

Honeywell

APT4000 Series 4-Wire pH Analyzers User Manual

70-82-25-103
Revision 2 – 09/03



66495

Copyright and Notices

© Copyright 2003 by Honeywell
Revision 2 – 09/03

Honeywell

Warranty/Remedy

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Contact your local sales office for warranty information. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace without charge those items it finds defective. The foregoing is Buyers' sole remedy and is **in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose.** Specifications may change without notice.

The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for this use.

While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

About This Document

Abstract

This document provides information specific to the APT4000 pH Analyzer.

Contacts

World Wide Web

The following lists Honeywell's World Wide Web sites that will be of interest to our customers.

<u>Honeywell Organization</u>	<u>WWW Address (URL)</u>
Corporate	http://www.honeywell.com
Industrial Measurement and Control	http://www.honeywell.com/imc

Telephone

Contact us by telephone at the numbers listed below.

	<u>Organization</u>	<u>Phone Number</u>
United States and Canada	Honeywell	1-800-423-9883 Tech. Support
		1-888-423-9883 Q&A Faxback (TACFACS)
		1-800-525-7439 Service

Address

Honeywell Industrial Measurement and Control, 1100 Virginia Drive,
Fort Washington, PA 19034

Contents

Safety information	5
Intended use	6
Trademarks	6
Overview of APT4000PH	7
Assembly	8
Package contents	8
Mounting plan	9
Pipe mounting, panel mounting	10
Installation and connection	13
Information on installation	13
Terminal assignments	13
Typical wirings pH	14
Typical wirings ORP	18
Protective wiring of relay outputs	20
User interface and display	22
Operation: Keypad	24
Safety features	25
Sensocheck, Sensoface sensor monitoring	25
GainCheck device self test	25
Automatic device self-test	25
Hold mode	26
To activate the Hold mode from outside	27
Configuration	28
Menu structure of configuration	29
Overview of configuration steps	30
Output 1	32
Output 2	40
Temperature compensation	46
Calibration mode	48
Alarm settings	50
Limit function	52
Controller	56
Control of rinsing probe and calibration probes	58

Parameter set 1/2 .....	.60
Default settings of parameter sets .....	.61
Parameter set, individual settings .....	.62
Calibration .....	.64
pH calibration .....	.65
Zero adjustment .....	.66
Automatic calibration with Calimatic .....	.68
Manual calibration .....	.70
Data entry of premeasured electrodes .....	.72
Product calibration .....	.74
ORP calibration .....	.76
Adjusting temp probe .....	.78
Measurement .....	.78
Diagnostics functions .....	.79
Controller functions .....	.82
PID controller .....	.82
Pulse length / pulse frequency controller .....	.84
Connecting a rinsing system .....	.85
Operation with automatic cleaning system .....	.85
Error messages (error codes) .....	.86
Calibration error messages .....	.88
Operating states .....	.90
Sensoface .....	.92
Appendix .....	.94
Product line and accessories .....	.94
Specifications .....	.95
Buffer tables .....	.101
Glossary .....	.108
Index .....	.112

Safety information

Be sure to read and observe the following instructions!

The analyzer has been designed in accordance with the state of the art and complying with the applicable safety regulations. When operating the analyzer, certain conditions may nevertheless lead to danger for the operator or damage to the analyzer.

Caution!

Commissioning may only be carried out by trained experts. Whenever it is likely that protection has been impaired, the analyzer shall be made inoperative and secured against unintended operation.

The protection is likely to be impaired if, for example:

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

Before recommissioning the analyzer, a professional routine test in accordance with EN 61010-1 must be performed. This test should be carried out by the manufacturer.

Caution!

Before commissioning it must be proved that the analyzer may be connected with other equipment.

Intended use

The APT4000PH is used for pH/mV, ORP, and temperature measurement in industry, environment, food processing and sewage treatment.

The rugged molded enclosure can be fixed into a control panel or mounted on a wall or at a post. The protective hood provides additional protection against direct weather exposure and mechanical damage.

The analyzer can be easily replaced and it accepts commercially available electrodes with a nominal zero point at pH 7 and DURAFET II electrodes.

Trademarks

The following names are registered trademarks. For practical reasons they are shown without trademark symbol in this manual.

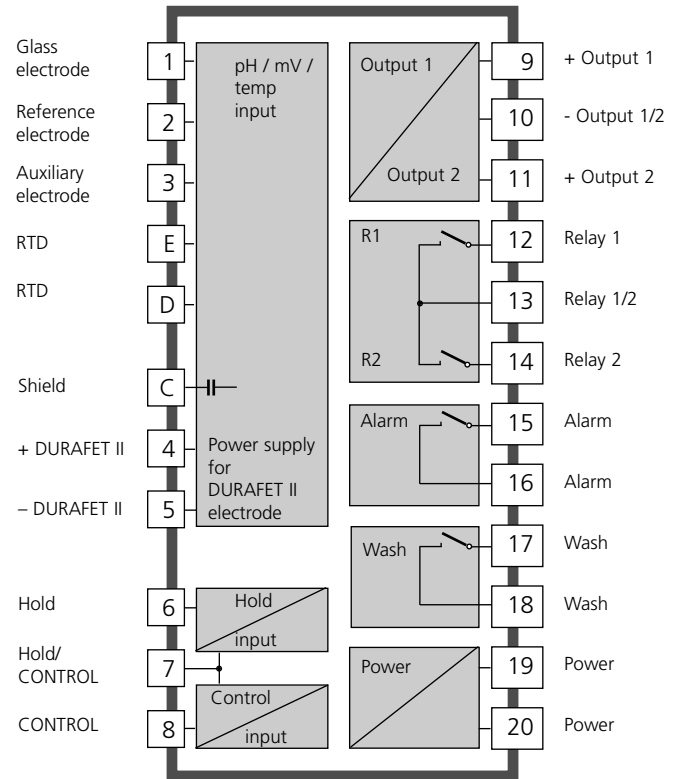
DURAFET®, MEREDIAN® are registered trademarks of Honeywell Inc., USA

EasyClean® is a registered trademark of Mettler Toledo GmbH, Switzerland.

Sensocheck®
Sensoface®
Calimatic®
GainCheck®

are registered trademarks of Knick GmbH & Co. KG, Germany.

Overview of APT4000PH



Package contents

Check the shipment for transport damage and completeness.

The package should contain:

- Front unit of APT4000PH
- Lower case
- Bag containing small parts
- Instruction manual
- Specific test report

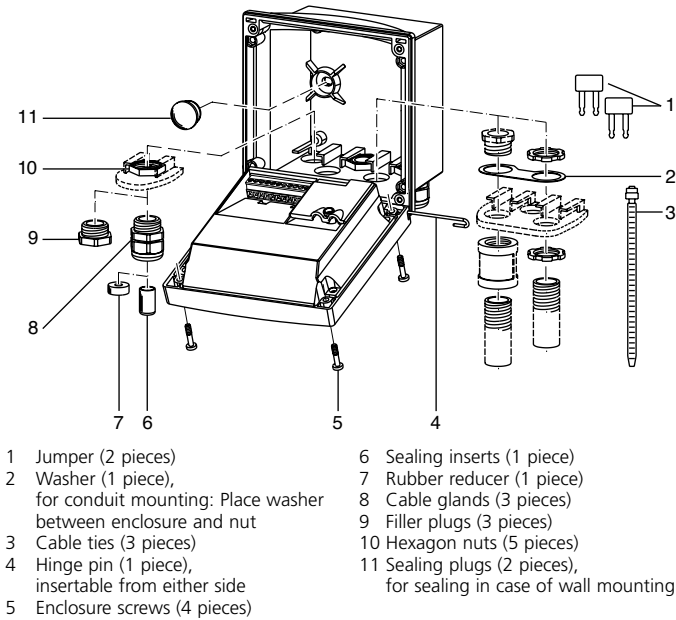


Fig. 1: Assembling the enclosure

Mounting plan

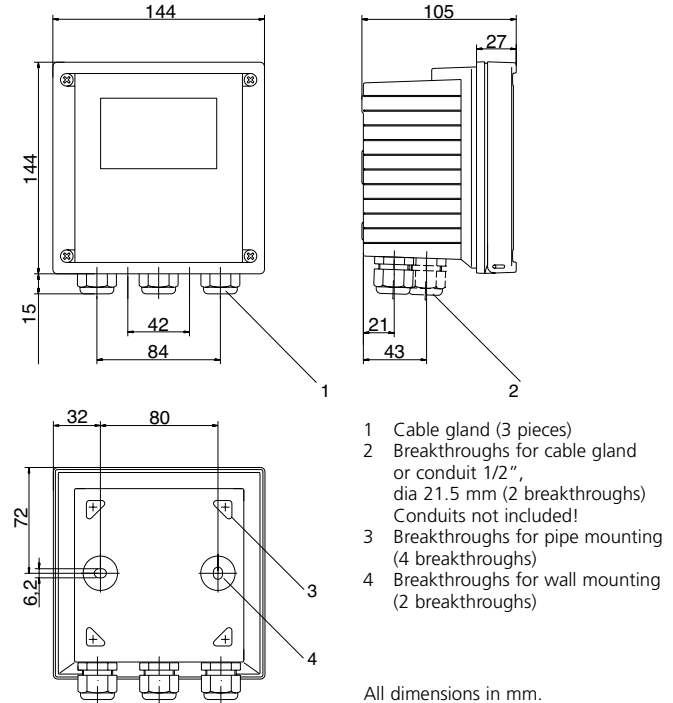
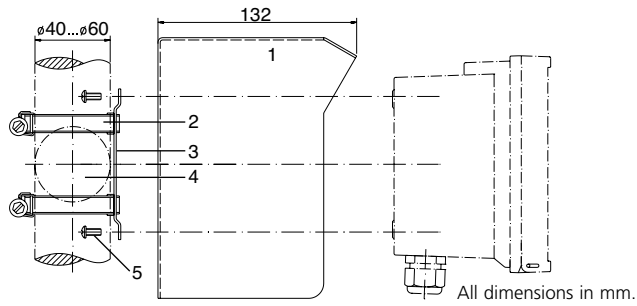


Fig. 2: Mounting plan



- 1 512005989-001 protective hood (if required)
- 2 Hose clamps with worm gear drive to DIN 3017 (2 pieces)
- 3 Pipe-mount plate (1 piece)
- 4 For vertical or horizontal posts or pipes
- 5 Self-tapping screws (4 pieces)

Fig. 3: 51205988-001 pipe-mount kit

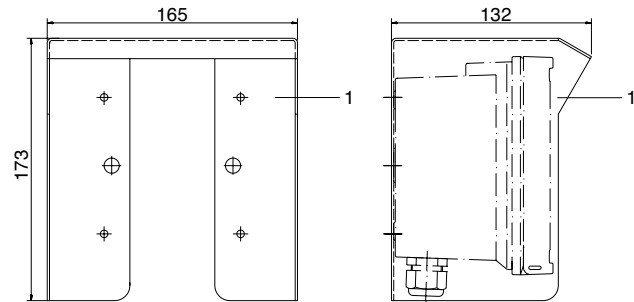
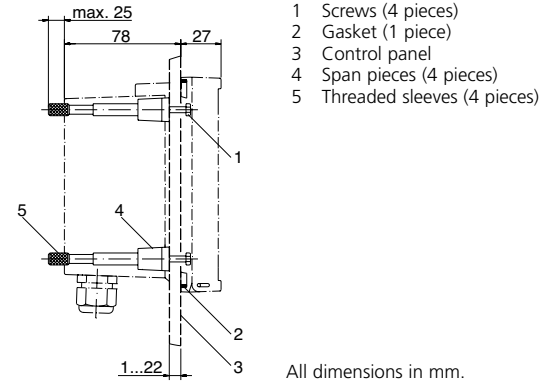


Fig. 4: 51205989-001 protective hood for wall and pipe mounting



- 1 Screws (4 pieces)
- 2 Gasket (1 piece)
- 3 Control panel
- 4 Span pieces (4 pieces)
- 5 Threaded sleeves (4 pieces)

Fig. 5: 51205990-001 panel-mount kit

Information on installation

Caution!

- The analyzer may only be installed by trained experts in accordance with this instruction manual and as per applicable local and national codes.
- Be sure to observe the technical specifications and input ratings.
- Be sure not to notch the conductor when stripping the insulation.
- Before connecting the analyzer to the power supply, make sure that its voltage lies within the range 20.5 to 253 V AC/DC.
- When commissioning, a complete configuration must be carried out by the system administrator.

