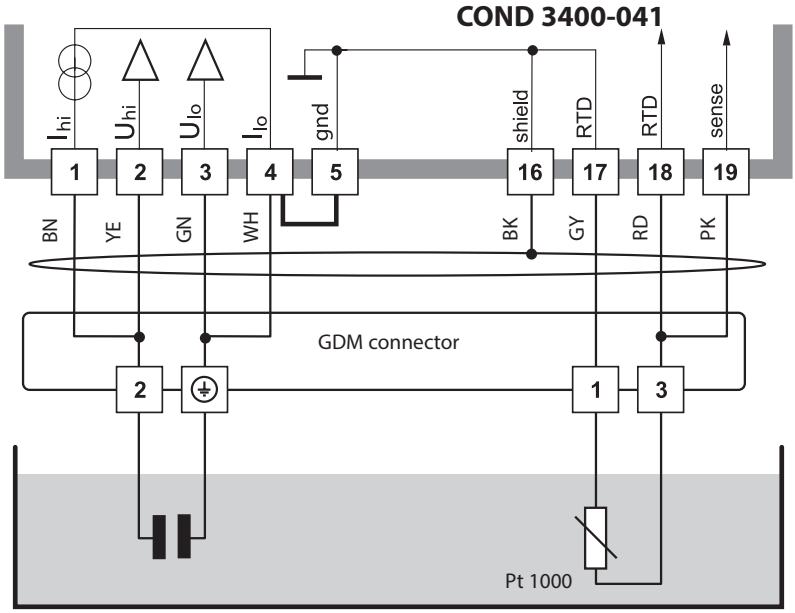


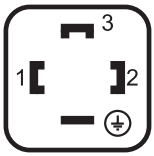
Screw clamp connection

VP cable	Module terminal
Coax core	1
Coax shield	2
Gray	3
Blue	4 (jumper 4-5)
Shield	16
Green	17
White	18 (jumper 18-19)

Wiring Example 6

Conductivity measurement with the SE 630 (ZU 0071) 2-electrode sensor
Connection via GDM connector



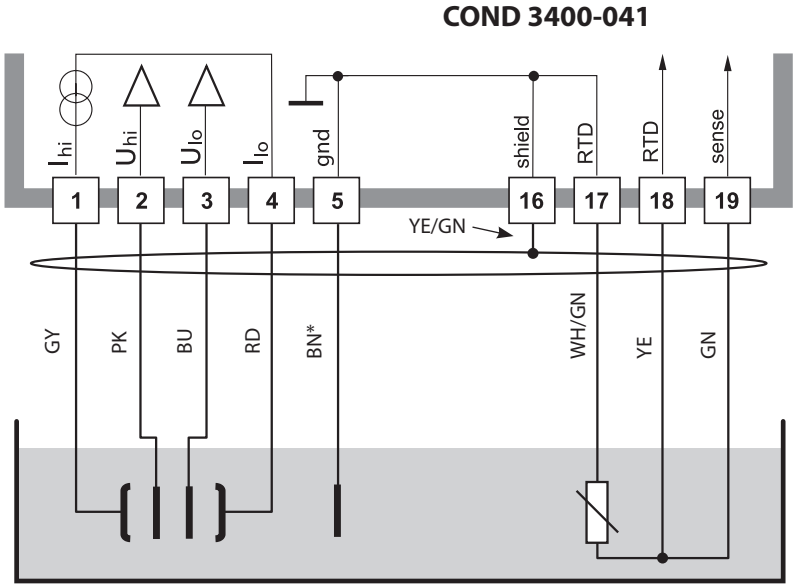


Plug-in connection: GDM

Pin	Wire color	Module terminal
1	Gray	17
2	Brown and yellow	1 and 2
3	Red and pink	18 and 19
⏚	Green and white	3 and 4

Wiring Example 7

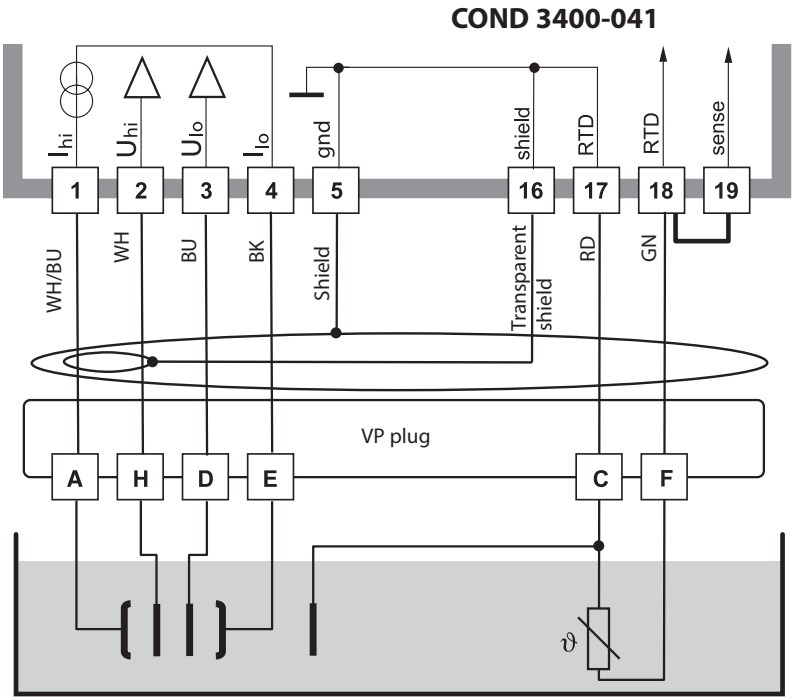
Conductivity measurement with 4-electrode fringe-field sensor
(SE 600/SE 603)

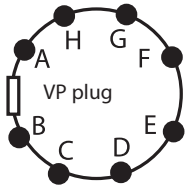


* SE 600: Equipotential bonding, brown wire
SE 603: Additional equipotential bonding electrode must be installed (or jumper 4–5)

Wiring Example 8

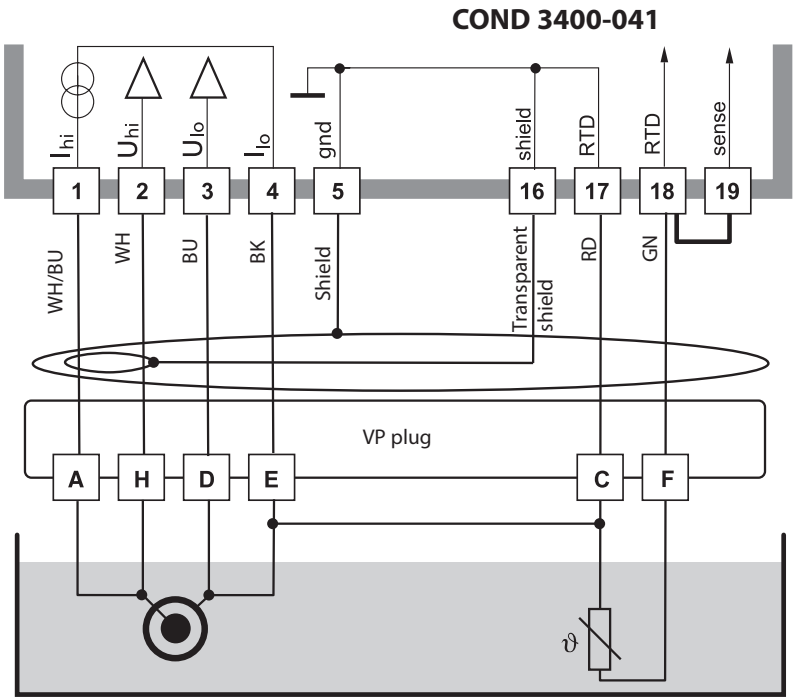
Conductivity measurement with 4-electrode sensor
Mettler-Toledo InPro 7100 series
Connection via LF-VP cable

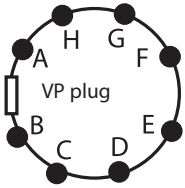




Wiring Example 9

Conductivity measurement with 2-electrode sensor
Mettler-Toledo InPro 7000 series
Connection via Thornton cable





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 conductivity meter delivers an imprecise or wrong output value! Every conductivity sensor has its individual cell constant.
To determine the correct conductivity value, the conductivity meter must be adjusted to the sensor. From the sensor signal and the cell constant, the meter calculates the conductivity value to be displayed.

Procedure
Every conductivity sensor has its individual cell constant.
Depending on the sensor design, the cell constant may vary over a wide range. As the conductivity is calculated from the measured conductance and the cell constant, this must be known to the measuring system. For calibration or sensor standardization, either the known (stamped on) cell constant of the conductivity sensor used is entered in the measuring system or it is determined automatically by measuring a calibration solution with a known conductivity. The data are stored in a calibration record. By "Adjustment" the determined calibration data can be used for correction (see following page).

- Use fresh calibration solutions only!
- The calibration solution used must have been selected during parameter setting.
- Calibration accuracy decisively depends on the exact detection of the calibration solution's temperature. Using the measured or entered temperature, the Protos determines the nominal value for the calibration solution from a stored table.
- Observe response time of temperature probe!
- For exact determination of the cell constant, wait until the temperature probe and calibration solution have the same temperature.

Adjustment
means that the cell constant determined by a calibration is taken over.
It is entered in the calibration record. (Cal record can be called up in the Diagnostics menu for the COND 3400(X)-041 module.) The value is 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	HOLD 0249 mS/cm 25.6 °C Calibration data record Calibration 31.03.10 12:30 Cal mode Automatic Cal temp 25.6 °C Conductivity 0249 mS/cm Cell constant 2.7450 /cm End Adjust	**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.
	HOLD 0249 mS/cm 25.6°C Module COND 3400-041 Stored calibration data record Calibration 31.03.10 12:30 Start new calibration View/adjust calibration data record Return	**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.

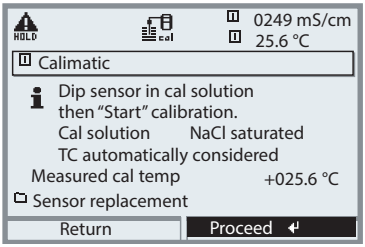
Note: The display may vary depending on the device version.

1) with Protos 3400

Temperature Compensation During Calibration

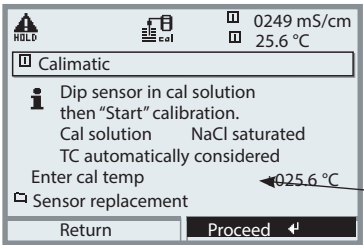
The conductivity value of the calibration solution is temperature-dependent. For calibration, the calibration solution temperature must therefore be known in order to choose the actual value from the conductivity table.
During parameter setting you define whether cal temperature is measured automatically or must be entered manually.

