Instruction Manual

DULCOMETER® 2201 X pH

ProMinent Dosiertechnik GmbH • D-69123 Heidelberg • Germany

ProMinent Dosiertechnik GmbH
Im Schuhmachergewann 5–11
D-69123 Heidelberg
Postfach 10 17 60
D-69007 Heidelberg
Telephone: +49 (06221) 842-0
Fax: +49 (06221) 842-419
info@prominent.de
www.prominent.de

We reserve the right to make technical changes.

TA-194.100-PME01 290601

Software Version: 3.x

Safety Precautions

Be sure to read and observe the following requirements!

DULCOMETER® 2201 X pH is approved for operation in hazardous locations.

Warning Before connecting the device to a power supply unit, make sure that this is an associated apparatus.

Whenever it is likely that the protection has been impaired, the device shall be made inoperative and secured against unintended operation.
The protection is likely to be impaired if, for example:

- ❏ the device shows visible damage
- ❏ the device fails to perform the intended measurements
- ❏ after prolonged storage at temperatures above 70 °C
- ❏ after severe transport stresses

Before recommissioning the device, a professional routine test in accordance with EN 61010-1 must be performed. This test should be carried out at our factory.

The device shall not be used in a manner not specified by this manual.

Information on this Instruction Manual

ITALICS are used for texts which appear in the display.

Bold print is used to represent keys, e.g. **cal**.

Keys for which the functions are explained are frequently shown in the left-hand column.

Note

Notes provide important information that should be strictly followed when using the device.

Warning

Warning means that the instructions given must always be followed for your own safety. Failure to follow these instructions may result in injuries.

Mode Codes

After pressing **conf** or **cal** you can enter one of the following codes to access the designated mode:

conf, 0000: Error info
conf, 1200: Configuration
conf, 5555: Current source

cal, 0000: Cal info
cal, 1015: Temperature probe adjustment
cal, 1100: Calibration
cal, 2222: Test mode (electrode potential display)

Contents

1 Assembly

Package Contents and Unpacking

Unpack the device carefully and check the shipment for transport damage and completeness.
The package contains:

– Front unit of DULCOMETER® 2201 X pH

– Lower case

– Short instruction sheet

– This instruction manual

– Bag containing:

①	2 sealing plugs	⑦	1 hinge pin
②	5 hexagon nuts	⑧	3 cable ties
③	3 cable glands	⑨	3 filler plugs
④	1 rubber reducer	⑩	3 gaskets
⑤	1 sealing insert	⑪	1 washer
⑥	4 enclosure screws	⑫	1 jumper

Assembly

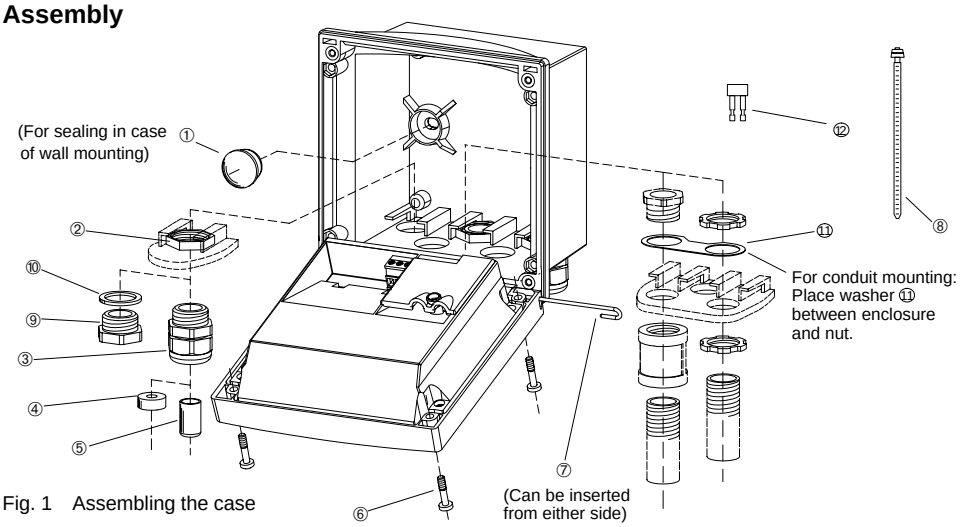


Fig. 1 Assembling the case

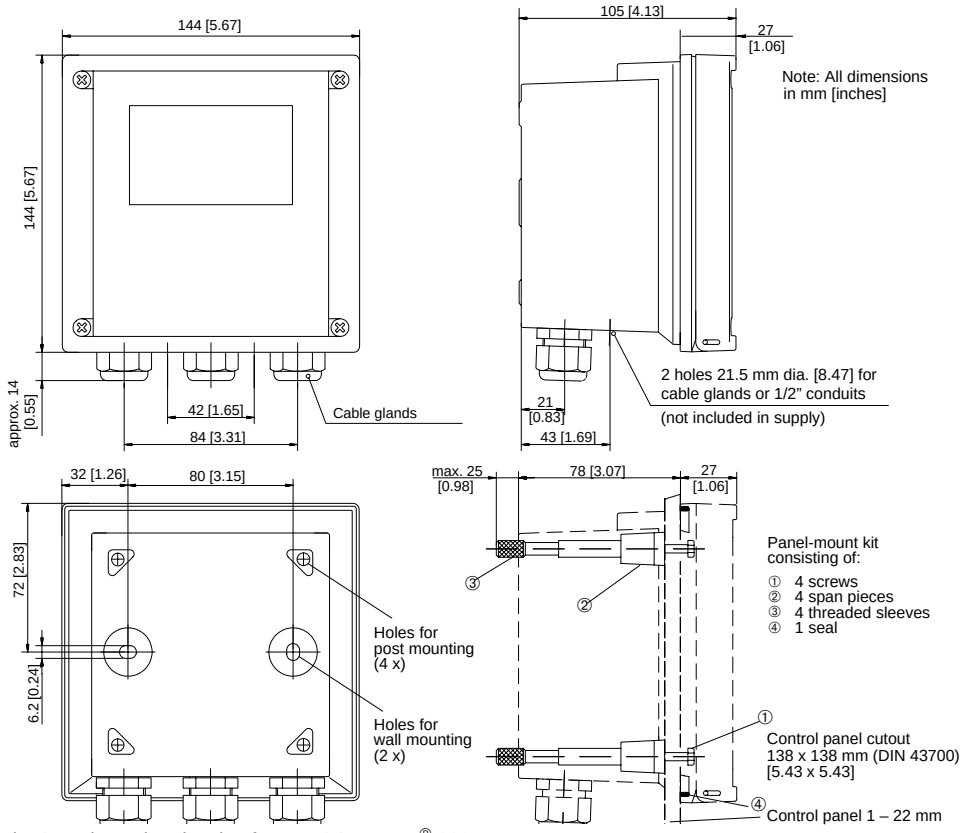


Fig. 2 Dimension drawing for DULCOMETER® 2201 X pH, mounting diagram and panel-mount kit (Order No. 1008708)

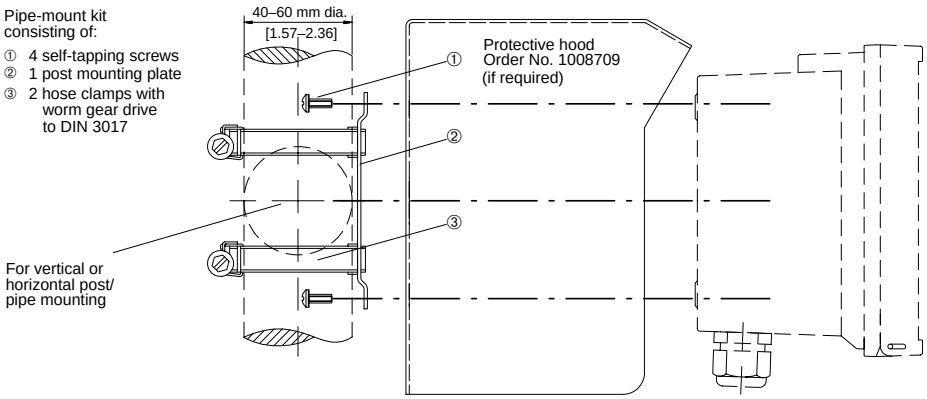


Fig. 3 Pipe-mount kit (Order No. 1008707)