The terminals are suitable for single wires and flexible leads up to 2.5 mm² (AWG 14).

Terminal assignments

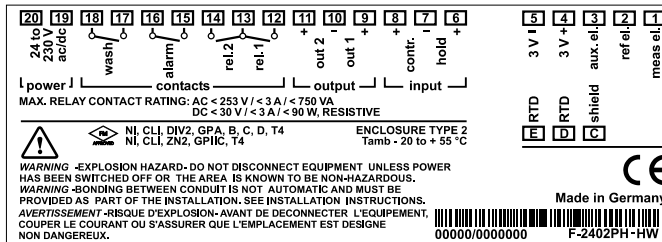
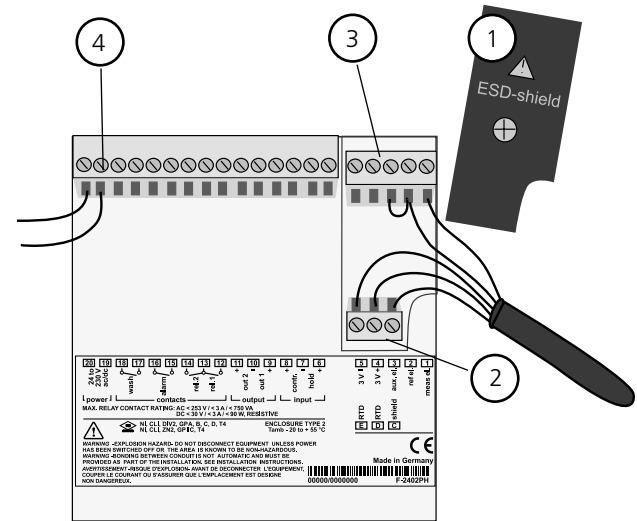


Fig. 6: Terminal assignments APT4000PH



- 1 ESD shield covering the signal inputs (Screw off for assembly)
Note: The cable shield must end under the ESD shield. (Cut lines if required)
- 2 Terminals for temperature probe and outer shield
- 3 Terminals for electrode
- 4 Connection of power supply

Fig. 7: Information on installation, rear side of analyzer

Division 2 wiring

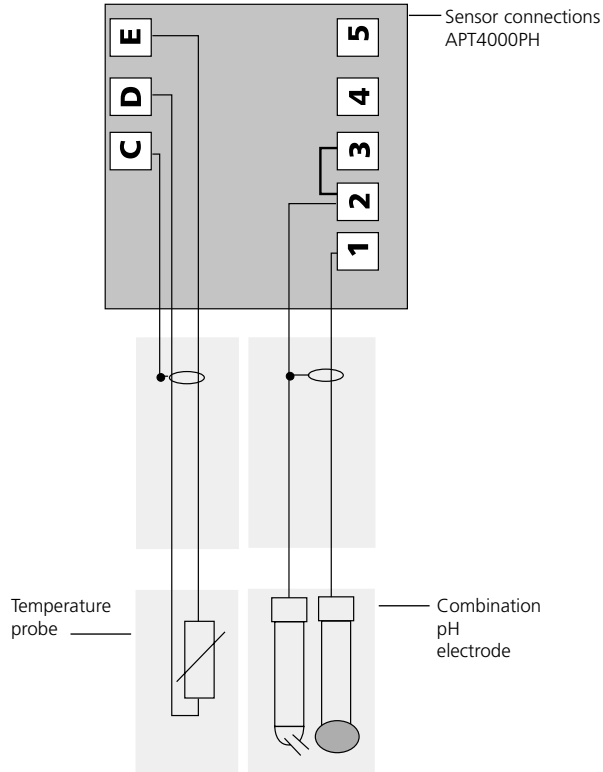


The connections to the analyzer are incandive and must be installed in accordance with the National Electric Code (ANSI-NFPA 70) Division 2 hazardous (classified) location incandive wiring techniques.

Typical wirings pH

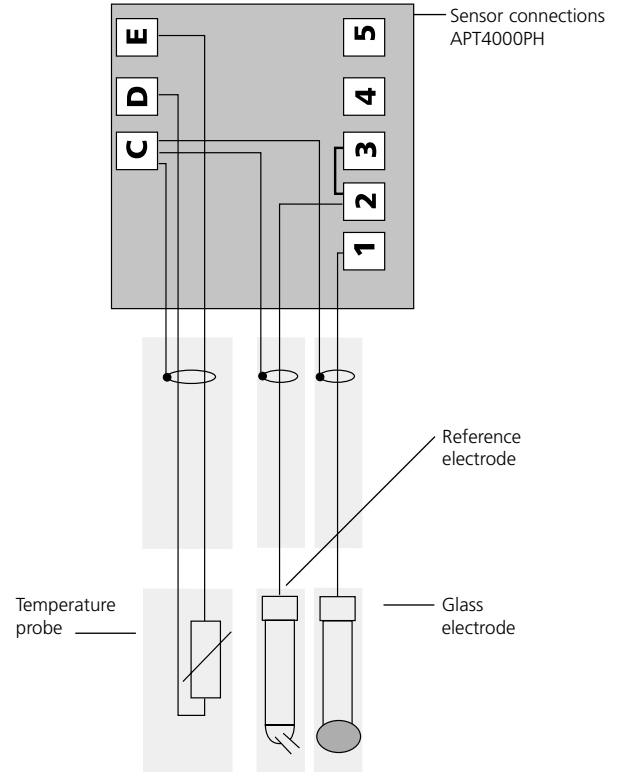
Example 1:

pH measurement with monitoring of glass electrode



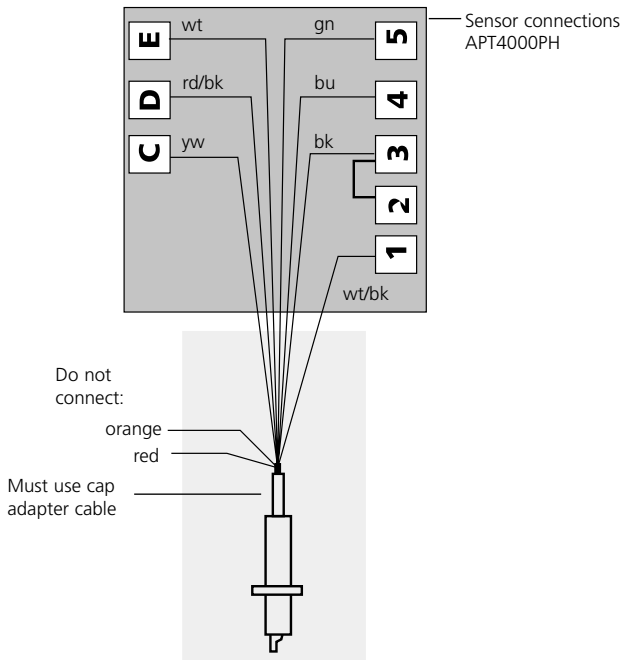
Example 2:

pH measurement with monitoring of glass electrode and reference electrode

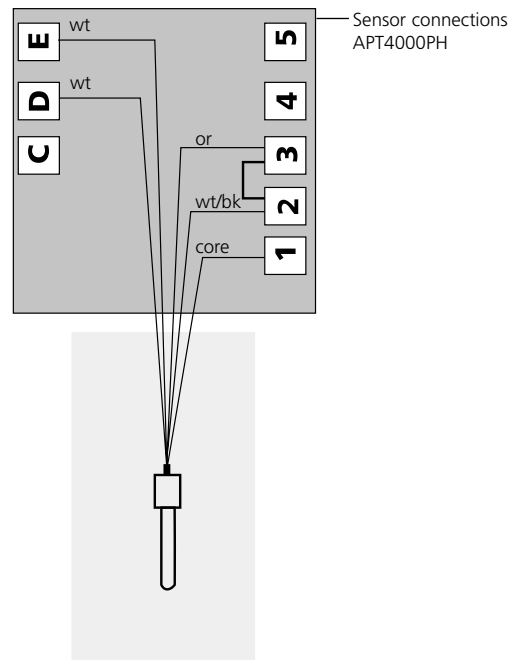


Typical wirings

Example 3:
pH measurement with DURAFET II electrode

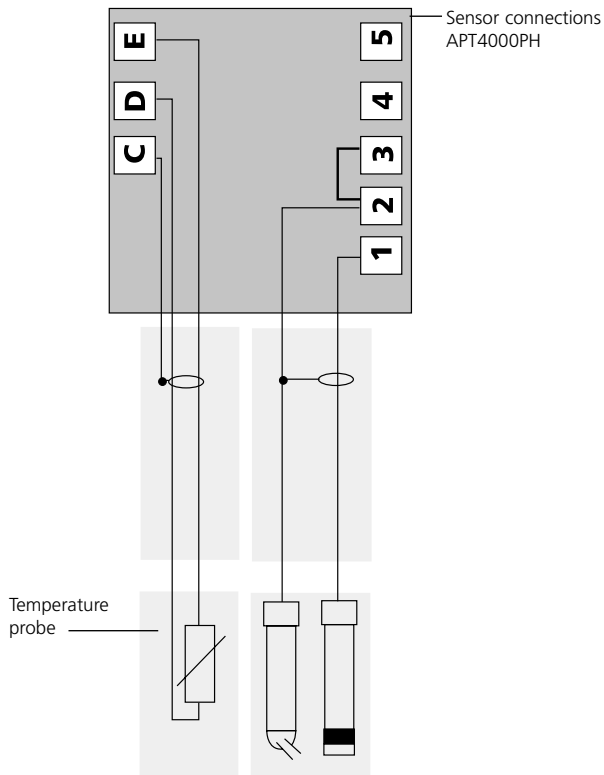


Example 4:
pH measurement with MEREDIAN electrode



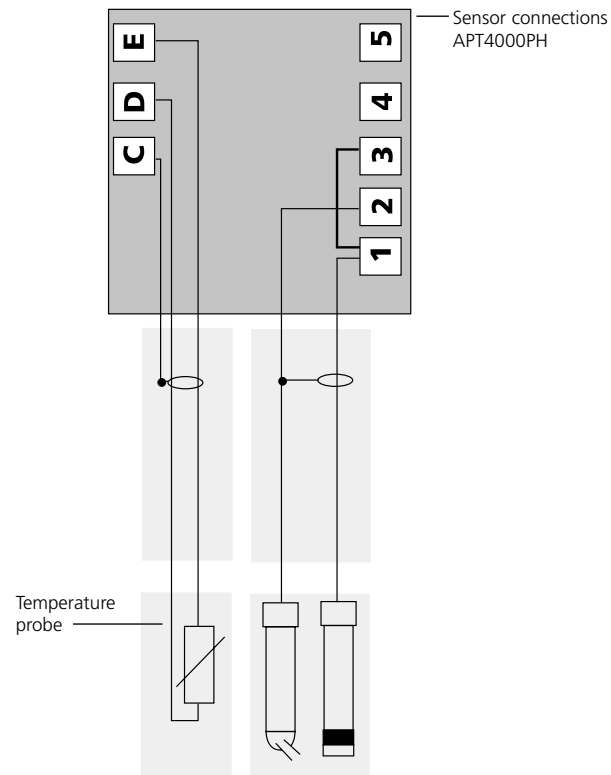
Example 5:

ORP measurement without monitoring of reference electrode



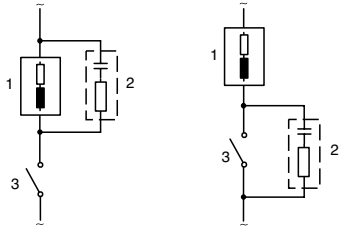
Example 6:

ORP measurement with monitoring of reference electrode



Protective wiring of relay contacts

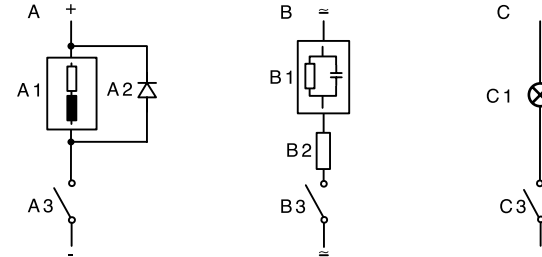
Relay contacts are subjected to electrical erosion. Especially with inductive and capacitive loads, the service life of the contacts will be reduced. For suppression of sparks and arcing, components such as RC combinations, nonlinear resistors, series resistors and diodes should be used.