Automatic Temperature Compensation



For automatic cal temp detection, the Protos measures the temperature of the calibration solution with a temperature probe (Pt 100 / Pt 1000 / NTC 30 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 calibration 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

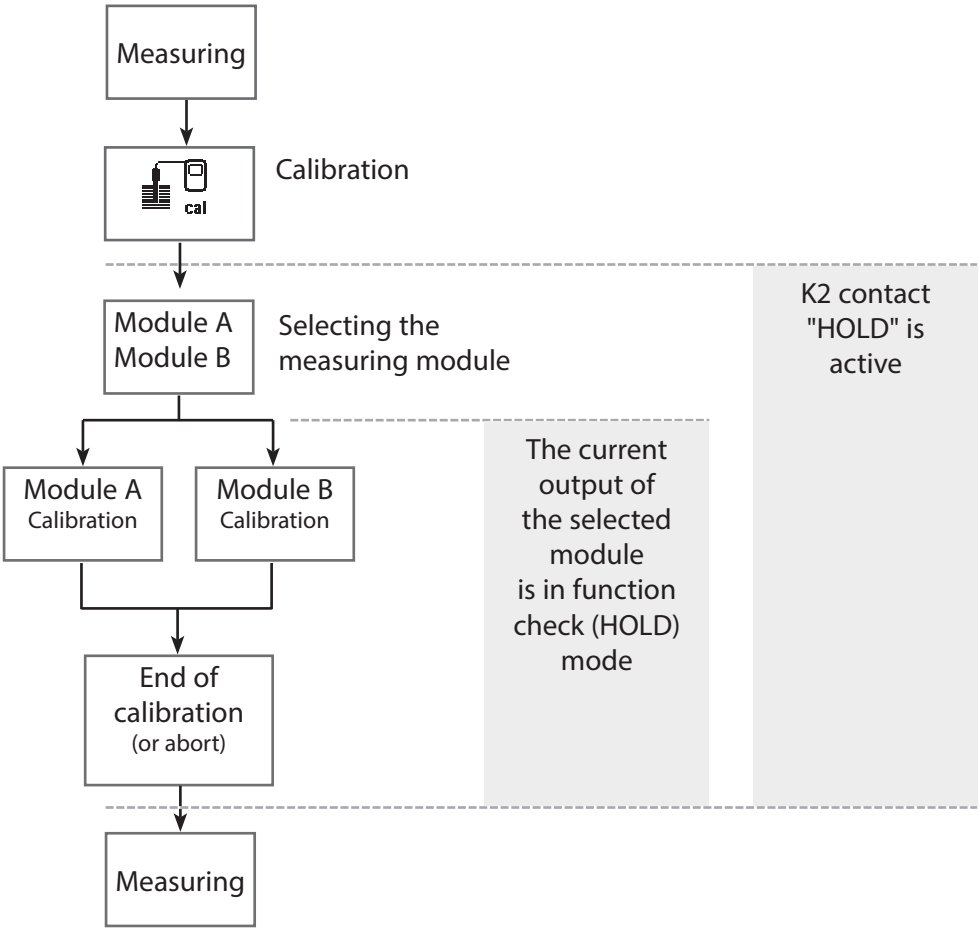


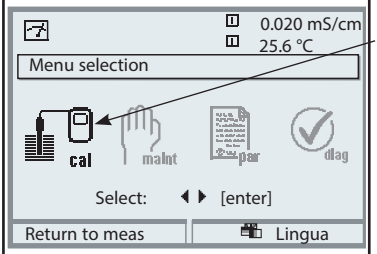
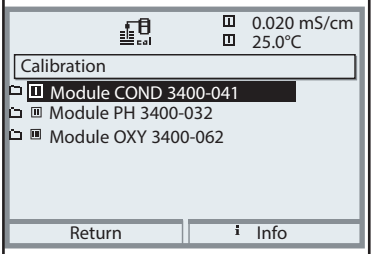
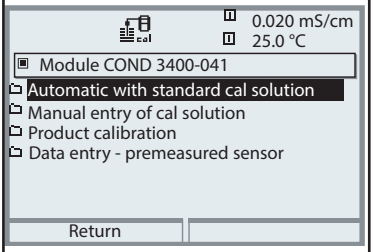
The temperature of the calibration solution must be entered manually in the Calibration menu. When "Cal temp automatic" is set, "Measured cal temp" appears in the menu. When "Cal temp manual" is set, "Enter cal temp" appears in the menu.

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, confirm with **enter**, passcode 1147 (The passcode can be edited by the administrator.).
		Calibration: Select "Module COND"
		Select calibration method: • Automatic with standard cal solution • Manual entry of cal solution • Product calibration • Data entry - premeasured sensor • Temp probe adjustment (with Protos II 4400(X)) When you call up calibration, the analyzer automatically proposes the previous calibration method. If you do not want to calibrate, "Return" with the left softkey. **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 Calibration with Standard Calibration Solution

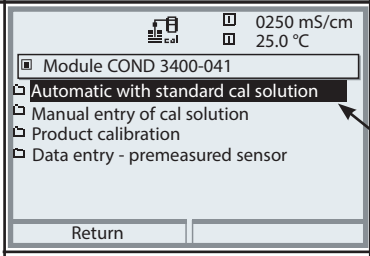
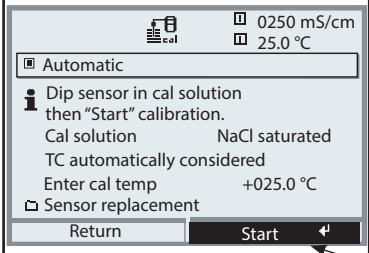
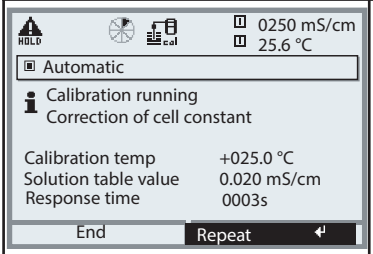
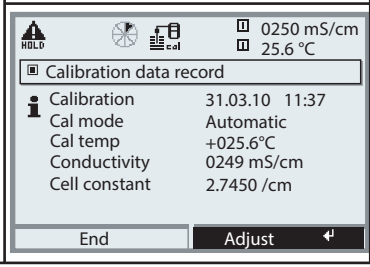
Automatic with Standard Calibration Solution
For automatic calibration, the conductivity sensor is immersed in a standard calibration solution (NaCl or KCl, selected during parameter setting). From the measured conductance and temperature, the Protos automatically calculates the cell constant. The temperature dependence of the calibration solution is taken into account.

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

NOTICE!
- Use fresh calibration solutions only! The calibration solution used must have been selected during parameter setting.
- Calibration accuracy decisively depends on the exact detection of the calibration solution's temperature. Using the measured or entered temperature, the Protos determines the nominal value for the calibration solution from a stored table.
- Observe response time of temperature probe!
- For exact determination of the cell constant, wait until the temperature probe and calibration solution have the same temperature.

Be sure to observe during calibration:
- If the measured conductance or the measured temperature fluctuate greatly, the calibration procedure is aborted after 2 min.
- If an error message appears, you have to repeat calibration.

Adjustment: Taking over the values determined by calibration
- When the values determined by calibration are correct, they must be taken over to adjust the analyzer.

Menu	Display	Action
cal		Select calibration menu Select "Module COND" Select calibration method: "Automatic with standard cal solution", confirm with **enter**.
		Display of selected calibration solution. Enter process temperature, if manual temperature adjustment has been selected. Dip sensor in calibration solution. Start calibration with softkey or **enter**.
		Calibration is running. The display shows: • Calibration temperature • Solution table value (conductivity in dependence on cal temperature) • Response time
		**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.

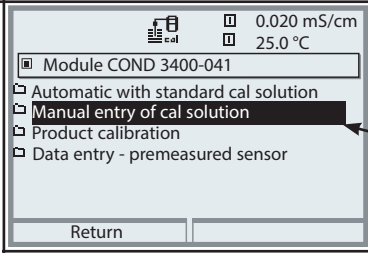
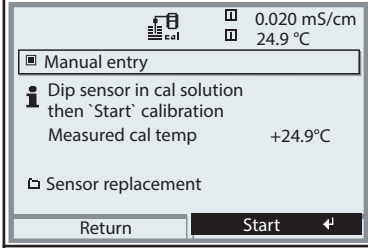
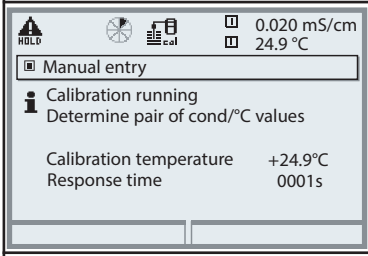
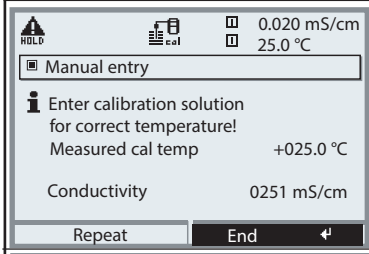
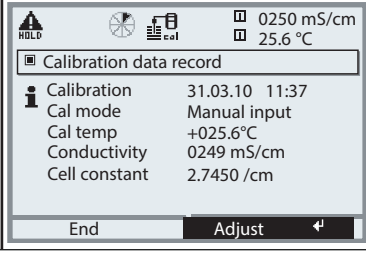
Manual Entry of Calibration Solution
For calibration with manual entry of the calibration solution's conductivity, the sensor is immersed in a calibration solution. Protos determines a conductivity/ calibration temperature value pair. Then, the temperature-corrected conductivity value of the solution must be entered. To do this, read off the conductivity for the temperature displayed from the TC table of the calibration solution. Intermediate conductivity values must be interpolated. Protos automatically calculates the cell constant.

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

NOTICE!
- Use fresh calibration solutions only!
- Calibration accuracy decisively depends on the exact detection of the calibration solution's temperature.
- Observe response time of temperature probe!
- For exact determination of the cell constant, wait until the temperature probe and calibration solution have the same temperature.

Be sure to observe during calibration:
- If the measured conductance or the measured temperature fluctuate greatly, the calibration procedure is aborted after 2 min.
- If an error message appears, you have to repeat calibration.

Adjustment: Taking over the values determined by calibration
- When the values determined by calibration are correct, they must be taken over to adjust the analyzer.

Menu	Display	Action
cal		Select calibration menu Select "Module COND" Select calibration method: "Manual entry of cal solution", confirm with **enter**.
		Enter process temperature, if manual temperature adjustment has been selected. Immerse sensor in cal solution. Start calibration with softkey or **enter**.
		Calibration is running. The display shows: • Calibration temperature • Response time
		Enter conductivity. End calibration with softkey ("End").
		**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 by Sampling)
When the sensor cannot be removed, e.g. for sterility reasons (for biotechnical processes), its cell constant can be determined with "sampling".
To do so, the currently measured process value (conductivity or concentration [1)]) is saved by the Protos.
Immediately afterwards, you take a sample from the process. The sample value should be measured at process conditions (same temperature!). The determined value is entered in the measuring system. From the difference between process value and sample value, the Protos calculates the cell constant of the conductivity sensor.

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

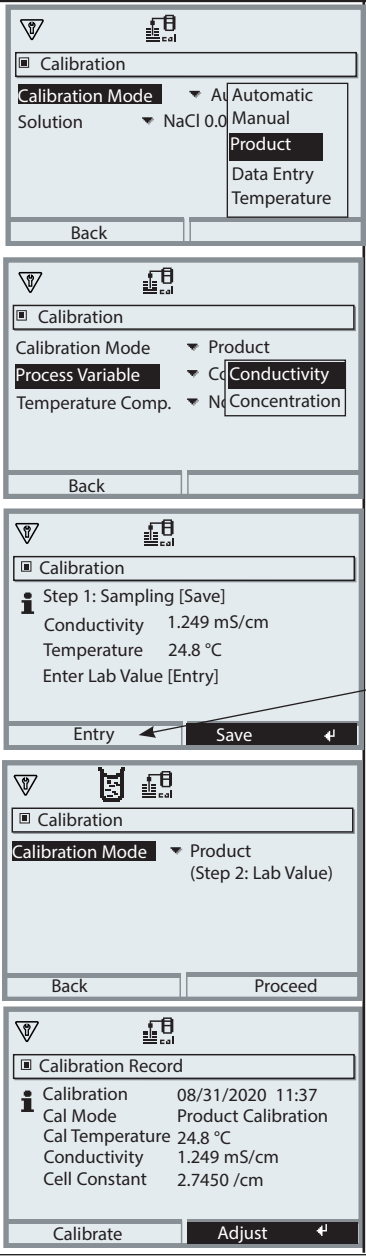
Product calibration without TC correction (for conductivity)
Take a sample from the process. Measure its value at the temperature at which the sample has been taken ("Sample temp", see display). To do so, it may be necessary to thermostat the sample correspondingly in the lab.
Temperature compensation must be turned off at the comparison meters (TC = 0 %/K).

Product calibration with TC correction Tref = 25 °C/77 °F (for conductivity)
Take a sample from the process. When measuring in the lab (TC linear), be sure that the same values are set for reference temperature and temperature coefficient in the comparison meter and in the Protos. Furthermore, the measuring temperature should correspond to the sample temperature (see display). Transport the sample in an insulated container (Dewar).

NOTICE!
Product calibration can only be performed if the process medium is stable. That means, for example, that there are no chemical reactions which have an effect on the process conductivity. At higher temperatures, the sample values can also be invalidated due to evaporation.

1) with Protos II 4400(X) and add-on function FW4400-009

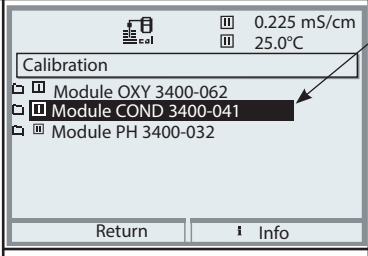
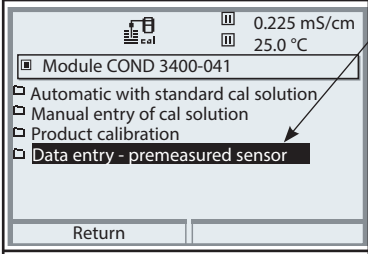
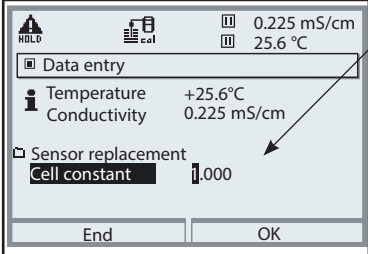
Note: The display may vary depending on the device version.