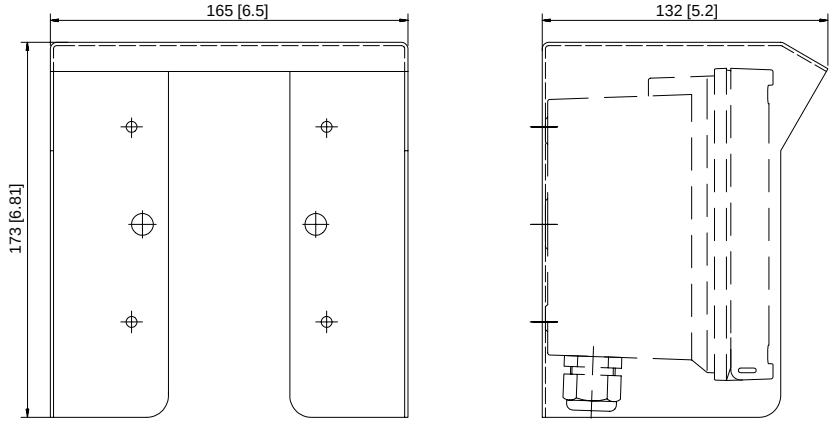
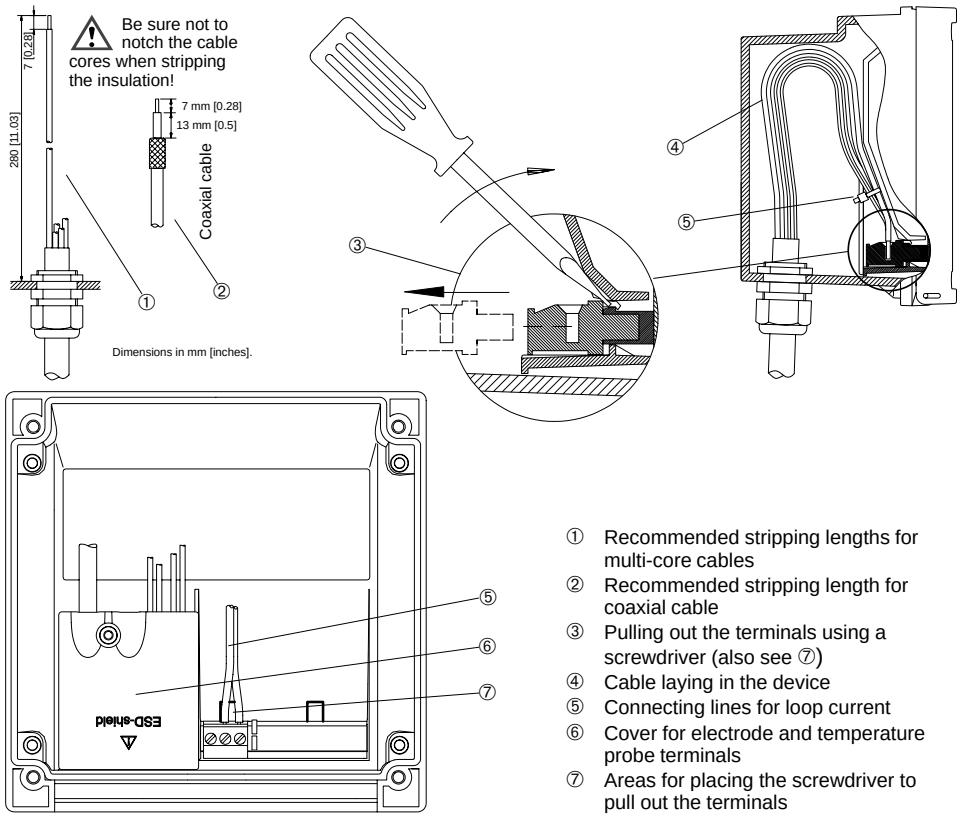


Fig. 4 Protective hood (Order No. 1008709) for wall and pipe mounting



① Recommended stripping lengths for multi-core cables
② Recommended stripping length for coaxial cable
③ Pulling out the terminals using a screwdriver (also see ⑦)
④ Cable laying in the device
⑤ Connecting lines for loop current
⑥ Cover for electrode and temperature probe terminals
⑦ Areas for placing the screwdriver to pull out the terminals

Fig. 5 Installation information DULCOMETER® 2201 X pH

2 Installation, Connection and Commissioning

Proper Use

DULCOMETER® 2201 X pH is used for pH and temperature measurement in industry, the environment, food processing and waste-water field. It can be either field-mounted or fixed into a control panel.

Note

DULCOMETER® 2201 X pH is approved for operation in hazardous locations.

Overview of the DULCOMETER® 2201 X pH

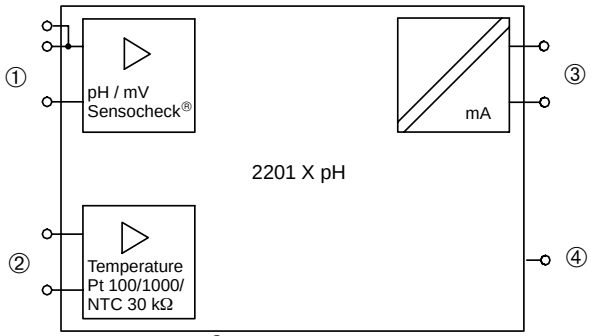


Fig. 6 System functions of DULCOMETER® 2201 X pH

① Inputs for glass and reference electrode
② Input for temperature probe
③ Current loop 4 – 20 mA, either for pH or mV
④ Equipotential bonding

Terminal Assignment

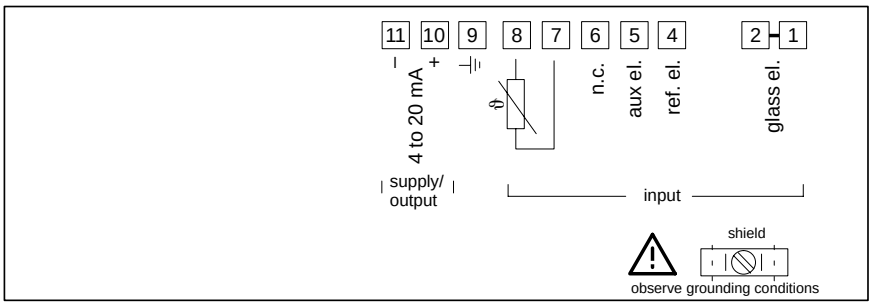


Fig. 7 Terminal assignment of DULCOMETER® 2201 X pH

Installation and Commissioning

Warning

Installation and commissioning of the DULCOMETER® 2201 X pH may only be carried out in accordance with this instruction manual and per applicable local and national codes. Be sure to observe the technical specifications and input ratings.

Warning

Do not use alternating current or mains power supply!

Warning

DULCOMETER® 2201 X pH may only be connected to an explosion-proof power supply unit (for input ratings refer to annex of Certificate of Conformity).

Warning

When commissioning, a *complete configuration* must be carried out.

For easier installation, the terminal strips are of a plug-in design. The terminals are suitable for single wires and flexible leads up to 2.5 mm^2 (AWG 14) (see Pg. 9).
See Pg. 12 and following for connection examples.

Warning

Do not use cable clamp (shield) for reference electrode connection when auxiliary electrode (solution ground) is in use.

Wiring Diagrams (pH)

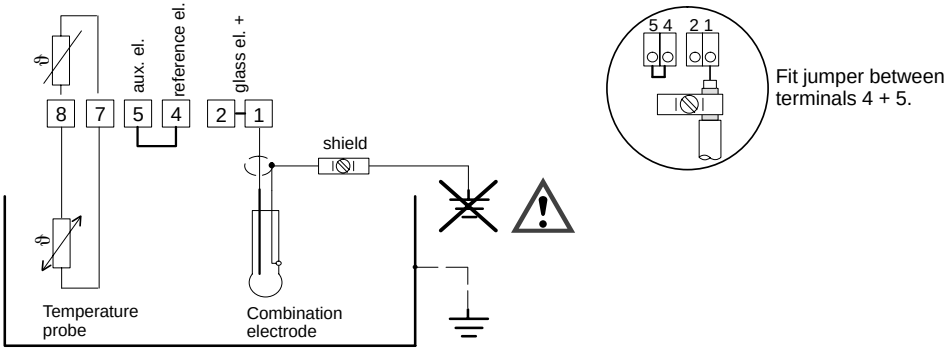


Fig. 8a pH measurement with combination electrode and temperature probe, Sensocheck® limited to the glass electrode only

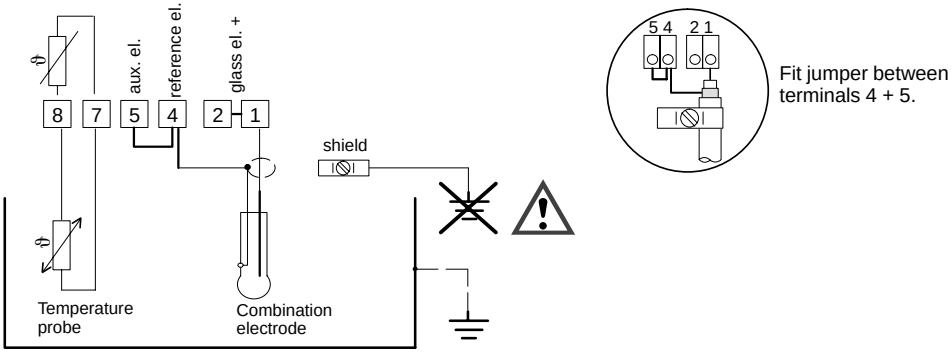


Fig. 8b pH measurement with combination electrode and temperature probe, Sensocheck® limited to the glass electrode only