Typical AC applications with inductive load

- 1 Load
- 2 RC combination, e.g. RIFA PMR 209
Typical RC combinations for 230 V AC:
Capacitor 0.1 μ F / 630V,
Resistor 100 Ohms / 1 W
- 3 Contact

Typical protective wiring measures



A: DC application with inductive load

B: AC/DC applications with capacitive load

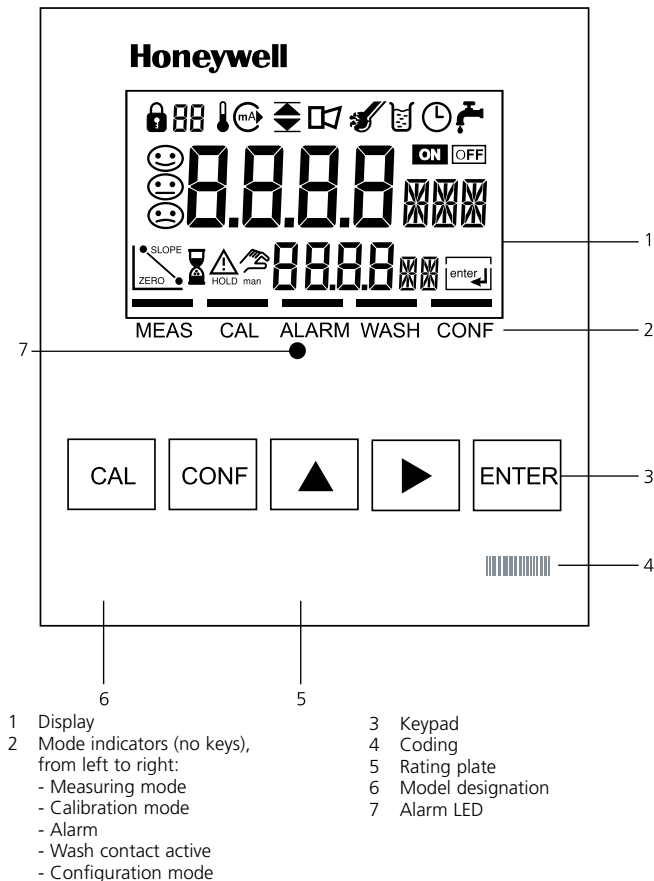
C: Connection of incandescent lamps

- A1 Inductive load
- A2 Free-wheeling diode, e.g. 1N4007 (Observe polarity)
- A3 Contact
- B1 Capacitive load
- B2 Resistor, e.g. 8 Ohms/1 W at 24 V / 0.3 A
- B3 Contact
- C1 Incandescent lamp, max 60 W / 230 V, 30 W / 115 V
- C3 Contact

Warning!

Make sure that the maximum ratings of the relay contacts are not exceeded even during switching!

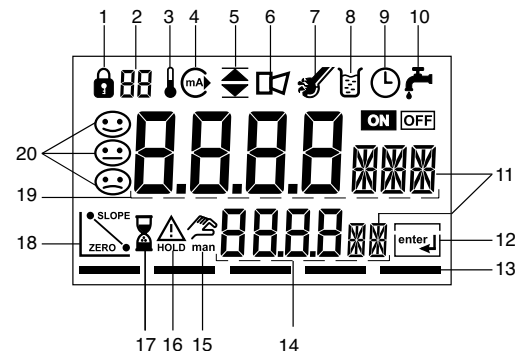
User interface








- 1 Display
- 2 Mode indicators (no keys), from left to right:
 - Measuring mode
 - Calibration mode
 - Alarm
 - Wash contact active
 - Configuration mode







- 3 Keypad
- 4 Coding
- 5 Rating plate
- 6 Model designation
- 7 Alarm LED

Display



- 1 Mode code entry
 - 2 Display of meas. variable *
 - 3 Temperature
 - 4 Current output
 - 5 Limit values
 - 6 Alarm
 - 7 Sensocheck
 - 8 Calibration
 - 9 Interval/response time
 - 10 Wash contact
 - 11 Measurement symbols
 - 12 Proceed with **ENTER**
 - 13 Bar for identifying the device status, above mode indicators, from left to right:
 - Measuring mode
 - Calibration mode
 - Alarm
 - Wash contact active
 - Configuration mode
 - 14 Lower display
 - 15 Manual temp indicator
 - 16 Hold mode active
 - 17 Waiting time running
 - 18 Electrode data
 - 19 Main display
 - 20 Sensoface
- * Not in use


	Start, end calibration
	Start, end configuration
	Select digit position (selected position flashes)
	Edit digit
	<ul style="list-style-type: none"> • Calibration: Continue in program sequence • Configuration: Confirm entries, next configuration step • Measuring mode: Display output current


 ➔ 	Cal Info, display of asymmetry potential and slope
 ➔ 	Error Info, display last error message
 + 	Start GainCheck device self-test


Safety functions

Sensocheck, Sensoface sensor monitoring

Sensocheck continuously monitors the sensor and leads. Sensocheck can be switched off (Configuration, Pg 51).

 Sensoface provides information on the electrode condition. The asymmetry potential (zero), slope and response time during calibration are evaluated. The three Sensoface indicators provide the user with information about wear and required maintenance of the sensor.







Note: When measuring with DURAFET electrodes, Sensocheck is not active.

GainCheck device self test

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

Start GainCheck device self-test:  + 

Automatic device self-test

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

Hold mode

Display:



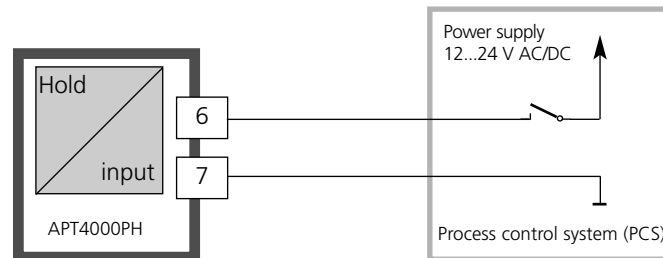
The Hold mode is a safety state during configuration and calibration. Output current is frozen (LAST) or set to a fixed value (Fix). Alarm and limit contacts are disabled.

If the calibration or configuration mode is exited, the APT4000PH remains in the Hold mode for safety reasons.

This prevents undesirable reactions of the connected peripherals due to incorrect configuration or calibration. The measured value and "Hold" are displayed alternately. The APT4000PH only returns to measuring mode after **ENTER** is pressed and a waiting time of 20 s has passed.

To activate the Hold mode from outside





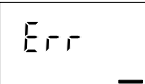


The Hold mode can be activated from outside by sending a signal to the Hold input (e.g. from the process control system).



Hold active	Hold inactive
10 ... 30 V AC/DC	0 ... 2 V AC/DC

Configuration

In the Configuration mode you set the analyzer parameters.

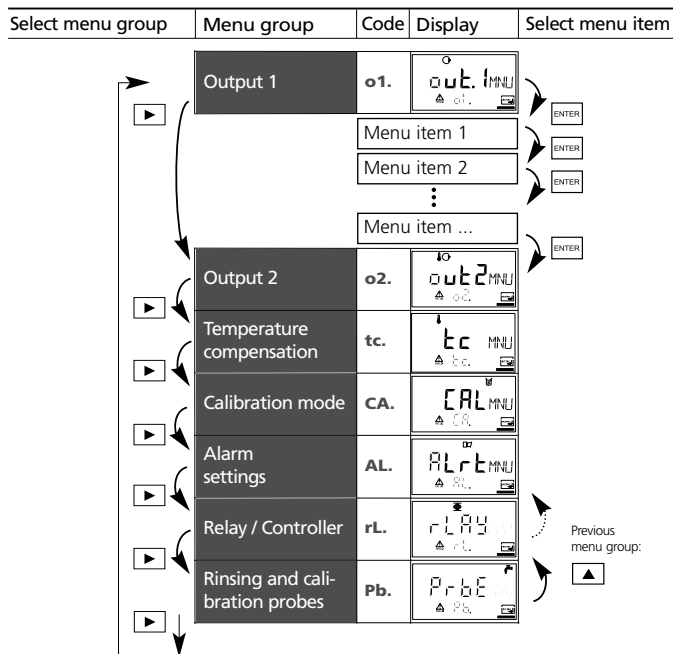
Activate		Activate with CONF
		Enter mode code "1200" Edit parameter with ▶ and ▲ , confirm/continue with ENTER . (End with CONF ENTER .)
Hold	 	During configuration the APT4000PH remains in the Hold mode for reasons of safety. The output current is frozen (at its last value or at a preset fixed value, depending on the configuration), limit and alarm contacts are inactive. The controller is in the configured state, Sensoface is off, mode indicator "Configuration" is on.
Input errors		The configuration parameters are checked during the input. In the case of an incorrect input "Err" is displayed for approx. 3 s. The incorrect parameters cannot be stored. Input must be repeated.
End	 	End with CONF . The measured value and Hold are displayed alternately, "enter" flashes. End Hold mode with ENTER . The display shows the measured value. The output current remains frozen for another 20 s (Hold icon on, "hourglass" flashes).

Menu structure of configuration

The configuration steps are assigned to different menu groups. With the arrow keys you can jump between the individual menu groups.

Each menu group contains menu items for setting the parameters. Pressing **ENTER** opens a menu item. The values are edited using the arrow keys. Pressing **ENTER** confirms/stores the settings.

Return to measurement: Press **CONF**.



Overview of configuration steps


Code	Menu	Selection / Default
out1	Output 1	
o1.	Select measured variable Select electrode type Select current range Enter current beginning Enter current end Time constant of output filter 22 mA signal in the case of error Signal behavior during Hold Enter fixed value	pH / ORP GLAS EL / Fet EL 0-20 mA / 4-20 mA XX.XX pH / XXXX mV (00.00 pH) XX.XX pH / XXXX mV (14.00 pH) 0 ... 120 SEC (0 SEC) ON / OFF LAST / Fix 000.0 ... 021.0 mA (021.0 mA)
out2	Output 2	
o2.	Select temperature unit Select temperature probe Select current range Enter current beginning Enter current end Time constant of output filter 22 mA signal in the case of temp error Signal behavior during Hold Enter fixed value	°C / °F Pt100/Pt1000/NTC30/ NTC8.55 0-20 mA / 4-20 mA XXX.X (000.0 °C) XXX.X (100.0 °C) 0 ... 120 (0 SEC) ON / OFF LAST / Fix 000.0 ... 021.0 mA (021.0 mA)
tc.	Temperature compensation	
tc.	Temp detection during meas Temp detection during cal Enter TC process medium	Auto /man (man: XXX.X°C (025.0°C)) Auto /man (man: XXX.X°C (025.0°C)) -19.99 ... +19.99%/K (00.00%/K)
CAL	Calibration mode	
CA.	Select calibration mode Enter cal timer interval	-04-BUF / MAN / DAT 0000 ... 9999 h (0000 h)

Code	Menu	Selection / Default
ALrt	Alarm settings	
AL.	Select Sensocheck Enter alarm delay LED in Hold mode	ON / OFF 0000 ... 0600 SEC (0010 SEC) ON / OFF
rLAY	Relay 1/2: Limit values, controller	
rL.	Select limit function / controller	LiMIT / CtROL
L1.	Select contact function Select contact response Enter switching point Enter hysteresis Enter delay	Lo / Hi N/O / N/C XX.XX pH / XXXX mV (00.00 pH) XX.XX pH / XXXX mV (00.50 pH) 0000 ... 9999 SEC (0010 SEC)
L2.	Select contact function Select contact response Enter switching point Enter hysteresis Enter delay	Lo / Hi N/O / N/C XX.XX pH / XXXX mV (14.00 pH) XX.XX pH / XXXX mV (00.50 pH) 0000 ... 9999 SEC (0010 SEC)
Ct.	Enter controller setpoint Enter neutral zone (P) Controller gain K _p (I) Reset time T _r (D) Rate time T _d Controller PLC: Pulse length PFC: Pulse frequency Select Hold behavior	XX.XX pH / XXXX mV (07.00 pH) XX.XX pH / XXXX mV (01.00 pH) 0010 ... 9999 % (100 %) 0000 ... 9999 SEC (0000 SEC) 0000 ... 9999 SEC (0000 SEC) PLC / PFC 0001 ... 0600 SEC (0010 SEC) 0001 ... 0180 /min (0060 /min) Y LAST / Y Off
PrbE	Rinsing and cleaning probes	
Pb.	Select cleaning / calibration probe	EASYCLN / rinse
rinse	Rinsing interval Rinse duration Contact response	000.0 ... 999.9 h (000.0 h) 0000 ... 1999 SEC (0060 SEC) N/O / N/C
EASYCLN	Cleaning interval Calibration interval	000.0 ... 999.9 h (000.0 h) 000.0 ... 999.9 h (000.0 h)
	Lock cleaning / calibration interval	ON / OFF



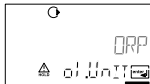
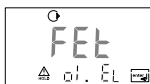

Configuration

Output 1

Select type of electrode. Measurement procedure.