Menu	Display	Action
cal		Select calibration. Select COND module. Select Calibration Mode > Product and press **enter** to confirm. Select Process Variable > Conductivity or Concentration[1)]. Conductivity: calibration with/without temperature compensation Concentration: Select the medium. **Step 1** Take sample. Store measured value and temperature at the moment of sampling ("Save" softkey or **enter**). The analyzer automatically returns to calibration mode selection. Press **meas** to return to measurement. **Exception:** Sample value can be determined and entered on site: Left softkey: "Input" **Step 2** Lab value has been measured. Open the calibration menu again. Right softkey: "Input" Enter reference value ("Lab value"). Confirm with "OK" or repeat calibration. **Adjustment** Press "Adjust" softkey to take over the values determined during calibration for calcuslating the measured variables.

1) with Protos II 4400(X) and add-on function FW4400-009

Data Entry of Premeasured Sensors
Entry of cell constant and zero point of a sensor, related to 25 °C/77 °F, 1013 mbar.

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

Menu	Display	Action
cal		**Select module: COND** During calibration, the output currents (1 and 2), limit contacts, and controller output are in HOLD mode. Confirm with **enter**
		Select calibration method "Data entry" Confirm with **enter**
		Enter the cell constant of a premeasured sensor. Confirm with "OK" or repeat calibration. With "Concentration" enabled, a concentration calibration can be performed by changing the cell constant value – ***NOTICE!*** The cell constant value is immediately changed in the memory, even if calibration is aborted by pressing **meas**.

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

Sensor Calibration

Since the cell constant is subject to production-related variances, the dismounted sensor should be calibrated with a calibration solution (e.g. NaCl saturated). The cell constant of the sensor – particularly of a fringe-field sensor – depends on the type of installation:

- When the sensor is mounted in a free space (minimum distances exceeded), the cell constant can be entered directly as given in the specifications. Calibration method: "Data entry"

- When mounted in restricted space (minimum distances not kept), the sensor must be calibrated when mounted since the resulting cell constant has changed. Calibration method: "Product calibration".

SE 630 Sensor

The SE 630 sensor can be calibrated automatically or manually.
A suitable calibration solution is 0.01 mol/l NaCl, for example.

SE 604 Sensor

The SE 604 sensor must be calibrated with direct input of the cell constant since calibration solutions in the µS/cm range are not stable.

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

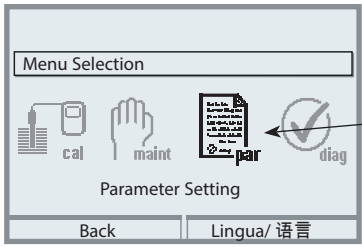
Temp Probe Adjustment
This function allows compensating for the individual temperature probe tolerance and the influence of the lead resistances to increase the accuracy of temperature measurement. Make sure that the process temperature is precisely measured using a calibrated reference thermometer when 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. 60.

Parameter Setting

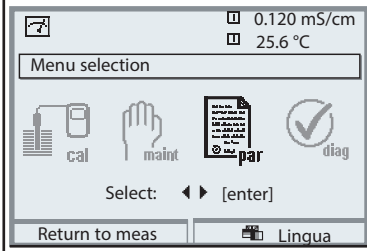
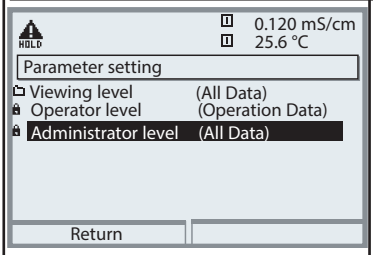
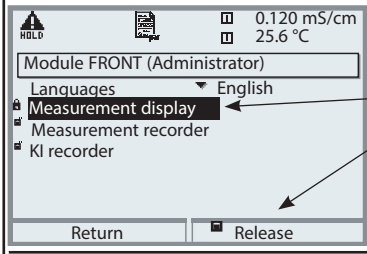
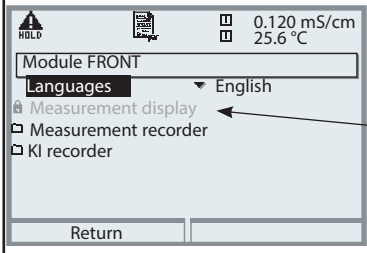
⚠ CAUTION! Incorrect parameter settings or adjustments can result in incorrect outputs.
The Protos II 4400(X) must therefore be commissioned by a system specialist, all its parameters must be set, and it must be fully adjusted.

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

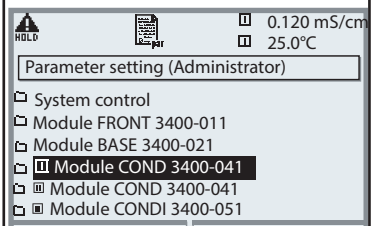
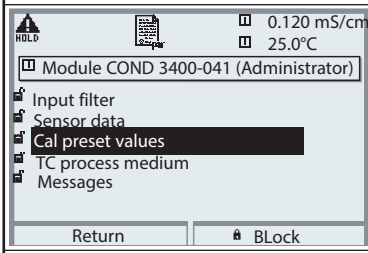
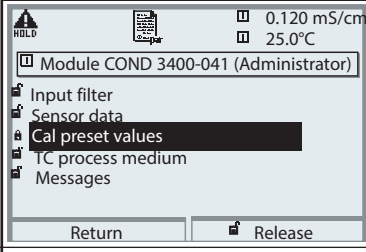
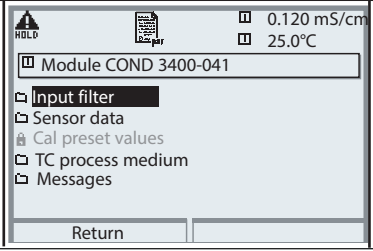
Viewing level, Operator level, Administrator level
Note: Function check (HOLD) mode active (Setting: BASE module)

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!

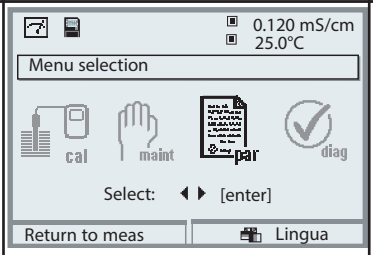
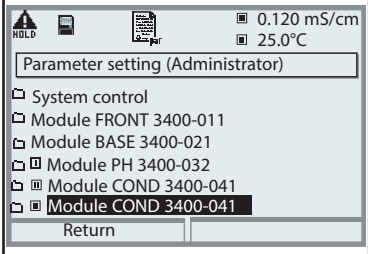
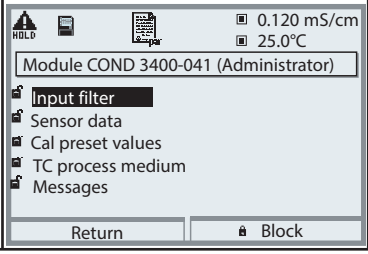
Note: The display may vary depending on the device version.

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 COND" (e.g.) using arrow keys, press **enter** to confirm.
		Select "Cal preset values" using arrow keys. "Block" 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 COND". 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. Passcode as delivered: 1989
		Select module, press **enter** to confirm. (In the Figure, the "Module COND" is selected, for example.)
		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

Default Settings and Selection Range
Note: Function check (HOLD) mode active.

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

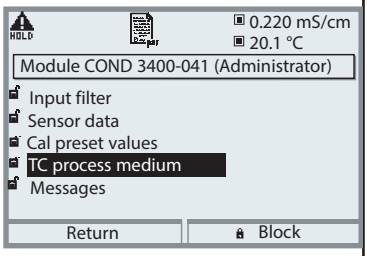
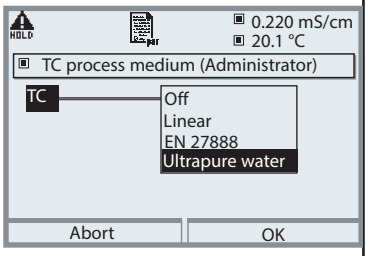
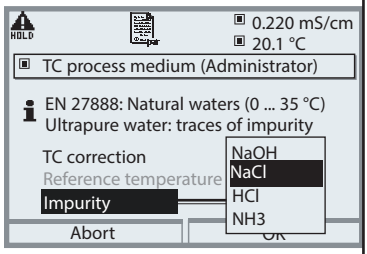
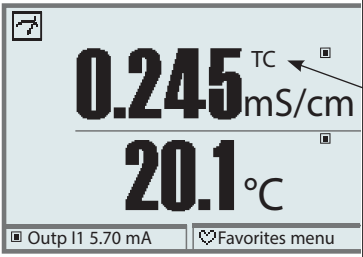
Parameter	Default	Selection / Range
Input filter		
• Pulse suppression	Off	Off, On
Sensor data		
• Sensor type	Other 2-EL sensor	Other 2-El sensor, Other 4-El sensor Sensor SE 600, Sensor SE 602, Sensor SE 603, Sensor SE 604, Sensor SE 610, Sensor SE 620, Sensor SE 630,
• Nominal cell constant	1.0000 cm^{-1}	X.XXXX (entry) depending on selected sensor
• Temperature detection	Pt 1000	Pt100, Pt1000, NTC30kohm, Ni100 (sensor selection)
Measuring temp	Auto	Auto, manual: Default +25.0 °C (entry)
Cal temp	Auto	Auto, manual: Default +25.0 °C (entry)
• Sensocheck	Off	Off, Failure, Maint. request
Protos II 4400(X): Cal Presettings		
Calibration Mode	Automatic	Automatic, Manual, Product, Data Entry, Temperature
Automatic:		Automatic: Cal solution NaCl 0.01 mol/l,
• Cal. Solution	NaCl saturated	NaCl 0.1 mol/l, NaCl saturated, KCl 0.01 mol/l KCl 0.1 mol/l, KCl 1 mol/l
Product:	Conductivity	Conductivity, Concentration[1)]
• Conductivity	Without TC	With/Without TC
• Concentration [1)]	NaCl (0...26 %)	Medium, see p. 39
Protos 3400: Cal preset values		
Calibration solution	NaCl saturated	NaCl ..., KCl ..., see above
Product calibration	Without TC	Without TC, with TC
TC process medium		
• TC correction	Off	Off, linear, EN 27888, ultrapure water
• Reference temp		(Linear: Enter reference temp +025.0 °C)
• Impurity		(Ultrapure water: NaOH, NaCl, HCl, NH_3) (Adjustment range depending on parameter)

1) with add-on function FW4400-009
2) with add-on function SW3400-008/FW4400-008

TC Process Medium

Note: Function check (HOLD) mode active.

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

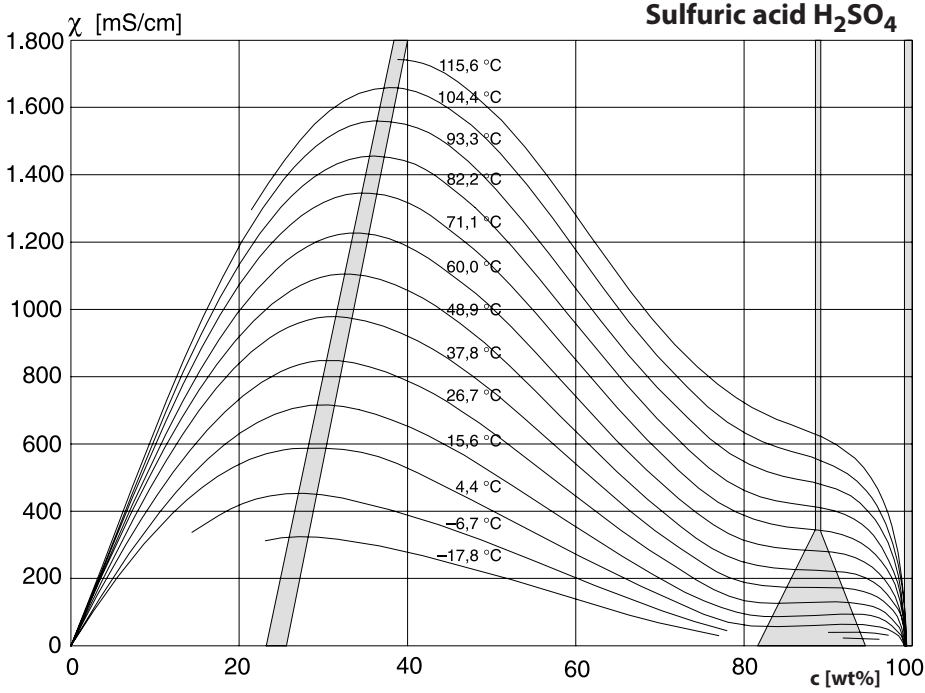
Menu	Display	Action
par		**TC process medium** You can choose from: • Linear (input of TC coefficient) • EN 27888 • Ultrapure water (add-on function SW3400-008 / FW4400-008)
		When you have selected "Ultrapure water", you must specify the type of impurity: **NaOH** Alkaline ultrapure water
		**NaCl** Neutral ultrapure water, for conductivity measurement in water processing behind gravel bed filter **HCl** Acidic ultrapure water, for conductivity measurement behind cation filter **NH_3** Ammoniacal ultrapure water
		When the TC correction for process medium is switched on, "TC" appears in the display in measuring mode.