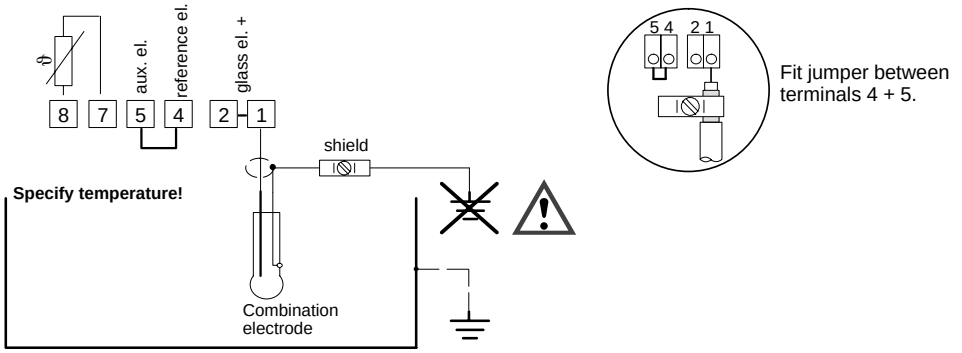


Fig. 9 pH measurement with combination electrode without temperature probe, Sensocheck® limited to the glass electrode only

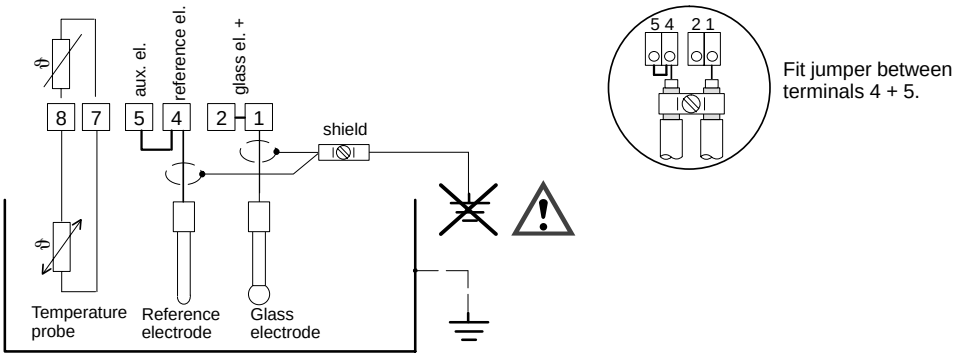


Fig. 10 pH measurement with separate glass and reference electrode and temperature probe, Sensocheck® limited to the glass electrode only

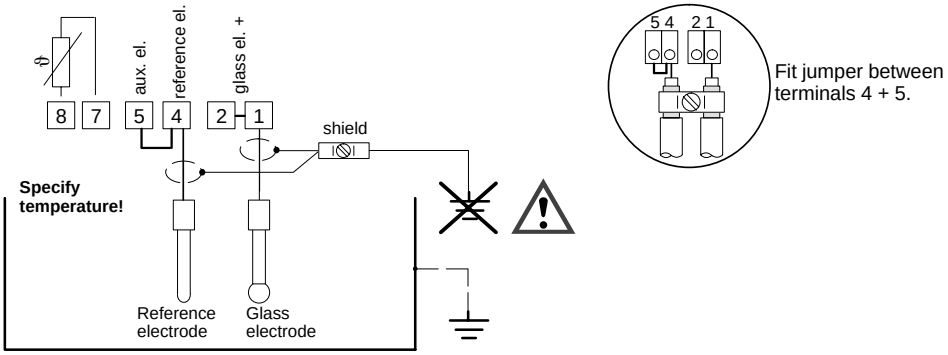


Fig. 11 pH measurement with separate glass and reference electrode without temperature probe, Sensocheck® limited to the glass electrode only

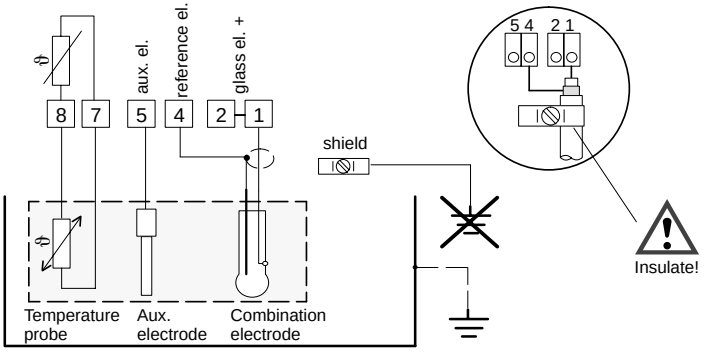


Fig. 12 pH measurement with combination and aux. electrode and temperature probe, Sensocheck® for glass and reference electrode

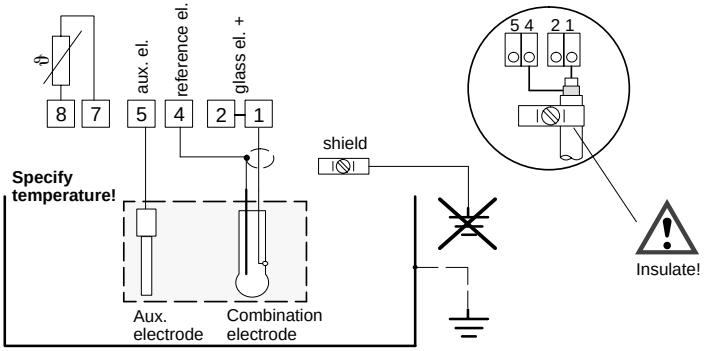


Fig. 13 pH measurement with combination and aux. electrode without temperature probe, Sensocheck® for glass and reference electrode

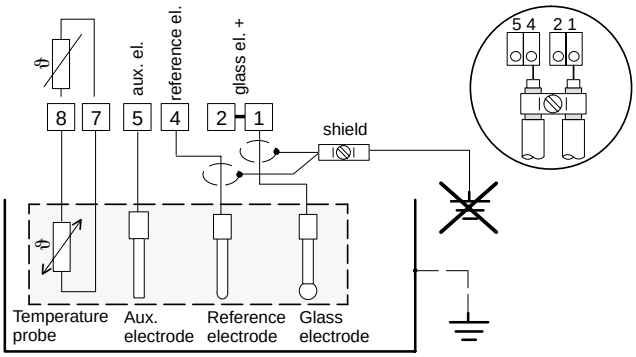


Fig. 14 pH measurement with separate glass, reference and aux. electrode and temperature probe, Sensocheck® for glass and reference electrode

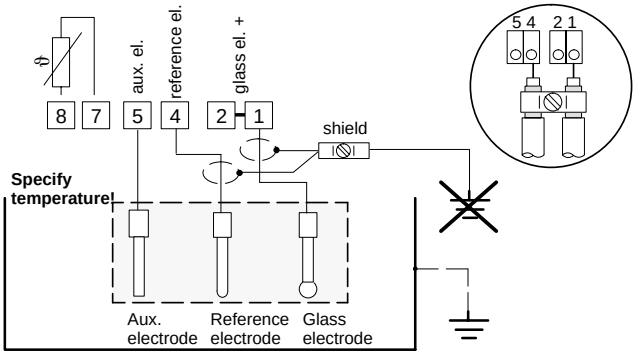


Fig. 15 pH measurement with separate glass, reference and aux. electrode without temperature probe, Sensocheck® for glass and reference electrode

Wiring Diagrams (ORP)

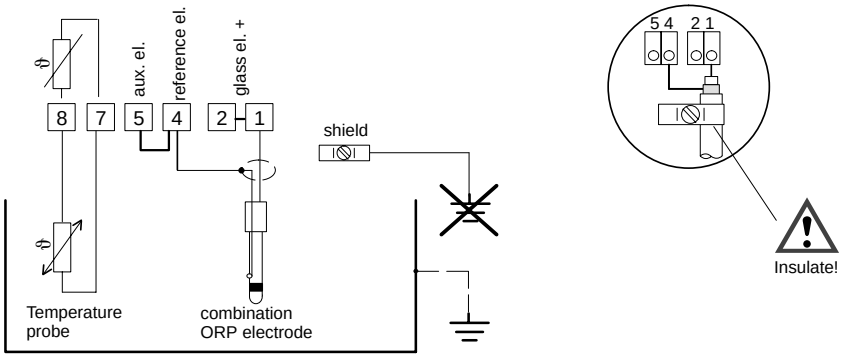


Fig. 16 ORP measurement with separate combination ORP electrode and temperature probe