Menu group	code	Display	Select menu item
Output 1	o1.		Select measured variable
			Select electrode type
			Select 0-20 / 4-20 mA
			Enter current beginning
			Enter current end
			Set output filter
			22 mA in the case of error
			Hold mode

End:
Press CONF, then ENTER


Code	Display	Action	Choices
o1.		Select configuration (Press CONF .)	
	 After correct input a welcome text (Conf) is displayed for approx. 3 s	Enter mode code "1200" (Select position with ► key and edit number with ▲ key. When the display reads "1200", press ENTER to confirm.)	
		The APT4000PH is in Hold mode (Hold icon is on).	
		Select measured variable pH/ORP Select with ► key Proceed with ENTER	pH/ORP
	 	Only with pH selected: Select electrode type: • ISFET electrode • Glass electrode Select with ► key Proceed with ENTER	FET (Glas)

Note: Characters represented in gray are flashing and can be edited.


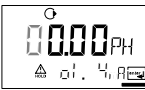

Configuration

Output 1

Output current range. Current beginning. Current end.

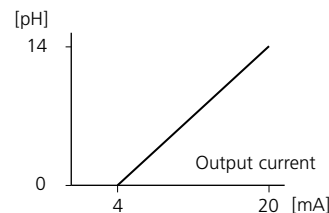
Menu group	Code	Display	Select menu item
Output 1	o1.		Select measured variable
			Select electrode type
			Select 0-20 / 4-20 mA
			Enter current beginning
			Enter current end
			Set output filter
			22 mA in the case of error
			Hold mode

End:
Press **CONF**, then **ENTER**

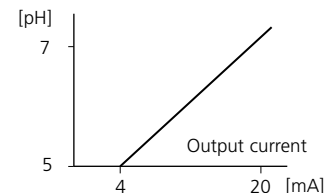
Code	Display	Action	Choices
o1.		Set output current range Select with ► key Proceed with ENTER	4-20 mA (0-20 mA)
		Current beginning Enter lower end of scale, depending on measured variable selected (pH or ORP) Select with ► key, edit number with ▲ key, proceed with ENTER	00.00 pH (pH: -2 ... 16) / (ORP: -1500 mV to +1500 mV)
		Current end Enter upper end of scale, depending on measured variable selected (pH or ORP) Select with ► key, edit number with ▲ key, proceed with ENTER	14.00 pH (pH: -2 ... 16) / (ORP: -1500 mV to +1500 mV)

Assignment of measured values: Current beginning and current end

Example 1: Range pH 0 to 14



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



Configuration

Output 1

Time constant of output filter

Menu group	Code	Display	Select menu item
Output 1	o1.		Select measured variable
			Select electrode type
			Select 0-20 / 4-20 mA
			Enter current beginning
			Enter current end
			Set output filter
			22 mA in the case of error
			Hold mode

End:
Press CONF, then ENTER

Code	Display	Action	Choices
o1.		Time constant of output filter Default setting: 0 s (inactive). To specify a time constant: Select with ► key, edit number with ▲ key, proceed with ENTER	0 SEC (0 to 120 SEC)

Time constant of output filter

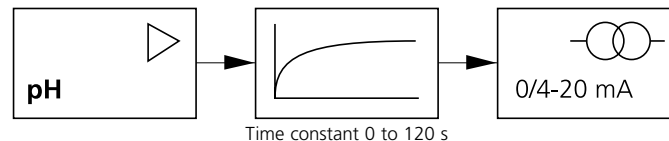
To smoothen the current output, a low-pass filter with adjustable filter time constant can be switched on. When there is a jump at the input (100 %), the output level is 63 % after the time constant has been reached.

The time constant can be set from 0 to 120 s.

If the time constant is set to 0 s, the current output follows the input.

Note:

The filter only acts on the current output, not on the display, the limit values, or the controller!



Configuration

Output 1

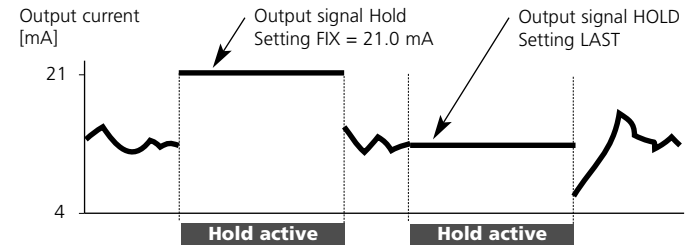
Output current during Error and Hold.

Menu group	Code	Display	Select menu item
Output 1	o1.		Select measured variable
			Select electrode type
			Select 0-20 / 4-20 mA
			Enter current beginning
			Enter current end
			Set output filter
			22 mA in the case of error
			Hold mode

End:
Press CONF, then ENTER

Code	Display	Action	Choices
o1.		22 mA signal for error message Select with ► key Proceed with ENTER	OFF (ON)
		Output signal during Hold LAST: During Hold the last measured value is maintained at the output FIX: During Hold a value (to be entered) is maintained at the output. Select with ► key Proceed with ENTER	LAST (FIX)
	 	Only with FIX selected: Enter current which is to flow at the output during Hold Select with ► key, edit number with ▲ key, proceed with ENTER	021.0 mA (000.0 to 021.0 mA)

Output signal for Hold:



Configuration

Output 2

Temperature unit and probe. Output current.

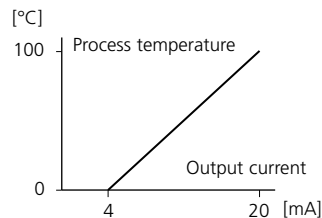
Menu group	Code	Display	Select menu item
Output 2	o2.		Select °C/°F
			Select temperature probe
			Select 0-20 / 4-20 mA
			Enter current beginning
			Enter current end
			Set output filter
			22 mA for temp error
			Hold mode

End:
Press **CONF**, then **ENTER**

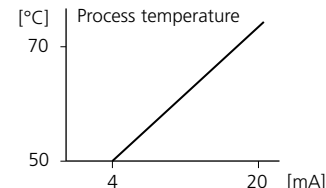
Code	Display	Action	Choices
o2.		Specify temperature unit Select with ► key Proceed with ENTER	°C (°F)
		Select temperature probe Select with ► key Proceed with ENTER	NTC8.55 (NTC30, PT100, PT1000)
		Set output current range Select with ► key Proceed with ENTER	4-20 mA (0-20 mA)
		Current beginning: Enter lower end of scale. Select with ► key, edit number with ▲ key, proceed with ENTER	000.0 °C (XXX.X)
		Current end: Enter upper end of scale. Select with ► key, edit number with ▲ key, proceed with ENTER	100.0 °C (XXX.X)

Process temperature: Current beginning and current end

Example 1: Range 0 to 100 °C




Example 2: Range 50 to 70 °C.
Advantage: Higher resolution in range of interest




Configuration

Output 2

Time constant of output filter.

Menu group	Code	Display	Select menu item
Output 2	o2.		Select °C/°F
			Select temperature probe
			Select 0-20 / 4-20 mA
			Enter current beginning
			Enter current end
			Set output filter
			22 mA for temp error
			Hold mode

End:
Press CONF, then ENTER

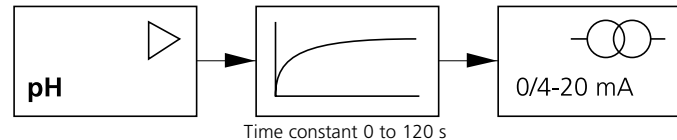
Code	Display	Action	Choices
o2.		Time constant of output filter Default setting: 0 s (inactive). To specify a time constant: Select with ► key, edit number with ▲ key, proceed with ENTER	0 SEC (0 to 120 SEC)

Time constant of output filter

To smoothen the current output 2, a low-pass filter with adjustable filter time constant can be switched on. When there is a jump at the input (100 %), the output level is 63 % after the time constant has been reached. The time constant can be set from 0 to 120 s. If the time constant is set to 0 s (default), the current output follows the input.

Note:

The filter only acts on the current output, not on the display!



Configuration

Output 2

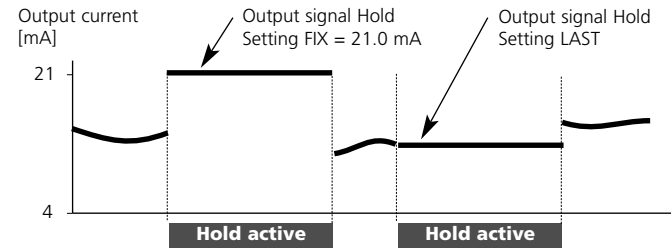
Temperature error. Output current during Hold.

Menu group	Code	Display	Select menu item
Output 2	o2.		Select °C/°F
			Select temperature probe
			Select 0-20 / 4-20 mA
			Enter current beginning
			Enter current end
			Set output filter
			22 mA for temp error
			Hold mode

End:
Press CONF, then ENTER

Code	Display	Action	Choices
o2.		22 mA signal for error message Select with ► key Proceed with ENTER	OFF (ON)
		Output signal during Hold LAST: During Hold the last measured value is maintained at the output FIX: During Hold a value (to be entered) is maintained at the output Select with ► key Proceed with ENTER	LAST (FIX)
		Only with FIX selected: Enter current which is to flow at the output during Hold Select with ► key, edit number with ▲ key, proceed with ENTER	021.0 mA (000.0 to 021.0 mA)

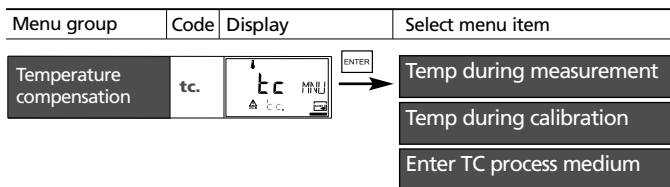
Output signal during Hold:



Configuration

Temperature compensation

Temp detection for meas/cal. TC process medium




End:
Press CONF, then ENTER





Code	Display	Action	Choices
tc.		Select temp detection during measurement (Auto/MAN) AUTO: Temp detection with temperature probe MAN: Manual temperature input Select with ► key, proceed with ENTER	AUT (MAN)
		Only with manual temp detection selected (MAN) Enter temperature. Select position with ► key, edit number with ▲ key, proceed with ENTER	25 °C (XXX.X)
		Select temp detection during calibration (Auto/MAN) Select with ► key, proceed with ENTER	AUT (MAN)
		Only with manual temp detection selected (MAN) Enter temperature. Select position with ► key, edit number with ▲ key, proceed with ENTER	25 °C (XXX.X)
		For pH measurement only: Enter temperature compensation of process medium Select position with ► key, edit number with ▲ key, proceed with ENTER	00.00 %/K (-19.99 to 19.99 %/K)

Configuration

Calibration mode

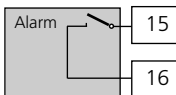
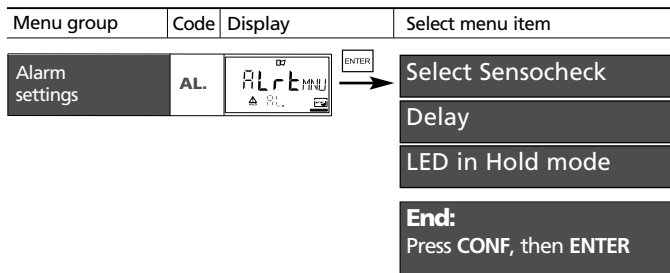
Menu group	Code	Display	Select menu item
Calibration mode	CA.		<p>Calibration mode</p> <p>Cal timer interval</p>

End:
Press CONF, then ENTER

Code	Display	Action	Choices
CA.		<p>For pH measurement only: Select calibration mode BUF: Calibration with Calimatic auto- matic buffer selection. To do so, you must select your buffer set: -01- BUF: Mettler-Toledo -02-BUF: Merck Titrisols, Riedel Fixanals -03-BUF: Ciba (94) -04-BUF: NIST technical buffers -05-BUF: NIST standard buffers -06-BUF: HACH buffers -07-BUF: WTW technical buffers</p> <p>MAN: Calibration with manual buffer entry</p>	-04-BUF (-01-BUF/ -02-BUF/ -03-BUF/ -04-BUF/ -05-BUF/ -06-BUF/ -07-BUF/ MAN/ DAT)
		DAT: Entry of asymmetry potential and slope of premeasured electrodes Select with ► key, proceed with ENTER	
			
		<p>Enter calibration interval: Entry of time interval within which the analyzer is to be calibrated. With a time interval of 0000 hrs the calibration timer is not active. Select position with ► key, edit number with ▲ key, proceed with ENTER</p>	0000 h (0000 to 9999 h)

Configuration

Alarm settings






Alarm contact

The alarm contact is closed during normal operation (N/C). It opens in the case of alarm or power outage. As a result, a failure message is provided even in the case of line breakage (fail-safe behavior). For contact ratings, see Specifications.