Parameter Setting: Concentration Curves

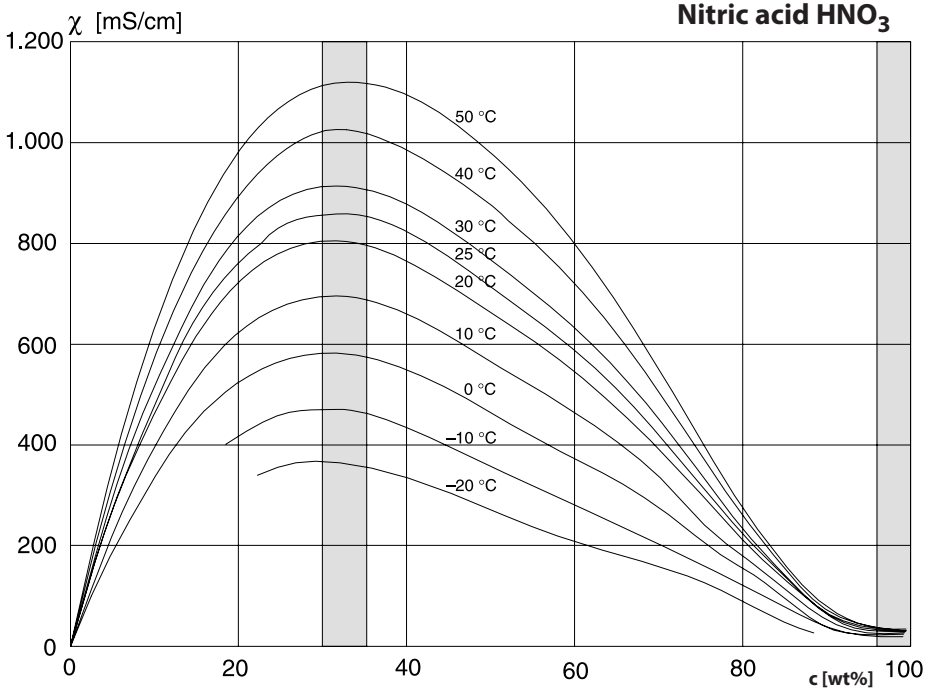
Default Settings and Selection Range (SW 3400-009 / FW4400-009)
Note: Function check (HOLD) mode active.

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

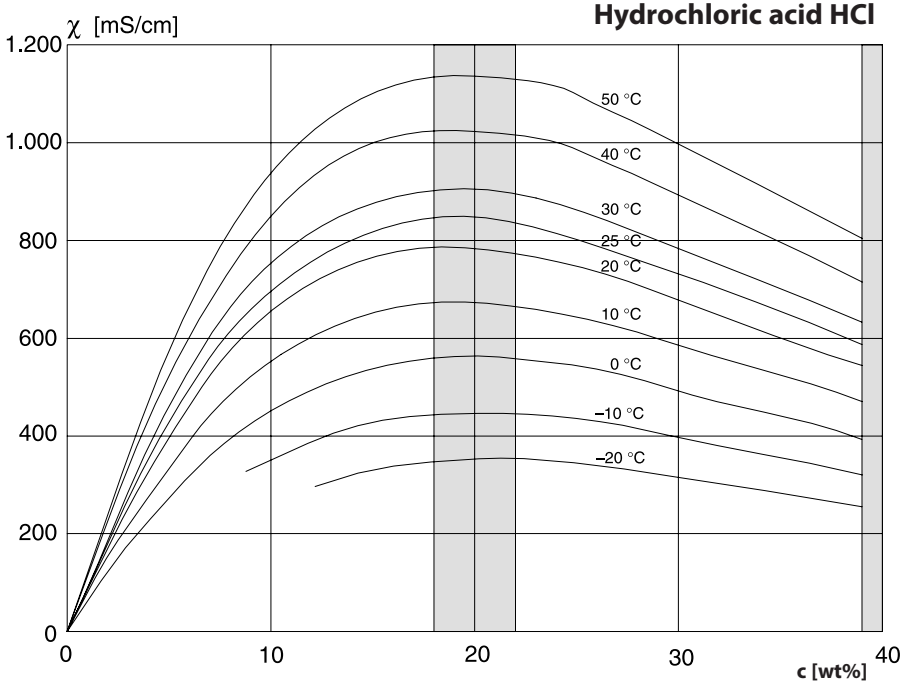
Parameter	Default	Selection / Range
Concentration (with add-on function SW3400-009/FW4400-009 only • Medium ("Yes" selected)	Off H_2SO_4 (0-30%)	On, Off NaCl (0-28 %), HCl (0-18 %), NaOH (0-24 %), H_2SO_4 (0-37 %), HNO_3 (0-30 %), H_2SO_4 (89-99 %), HCl (22-39 %), HNO_3 (35-96 %), H_2SO_4 (28-88 %), NaOH (15-50 %), Oleum (12-45%) Table
USP function • Reduced limit • Monitoring	Off 100 % Off	On, Off 10 % ... 100% Off, Failure, Maint. request



Nitric acid HNO_3



Hydrochloric acid HCl



Sodium hydroxide solution NaOH

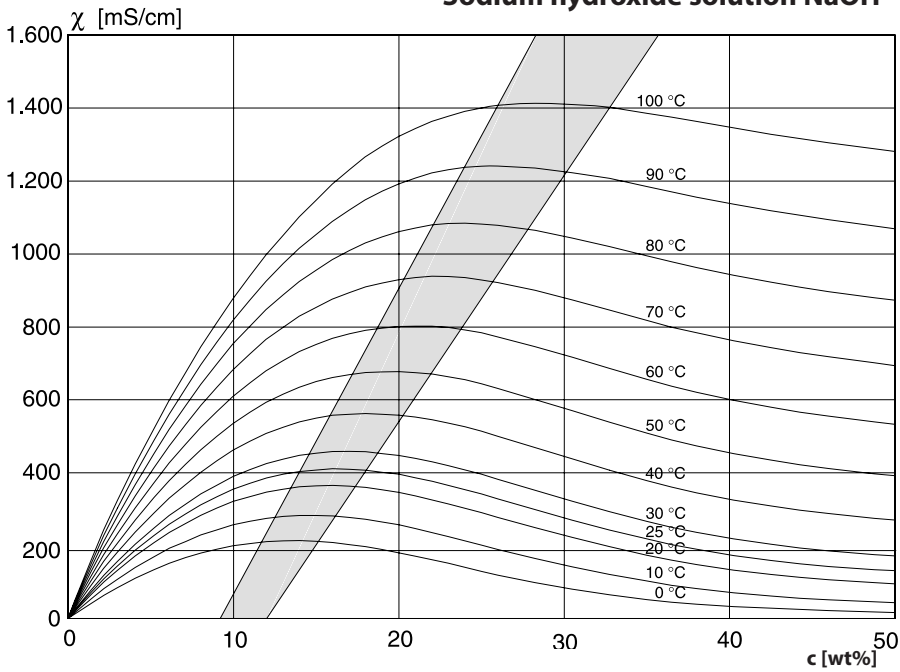
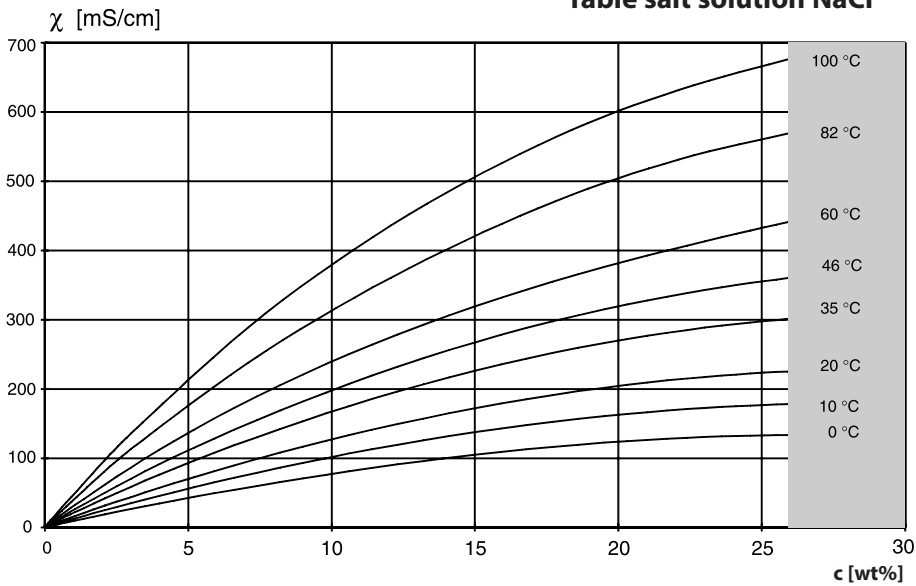
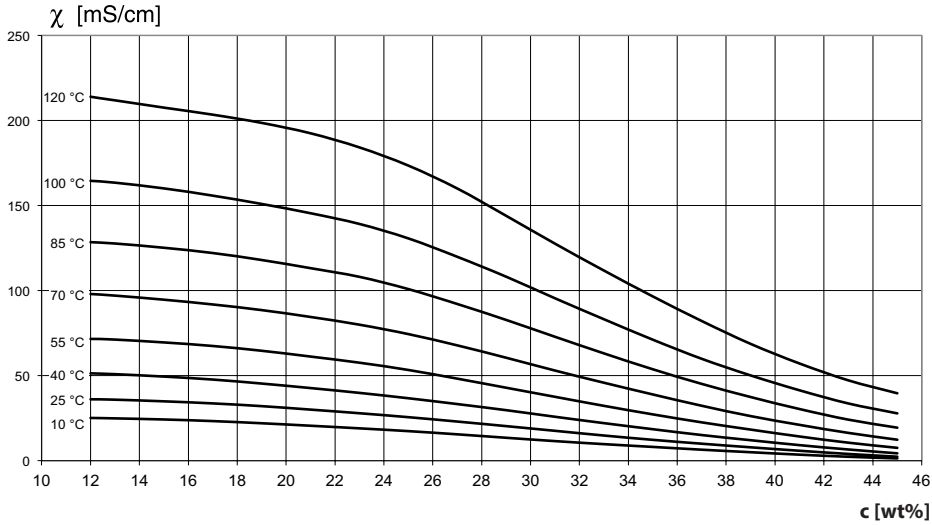


Table salt solution NaCl



Oleum $H_2SO_4 \cdot SO_3$



Concentration Table

Menu selection: Parameter setting > System control > Concentration table

Specifying a concentration solution for conductivity measurement
To specify the customer-specific solution, 5 concentration values A-E are entered in a matrix together with 5 temperature values 1-5. To do so, first enter the 5 temperature values, then enter the respective conductivity values for each concentration A-E.
These solutions will then be available in addition to the permanently stored standard solutions (select "Table").