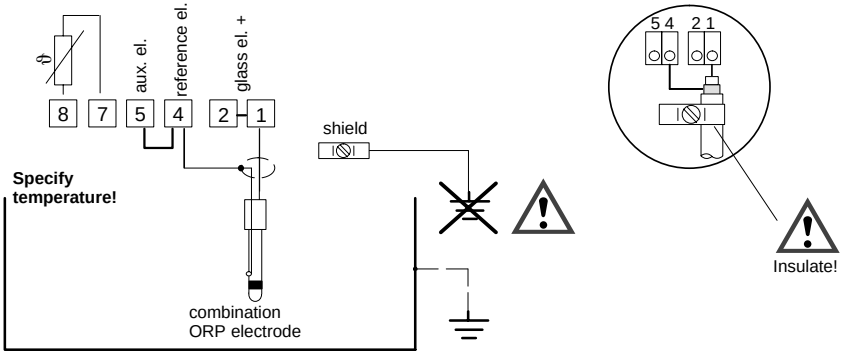


Fig. 17 ORP measurement with combination ORP electrode without temperature probe

3 Operation

User Interface

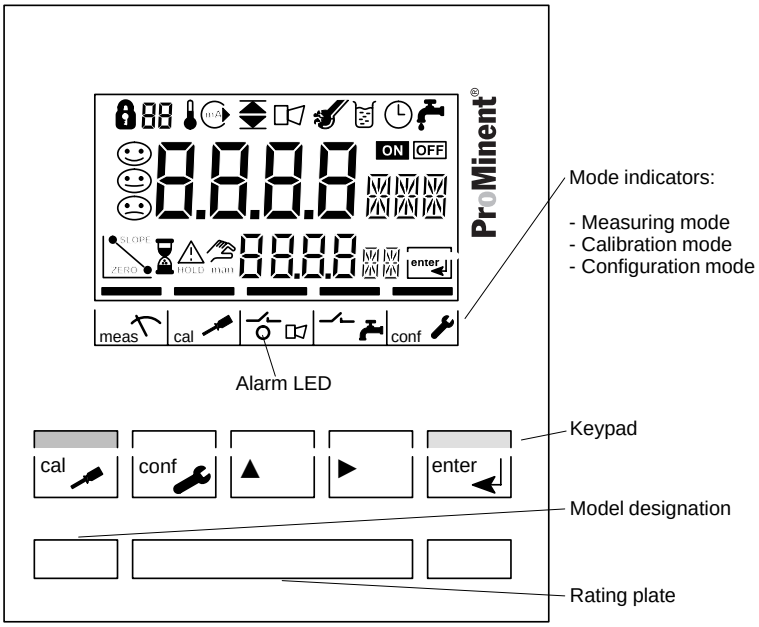


Fig. 18 Front view of DULCOMETER® 2201 X pH

Display

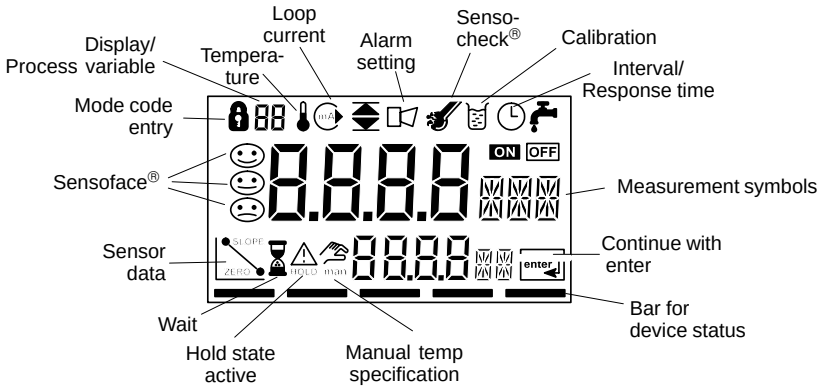


Fig. 19 Display

Keypad

cal — Start, end calibration

conf — Start, end configuration

▶ — Select digit position (selected position flashes)

▲ — Change digit

enter — Prompt in display: continue in program sequence, Configuration: Confirm entries, next configuration step, Measuring mode: Display output current

cal → enter — Cal info, display asymmetry potential (zero) and slope (see Pg. 31)

conf → enter — Error info, display last output error message (see Pg. 31)

▲ + ▶ — Start GainCheck® manual device self-test (see Pg. 20)

Safety Functions

Sensoface® electrode monitoring

Sensoface® provides information on the electrode condition. The asymmetry potential, slope and response time during calibration are evaluated.
Sensocheck® continuously monitors the glass and reference electrode.

For more detailed information, see chapter “Diagnostic, Maintenance and Cleaning” (Pg. 32).

GainCheck® manual self-test

▲ + ▶ Simultaneously pressing ▲ and ▶ starts the manual device self-test.

A display test is carried out, the software version is displayed and the memory and measured value transmission are checked.

Automatic self-test

The automatic device self-test checks the memory and the measured-value transmission. It runs automatically in the background at fixed intervals.

Outputs

Loop current

The loop current is controlled by the process variable selected in the configuration.
The current beginning and end can be set to any desired value.
To check connected peripherals (e.g. limit switches, controllers), the loop current can be manually specified (see Pg. 36).

Alarm

During an error message the alarm LED flashes.
Alarm response time is permanently set to 10 s.

Error messages can also be signaled with a 22 mA signal via the loop current (see table on Pg. 23).

Configuration

Here the basic settings of the device are carried out. Symbols show which parameter is being configured.

Activate with **conf**
change parameter with ▲ and ▶,
confirm/continue with **enter**,
end configuration with **conf**

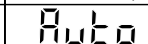
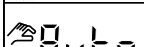
Mode code *“1200”*

During configuration the loop current is frozen
.

When the configuration mode is exited, the device remains in the Hold state for safety reasons. This prevents undesirable reactions of the connected peripherals (e.g. limit switches, controllers) due to incorrect settings. The measured value and *Hold* are displayed alternately. Now you can check whether the measured value is plausible and specifically end the Hold state with **enter**. After 20 sec (measured value stabilization) the Hold state is ended.

Configuration parameters

Before attempting any changes refer to the parameter setup list shown below. This table presents the possible options and the factory settings.

Picto-graph	Parameter	Choices	Factory Setting
	Meas. variable (when changed, complete configuration required)	pH 0.00 to 14.00 ORP –1,500 to +1,500 mV	**pH**
	Temperature display / detection	 °C / °F automatic detection	**Auto °C**
		 °C / °F manual specification	
		 °C/ °F automatic detection during measurement manual specification during calibration	
	Temperature probe	Pt 100 / Pt 1000 / NTC 30 kΩ	**Pt 1000**
	Current beginning, current end	4 mA, 0 to 14 pH, 20 mA, 0 to 14 pH	**4 mA, 0 pH** **20 mA, 14 pH**
	Hold state	Last: Last current value Fix: Loop current specified	**Last**
	22 mA signal for error message	On / OFF	**OFF**
	Sensocheck® (sensor diagnostics)	On / OFF	**OFF**
	Calibration mode: Automatic with Calimatic®	BUF –00– Knick techn. buffers BUF –01– Mettler Toledo techn. buffers BUF –02– ProMinent BUF –03– Ciba (94) BUF –04– Mettler Toledo (USA) BUF –05– NIST standard buffers BUF –06– HACH BUF –07– WTW	**BUF –02–**
	Manual	MAN Manual buffer entry DAT Data entry of premeasured values	
	Calibration timer interval	0000 to 9999 hours	**0000 (OFF)**

Calibration

You can conduct either a one or a two-point calibration. The calibration can be carried out with the Calimatic® automatic buffer recognition, with manual buffer input or by entering pre-measured electrode data.

Activate with **cal**
confirm/continue with **enter**,
abort with **cal ➜ enter**

During calibration the loop current is frozen. The device is in the Hold state.

When the calibration mode is exited, the device remains in the Hold state for safety reasons. This prevents undesirable reactions of the connected peripherals (e.g. limit switches, controllers) due to incorrect settings. The measured value and *Hold* are displayed alternately. Now you can check whether the measured value is plausible and specifically end the Hold state with **enter** or repeat calibration with **cal.** If you end the Hold state, the device will return to measuring mode after 20 sec (measured value stabilization).

Automatic calibration with Calimatic® BUF and automatic calibration temp detection

Note

The device can only operate properly when the buffer solutions used correspond to the configured buffer set. Other buffer solutions, even those with the same nominal values, may demonstrate a different temperature behavior. This leads to measurement errors.

Activate calibration by pressing the **cal** key.
Using the ▲ , ▶ keys enter mode code *"1100"* and then press **enter**.

Remove electrode and temperature probe and immerse them in the first buffer solution; it does not matter which buffer solution is taken first.

Start calibration with **enter**.

While the hour glass flashes, the electrode and temperature probe remain in the first buffer solution.

Note

The response time of the electrode and the temperature probe is considerably reduced if the electrode is first moved about in the buffer solution and then held still. Stirring provides stable values faster.