Error messages can also be signaled by a 22 mA output current (see Pg 39, 45, 86).

The operating behavior of the alarm contact is shown on Pg 90.



The **alarm delay** acts on the LED, the 22 mA signal and the alarm contact.

Code	Display	Action	Choices
AL.		Select Sensocheck (continuous monitoring of glass and reference electrode – not available with DURAFET II pH electrode) Select with ► key, proceed with ENTER	ON / OFF
		Alarm delay Select with ► key, edit number with ▲ key, proceed with ENTER	0010 SEC (0000 to 0600 SEC)
		LED in Hold mode Select with ► key, edit number with ▲ key, proceed with ENTER	ON / OFF
		LED state:	
	Parameter setting	Alarm	Hold
	ON	on	flashes
	OFF	flashes	off








Configuration

Limit function

Relay 1

Menu group	Code	Display	Select menu item
Relay / Controller	rL.		L1. Contact function
			Contact response
			Enter switching point
			Enter hysteresis
			Delay
			L2. Relay 2 menu group
			Ct. Controller menu group

End:
Press CONF, then ENTER

Code	Display	Action	Choices
rL.		Use of relays: <ul style="list-style-type: none"> Limit function (LiMIT) Controller (CtROL) Select with ► key, proceed with ENTER	LiMIT (CtROL)
		Note: Selecting CtROL leads to Controller menu group Ct.	
L1.		Limit 1 function , see Page 55. Select with ► key, proceed with ENTER	Lo (Hi)
		Limit 1 contact response N/C: normally closed contact N/O: normally open contact Select with ► key, proceed with ENTER	N/O (N/C)
		Limit 1 switching point Select with ► key, edit number with ▲ key, proceed with ENTER	00.00 pH (XX.XX pH XXXX mV)
		Limit 1 hysteresis Select with ► key, edit number with ▲ key, proceed with ENTER	00.50 pH (XX.XX pH XXXX mV)
		Limit 1 delay The contact is activated with delay (deactivated without delay) Select with ► key, edit number with ▲ key, proceed with ENTER	0010 SEC (0 to 9999 SEC)

Configuration

Limit function

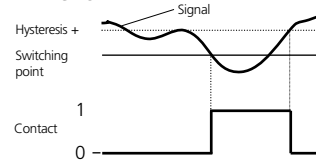
Relay 2

Menu group	Code	Display	Select menu item
Relay / Controller	rL		
	L1.		Relay 1 menu group
	L2.		Contact function
			Contact response
			Enter switching point
			Enter hysteresis
			Delay
	Ct.		Controller menu group

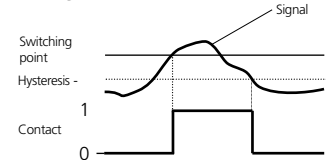
End:
Press **CONF**, then **ENTER**

Code	Display	Action	Choices
L2.		Select Limit 2, see Fig. below. Select with ► key, proceed with ENTER	Hi (Lo)
		Limit 2 contact response N/C: normally closed contact N/O: normally open contact Select with ► key, proceed with ENTER	N/O (N/C)
		Limit 2 switching point Select with ► key, edit number with ▲ key, proceed with ENTER	14.00 pH (XX.XX pH XXXX mV)
		Limit 2 hysteresis Select with ► key, edit number with ▲ key, proceed with ENTER	00.50 pH (XX.XX pH XXXX mV)
		Limit 2 delay The contact is activated with delay (deactivated without delay) Select with ► key, edit number with ▲ key, proceed with ENTER	0010 SEC (0 to 9999 SEC)

Limit Lo



Limit Hi



Configuration

Controller

(for description see Pg 82 and the following)
Setpoint. Neutral zone

Menu group	Code	Display	Select menu item
Relay / Controller	rL.		L1. Relay 1 menu group
			L2. Relay 2 menu group
			Ct. Controller setpoint
			Enter neutral zone
			(P) Controller gain
			(I) Reset time TR
			(D) Rate time TD
			Pulse length/Pulse frequency
			PLC: Pulse length
			PFC: Pulse frequency
			Hold behavior

End:
Press CONF, then ENTER

Code	Display	Action	Choices
Ct.		Setpoint Select with ► key, edit number with ▲ key, proceed with ENTER	07.00 pH (XX.XX pH / XXXX mV)
		Neutral zone (dead band) Select with ► key, edit number with ▲ key, proceed with ENTER	01.00 pH (XX.XX pH / XXXX mV)
		Controller: P-action component Select with ► key, edit number with ▲ key, proceed with ENTER	0100 % (0010 to 9999 %)
		Controller: I-action component (reset time). Select with ► key, edit number with ▲ key, proceed with ENTER	0000 SEC (0000 to 9999 SEC)
		Controller: D-action component (Rate time). Select with ► key, edit number with ▲ key, proceed with ENTER	0000 SEC (0000 to 9999 SEC)
		Pulse length/Pulse frequency Select with ► key, proceed with ENTER	PLC (PFC)
		PLC: Pulse length Select with ► key, edit number with ▲ key, proceed with ENTER	0010 sec (0001 to 0600 SEC)
		PFC: Pulse frequency Select with ► key, edit number with ▲ key, proceed with ENTER	0060/min (0001 to 0180 /min)
		Behavior during Hold Select with ► key, proceed with ENTER	Y LAST (Y Off)

Configuration

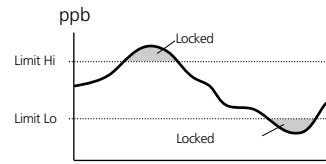
Control of rinsing and calibration probes

Menu group	Code	Display	Select menu item
Rinsing and calibration probes	Pb.		Rinsing/calibration probe
			Rinsing interval
			Rinse duration
			Contact response
			Cleaning interval
			Calibration interval

Code	Display	Action (rinsing probe)	Selection
Pb.		Control of: <ul style="list-style-type: none"> Rinsing probe (rinse) Calibration probe (EasyClean) Select with ► key Proceed with ENTER	rinse (EASYCLN) EASYCLN: see opposite page
		Rinsing interval Select with ► key, edit number with ▲ key, proceed with ENTER	000.0 h (XXX.X h)
		Rinse duration Select with ► key, edit number with ▲ key, proceed with ENTER	0060 s (0000 to 1999 SEC)
		Contact type Select with ► key Proceed with ENTER	NO (N/C)

Code	Display	Action (calibration probe)	Selection
Pb.		Calibration probe (EasyClean) Select with ► key Proceed with ENTER	EASYCLN
		Cleaning interval (EasyClean only) Select with ► key, edit number with ▲ key, proceed with ENTER	000.0 h (XXX.X h)
		Calibration interval (EasyClean only) Select with ► key, edit number with ▲ key, proceed with ENTER	000.0 h (XXX.X h)
		Lock cleaning (calibration) interval* On: The APT4000PH only starts a cleaning (calibration) interval if the measured value lies within the tolerated range (Limit Lo/Limit Hi).	Off (On)

**“Lock cleaning (calibration) interval” function:



The APT4000PH only starts a cleaning (calibration) interval if the measured value lies within the tolerated range (Limit Lo/Limit Hi). (For limit setting, refer to Pages 53, 55)

Display	Action	Remark
	Switch between parameter sets Press CONF key, ENTER code 7654 Select with ▶ key, edit number with ▲ key, proceed with ENTER	Wrong settings change the measurement properties! If an invalid code is entered, the APT4000PH returns to measuring mode.
		Welcome display (ConF) appears for approx. 3 sec
	Select parameter set 1 or 2. Select with ▶ key, proceed with ENTER	
 	Since the complete device config- uration is changed in one step, there is a security prompt (No/Yes). When pressing ENTER directly, the selection is not stored.	

Default settings of parameter sets

Two complete parameter sets are stored in the EEPROM.
As delivered, the two sets are identical but can be edited.

Note:

Fill in your configuration data on the following pages.








Code.	Parameter	Default setting	Code.	Parameter	Default setting
o1.	pH/ORP unit	pH	rL.	Relay function	Limit
o1.	Electrode type	FET	L1.	Contact function	Lo
o1.	0/4-20 mA	4-20 mA	L1.	Contact response	N/O
o1.	Current beginning	00.00 pH	L1.	Switching point	00.00 pH
o1.	Current end	14.00 pH	L1.	Hysteresis	00.50 pH
o1.	Filter time	0 sec	L1.	Delay	0010 sec
o1.	22mA signal	OFF	L2.	Contact function	Hi
o1.	Hold behavior	LAST	L2.	Contact response	N/O
o1.	Fix current	021.0 mA	L2.	Switching point	14.00 pH
o2.	Unit °C / °F	°C	L2.	Hysteresis	00.50 pH
o2.	Temp probe	8.55 NTC	L2.	Delay	0010 sec
o2.	0/4...20mA	4-20 mA	Ct.	Setpoint	07.00 pH
o2.	Current beginning	000.0 °C	Ct.	Neutral zone	01.00 pH
o2.	Current end	100.0 °C	Ct.	P action	0100 %
o2.	Filter time	0 sec	Ct.	I action	0000 sec
o2.	22mA signal	OFF	Ct.	D action	0000 sec
o2.	Hold behavior	LAST	Ct.	PLC/PFC controller	PLC
o2.	Fix current	021.0 mA	Ct.	Pulse length	0010 sec
tc.	TC measurement	Auto	Ct.	Pulse frequency	0060 /min
tc.	Measuring temp	025.0 °C	Ct.	Hold behavior	LAST
tc.	TC calibration	Auto	Pb.	EasyCLN/Rinse	Rinse
tc.	Calibration temp	025.0 °C	Pb.	Rinsing interval	000.0 h
tc.	TC medium	00.00 %/K	Pb.	Rinse duration	0060 sec
CA.	Cal solution	-04-BUF	Pb.	Contact type	N/O
CA.	Cal interval	0000 h	Pb.	Cleaning interval	000.0 h
AL.	Sensocheck	OFF	Pb.	Calibration interval	000.0 h
AL.	Alarm delay	0010 sec	Pb.	Lock interval	Off
AL.	LED Hold	off			

Code. Parameter	Setting	
o1. pH/ORP unit	_____	_____
o1. Electrode type	_____	_____
o1. 0/4-20 mA	_____	_____
o1. Current beginning	_____	_____
o1. Current end	_____	_____
o1. Filter time	_____	_____
o1. 22mA signal	_____	_____
o1. Hold behavior	_____	_____
o1. Fix current	_____	_____
o2. Unit °C / °F	_____	_____
o2. Temp probe	_____	_____
o2. 0/4...20mA	_____	_____
o2. Current beginning	_____	_____
o2. Current end	_____	_____
o2. Filter time	_____	_____
o2. 22mA signal	_____	_____
o2. Hold behavior	_____	_____
o2. Fix current	_____	_____
tc. TC measurement	_____	_____
tc. Measuring temp	_____	_____
tc. TC calibration	_____	_____
tc. TC medium	_____	_____
CA. Cal solution	_____	_____
CA. Cal interval	_____	_____
AL. Sensocheck	_____	_____
AL. Alarm delay	_____	_____
AL. LED Hold	_____	_____

Code. Parameter	Setting	
rL. Relay function	_____	_____
L1. Contact function	_____	_____
L1. Contact response	_____	_____
L1. Switching point	_____	_____
L1. Hysteresis	_____	_____
L1. Delay	_____	_____
L2. Contact function	_____	_____
L2. Contact response	_____	_____
L2. Switching point	_____	_____
L2. Hysteresis	_____	_____
L2. Delay	_____	_____
Ct. Setpoint	_____	_____
Ct. Neutral zone	_____	_____
Ct. P action	_____	_____
Ct. I action	_____	_____
Ct. D action	_____	_____
Ct. PLC/PFC controller	_____	_____
Ct. Pulse length	_____	_____
Ct. Pulse frequency	_____	_____
Ct. Hold behavior	_____	_____
Pb. EasyCLN/Rinse	_____	_____
Pb. Rinsing interval	_____	_____
Pb. Rinse duration	_____	_____
Pb. Contact type	_____	_____
Pb. Cleaning interval	_____	_____
Pb. Calibration interval	_____	_____
Pb. Lock interval	_____	_____

Calibration

Calibration adjusts the analyzer to the electrode.