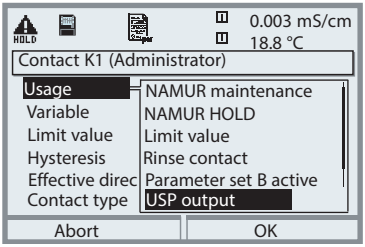
Menu	Display	Action
par	HOLD 0.020 mS/cm 25.6 °C System control (Administrator) Calculation Blocks Point of measurement Release of options Logbook Concentration table Factory setting Return	**To enter values** • Open parameter setting • System control • Select "Concentration table"
	HOLD 0.020 mS/cm 25.6 °C Concentration table (Administrator) Temperature 1 +000.0 °C Temperature 2 +005.0 °C Temperature 3 +010.0 °C Temperature 4 +015.0 °C Temperature 5 +020.0 °C Abort OK	Enter 5 temperature values (right/left arrow keys to select position, up/down arrow keys to edit number, confirm by pressing **enter**.)
	HOLD 0.020 mS/cm 25.6 °C Concentration table (Administrator) Concentration A: 05.00 wt% 1. Cond at +000.0 °C 0.000 µS/cm 2. Cond at +005.0 °C 0.000 µS/cm 3. Cond at +010.0 °C 0.000 µS/cm 4. Cond at +015.0 °C 0.000 µS/cm 5. Cond at +020.0 °C 0.000 µS/cm Abort OK	Enter values for concentrations A-E for the respective temperatures. The table values must be continuous. Maxima/minima are not permitted. Incorrect entries are marked with ✕.

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

The concentration table is selected as follows:
Parameter Setting > COND Module > Cal Presettings:
Calibration Mode: Automatic, Cal Solution: Table.

USP Function

Monitoring of Ultrapure Water in the Pharmaceutical Industry
(To configure: Select Parameter setting COND module)



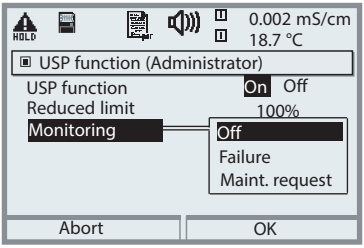
USP Function, Define Relay Output
When a COND module is installed, one of the floating relay outputs of the BASE module (K1, K2 or K3) can be assigned to the USP function.

- Select parameter setting:
- Administrator level (HOLD active!)
- Module BASE: Define contact "Usage"

The USP can be selected as USP% process variable for output (display, current output, limit value, measurement recorder)

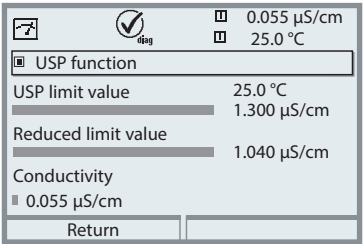
According to the "USP" directive (U.S.Pharmacopeia), Appendix 5, Section 645 "Water Conductivity" the conductivity of pharmaceutical waters can be monitored online.
To do so, the conductivity is measured without temperature compensation and compared with limit values. The water is usable without further test steps when the conductivity is below the USP limit.

Reduced Limit:
The USP limit can be reduced down to 10 % (Parameter setting).



Select USP function

- Select parameter setting, then:
- Administrator level (HOLD active!)
- Module COND: USP function



USP function: Diagnostics

- Select diagnostics:
- Module COND
- USP function: Display of USP limit, reduced limit, conductivity

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

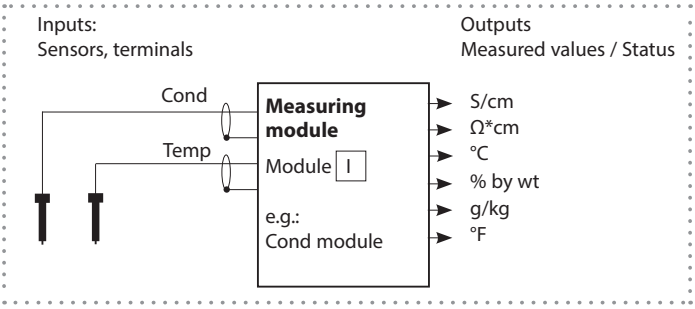
Calculation Blocks
Two measuring modules with all their measured values serve as input for the calculation block. In addition, the general device status (NAMUR signals) is taken into account. The difference between the existing values is calculated:

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

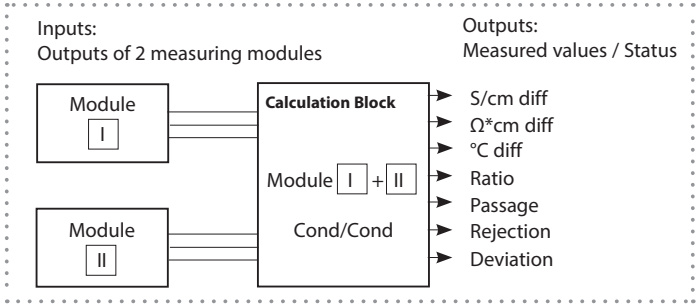
Measurement Display
All new process variables can be displayed as primary or as secondary value.

Controller
Controller functions are not supported.

Functionality of Measuring Module



Functionality of Calculation Block

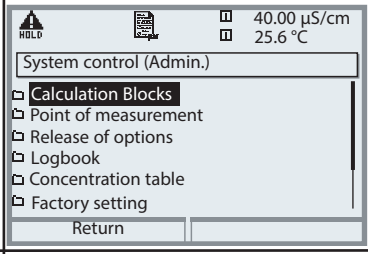
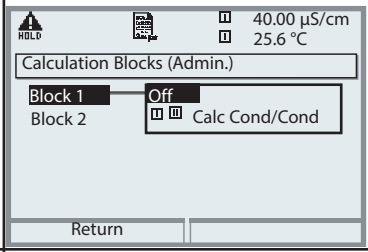
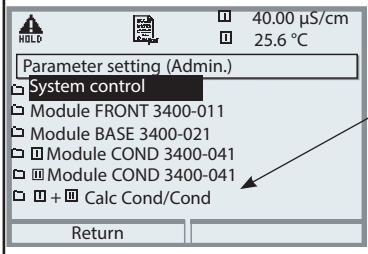


Activating a Calculation Block

Menu selection: Parameter setting > System control > Calculation Blocks

Combination of Measuring Modules
With three measuring modules the following Calculation Block combinations are possible: [I] + [II] , [I] + [III] , [II] + [III]

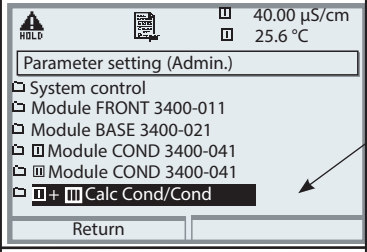
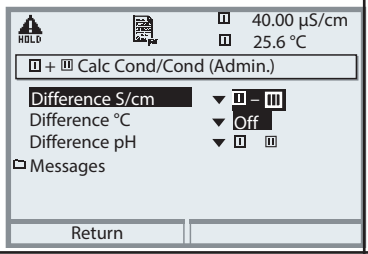
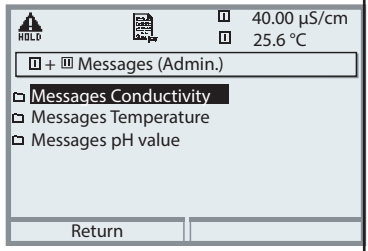
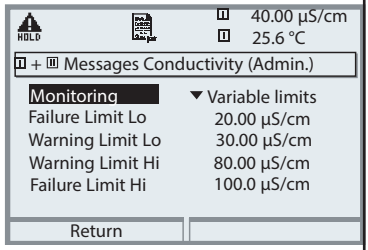
Two Calculation Blocks can be activated.

Menu	Display	Action
		**Calculation Blocks** • Open parameter setting • System control • Select "Calculation Blocks"
		• Depending on the modules installed, the possible combinations for Calculation Blocks are offered.
		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
par		**Select 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.
		The measured values which shall release a message are set using the arrow keys (left/right: select position, up/down: edit number). Confirm by pressing **enter**.

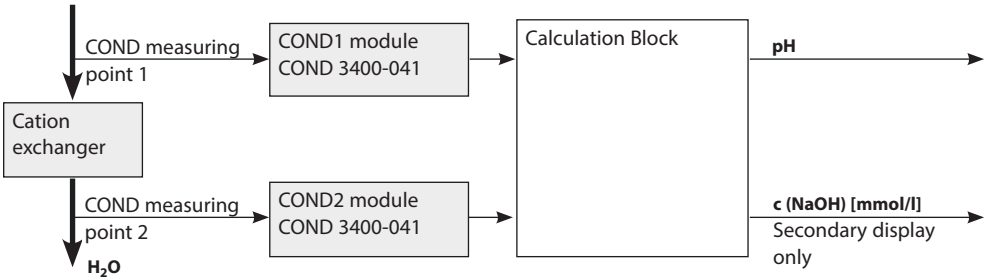
Note: The display may vary depending on the device version.

pH Value Calculation

Note: 2 conductivity modules required

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

Function
The conductivity before and after the ion exchanger is measured using two COND 3400-041 modules. From the two calculated conductivity values, a "Calculation Block" determines the concentration of sodium hydroxide solution and the pH value according to the calculation formulas shown below:



Calculating the Concentration of Sodium Hydroxide Solution / pH Value:

$$c(NaOH) = \frac{COND1 - 1/3\ COND2}{243}$$

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

Recommended pH Ranges:

10 ± 0.2 for < 136 bars operating overpressure or
9.5 ± 0.2 for > 136 bars operating overpressure

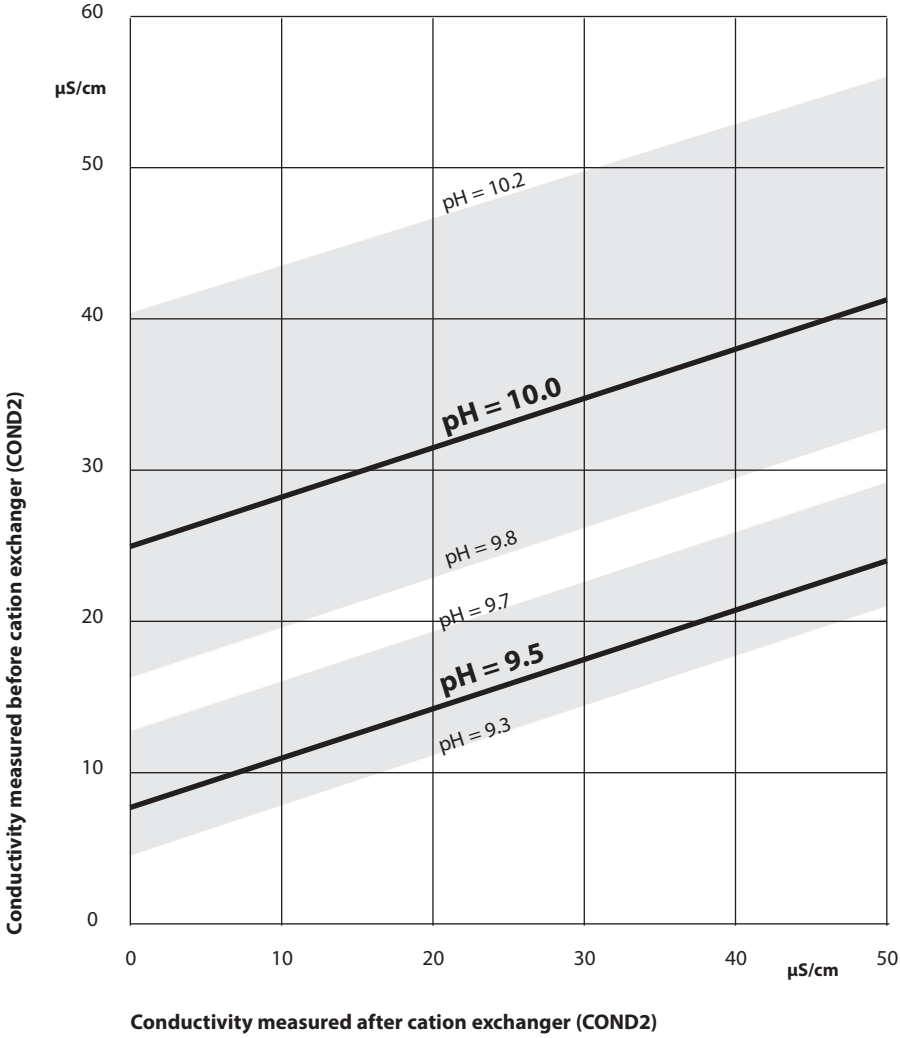
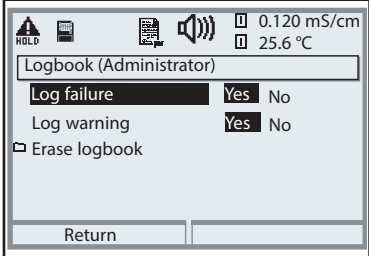
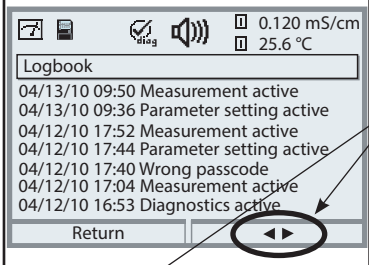
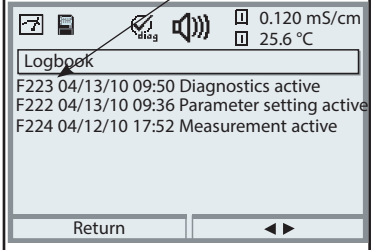
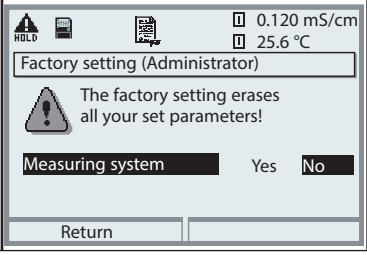