Buffer recognition

Nominal buffer value is displayed

Stability check:
measured mV value is displayed

Note

The stability check can be aborted with **cal**. However, accuracy of the calibration will be compromised.

Calibration with the first buffer is completed. Remove the electrode and temperature probe from the first buffer solution and rinse off both thoroughly.

❑ If you would like to carry out a <u>one-point calibration</u>, end the calibration now with **cal**. The device then shows the newly determined asymmetry potential in the lower display and the old slope in the main display.

❑ If you would like to carry out a <u>two-point calibration</u>, immerse the electrode and the temperature probe in the second buffer solution. Now start the calibration again with **enter**. The calibration process runs again as for the first buffer.

At the end of calibration the slope and asymmetry potential (based on 25 °C) of the electrode are displayed. Calibration is ended with **enter**. The device remains in the Hold state. You can now reinstall the electrode and the temperature probe and end the Hold state with **enter**. After 20 sec. (measured value stabilization) the device returns to measuring mode.

Automatic calibration with Calimatic® BUF and manual specification of calibration temp

Note

The device can only operate properly when the buffer solutions used correspond to the configured buffer set. Other buffer solutions, even those with the same nominal values, may demonstrate a different temperature behavior. This leads to measurement errors.

Activate calibration by pressing the **cal** key.
Using the ▲ , ▶ keys enter mode code *"1100"* and then press **enter**.

Remove the electrode and immerse it in the first buffer solution; it does not matter which buffer solution is taken first.
Enter the calibration temperature using the ▲ and ▶ keys.

Start calibration with **enter**.

While the hour glass flashes, the electrode remains in the first buffer solution.

Note

The response time of the electrode is considerably reduced if the electrode is first moved about in the buffer solution and then held still. Stirring provides stable values faster.

Buffer recognition

Nominal buffer value is displayed

Stability check:
measured mV value is displayed

Note

The stability check can be aborted with **cal**. However, accuracy of the calibration will be compromised.

Calibration with the first buffer is completed. Remove the electrode from the first buffer solution and rinse it off thoroughly.

❏ If you would like to carry out a <u>one-point calibration</u>, end the calibration now with **cal**. The device then shows the newly determined asymmetry potential in the lower display and the old slope in the main display.

❏ If you would like to carry out a <u>two-point calibration</u>, immerse the electrode in the second buffer solution. Now start the calibration again with **enter**. The calibration process runs again as for the first buffer.

At the end of calibration the slope and asymmetry potential (based on 25 °C) of the electrode are displayed. Calibration is ended with **enter**. The device remains in the Hold state. You can now reinstall the electrode and end the Hold state with **enter**. After 20 sec. (measured value stabilization) the device returns to measuring mode.

Manual calibration MAN
with automatic calibration temp detection
(if selected in Conf mode)

For calibration with manual buffer specification, you must enter the pH value of the buffer solution used in the device **for the proper temperature**.
This enables calibration with any desired buffer solution.

Activate calibration by pressing the **cal** key.
Using the ▲ , ▶ keys enter mode code *"1100"* and then press **enter**.

Remove electrode and temperature probe and immerse them in the first buffer solution; it does not matter which buffer solution is taken first. Confirm with **enter**.

Set the pH value of your buffer solution for the proper temperature with ▲ and ▶. Start calibration with **enter**.

Note

The response time of electrode and temperature probe is considerably reduced if the electrode is first moved about in the buffer solution and then held still.

Stability check: measured mV value is displayed.

Note

The stability check can be aborted with **cal**. However, the calibration accuracy will be compromised.

Calibration with the first buffer is completed. Remove the electrode and temperature probe from the first buffer solution and rinse off both thoroughly.

- ❏ If you would like to carry out a one-point calibration, press **cal** to end the calibration now. The device then shows the newly determined asymmetry potential (zero point) in the main display and the old slope in the lower display.
- ❏ If you would like to carry out a two-point calibration, immerse the electrode in the second buffer solution. Enter the pH value of the second buffer solution as has been done with the first buffer. Now start the calibration again with **enter**. The calibration process runs again as for the first buffer.

At the end of calibration the slope and asymmetry potential (based on 25 °C) of the electrode are displayed. Press **enter** to end calibration. The device remains in the Hold state. You can now reinstall the electrode and temperature probe and end the Hold state with **enter**. After 20 sec (measured value stabilization) the device returns to measuring mode.

Manual calibration MAN
with manual specification of calibration temp
(if selected in Conf mode)

For calibration with manual buffer specification, you must enter the pH value of the buffer solution used in the device **for the proper temperature**.
This enables calibration with any desired buffer solution.

Activate calibration by pressing the **cal** key.
Using the ▲ , ▶ keys enter mode code *"1100"* and then press **enter**.

Remove the electrode and immerse it in the first buffer solution; it does not matter which buffer solution is taken first. Enter the calibration temperature using the ▲ and ▶ keys and confirm with **enter**.

Set the pH value of your buffer solution for the proper temperature with ▲ and ▶. Start calibration with **enter**.

Note

The response time of electrode is considerably reduced if the electrode is first moved about in the buffer solution and then held still.

Stability check: measured mV value is displayed.

Note

The stability check can be aborted with **cal**. However, the calibration accuracy will be compromised.

Calibration with the first buffer is completed. Remove the electrode from the first buffer solution and rinse it off thoroughly.

❏ If you would like to carry out a one-point calibration, press **cal** to end the calibration now. The device then shows the newly determined asymmetry potential (zero point) in the main display and the old slope in the lower display.

❏ If you would like to carry out a two-point calibration, immerse the electrode in the second buffer solution. Enter the pH value of the second buffer solution as has been done with the first buffer. Now start the calibration again with **enter**. The calibration process runs again as for the first buffer.

At the end of calibration the slope and asymmetry potential (based on 25 °C) of the electrode are displayed. Press **enter** to end calibration. The device remains in the Hold state. You can now reinstall the electrode and end the Hold state with **enter**. After 20 sec (measured value stabilization) the device returns to measuring mode.

Data entry of premeasured electrodes DAT

You can directly enter the slope and asymmetry potential of an electrode. The values must be known, e.g. determined beforehand in the laboratory.

Activate calibration by pressing the **cal** key.
Using the ▲ , ▶ keys enter mode code *"1100"* and then press **enter**.

Enter asymmetry potential, confirm with **enter**

Enter slope, confirm with **enter**

At the end of calibration the slope and asymmetry potential (based on 25 °C) of the electrode are displayed. Press **enter** to end calibration. The device remains in the Hold state. You can now reinstall the electrode and the temperature probe and end the Hold state with **enter**. After 20 sec. (measured value stabilization) the device returns to measuring mode.

Convert slope [%] to slope [mV/pH] at 25 °C

%	78	80	82	84	86	88	90	92	94	96	98	**100**	102
mV/pH	46.2	47.4	48.5	49.7	50.9	52.1	53.3	54.5	55.6	56.8	58.0	**59.2**	60.4

Adjustment of temperature probe

Note

This function should only be used by experts. Incorrectly set parameters may go unnoticed, but change the measuring properties. Especially for Pt 100 temperature probe, it is advisable to perform an adjustment.

Activate calibration by pressing the **cal** key.
Using the ▲ , ▶ keys enter mode code *"1015"* and then press **enter**.

Measure the temperature of the process medium using an external thermometer.

Using the ▲ , ▶ keys enter the determined temperature value in the main display. If you take over the temperature value shown in the lower display, the correction is without effect.

Press **enter** to confirm the temperature value.

The device remains in the Hold state. You can end the Hold state with **enter**. After 20 sec (measured value stabilization) the device returns to measuring mode.

Measurement

Measuring mode

In the measuring mode the main display shows the configured measured variable (pH or mV) and the secondary display the temperature.

Cal info

With **cal** and mode code *"0000"* you can activate the cal info. Cal info shows the current calibration data for approx. 20 sec. The 20 sec can be reduced by pressing **enter**. During cal info the device is not in Hold state.

Error info

With **conf** and mode code *"0000"* you can activate the error info. Error info shows the most recent error message for approx. 20 sec. After that the message will be deleted. The 20 sec can be reduced by pressing **enter**. During error info the device is not in Hold state.

Manual temperature specification

The  indicator signals that the temperature will be manually specified. The measuring temperature can be set in the configuration, the calibration temperature in calibration.

Hold state

The device will enter the Hold state under the following conditions:

For calibration:	Mode code 1015
	Mode code 1100
	Mode code 2222
configuration:	Mode code 1200
	Mode code 5555

The loop current is frozen at *Last* or *Fix* (configuration Pg. 23). If the calibration or configuration mode is exited, the device remains in the Hold state for safety reasons. This prevents undesirable reactions of the connected peripherals (e.g. limit switches, controllers) due to incorrect settings. The measured value and *Hold* are displayed alternately. Now you can check whether the measured value is plausible and specifically end the Hold state with **enter**. After 20 sec (measured value stabilization) the device returns to measuring mode.