Activate		Activate with CAL
		Enter mode code: 1100 Select with ► key, edit number with ▲ key, proceed with ENTER (End with CAL ENTER .)
Hold	  Hold icon	During calibration the APT4000PH remains in the Hold mode for reasons of safety. Output current is frozen (last value or preset fixed value, depending on configuration), limit and alarm contacts are inactive. The controller is in the configured state, Sensoface is off, mode indicator "Configuration" is on.
Input errors		The calibration parameters are checked during the input. In the case of an incorrect input "Err" is displayed for approx. 3 sec. The incorrect parameters cannot be stored. Input must be repeated.
End	 	End with CAL . The measured value and Hold are displayed alternately, "enter" flashes. Press ENTER to end the Hold mode. The measured value is displayed. The output current remains frozen for another 20 sec (Hold icon on, "hourglass" flashes).

pH calibration

Calibration is used to adapt the analyzer to the individual electrode characteristics, namely asymmetry potential and slope. Calibration can be performed with Calimatic automatic buffer recognition, with manual buffer input, by entering premeasured electrode data, or by sampling the product.

When using DURAFET electrodes, you must adjust the zero point first. Then you can conduct either a one or a two-point calibration.


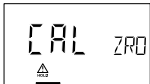


Caution



- All calibration procedures must be performed by trained personnel. Incorrectly set parameters may go unnoticed, but change the measuring properties.
- The response time of the electrode and temperature probe is considerably reduced if the electrode is first moved about in the buffer solution and then held still.
- The analyzer can only operate properly when the buffer solutions used correspond to the configured set. Other buffer solutions, even those with the same nominal values, may demonstrate a different temperature behavior. This leads to measurement errors.

When using DURAFET electrodes or electrodes with a zero point other than pH 7, the nominal zero point must be adjusted each time a new electrode is connected. This is important if you want to obtain reliable Sensoface messages. The Sensoface messages issued during all further calibrations are based on this basic calibration.

Zero adjustment

Allows use of electrodes with differing nominal zero (DURAFET II pH electrodes)

Display	Action	Remark
	Press CAL key, enter code 1001 Select with ▶ key, edit number with ▲ key, proceed with ENTER	APT4000PH is in the Hold mode. If an invalid code is entered, the APT4000PH returns to measuring mode.
	Ready for calibration The "CAL", and "enter" icons are flashing	Display (3 s)
	Immerse electrode in a pH 7.00 buffer. Enter the temperature-corrected pH value in the range 6.50 to 7.50 using the arrow keys (see buffer table). Confirm with ENTER .	If the zero offset of the electrode is too large ($> \pm 200$ mV), the CAL ERR error message is generated. In that case the electrode cannot be calibrated.
	Stability check: The measured mV value is displayed. The "hourglass" icon is flashing.	Note: Stability check can be stopped (by pressing CAL). However, this reduces calibration accuracy.

Display	Action	Remark
	At the end of the adjustment procedure asymmetry potential [mV] (based on 25 °C) of the electrode are displayed. Proceed with ENTER	These is not the final electrode value! Zero and slope must be determined with a complete 2-point calibration (cal 1100) (see following pages).
	Security prompt. Display of pH value (alternately with Hold) and temperature, "enter" flashes, Sensoface is active. Place electrode in process. Press ENTER to end the zero point calibration.	After end of calibration, the outputs remain in Hold mode for approx. 20 sec.



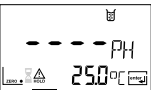

Information on zero adjustment






After having adjusted the nominal zero point, be sure to calibrate the electrode following one of the procedures as described on the next pages:

- Automatic calibration with Calimatic
- Manual calibration
- Data entry of premeasured electrodes

Automatic calibration with Calimatic (BUF -xx-) Temperature detection automatic or manual




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






Display	Action	Remark
	Press CAL key, enter code 1100. Select with ▶ key, edit number with ▲ key, proceed with ENTER	If an invalid code is entered, the APT4000PH returns to measuring mode.
	Remove the electrode and temperature probe, clean them and immerse them in the first buffer solution (in any order). When "Manual temp detection" has been configured, enter value in the secondary display using the arrow keys. Start with ENTER .	Analyzer in Hold mode, measured value frozen. Sensoface inactive.
	Buffer recognition While the "hourglass" icon flashes, the electrode and temperature probe remain in the first buffer solution.	The response time of the electrode and temperature probe is considerably reduced if the electrode is first moved about in the buffer solution and then held still.
	Buffer recognition terminated, the nominal buffer value is displayed.	

Display	Action	Remark
	Stability check: The measured mV value is displayed.	To abort stability check: Press CAL . (accuracy reduced)
	Calibration with the first buffer is terminated. Remove the electrode and temp probe from the first buffer solution and rinse them thoroughly.	
	<ul style="list-style-type: none"> One-point calibration: End with CAL. Slope [%] and asymmetry potential [mV] of the electrode are displayed. Proceed with ENTER. 	For one-point calibration only: 
	<ul style="list-style-type: none"> Two-point calibration: Immerse electrode and temp probe in the second buffer solution. Start with ENTER. 	The calibration process runs again as for the first buffer.
	Retract electrode and temp probe out of second buffer, rinse off, re-install. Repeat calibration: CAL , End calibration: ENTER .	Slope and asymmetry potential of electrode (related to 25 °C) are displayed.
	pH value and Hold are displayed alternately. Proceed with ENTER . Hold is deactivated after 20 s	Security prompt.

Manual calibration Temperature detection automatic or manual

For calibration with manual buffer specification, you must enter the pH value of the buffer solution used in the analyzer for the proper temperature. This presetting enables calibration with any desired buffer solution. The MAN calibration mode and the type of temperature detection are selected in the configuration mode.

Display	Action	Remark
	Press CAL key, enter code 1100 Select with ▶ key, edit number with ▲ key, proceed with ENTER	If an invalid code is entered, the APT4000PH returns to measuring mode.
	Remove the electrode and temperature probe, clean them and immerse them in the first buffer solution (in any order). When "Manual temp detection" has been configured, enter value in the secondary display using the arrow keys. Start with ENTER .	Analyzer in Hold mode, measured value frozen. Sensoface inactive.
	Enter the pH value of your buffer solution for the proper temperature. While the "hourglass" icon flashes, the electrode and temperature probe remain in the first buffer solution.	The response time of the electrode and temperature probe is considerably reduced if the electrode is first moved about in the buffer solution and then held still.

Display	Action	Remark
	Stability check: The measured mV value is displayed.	To abort stability check: Press CAL . (accuracy reduced)
	Calibration with the first buffer is terminated. Remove the electrode and temp probe from the first buffer solution and rinse them thoroughly.	
	<ul style="list-style-type: none"> One-point calibration: End with CAL. 	For one-point calibration only:
	Slope [%] and asymmetry potential [mV] of the electrode are displayed. Proceed with ENTER .	
	<ul style="list-style-type: none"> Two-point calibration: Immerse electrode and temperature probe in the second buffer solution. Enter the pH value of the second buffer solution. Start with ENTER. 	The calibration process runs again as for the first buffer.
	Retract electrode and temp probe out of second buffer, rinse off, re-install. Repeat calibration: CAL , End calibration: ENTER .	Slope and asymmetry potential of electrode (related to 25 °C) are displayed.
	pH value and Hold are displayed alternately. Proceed with ENTER . Hold is deactivated after 20 s	Security prompt.

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

Display	Action	Remark
	Press CAL key, enter code 1100 Select with ▶ key, edit number with ▲ key, proceed with ENTER	If an invalid code is entered, the APT4000PH returns to measuring mode.
	Ready for calibration Start with ENTER .	Analyzer in Hold mode, measured value frozen. Sensoface inactive.
	Enter asymmetry potential [mV]. Select with ▶ key, edit number with ▲ key, proceed with ENTER	
	Enter slope [%]. Select with ▶ key, edit number with ▲ key, proceed with ENTER	
	The APT4000PH displays the new slope and asymmetry potential (at 25 °C). Proceed with ENTER .	
	pH value and Hold are displayed alternately. Proceed with ENTER . Hold is deactivated after 20 sec.	Security prompt.

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

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

Converting asymmetry potential in electrode zero point:

$$\text{ZERO} = 7 - \frac{V_{AS} [\text{mV}]}{S [\text{mV} / \text{pH}]}$$

ZERO Electrode zero point
 V_{AS} Asymmetry potential
 S Slope

Product calibration



Calibration by sampling






During product calibration the electrode remains in the process. The measurement process is only interrupted briefly.

Procedure: During sampling the currently measured value is stored in the APT4000PH. The APT4000PH immediately returns to measuring mode. The calibration mode indicator flashes and reminds you that calibration has not been terminated.

The sample is measured in the lab or directly on the site using a portable meter. To ensure an exact calibration, the sample temperature should correspond to the measured process temperature. The sample value is then entered in the APT4000PH. From the difference between the stored measured value and entered sample value, the APT4000PH calculates the new asymmetry potential (one-point calibration).

If the sample is invalid, you can take over the value stored during sampling. In that case the old calibration values are stored. Afterwards, you can start a new product calibration.

Display	Action	Remark
	Product calibration step 1: Press CAL key, enter code 1105 (Select with ▶ key, edit number with ▲ key, proceed with ENTER)	If an invalid code is entered, the APT4000PH returns to measuring mode.
	Take sample and store value. Proceed with ENTER	Now the sample can be measured in the lab.

Display	Action	Remark
	Measuring mode: From the flashing CAL mode indicator you see that sample calibration has not been terminated.	While the sample value is determined, the APT4000PH is in measuring mode.
	Product calibration step 2: When the sample value has been determined, call up the product calibration once more (CAL , code 1105).	Display (approx. 3 sec)
	Enter lab value. The new asymmetry potential is calculated.	
	Display of slope and new asymmetry potential (related to 25°C). End calibration with ENTER .	New calibration: Press CAL .
	The measured value is shown in the main display alternately with "Hold"; "enter" flashes. End with ENTER .	After end of calibration, the outputs remain in Hold mode for approx. 20 sec.

ORP calibration mode is automatically preset when ORP measurement is configured. The potential of a redox electrode can be calibrated using a redox buffer solution. For this purpose, the difference between the potential measured and the potential specified for the calibration solution is determined. During measurement, the APT4000PH then adds this difference to the potential measured.

$mV_{ORP} = mV_{meas} + \Delta mV$	mV_{ORP} = displayed ORP
	mV_{meas} = direct electrode potential
	ΔmV = delta value, calculated during calibration

It is also possible to relate the electrode potential to another reference system – such as the standard hydrogen electrode. In that case, the temperature-corrected potential (see table) of the reference electrode used must be entered. During measurement, this value is then added to the ORP measured. Please make sure that measurement and calibration temperature are the same, since the temperature response of the reference electrode is not automatically taken into account.