Figure:
Conditioning the feed water of natural circulation boilers with sodium hydroxide. Relationship between the pH value and the conductivity measured before and after the cation exchanger.
Source: Appendix to VGB guideline for boiler feed water, boiler water, and steam of steam generators above 68 bars permissible operating overpressure (VGB-R 450 L, edition 1988)

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, e.g. calibrations, warning and failure messages, power failure (Protos 3400: 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 or Data Card and Protos II 4400(X), max. 50,000 entries (Protos 3400) 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

Parameter Setting > COND Module > Messages: Default settings and selection range

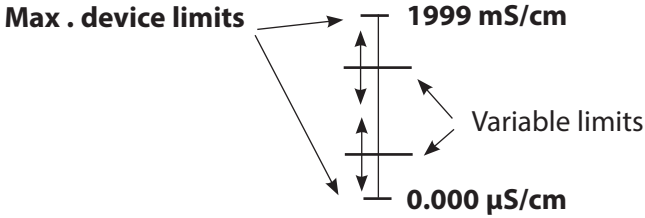
Note: Function check (HOLD) mode active

Parameter	Default	Selection / Range
Messages		
• Conductivity	Limits max	Off, device limits max., variable limits*
• Resistivity	Off	Off, device limits max., variable limits*
• Concentration	Off	Off, device limits max., variable limits*
• Temperature	Off	Off, device limits max., variable limits*
• Salinity	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

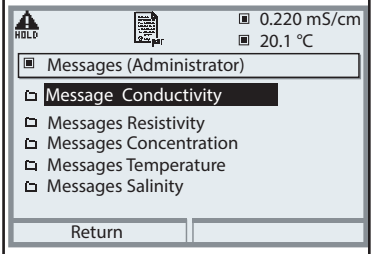
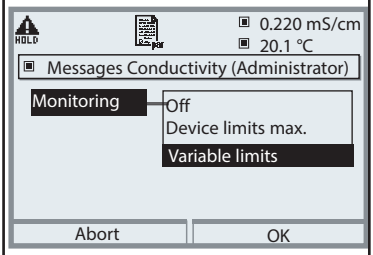
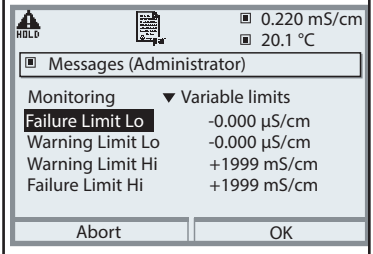
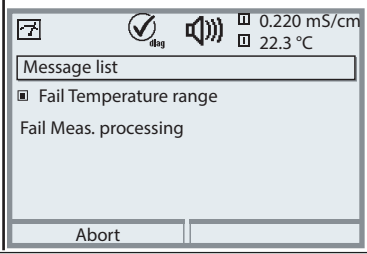
- Max. device limits: Maximum measuring range of device
- Variable limits: Range limits specified



Parameter Setting

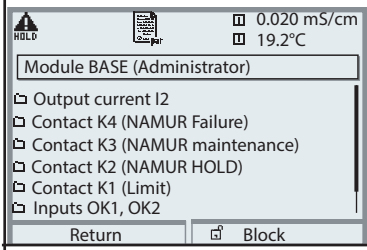
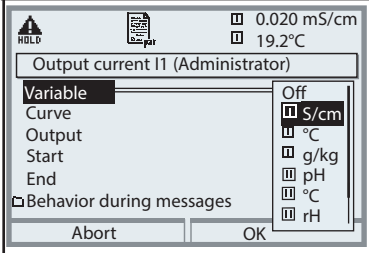
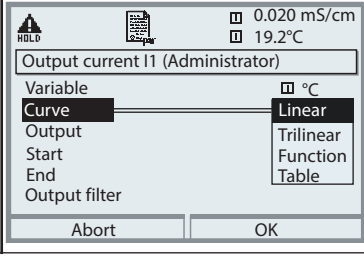
Parameter Setting > COND Module > Messages
Note: Function check (HOLD) mode active

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

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. conductivity) is outside the measurement 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 open the Diagnostics menu. The messages are displayed in the "Message list".

Parameter Setting: BASE Module

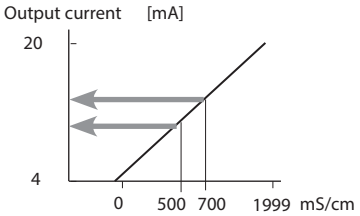
Menu selection: Parameter Setting > BASE Module
Note: Function check (HOLD) active

Menu	Display	Action
par		**Configuring the Current Output** • Open parameter setting • Enter passcode • Select "Module BASE" • Select "Output current ..."
		• Select process variable
		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". See also: "Minimum span"

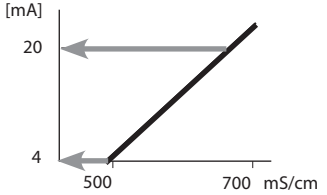
Note: The display may vary depending on the device version.

Assignment of Measured Values: Start (4 mA) and End (20 mA)

Example 1:
Range 0 ... 1999 mS/cm



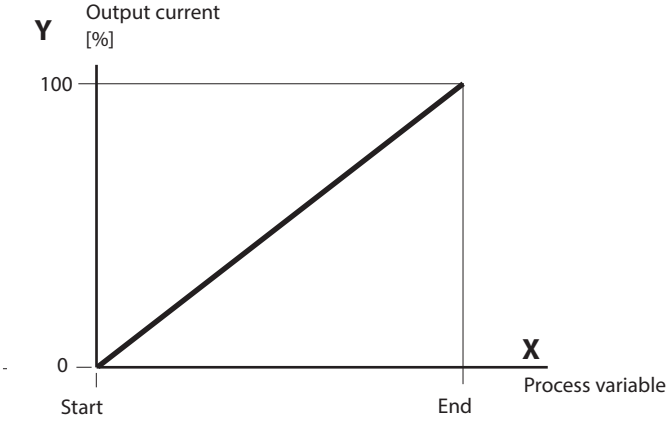
Example 2: Range 500 ... 700 mS/cm
Advantage: Higher resolution in range of interest



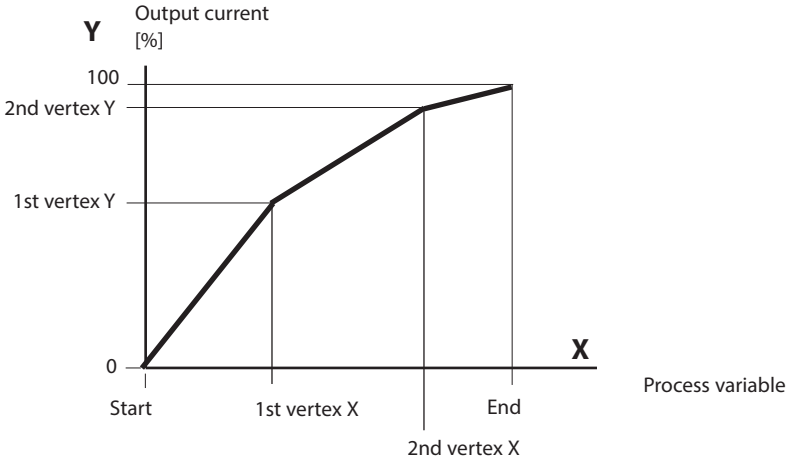
Current Outputs: Characteristics

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:

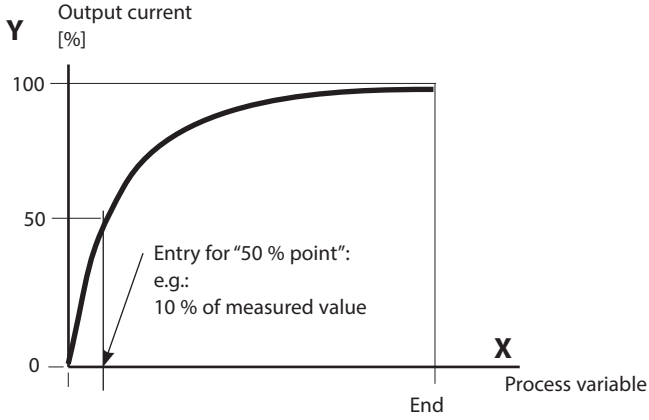


- **Note: Bilinear characteristic**
  For a bilinear characteristic, identical parameters are entered for the two vertices (1st vertex, 2nd vertex).

- **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

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

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

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

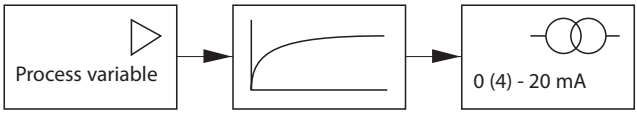
Logarithmic output curve over two decades:
S: 1 % of maximum value
X50%: 10 % of maximum value
E: Maximum value

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!

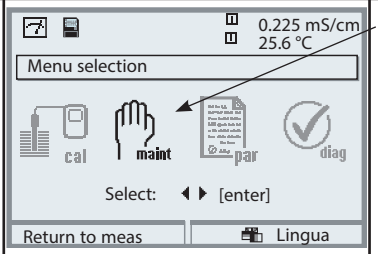
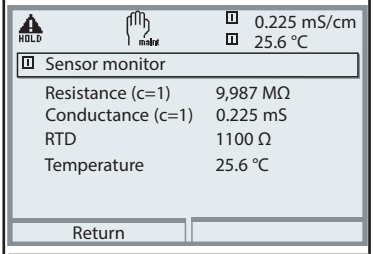
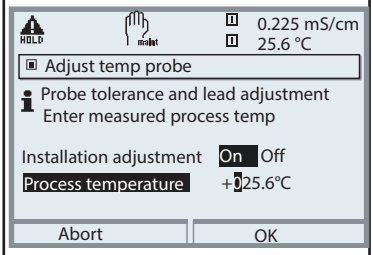


Time interval 0 ... 120 sec

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

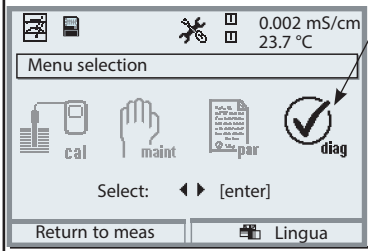
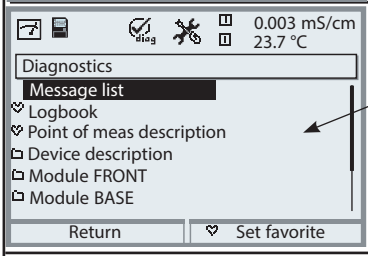
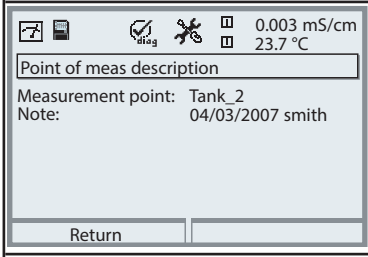
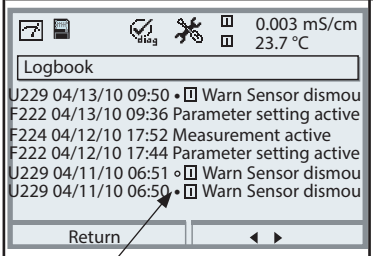
Menu	Display	Action
maint		**Open Maintenance** From the measuring mode: Press **menu** key to select menu. Select maintenance using arrow keys, confirm by pressing **enter**. Passcode 2958 (The passcode can be edited by the administrator.) Then select COND module.
		**Sensor Monitor** During maintenance,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