4 Diagnostics, Maintenance and Cleaning

Sensoface®, Sensocheck®

Sensoface® provides information on the electrode condition. The slope, asymmetry potential and response time during calibration are evaluated. **Sensocheck®** continuously monitors the glass and reference electrode. With Sensocheck® turned off no  appears.

Three Smileys provide information on wear and required maintenance. However, the device can still determine the measured variable and output it via the loop current.

Note 

The worsening of a Sensoface® criterion leads to the devaluation  or  of the Sensoface® indicator.

An improvement  of the Sensoface® indicator can only take place after calibration or removal of an electrode defect.  is only displayed when Sensocheck® has been activated.

Note 

The condition for accurate information is proper calibration.

Sensoface® displays during calibration		
Display	Problem	Status
	Electrode response time	 The electrode adjusts slowly. You should consider replacing it. It may be possible to achieve an improvement by cleaning or, in the case of an electrode stored dry, by “watering”.  The electrode adjusts very slowly to the measured value. Correct measurement is no longer ensured. The electrode should be replaced.
	Asymmetry potential and slope	 Asymmetry potential (zero point) and slope of the electrode are still okay, however the electrode should be replaced soon.  Asymmetry potential (zero point) and/or slope of the electrode have reached values which no longer ensure proper calibration. It is advisable to replace the electrode.

Sensoface® displays during measurement		
Display	Problem	Status
	Calibration timer	 Over 80 % of the calibration interval has already past.  The calibration interval has been exceeded.
	Electrode defect	 Check the electrode and its connections (also see error messages 33 and 34).

Error Messages

When one of the following error messages is output, the device can no longer correctly determine the measured variable or output it via the loop current.

During an error message the alarm LED flashes. The alarm response time is permanently set to 10 sec.

During alarm condition the device does not switch into Hold state. The current loop will remain active and still represents the currently displayed reading. If 22 mA function is configured (see page 23), error messages will also be indicated with a 22 mA signal.

Error info

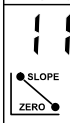
With **conf** and mode code *"0000"* you can activate the error info. Error info shows the most recent error message for approx. 20 sec. After that the message will be deleted. The 20 sec can be reduced by pressing **enter**. During error info the device is not in Hold state.

Error number	Display (flashing)	Problem	Possible causes
Err 01		pH electrode	- Electrode defective - Too little electrolyte in electrode - Electrode not connected - Break in electrode cable - Incorrect electrode connected - Measured pH value less than 0 or greater than +14
Err 02		Redox electrode	- Electrode defective - Electrode not connected - Break in electrode cable - Measured electrode voltage less than –1500 mV or greater than +1500 mV

Error number	Display (flashing)	Problem	Possible causes
Err 03		Temperature probe	- Incorrect temperature probe connected or configured - Open or short circuit in temperature probe - Measured temperature less than –20 °C or greater than +150 °C (NTC 30 kΩ: +130 °C)
Err 21		Loop current	- Measured value below configured current beginning - Check configuration current beginning (see Pg. 23)
Err 22		Loop current	- Measured value above configured current end - Check configuration current end (see Pg. 23)
Err 23		Loop current	- Configured current span too large or too small (Difference between current beginning and end)
Err 33		Glass electrode	- Glass electrode defective - Connection cable or electrode cap defective - Connection terminals or electrode cap dirty
Err 34		Reference electrode	- Reference electrode defective - Connection cable or electrode cap defective - Connection terminals or electrode cap dirty - Jumper between terminal 4 and 5 missing (see Figs. 8a – 11 on Pg. 12 and the following)
Err 98		System error	- Configuration or calibration data defective; completely reconfigure and recalibrate the device - Measured value transmission defective - Memory error in device program (PROM defective)
Err 99		Factory settings	- EEPROM or RAM defective, - Error in factory settings This error message normally should not occur, as the data are protected from loss by multiple safety functions. Should this error message nevertheless occur, there is no remedy. The device must be repaired and recalibrated at the factory.

Calibration Error Messages

(only during calibration)

Display	Problem	Possible causes
	Asymmetry potential (zero) out of range ⟨±60 mV)	- Electrode “worn out” - Buffer solutions contaminated - Buffer does not belong to configured buffer set - Temperature probe not immersed in buffer solution (for automatic temperature compensation) - Wrong buffer temperature set (for manual temperature specification) - Electrode with nominal zero point < pH 6 or > pH 8 is used
	Electrode slope out of range (80 – 103 %)	- Electrode “worn out” - Buffer solutions contaminated - Buffer does not belong to configured buffer set - Temperature probe not immersed in buffer solution (for automatic temperature compensation) - Wrong buffer temperature set (for manual temperature specification) - Electrode used has different nominal slope
	Problems during recognition of the buffer solution	- Same or similar buffer solution was used for both calibration steps - Buffer solution used does not belong to buffer set currently configured in the device - During manual calibration the buffer solutions were not used in the specified order - Buffer solutions contaminated - Electrode defective - Electrode not connected - Electrode cable defective - Wrong buffer temperature set (for manual temperature specification)
	Calibration was canceled after approx. 2 minutes, because the electrode drift was too large.	- Electrode defective or dirty - No electrolyte in the electrode - Electrode cable insufficiently shielded or defective - Strong electric fields influence the measurement - Major temperature fluctuation of the buffer solution - No buffer solution or extremely diluted

Diagnostics Functions

Cal info

Pressing **cal** and entering mode code *"0000"* is going to activate the cal info. Cal info shows the current calibration data for approx. 20 sec. During cal info the device is not in Hold state.

Error info

Pressing **conf** and entering mode code *"0000"* is going to activate the error info. Error info shows the most recent error message for approx. 20 sec. After that the message will be deleted. The 20 sec can be reduced by pressing **enter**. During error infothe device is not in Hold state.

Display electrode potential

During electrode maintenance it is useful to directly indicate the electrode potential. This allows, for example, to check electrode response after cleaning.

Pressing **cal** and entering mode code *"2222"* will display the electrode potential. The device is in Hold state.

Display loop current

Pressing **enter** in measuring mode displays the loop current for a few seconds.

Current source

To check the connected peripherals (e.g. limit switches, controllers), the loop current can be manually specified.

Warning

In the current source function the loop current no longer follows the measured value! It is manually specified.
Therefore, it must be ensured that the connected devices (control room, controllers, indicators) do not interpret the current value as a measured value!

Pressing **conf** and entering mode code *"5555"* you enter the current source mode. Specify the loop current using ▶, ▲ and **enter**. The present loop current is shown in the lower display.
Pressing **conf** exits the current source mode again.

GainCheck® manual device self-test

To start press ▲ and ▶ simultaneously.

A display test is carried out, the software version is displayed and the memory and measured-value transmission checked.

Automatic device self-test

The automatic device self-test checks the memory and the measured-value transmission. It runs automatically in the background at fixed intervals.

Maintenance and Cleaning

Maintenance

DULCOMETER® 2201 X pH contains no user repairable components.

Cleaning

To remove dust, dirt and spots, the external surfaces of the device may be wiped with a damp, lint-free cloth. A mild household cleaner may also be used if necessary.