Temperature dependence of commonly used reference systems

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

Display	Action	Remark
	Activate calibration (Press CAL). Enter mode code 1100 Select with ► key, edit number with ▲ key, proceed with ENTER .	If an invalid code is entered, the APT4000PH returns to measuring mode.
	Remove the electrode and temperature probe, clean them and immerse them in the redox buffer.	Display (approx. 3 sec) APT4000PH is in the Hold mode.
	Enter desired value for redox buffer (Secondary display: Electrode potential displayed for approx. 6 s) Select with ► key, edit number with ▲ key, proceed with ENTER	After approx. 6 s the secondary display shows the measured temperature.
	Display of electrode data (delta value) Proceed with ENTER . Rinse electrode and temperature probe and reinstall them.	“Zero” and “enter” icons are flashing, Sensiface is active.
	The measured ORP value [mV] is shown in the main display alternately with “Hold”, “enter” flashes. End with ENTER .	After end of calibration, the outputs remain in Hold mode for approx. 20 sec.

Temperature probe adjustment

Display	Action	Remark
	Activate calibration (Press CAL , enter 1015) Select with ▶ key, edit number with ▲ key, proceed with ENTER	Wrong settings change the measurement properties! If an invalid code is entered, the APT4000PH returns to measuring mode.
	Measure the temperature of the process medium using an external thermometer	APT4000PH is in Hold mode.
	Enter measured temperature value. Select with ▶ key, edit number with ▲ key, proceed with ENTER End adjustment with ENTER . Hold will be deactivated after 20 sec.	Default: Current value of secondary display.

Measurement

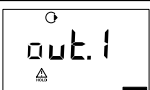

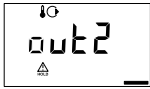



Display	Remark
	In the measuring mode the main display shows the configured process variable (pH or ORP [mV]), the secondary display shows the temperature. During calibration you can return to measuring mode by pressing the CAL , during configuration by pressing CONF . (Waiting time for measured value stabilization approx. 20 sec).



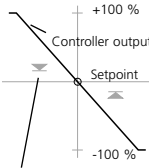
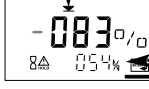
Diagnostics functions

Display	Remark
	Display of output currents Press ENTER while in measuring mode. The current at output 1 is shown in the main display, the current at output 2 in the secondary display. After 5 sec the APT4000PH returns to measuring mode.
	Display of calibration data (Cal Info) Press CAL while in measuring mode and enter code 0000. The slope is shown in the main display, the asymmetry potential in the secondary display. After 20 sec the APT4000PH returns to measuring mode (immediate return at pressing CAL).
	Display of electrode potential (Sensor monitor) Press CONF while in measuring mode and enter code 2222. The (uncompensated) electrode potential is shown in the main display, the measuring temperature in the secondary display. Press ENTER to return to measurement.
	Display of last error message (Error Info) Press CONF while in measuring mode and enter code 0000. The last error message is displayed for approx. 20 sec. After that the message will be deleted. (immediate return to measurement at pressing ENTER).

Diagnostics functions

These functions are used for testing the connected peripherals.

Display	Action / Remarks
 	<p>Specify current at output 1</p> <ul style="list-style-type: none"> Press CONF, enter code 5555 <p>The current indicated in the main display for output 1 can be edited.</p> <p>Select with ► key, edit number with ▲ key, proceed with ENTER</p> <p>The actually measured current is shown in the secondary display. The APT4000PH is in Hold mode. Press ENTER to return to measurement (Hold remains active for another 20 sec).</p>
 	<p>Specify current at output 2</p> <ul style="list-style-type: none"> Press CONF, enter code 5556 <p>The current indicated in the main display for output 2 can be edited.</p> <p>Select with ► key, edit number with ▲ key, proceed with ENTER</p> <p>The actually measured current is shown in the secondary display. The APT4000PH is in Hold mode. Press ENTER to return to measurement.</p>
  <p>▶ Select a relay</p> <p>▲ Test 0/1</p> <p>ENTER Return to measurement</p>	<p>Relay test (manual test of contacts)</p> <ul style="list-style-type: none"> Press CONF, enter code 5557 <p>The relays are frozen. This state is indicated in the display. The 4 digits in the display correspond to the 4 relays (as on terminal plate):</p> <p>1st digit: R1 2nd digit: R2 3rd digit: AL 4th digit: CLN</p> <p>Function test using arrow keys – see left column.</p> <p>When exiting the function (ENTER), the relays are set corresponding to the measured value.</p>

Display	Action / Remarks
 	<p>Controller test (manual specification of controller output)</p> <ul style="list-style-type: none"> Press CONF, enter code 5559 <p>After function activation “Ctrl” is displayed for approx. 3 sec.</p> <p>With controller turned off, “OFF” is displayed in addition, then return to measuring mode.</p> <p>The function is used to start up control loops or check the actuators.</p> <p>For bumpless changeover to automatic operation (exiting this function), configure an I-action component (reset time).</p>
<p>Controller characteristic</p>  <p>The arrows indicate which relay (valve) is active:</p> <ul style="list-style-type: none"> ▶ Relay 2 active (Meas. value > setpoint) ▼ Relay 1 active (Meas. value < setpoint) 	<p>Specify value:</p> <p>Select with ► key, edit number with ▲ key, proceed with ENTER</p> <p>APT4000PH is in Hold mode. Press ENTER to return to measurement (Hold remains active for another 20 sec).</p> <p>Controller output -100 to 0 %: Relay 2 active</p> <p>Controller output 0 to +100 %: Relay 1 active</p>
	<p>Momentary controller output (adjusted value has not been stored yet)</p>

Controller functions

PID controller

P controller

Application in integrating systems
(e.g. closed tank, batch processes).

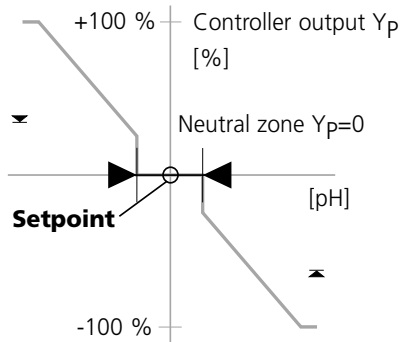
PI controller

Application in non-integrating systems
(e.g. drains).

PID controller

The additional derivative action compensates for measurement peaks.

Controller characteristic



Controller equations

$$\text{Controller output } Y = Y_p + \frac{1}{T_R} \int Y_p dt + T_D \frac{dY_p}{dt}$$

P-action I action D action

Proportional action Y_p

with:
 Y_p Proportional action
 T_R Reset time [s]
 T_D Rate time [s]
 K_C Controller gain [%]
 Constant 5 (for pH)
 500 mV (for ORP)

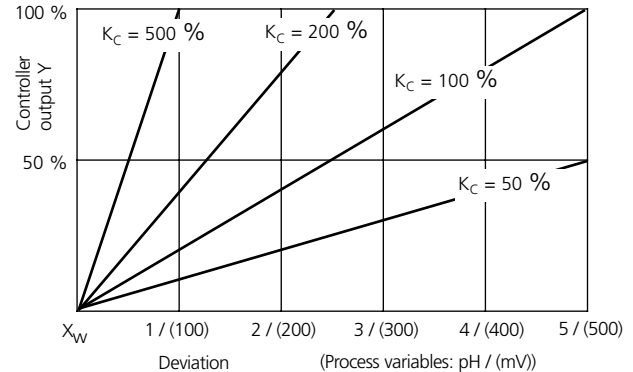
$$Y_p = \frac{\text{Setpoint} - \text{Meas. value}}{\text{Constant}} * K_C$$

Neutral zone ($Y=0$)

Tolerated deviation from setpoint.

The setting "1pH", for example, permits a deviation of ± 0.5 pH from the desired value without activating the controller.

Proportional action (Gradient K_C [%])



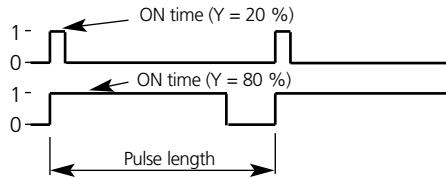
Controller functions

Pulse length / pulse frequency controller

Pulse length controller (PLC)

The pulse length controller is used to operate a valve as an actuator. It switches the contact on for a time that depends on the controller output. The period is constant. A minimum ON time of 0.5 sec is maintained even if the controller output takes corresponding values.

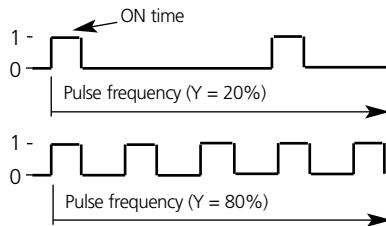
Output signal (switching contact) of pulse length controller



Pulse frequency controller (PFC)

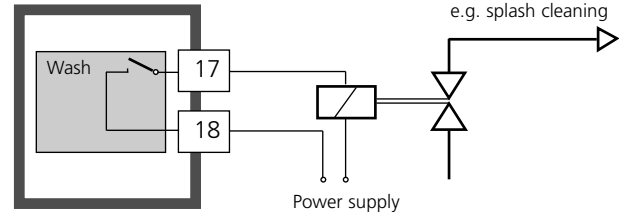
The pulse frequency controller is used to operate a frequency-controlled actuator. It varies the frequency with which the contacts are switched on. The maximum pulse frequency [pulses/min] can be defined. It depends on the actuator. The Contact ON time is constant. It is automatically calculated from the user-defined maximum pulse frequency:

Output signal (switching contact) of pulse frequency controller



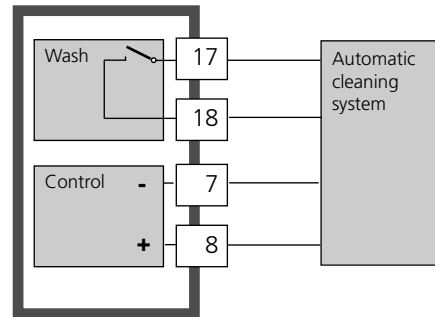
Connecting a rinsing system

The "Wash" contact can be used to connect a simple splash cleaning system. Rinse time and rinsing interval are defined during configuration (Pg 58).
















Operation with automatic cleaning system

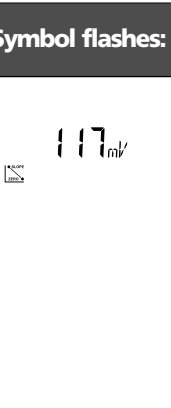


The APT4000PH allows connection of an automatic cleaning system. The cleaning cycle is activated according to the cleaning interval defined during configuration (Pg 59).

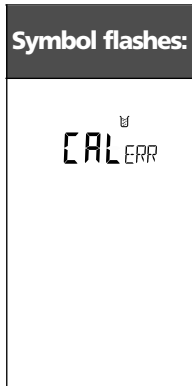
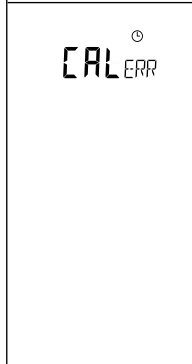


Error messages (Error Codes)

Error	Display	Problem Possible causes	Alarm contact	Red LED	Out 1 (22 mA)	Out 2 (22 mA)
ERR 01	Measured value flashes	pH electrode <ul style="list-style-type: none"> • Electrode defective • Too little electrolyte in electrode • Electrode not connected • Break in electrode cable • Incorrect electrode connected • Measured pH value < -2 or > 16 • Measured pH value < -1999 mV or > 1999 mV 	x	x	x	
ERR 02	Measured value flashes	Redox electrode <ul style="list-style-type: none"> • Electrode defective • Electrode not connected • Break in electrode cable • Incorrect electrode connected • Electrode potential < -1500 mV • Electrode potential > 1500 mV 	x	x	x	
ERR 98	“Conf” flashes	System error Configuration or calibration data defective; completely reconfigure and recalibrate the analyzer. Memory error in device program	x	x	x	x
ERR 99	“FAIL” flashes	Factory settings EEPROM or RAM defective This error message only occurs in the case of a complete defect. The analyzer must be repaired and recalibrated at the factory.	x	x	x	x

Error	Symbol (flash-ing)	Problem Possible causes	Alarm contact	Red LED	Out 1 (22 mA)	Out 2 (22 mA)
ERR 03		Temperature probe Open or short circuit Temperature range exceeded	x	x	x	x
ERR 11		Current output 1 Current below 0 (3.8) mA	x	x	x	
ERR 12		Current output 1 Current above 20.5 mA	x	x	x	
ERR 13		Current output 1 Current span too small / too large	x	x	x	
ERR 21		Current output 2 Current below 0 (3.8) mA	x	x		x
ERR 22		Current output 2 Current above 20.5 mA	x	x		x
ERR 23		Current output 2 Current span too small / too large	x	x		x
ERR 41		Rinsing probe: Communication	x	x	x	x
ERR 42		Calibration error				
ERR 33		Sensochek: Glass electrode	x	x	x	
ERR 34		Reference electrode				
		• Zero error, Sensoface active, see Pg 92				
		• Slope error, Sensoface active, see Pg 92				
		• Response time exceeded, Sensoface active, see Pg 92				
		• Cal interval expired, Sensoface active, see Pg 92				