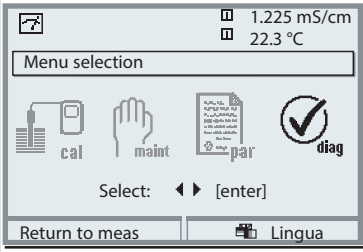
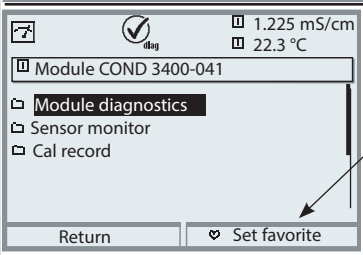
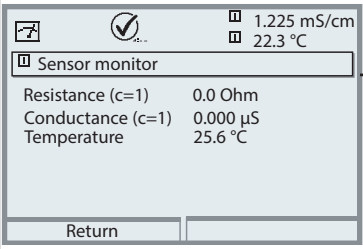
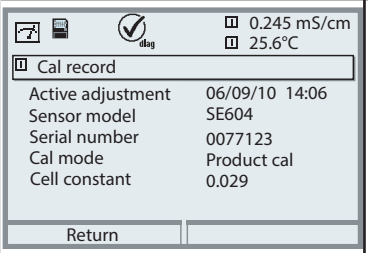
Menu	Display	Action
diag		**Opening the Diagnostics Menu** From the measuring mode: Press **menu** key to select menu. Select diagnostics using arrow keys, confirm by pressing **enter**.
		The "Diagnostics" menu gives an overview of all functions available. Functions which have been set as "Favorite" can be directly accessed from the measuring mode.
		**Point of Meas Description** Allows entering a tag number and a note. Select position: left/right arrow key, select character: up/down arrow key. Confirm the entry by pressing **enter**.
	 Releasing module: • Message activated ◦ Message deactivated	**Logbook** Shows the last events[1] with date and time, e.g. calibrations, warning and failure messages, power failure. This permits quality management documentation to ISO 9001. (For parameter setting, see p. 50)

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

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

Diagnostic Functions

Menu selection: Diagnostics > COND ... Module
Module diagnostics, sensor monitor, cal record

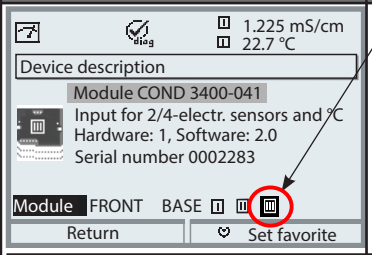
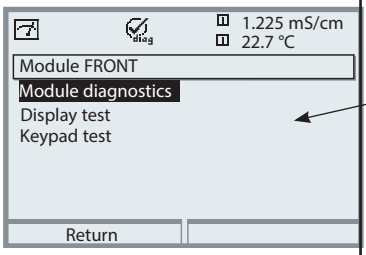
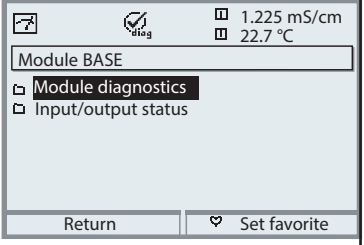
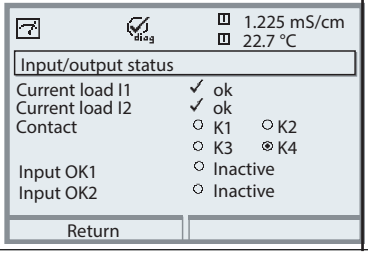
Menu	Display	Action
diag		**Opening the diagnostics menu** From the measuring mode: Press **menu** key to select menu. Select diagnostics using arrow keys, confirm by pressing **enter**. Then select "Module COND".
		The Diagnostics menu gives an overview of all diagnostic functions available. Messages 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.). **Sensor Monitor** Shows the values currently measured by the sensor. Important function for diagnostics and validation! (cf Maintenance)
		**Calibration/Adjustment Record** Data of the last adjustment/calibration **Temp. Offset Log** Shows the data from the last temperature adjustment performed on the currently connected sensor.[1)]

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

1) with Protos II 4400(X)

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.

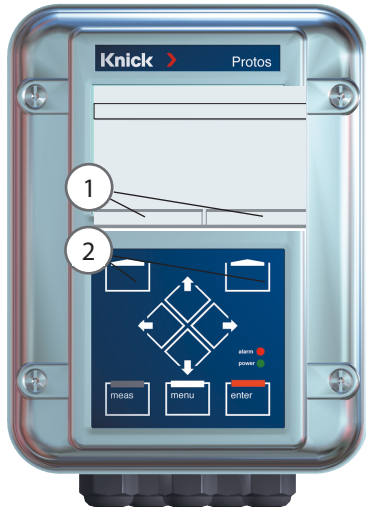
Setting Diagnostic Messages as Favorite

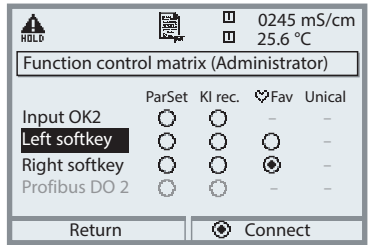
Menu selection: Parameter setting > System control > Function control matrix

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)]





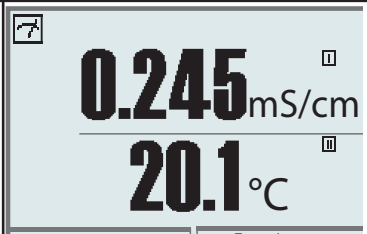
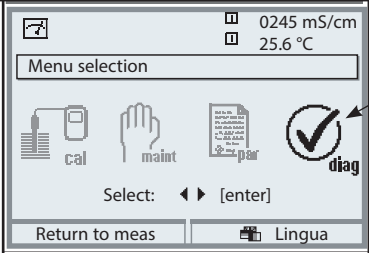
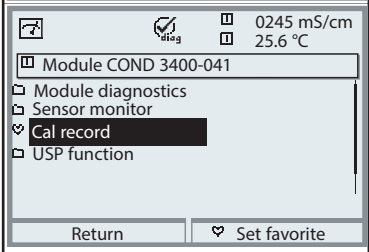
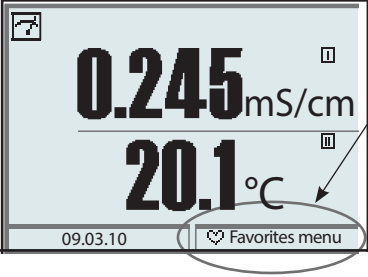
Example:
"Favorites" to be selected with "Right softkey"

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

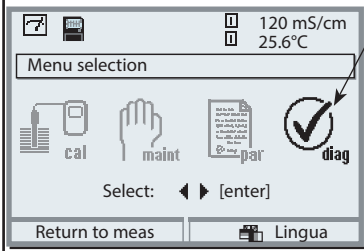
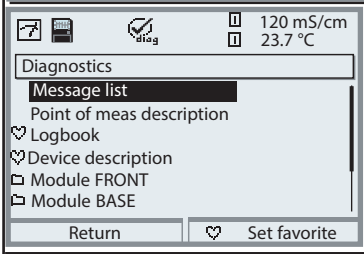
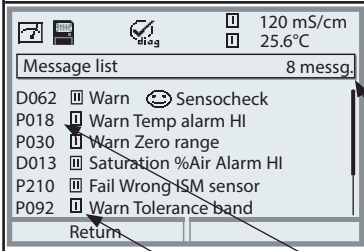
Menu	Display	Action
		**Favorites menu** Diagnostic functions can be called directly from the measuring mode using a softkey. The "Favorites" are selected in the Diagnostics menu.
diag		**Select favorites** Press **menu** key to select menu. Select diagnostics using arrow keys, confirm with **enter**. 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 for COND 3400-041 Module with Protos 3400

No.	COND messages	Message type
C008	Meas. processing (factory settings)	FAIL
C009	Module failure (Firmware Flash check sum)	FAIL
C010	Conductivity range	FAIL
C011	Conductivity Alarm LO_LO	FAIL
C012	Conductivity Alarm LO	WARN
C013	Conductivity Alarm HI	WARN
C014	Conductivity Alarm HI_HI	FAIL
C015	Temperature range	FAIL
C016	Temperature Alarm LO_LO	FAIL
C017	Temperature Alarm LO	WARN
C018	Temperature Alarm HI	WARN
C019	Temperature Alarm HI_HI	FAIL
C020	Resistivity range	FAIL
C021	Resistivity Alarm LO_LO	FAIL
C022	Resistivity Alarm LO	WARN
C023	Resistivity Alarm HI	WARN
C024	Resistivity Alarm HI_HI	FAIL
C025	Concentration range	FAIL
C026	Concentration Alarm LO_LO	FAIL
C027	Concentration Alarm LO	WARN
C028	Concentration Alarm HI	WARN
C029	Concentration Alarm HI_HI	FAIL
C035	Cell constant range	WARN
C040	Salinity range	FAIL
C041	Salinity Alarm LO_LO	FAIL
C042	Salinity Alarm LO	WARN
C043	Salinity Alarm HI	WARN

No.	COND messages	Message type
C044	Salinity Alarm HI_HI	FAIL
C045	Conductance range	FAIL
C050	man. Temperature range	FAIL
C060	SAD SENSOFACE: Polarization	User-defined
C061	SAD SENSOFACE: Cable	User-defined
C090	USP limit value	User-defined
C200	Reference temperature	WARN
C201	TC correction	WARN
C202	TC range	WARN
C203	TC range	FAIL
C204	Cal: Sensor unstable	Text
C205	Cal: Sensor failure	Text
C254	Module reset	Text

No.	Calculation Block COND/COND messages	Message type
E010	Conductivity-Diff Range	FAIL
E011	Conductivity-Diff Alarm LO_LO	FAIL
E012	Conductivity-Diff Alarm LO	WARN
E013	Conductivity-Diff Alarm HI	WARN
E014	Conductivity-Diff Alarm HI_HI	FAIL
E015	Temperature-Diff Range	FAIL
E016	Temperature-Diff Alarm LO_LO	FAIL
E017	Temperature-Diff Alarm LO	WARN
E018	Temperature-Diff Alarm HI	WARN
E019	Temperature-Diff Alarm HI_HI	FAIL

No.	Calculation Block COND/COND messages	Message type
E020	Resistivity-Diff range	FAIL
E021	Resistivity-Diff Alarm LO_LO	FAIL
E022	Resistivity-Diff Alarm LO	WARN
E023	Resistivity-Diff Alarm HI	WARN
E024	Resistivity-Diff Alarm HI_HI	FAIL
E030	RATIO range	FAIL
E031	RATIO Alarm LO_LO	FAIL
E032	RATIO Alarm LO	WARN
E033	RATIO Alarm HI	WARN
E034	RATIO Alarm HI_HI	FAIL
E035	PASSAGE range	FAIL
E036	PASSAGE Alarm LO_LO	FAIL
E037	PASSAGE Alarm LO	WARN
E038	PASSAGE Alarm HI	WARN
E039	PASSAGE Alarm HI_HI	FAIL
E045	REJECTION range	FAIL
E046	REJECTION Alarm LO_LO	FAIL
E047	REJECTION Alarm LO	WARN
E048	REJECTION Alarm HI	WARN
E049	REJECTION Alarm HI_HI	FAIL
E050	DEVIATION range	FAIL
E051	DEVIATION Alarm LO_LO	FAIL
E052	DEVIATION Alarm LO	WARN
E053	DEVIATION Alarm HI	WARN
E054	DEVIATION Alarm HI_HI	FAIL
E055	c(NaOH) range	FAIL
E060	pH value range	FAIL
E061	pH value Alarm LO_LO	FAIL
E062	pH value Alarm LO	WARN
E063	pH value Alarm HI	WARN
E064	pH value Alarm HI_HI	FAIL

Messages for COND 3400(X)-041 Module with Protos II 4400(X)