5 Annex

Product Line

Device

	Ref. No.
DULCOMETER® 2201 X pH for application in hazardous areas	1008672

Mounting Accessories

	Ref. No.
Pipe-mount kit	1008707
Panel-mount kit	1008708
Protective hood	1008709

Suggested Power Supplies

	Ref. No.
Repeater power supply	
90 - 253 Vac	1008721
24 Vac/dc	1008722

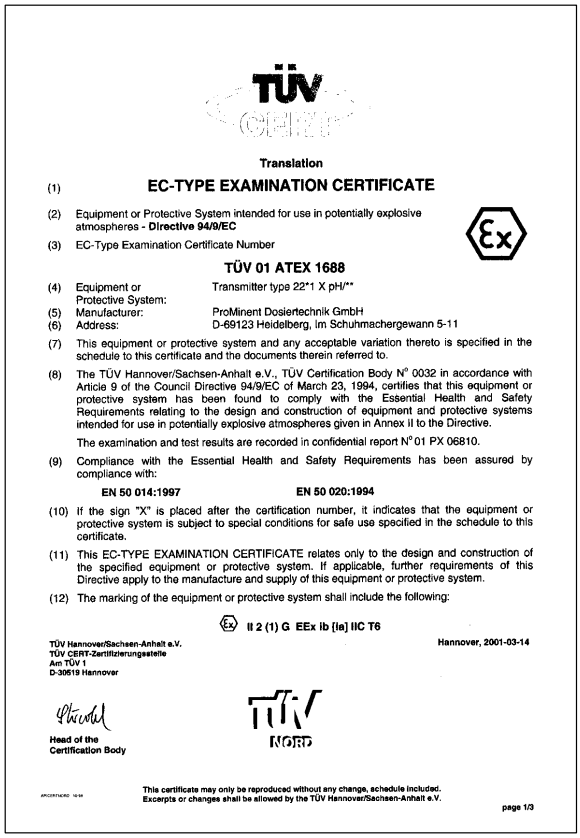
Specifications

pH/mV input EEx ia IIC		
Ranges	pH value	0.00 to +14.00
	mV value	–1500 to +1500 mV
Glass	Input resistance	> $0.5 \cdot 10^{12}$ Ω
	Input current (20 °C)[1)]	< $2 \cdot 10^{-12}$ A
Reference	Input resistance	> $1 \cdot 10^{10}$ Ω
	Input current (20 °C)[1)]	< $1 \cdot 10^{-10}$ A
Meas. error (± 1 count)	pH value	< 0.02
	mV	< 1 mV
Electrode monitoring	Sensocheck®: Monitoring of glass and reference electrode (can be switched off)	
Alarm limits	Determination during calibration	
Electrode standardization*)	–Calimatic® automatic calibration with the buffer sets: -01 Knick technical buffers (correspond to Mettler Toledo techn. buffers) 2.00/4.01/7.00/9.21 -02- ProMinent® 2.00/4.00/7.00/9.00 -03- Ciba (94) 2.06/4.00/7.00/10.00 -04- Mettler Toledo (USA) 4.00/7.00/10.01 -05- Standard buffers NIST 4.006/6.865/9.180 -06- HACH 4.00/7.00/10.18 -07- WTW techn. buffers 2.00/4.01/7.00/10.00	
	–Manual entry of individual buffer values (MAN) –Data entry for pre-measured electrodes (DAT) –Temperature probe adjustment	
Cal timer	0 to 9999 h	
Calibration ranges	Asymmetry potential	± 60 mV
	Slope	80 to 103 %
	For values outside this range, display message (Sensoface®)	
Temp input	Pt 100 / Pt 1000 / NTC 30 kΩ EEx ia IIC	
Ranges	NTC	–20.0 to +130.0 °C –4 to +266 °F
	Pt	–20.0 to +150.0 °C –4 to +302 °F
Meas. error	< 0.5 K[2)]	± 1 count
Temp compensation	automatic with Pt 100 / Pt 1000 / NTC 30 kΩ or manual	
Display	LC display, alarm LED	
Loop current EEx ib IIC	4 to 20 mA, floating 22 mA for error message*) supply voltage 12 to 30 V I_{max} = 100 mA, P_{max} = 0.8 W	
Current error	< 0.3 % of current value ± 50 µA	
Current source	3.80 mA to 22.00 mA	
Start/end of scale*)	as desired within pH or mV ranges	
Spans*)	pH value	2.00 to 14.00
	mV value	200 to 3000 mV

Explosion protection	II 2 (1) G EEx ib [ia] IIC T6 CE 0032 TÜV 01 ATEX 1688
Data retention	> 10 years (EEPROM)
EMC	Emitted interference: EN 61 326 Class B Immunity to interference: EN 61 326, EN 61 326/A1
Temperature	Operating/environmental temp –20 to +55 °C Transport and storage temp –20 to +70 °C
Enclosure	Material: thermoplastic polyester, reinforced (polybutylene terephthalate) Protection: IP 65 Color: bluish gray RAL 7031
Cable glands	3 breakthroughs for included cable glands 2 breakthroughs for cable glands, NPT 1/2 “ or Rigid Metallic Conduit
Dimensions	See Dimension drawings, Pg. 7 ff
Weight	approx. 1 kg

*) user defined 1) doubles every 10 K
2) Pt 100: 1 K

EC-Type-Examination Certificate



Translation

(1) **EC-TYPE EXAMINATION CERTIFICATE**

(2) Equipment or Protective System intended for use in potentially explosive atmospheres - **Directive 94/9/EC**

(3) EC-Type Examination Certificate Number

TÜV 01 ATEX 1688

(4) Equipment or Protective System: Transmitter type 22*1 X pH/**

(5) Manufacturer: ProMinent Dosiertechnik GmbH

(6) Address: D-69123 Heidelberg, Im Schuhmachergewann 5-11

(7) This equipment or protective system and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

(8) The TÜV Hannover/Sachsen-Anhalt e.V., TÜV Certification Body N° 0032 in accordance with Article 9 of the Council Directive 94/9/EC of March 23, 1994, certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive.

The examination and test results are recorded in confidential report N° 01 PX 06810.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 50 014:1997 **EN 50 020:1994**

(10) If the sign "X" is placed after the certification number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-TYPE EXAMINATION CERTIFICATE relates only to the design and construction of the specified equipment or protective system. If applicable, further requirements of this Directive apply to the manufacture and supply of this equipment or protective system.

(12) The marking of the equipment or protective system shall include the following:

II 2 (1) G EEx ib [ia] IIC T6

TÜV Hannover/Sachsen-Anhalt e.V.
TÜV CERT-Zertifizierungsstelle
Am TÜV 1
D-30519 Hannover

Hannover, 2001-03-14

Head of the Certification Body

This certificate may only be reproduced without any change, schedule included.
Excerpts or changes shall be allowed by the TÜV Hannover/Sachsen-Anhalt e.V.

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(13) **SCHEDULE**

TÜV NORD

(14) **EC-TYPE EXAMINATION CERTIFICATE N° TÜV 01 ATEX 1688**

(15) Description of equipment or protective system

The transmitter type 22°1 X pH/** is used for the recognition and processing of electrochemical quantities.

The maximum permissible ambient temperature is 55°C.

Electrical data

Current loop.....in type of protection "Intrinsic Safety" EEx ib IIC
(terminals 10, 11 or 14, 15) only for the connection to a certified intrinsically safe circuit with the following maximum values:
U_i = 30 V
I_i = 100 mA
P_i = 0,8 W
effective internal capacitance C_i = 20 nF
effective internal inductance L_i = 0,2mH

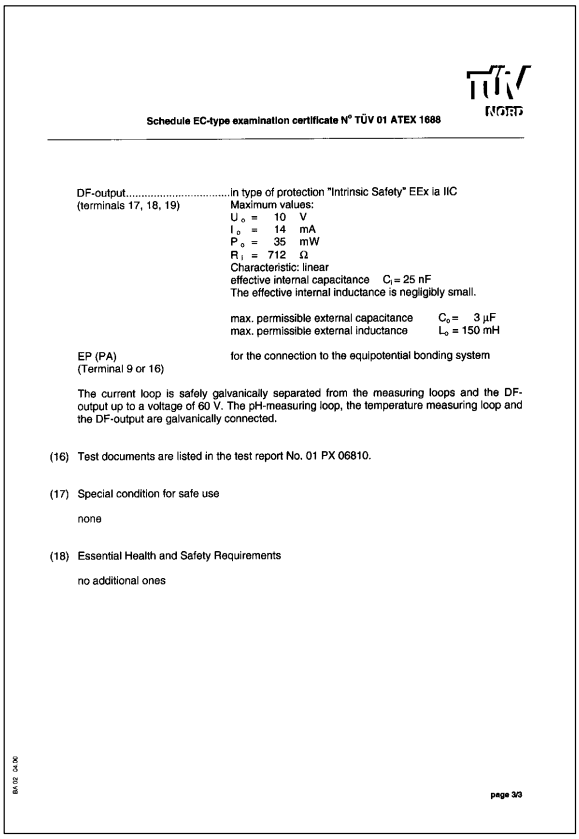
pH-measuring loop.....in type of protection "Intrinsic Safety" EEx ia IIC
(terminals 1/2, 4, 5) Maximum values:
U_o = 10 V
I_o = 12 mA
P_o = 15 mW
R_i = 450 Ω
Characteristic: linear
effective internal capacitance C_i = 50 nF
The effective internal inductance is negligibly small.

max. permissible external capacitance C_o = 3 µF
max. permissible external inductance L_o = 200 mH

Temperature measuring loop....in type of protection "Intrinsic Safety" EEx ia IIC
(terminals 7, 8) Maximum values:
U_O = 5 V
I_O = 3 mA
P_O = 4 mW
R_i = 1900 Ω
Characteristic: linear
effective internal capacitance C_i = 250 nF
The effective internal inductance is negligibly small.

max. permissible external capacitance C_o = 100 µF
max. permissible external inductance L_o = 1 H

BA 02 04.00



TÜV NORD

Schedule EC-type examination certificate N° TÜV 01 ATEX 1688

DF-output.....in type of protection "Intrinsic Safety" EEx ia IIC
(terminals 17, 18, 19) Maximum values:
U_o = 10 V
I_o = 14 mA
P_o = 35 mW
R_i = 712 Ω
Characteristic: linear
effective internal capacitance C_i = 25 nF
The effective internal inductance is negligibly small.

max. permissible external capacitance C_o = 3 µF
max. permissible external inductance L_o = 150 mH

EP (PA) for the connection to the equipotential bonding system
(Terminal 9 or 16)

The current loop is safely galvanically separated from the measuring loops and the DF-output up to a voltage of 60 V. The pH-measuring loop, the temperature measuring loop and the DF-output are galvanically connected.

(16) Test documents are listed in the test report No. 01 PX 06810.

(17) Special condition for safe use

none

(18) Essential Health and Safety Requirements

no additional ones

BA 02 d.CE

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Declaration of Conformity

EC Declaration of Conformity

We,

ProMinent Dosiertechnik GmbH
Im Schuhmachergewann 5 - 11
D - 69123 Heidelberg

hereby declare that, on the basis of its functional concept and design and in the version brought into circulation by us, the product specified in the following complies with the relevant, fundamental safety and health stipulations laid down by EC directives.
Any modification to the product not approved by us will invalidate this declaration.

Product description :	***Dulcometer transducer***
Product type :	***2201 X pH***
Serial number :	***see type identification plate on device***
Relevant EC regulations :	***EC - EMC - regulation (89/336/EEC subsequently 92/31 EEC)*** ***EC directive for devices in hazardous areas 94/9/EC***
Harmonised standards used, in particular :	***DIN EN 61326, DIN EN 50014, DIN EN 50020***
National standards and other technical specifications used, in particular :	
Date/manufacturer's signature :	***May 14, 2001***
The undersigned :	*Manfred Hüholt*

TEZ, CE, KE u HE KE 2201xph e 01-05-14.xls 17.05.0114:41

Buffer Charts

-01- Knick technical buffers
(correspond to Mettler-Toledo technical buffers)

°C	pH			
0	2.03	4.01	7.12	9.52
5	2.02	4.01	7.09	9.45
10	2.01	4.00	7.06	9.38
15	2.00	4.00	7.04	9.32
20	2.00	4.00	7.02	9.26
25	**2.00**	**4.01**	**7.00**	**9.21**
30	1.99	4.01	6.99	9.16
35	1.99	4.02	6.98	9.11
40	1.98	4.03	6.97	9.06
45	1.98	4.04	6.97	9.03
50	1.98	4.06	6.97	8.99
55	1.98	4.08	6.98	8.96
60	1.98	4.10	6.98	8.93
65	1.99	4.13	6.99	8.90
70	1.99	4.16	7.00	8.88
75	2.00	4.19	7.02	8.85
80	2.00	4.22	7.04	8.83
85	2.00	4.26	7.06	8.81
90	2.00	4.30	7.09	8.79
95	2.00	4.35	7.12	8.77

-02- ProMinent®

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

-03- Ciba (94) buffers
Nominal values: 2.06, 4.00, 7.00, 10.00

°C	pH			
0	2.04	4.00	7.10	10.30
5	2.09	4.02	7.08	10.21
10	2.07	4.00	7.05	10.14
15	2.08	4.00	7.02	10.06
20	2.09	4.01	6.98	9.99
25	2.08	4.02	6.98	9.95
30	2.06	4.00	6.96	9.89
35	2.06	4.01	6.95	9.85
40	2.07	4.02	6.94	9.81
45	2.06	4.03	6.93	9.77
50	2.06	4.04	6.93	9.73
55	2.05	4.05	6.91	9.68
60	2.08	4.10	6.93	9.66
65	2.07*	4.10*	6.92*	9.61*
70	2.07	4.11	6.92	9.57
75	2.04*	4.13*	6.92*	9.54*
80	2.02	4.15	6.93	9.52
85	2.03*	4.17*	6.95*	9.47*
90	2.04	4.20	6.97	9.43
95	2.05*	4.22*	6.99*	9.38*

* extrapolated

-04- Mettler Toledo (USA)

°C	pH		
0	4.00	7.12	10.32
5	4.00	7.09	10.25
10	4.00	7.06	10.18
15	4.00	7.04	10.12
20	4.00	7.02	10.06
25	**4.00**	**7.00**	**10.01**
30	4.01	6.99	9.97
35	4.02	6.98	9.93
40	4.03	6.98	9.89
45	4.04	6.97	9.86
50	4.06	6.97	9.83
55	4.06*	6.97*	9.83*
60	4.06*	6.97*	9.83*
65	4.06*	6.97*	9.83*
70	4.06*	6.97*	9.83*
75	4.06*	6.97*	9.83*
80	4.06*	6.97*	9.83*
85	4.06*	6.97*	9.83*
90	4.06*	6.97*	9.83*
95	4.06*	6.97*	9.83*

* extrapolated

-05- NIST standard-buffers

°C	pH		
0	4.010	6.984	9.464
5	4.004	6.951	9.395
10	4.000	6.923	9.332
15	3.999	6.900	9.276
20	4.001	6.881	9.225
25	**4.006**	**6.865**	**9.180**
30	4.012	6.853	9.139
35	4.021	6.844	9.102
40	4.031	6.838	9.068
45	4.043	6.834	9.038
50	4.057	6.833	9.011
55	4.071	6.834	8.985
60	4.087	6.836	8.962
65	4.109	6.841	8.942
70	4.126	6.845	8.921
75	4.145	6.852	8.903
80	4.164	6.859	8.885
85	4.185	6.868	8.868
90	4.205	6.877	8.850
95	4.227	6.886	8.833

-06- HACH buffers

Nominal values: 4.00, 7.00, 10.18

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

* values complemented

Buffer values up to 60 °C as specified by Bergmann & Beving Process AB.

-07- WTW technical buffers

°C	ST 1	ST 2	ST 3	ST 5
0	2.03	4.01	7.12	10.65
5	2.02	4.01	7.09	10.52
10	2.01	4.00	7.06	10.39
15	2.00	4.00	7.04	10.26
20	2.00	4.00	7.02	10.13
25	**2.00**	**4.01**	**7.00**	**10.00**
30	1.99	4.01	6.99	9.87
35	1.99	4.02	6.98	9.74
40	1.98	4.03	6.97	9.61
45	1.98	4.04	6.97	9.48
50	1.98	4.06	6.97	9.35
55	1.98	4.08	6.98	
60	1.98	4.10	6.98	
65	1.99	4.13	6.99	
70	2.00	4.16	7.00	
75	2.00	4.19	7.02	
80	2.00	4.22	7.04	
85	2.00	4.26	7.06	
90	2.00	4.30	7.09	
95	2.00	4.35	7.12	

Glossary

Asymmetry potential (zero point)
The voltage which a pH electrode gives off at a pH of 7. The asymmetry potential is different for every electrode and changes with age and wear.

Buffer set
Contains selected buffer solutions which can be used for automatic calibration with the Calimatic®. The buffer set must be selected prior to calibration.

Buffer solution
Solution with an exactly defined pH value for calibrating a pH meter.

cal
Key for activating and ending calibration.

Calibration
Adjustment of the pH meter to the current electrode characteristics. The asymmetry potential (zero point) and slope are adjusted. Either a one-or two-point calibration can be carried out. With one-point calibration only the asymmetry potential is adjusted.

Calibration buffer set
See Buffer set.

Calimatic®
Automatic buffer recognition. Before the first calibration, the buffer set used must be activated once. The patented Calimatic® then automatically recognizes the buffer solution used during calibration.

Combination electrode
Combination of glass and reference electrode in one body.

conf
Key for starting and ending configuration.

Electrode slope
Is indicated in % of the theoretical slope (59.2 mV/pH at 25 °C). The electrode slope is different for every electrode and changes with age and wear.

Electrode zero point
See Asymmetry potential.

GainCheck®
Device self-test which runs automatically in the background at fixed intervals. The memory and measured-value transmission are checked. You can also start the GainCheck® manually (see Pg. 20). Then a display test is also conducted and the software version displayed.

Mode code
Preset four-digit number to select certain modes.

One-point calibration Calibration with which only the electrode asymmetry potential (zero point) is taken into consideration. The previous slope value is retained. Only one buffer solution is required for a one-point calibration.

pH electrode system A pH electrode system consist of a glass and a reference electrode. If they are combined in one body, they are referred to as a combination electrode.

Response time Time from the start of a calibration step to the stabilization of the electrode potential.

Sensocheck® Sensocheck® continuously monitors the glass and reference electrodes.

Sensoface® provides information on the status of the electrode. The zero point, slope and response time are evaluated. The glass and reference electrodes are continuously monitored.

Slope See Electrode slope.

Two-point calibration Calibration with which the electrode asymmetry potential (zero point) and slope are determined. Two buffer solutions are required for two-point calibration.

Zero point See Asymmetry potential.

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Addresses and delivery information from the manufacturer:

ProMinent Dosiertechnik GmbH
Im Schuhmachergewann 5–11
D-69123 Heidelberg

Postfach 10 17 60
D-69007 Heidelberg – Germany

Phone: +49 (06221) 842-0
Fax: +49 (06221) 842-419
info@prominent.de
www.prominent.de