⊗Failure ⚠ Out of Specification ◈ Maintenance Required

No.	Message Type	COND Messages
C008	Failure	Meas. Processing (Factory Settings)
C009	Failure	Firmware Error
C010	Failure	Conductivity Range
C011	Failure	Conductivity Alarm LO_LO
C012	Out of Specification	Conductivity Alarm LO
C013	Out of Specification	Conductivity Alarm HI
C014	Failure	Conductivity Alarm LO_LO
C015	Failure	Temperature Range
C016	Failure	Temperature Alarm LO_LO
C017	Out of Specification	Temperature Alarm LO
C018	Out of Specification	Temperature Alarm HI
C019	Failure	Temperature Alarm HI_HI
C020	Failure	Resistivity Range
C021	Failure	Resistivity Alarm LO_LO
C022	Out of Specification	Resistivity Alarm LO
C023	Out of Specification	Resistivity Alarm HI
C024	Failure	Resistivity Alarm HI_HI
C025	Failure	Concentration Range
C026	Failure	Concentration Alarm LO_LO
C027	Out of Specification	Concentration Alarm LO
C028	Out of Specification	Concentration Alarm HI
C029	Failure	Concentration Alarm LO_LO
C040	Failure	Salinity Range
C041	Failure	Salinity Alarm LO_LO
C042	Out of Specification	Salinity Alarm LO
C043	Out of Specification	Salinity Alarm HI
C044	Failure	Salinity Alarm HI_HI
C045	Failure	Conductance Range
C060	User-defined	Sad Sensoface: Polarization
C061	User-defined	Sad Sensoface: Cable
C062	Maintenance Required	Sad Sensoface: Cell Constant
C070	Failure	TDS Range

C071	Failure	TDS Alarm LO_LO
C072	Out of Specification	TDS Alarm LO
C073	Out of Specification	TDS Alarm HI
C074	Failure	TDS Alarm HI_HI
C090	User-defined	USP Limit
C091	User-defined	Reduced USP Limit
C110	User-defined	CIP Counter
C111	User-defined	SIP Counter
C130	Text	SIP Cycle Counted
C131	Text	CIP Cycle Counted
C200	Out of Specification	Reference Temperature
C201	Out of Specification	Temperature Compensation
C202	Out of Specification	TC Adjustment Range
C203	Failure	TC Adjustment Range (Failure)
C204	Text	Cal: Sensor Unstable
C205	Text	Cal: Sensor Failure
C254	Text	Module Reset

No.	**Message Type**	**Calculation Block COND / COND Messages**
E010	Failure	Conductivity Diff Range
E011	Failure	Conductivity Diff LO_LO
E012	Out of Specification	Conductivity Diff Alarm LO
E013	Out of Specification	Conductivity Diff Alarm HI
E014	Failure	Conductivity Diff Alarm HI_HI
E015	Failure	Temperature Diff Range
E016	Failure	Temperature Diff Alarm LO_LO
E017	Out of Specification	Temperature Diff Alarm LO
E018	Out of Specification	Temperature Diff Alarm HI
E019	Failure	Temperature Diff Alarm HI_HI
E020	Failure	Resistivity Diff Range

No.	Message Type	Calculation Block COND / COND Messages
E021	Failure	Resistivity Diff Alarm LO_LO
E022	Out of Specification	Resistivity Diff Alarm LO
E023	Out of Specification	Resistivity Diff Alarm HI
E024	Failure	Resistivity Diff Alarm HI_HI
E030	Failure	RATIO Range
E031	Failure	RATIO Alarm LO_LO
E032	Out of Specification	RATIO Alarm LO
E033	Out of Specification	RATIO Alarm HI
E034	Failure	RATIO Alarm HI_HI
E035	Failure	PASSAGE Range
E036	Failure	PASSAGE Alarm LO_LO
E037	Out of Specification	PASSAGE Alarm LO
E038	Out of Specification	PASSAGE Alarm Hi
E039	Failure	PASSAGE Alarm HI_HI
E045	Failure	REJECTION Range
E046	Failure	REJECTION Alarm LO_LO
E047	Out of Specification	REJECTION Alarm LO
E048	Out of Specification	REJECTION Alarm Hi
E049	Failure	REJECTION Alarm HI_HI
E050	Failure	DEVIATION Range
E051	Failure	DEVIATION Alarm LO_LO
E052	Out of Specification	DEVIATION Alarm LO
E053	Out of Specification	DEVIATION Alarm Hi
E054	Failure	DEVIATION Alarm HI_HI
E055	Failure	c(NaOH) Range
E060	Failure	pH Value Range
E061	Failure	pH Value Alarm LO_LO
E062	Out of Specification	pH Value Alarm LO
E063	Out of Specification	pH Value Alarm HI
E064	Failure	pH Value Alarm HI_HI
E200	Maintenance Required	Calculation Block Configuration

Specifications

Specifications Protos COND 3400(X)-041

Cond input	Operation with 2- or 4-electrode sensors	
Conductivity	0.000 µS/cm ... 1999 mS/cm	
Resistivity	0.5 Ω cm ... 999 MΩ cm	
Concentration	0.00 ... 100.0 wt%	
Salinity	0.0 ... 45.0 g/kg (0 ... 35 °C)	
Meas. range	4-electrode sensors: 0.1 µS x c ... 2000 mS x c [2)] 2-electrode sensors: 0.1 µS x c ... 200 mS x c [2)]	
Display ranges	Resolution depending on cell constant	
	Cell constant	**Resolution of cond.**
	< 0.1200 cm^{-1}	0 µS/cm
	< 1.200 cm^{-1}	00.00 µS/cm
	< 12.00 cm^{-1}	000.0 µS/cm
	< 120.0 cm^{-1}	0.000 mS/cm
	≥ 120.0 cm^{-1}	00.00 mS/cm
Response time t_{90}	Approx. 1 s	
Measurement error[3)]	< 0.5 % meas. val. + 0.2 µS * c [2)]	

Temp compensation [1)]	- Without - Linear characteristic 00.00 ... 19.99 %/K (reference temp user-defined) - NLF natural waters to EN 27888 - Ultrapure water with NaCl traces (0 ... 120 °C / 32 ... 248 °F)*w - Ultrapure water with HCl traces (0 ... 120 °C / 32 ... 248 °F)*w - Ultrapure water with NH_3 traces (0 ... 120 °C / 32 ... 248 °F)*w - Ultrapure water with NaOH traces (0 ... 120 °C / 32 ... 248 °F)*w *w for all waters: Reference temp 25 °C / 77 °F

Specifications

Temperature input			
Temperature probe [1]	Pt100 / Pt1000 / NTC 30 kΩ / Ni 100 3-wire connection, adjustable		
Measurement range	Pt100 / Pt1000:		-50 ... 250 °C / -58 ... 482 °F
	NTC 30 kΩ:		-10 ... 150 °C / 14 ... 302 °F
	Ni 100:		-50 ... 180 °C / -58 ... 356 °F
Resolution	0,1 °C / °F		
Measurement error [3]	0.2 % meas.val. + 0.5 K		
Concentration determination [1]	For the substances:		
(SW3400-009/FW4400-009)	HNO_3	0 ... 30 wt%	–20 ... 50 °C / -4 ... 122 °F
		35 ... 96 wt%	–20 ... 50 °C / -4 ... 122 °F
	HCl	0 ... 18 wt%	–20 ... 50 °C / -4 ... 122 °F
		22 ... 39 wt%	–20 ... 50 °C / -4 ... 122 °F
	H_2SO_4 [4]	0 ... 37 wt%	–17.8 ... 110 °C / –0.04 ... 230 °F
		28 ... 88 wt%	–17.8 ... 115.6 °C / –0.04 ... 240.08 °F
		89 ... 99 wt%	–17.8 ... 115.6 °C / –0.04 ... 240.08 °F
	NaOH [5]	0 ... 24 wt%	0 ... 100 °C / 32 ... 212 °F
		15 ... 50 wt%	0 ... 100 °C / 32 ... 212 °F
	NaCl	0 ... 28 wt%	0 ... 100 °C / 32 ... 212 °F
	$H_2SO_4 \cdot SO_3$ (Oleum)	12 ... 45 wt%	0 ... 120 °C / 32 ... 248 °F
	User-defined concentration table (5x5 values)		
Sensor monitoring [1]	Sensocheck; Polarization and cable capacitance		
Sensoface	Provides information on the sensor condition		

Specifications

Sensor standardization [1)]	Operating modes - Automatic calibration with KCl or NaCl solution - Manual: entry of conductivity - Product calibration / adjustment to container - Entry of cell constant with simultaneous display of conductivity and temperature
Permissible cell constant	0.0050 ... 199.99 cm^{-1}
Calibration record	Recording of: Cell constant, calibration method, with date and time
Output curves [1)]	Linear Trilinear Function (logarithmic) As desired via table
USP function	Water monitoring in the pharmaceutical industry (USP) with possibility to enter a limit value (%) Output via relay contact (K1 ... K3, BASE) possible The USP value is available as USP% process variable (selectable for display, current output, limit value, measurement recorder).

1) User-defined
2) c = 0.0050 ... 199.99 cm^{-1}
3) Rated operating conditions , ± 1 count, plus sensor error
4) Range limits based on 27 °C / 80.6 °F
5) Range limits based on 25 °C / 77 °F

Specifications

General Data

Explosion protection (COND3400X-041 only)	EU-Type Examination Certificate KEMA 03ATEX2530 IECEx Certificate of Conformity IECEx DEK 11.0054 JPEx Certificates DEK23.0087/DEK23.0088 Ex ib [ia Ga] IIC T4 Gb 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 COND 3400(X)-041 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 module).
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.

COND 3400(X)-041 module

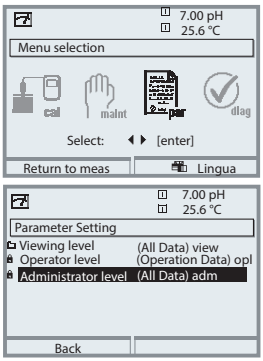
S/cm	20 %, min. 0.2 µS/cm
wt%	1.00
°C	10.0
g/kg	1.00
Ohm*cm	20 %, min. 100.0 ohms*cm
°F	10.0

Calculation Block COND/COND

Diff S/cm	20 %, min. 0.2 µS/cm
Diff °C	10.0
Diff Ohm*cm	20 %, min. 100.0 ohms*cm
RATIO	0.10
PASSAGE	10.0
REJECTION	10.0
DEVIATION	10.0
pH	1.00

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

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

COND 3400(X)-041 Module

Input filter	Pulse suppression
Sensor data • Sensor type • Nom. cell constant • Temperature detection - Temperature probe - Measuring temp - Calibration temp • Sensocheck	Representation of measured values on the display: - Select - Selection for Measurement / Calibration
Protos 3400: **Cal preset values** • Cal solution • Product calibration	 Select the calibration solution (NaCl 0.01 mol/l, NaCl 0.1 mol/l, NaCl saturated, KCl 0.01 mol/l KCl 0.1 mol/l, KCl 1 mol/l) Product calibration without/with temperature compensation
Protos II 4400(X): **Cal Presettings** Calibration Mode • Cal. Solution • Conductivity • Medium	 Automatic, Manual, Product, Data Entry, Temperature Automatic: Select cal. solution (NaCl 0.01 mol/l, NaCl 0.1 mol/l, NaCl saturated, KCl 0.01 mol/l KCl 0.1 mol/l, KCl 1 mol/l) Product: Conductivity, Concentration [1] Product Calibration, Conductivity: With/Without TC Product Calibration, Concentration [1]: Select the medium
TC process medium	Set the temperature compensation (off, linear, EN 27888, ultrapure water [2])
Concentration [1]	
USP function	Monitoring of ultrapure water
Messages • Conductivity • Resistivity • Concentration [1] • Temperature • Salinity	Off, Max. device limits, Variable limits

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

1) Only available with add-on function SW3400-008/FW4400-008
2) Only available with add-on function SW3400-009/FW4400-009

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

Calibration Menu

COND 3400(X)-041 Module

Automatic	
Calibration solution input	
Product calibration	
Data entry	
Temp probe adjustment [1]	Compensating for lead length

Maintenance Menu

BASE Module

Current source	Output current definable 0 ... 22 mA

COND 3400(X)-041 Module

Sensor monitor	For validation of sensor and complete signal processing
Temp probe adjustment [2]	Compensating for lead length

Diagnostics Menu

Message list	List of all messages
Point of meas 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	

COND 3400(X)-041 Module

Module diagnostics	Internal function test
Sensor monitor	Shows the values currently measured by the sensor
Cal./Adj. record	Data of last adjustment / calibration
Temp. offset log [1]	

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

Knick
Elektronische Messgeräte
GmbH & Co. KG

Beuckestraße 22 • 14163 Berlin
Germany
Phone: +49 30 80191-0
Fax: +49 30 80191-200
info@knick.de
www.knick-international.com

Copyright 2026 • Subject to change
Version: 10
This document was published on January 7, 2026.
The latest documents are available for download on our website below the corresponding product description.

105406 TA-201.041-100-KNEN10 Firmware version: 2.x