Symbol flashes:	Problem Possible causes
 <p>117 mV</p>	<p>Asymmetry potential out of range (± 60 mV)</p> <ul style="list-style-type: none"> • Electrode worn out • Buffer solution contaminated • Buffer does not belong to configured buffer set • Temperature probe not immersed in buffer solution (for automatic temperature compensation) • Wrong buffer temperature selected (for manual temperature specification) • Nominal electrode zero point \neq pH 7
 <p>120 %</p>	<p>Electrode slope out of range (80-103 %)</p> <ul style="list-style-type: none"> • Electrode worn out • Buffer solution 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
 <p>CAL ERR</p>	<p>Problems during recognition of the buffer solution</p> <ul style="list-style-type: none"> • Same or similar buffer solution was used for both calibration steps • Buffer solution used does not belong to buffer set currently configured in the analyzer

Symbol flashes:	Problem Possible causes
 <p>CAL ERR</p>	<p>Problems during recognition of the buffer solution (continued)</p> <ul style="list-style-type: none"> • During manual calibration the buffer solutions were not used in the specified order • Buffer solutions contaminated • Wrong buffer temperature set (for manual temperature specification) • Electrode defective • Electrode not connected • Electrode cable defective
 <p>CAL ERR</p>	<p>Calibration was canceled after approx. 2 min, because the electrode drift was too large.</p> <ul style="list-style-type: none"> • Electrode defective • Electrode 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

Operating state	Out 1	Out 2	Rel. 1/2 Controller	Rel. 1/2 Limit value	Wash contact	Alarm contact	LED	Time out
Measurement	■	■	■	■	■	■	■	
Cal Info (CAL) 0000	■	■	■	■	■	■	■	20 s
Error Info (CONF) 0000	■	■	■	■	■	■	■	20 s
Calibration (CAL) 1100	■	■	■					
Temp adjustment (CAL) 1015	■	■	■					

Operating state	Out 1	Out 2	Rel. 1/2 Controller	Rel. 1/2 Limit value	Wash contact	Alarm contact	LED	Time out
Product cal 1 (CAL) 1105	■	■	■	■	■	■		
Product cal 2 (CAL) 1105	■	■	■					
Configuration (CONF) 1200	■	■	■					20 min
Parameter set 1/2 (CONF) 7654	■	■	■					20 min
Sensor monitor (CONF) 2222	■	■	■	■	■	■		20 min
Current source 1 (CONF) 5555	■	■	■					20 min
Current source 2 (CONF) 5556	■	■	■					20 min
Relay test (CONF) 5557	■	■	■	■	■	■		20 min
Manual controller (CONF) 5559	■	■	■					20 min
Rinsing function	■	■	■		■			
Hold input	■	■	■					

Explanation:

■ active

■ as configured (LAST/Fix or LAST/Off)

Sensoface

(Sensocheck must have been activated during configuration.)

The little smiley in the display (Sensoface) alerts for electrode problems (defective sensor, defective cable, maintenance required). The permitted calibration ranges and the conditions for a friendly, neutral, or sad Sensoface are summarized in the following chart. Additional icons refer to the error cause.

Sensocheck

Continuously monitors the electrodes and wires for short circuits or open circuits. Critical values make the Sensoface "sad" and the corresponding icon flashes:



The Sensocheck message is also output as error message Err 33. The alarm contact is active, the red LED is lighted, output current 1 is set to 22 mA (when configured correspondingly). Sensocheck can be switched off during configuration (then Sensoface is also disabled). Exception: After calibration a Smiley is always displayed for confirmation.

Note

The worsening of a Sensoface criterion leads to the devaluation of the Sensoface indicator (Smiley becomes "sad"). An improvement of the Sensoface indicator can only take place after calibration or removal of an electrode defect.

Display	Problem	Status
	Asymmetry potential and slope	<p> Asymmetry potential (zero) and slope of the electrode are still okay. However, the electrode should be replaced soon.</p> <p> Asymmetry potential (zero point) and/or slope of the electrode have reached values which no longer ensure proper calibration. Replace the electrode.</p>
	Calibration timer	<p> Over 80 % of the calibration interval has already past.</p> <p> The calibration interval has been exceeded.</p>
	Electrode defective	<p> Check the electrode and its connections (also see error messages Err 33 and Err 34, Page 87).</p>

Product line and accessories

Devices	Order No.
pH/ORP Analyzer	APT4000PH
Mounting accessories	
Pipe-mount kit	51205988-001
Panel-mount kit	51205990-001
Protective hood	51205989-001

Specifications

pH/mV input	Input for pH or ORP electrodes or DURAFET II	
Measurement range	-1500 to +1500 mV	
Display range	pH value	-2.00 to 16.00
	ORP	-1999 to +1999 mV
Glass electrode input ¹⁾		
Input resistance	> 0.5 x 10 ¹² Ohms	
Input current	< 2 x 10 ⁻¹² A	
Reference electrode input ³⁾		
Input resistance	> 1 x 10 ¹⁰ Ohms	
Input current	< 1 x 10 ⁻¹⁰ A	
Meas. error ^{1,2,3)}		
pH value	< 0.02	TC: 0.002 pH/K (display)
mV value	< 1 mV	TC: 0.1 mV/K

Electrode standardization pH²⁾pH calibration

Operating modes		
	BUF	
	Buffer sets	Calimatic calibration with automatic buffer recognition:
	-01-	Mettler-Toledo 2.00/4.01/7.00/9.21
	-02-	Merck/Riedel de Haen 2.00/4.00/7.00/9.00/12.00
	-03-	Ciba (94) 2.06/4.00/7.00/10.00
	-04-	NIST technical 1.68/4.00/7.00/10.01/12.46
	-05-	NIST standard 1.679/4.006/6.865/9.180
	-06-	HACH 4.00/7.00/10.18
	-07-	WTW technical buffers 2.00/4.01/7.00/10.00
	MAN	Calibration with manual entry of individual buffer values
	DAT	Data entry of premeasured electrodes

Specifications

Zero adjustment	±200 mV
Max. calibration range	Asymmetry potential: ±60 mV Slope: 80 to 103 % (47.5 to 61 mV/pH)
Sensor standardization ORP ¹⁾	ORP calibration
Max. calibration range	-700 to +700 ΔmV
Cal timer	0000 to 9999 h
Sensocheck	Automatic monitoring of glass and reference electrode (can be disabled)
Sensoface	provides information on the electrode condition. Evaluation of zero/slope, response, calibration interval, Sensocheck
Temperature input ¹⁾	Pt100 / Pt1000 / NTC 30 kOhms / NTC 8.55 kOhms 2-wire connection, adjustable
Measurement range	Pt 100/Pt 1000: -20.0 to +200.0 °C (-4 to +392 °F) NTC 30 kOhms -20.0 to +150.0 °C (-4 to +302 °F) NTC 8.55 kOhms -10.0 to +130.0 °C (+14 to +266 °F)
Adjustment range	10 K
Resolution	0.1 °C / 1 °F
Meas. error ^{1,2,3}	< 0.5 K (< 1 K for Pt100; <1K for NTC >100°C)
Temp compensation of process medium	Linear -19.99 to +19.99 %/K (reference temp 25 °C)
Hold input	Galv. separated (OPTO coupler)
Function	Switches analyzer to Hold mode
Switching voltage	0 to 2 V (AC/DC) inactive 10 to 30 V (AC/DC) active

CONTROL input Function

Switching voltage

Output 1

Measured variable ¹⁾

Overrange¹⁾

Output filter¹⁾

Meas. error ¹⁾

Start/end of scale

Adm. span

Output 2

Process variable

Overrange¹⁾

Output filter¹⁾

Meas. error ¹⁾

Start/end of scale ¹⁾

Adm. span

Power output

Alarm contact

Contact ratings

Contact response

Alarm delay

Galv. separated (OPTO coupler)
Control input for automatic cleaning/ calibration system

0 to 2 V (AC/DC) inactive

10 to 30 V (AC/DC) active

0/4 to 20 mA, max. 10 V, floating

(galv. connected to output 2)

pH or mV value

22 mA in the case of error messages

Low-pass, filter time constant 0 to 120 s

< 0.3 % current value + 0.05 mA

As desired within range

for pH or mV

pH 2.00 to 18.00 / 200 to 3000 mV

0/4 to 20 mA, max. 10 V, floating

(galv. connected to output 1)

Temperature

22 mA in the case of temp error messages

Low-pass, filter time constant 0 to 120 s

< 0.3 % current value + 0.05 mA

20 to 200 °C / -4 to 392 °F

20 to 220 K (36 to 396 °F)

for operating an ISFET adapter

+3 V ($V_0 = 2.9$ to 3.1 V / $R_i = 360$ Ω

-3 V ($V_0 = -4.8$ to -3.7 V / $R_i = 360$ Ω

Relay contact, floating

AC < 250 V / < 3 A / < 750 VA

DC < 30 V / < 3 A / < 90 W

N/C (fail-safe type)

0000 to 0600 s

Limit values

	Output via relay contacts R1, R2
Contact ratings	Contacts R1, R2 floating, but inter-connected AC < 250 V / < 3 A / < 750 VA DC < 30 V / < 3 A / < 90 W
Contact response *)	N/C or N/O
Delay *)	0000 to 9999 s
Switching points *)	As desired within range
Hysteresis *)	00.00 to 05.00 pH units / 0000 to 0500 mV

PID process controller

	Output via relay contacts R1, R2 (see limit values) (Relay R1 base valve, relay R2 acid valve)
Setpoint specification *)	pH -02.00 to 16.00 / -1500 to +1500 mV
Neutral zone *)	pH 00.00 to 05.00 / 0000 to 0500 mV
P-action *)	Controller gain K_C : 0010 to 9999 %
I-action component *)	Reset time T_I : 0000 to 9999 s (0000 s = no integral action)
D-action component *)	Rate time T_D : 0000 to 9999 s (0000 s = no derivative action)
Controller type *)	Pulse length controller or pulse frequency controller
Pulse period *)	0001 to 0600 s, min. ON time 0.5 s (pulse length controller)
Max. pulse frequency *)	0001 to 0180 min ⁻¹ (Pulse frequency controller)

Cleaning function*)

	Relay contact, floating for controlling a simple rinsing system or an automatic cleaning system
Contact ratings	AC < 250 V / < 3 A / < 750 VA DC < 30 V / < 3 A / < 90 W
Contact response *)	N/C or N/O
Rinsing interval *)	000.0 to 999.9 h (000.0 h = cleaning function switched off)
Cleaning time *)	0000 to 1999 s
Calibration interval *)	000.0 to 999.9 h
Cleaning interval *)	000.0 to 999.9 h

Display

Main display	LC display, 7-segment with icons
Secondary display	Character height 17 mm, unit symbols 10 mm
Sensoface	Character height 10 mm, unit symbols 7 mm
Mode indicators	3 status indicators (friendly, neutral, sad Smiley) 5 status bars: "MEAS", "CAL", "ALARM", "WASH", "CONF" 18 further icons for configuration and messages
Alarm indication	Red LED in case of alarm or Hold, user defined

Keypad

5 keys: [CAL] [CONF] [▶] [▲] [ENTER]

Service functions

Current source	Current specifiable for output 1 and 2 (00.00 to 22.00mA)
Manual controller	Controller output entered directly (start of control process)
Device self-test	Automatic memory test (RAM, FLASH, EEPROM)
Display test	Display of all segments
Last Error	Display of last error occurred
Sensor monitor	Display of direct, uncorrected sensor signal (electrode)
Relay test	Manual control of the four switching contacts

Parameter sets*)

Two selectable parameter sets
for different applications

Data retention

Parameters and calibration data > 10 years
(EEPROM)

Specifications

Protection against electrical shock Protective separation of all extra-low-voltage circuits against mains by double insulation as per EN 61010-1

Power supply 24 (-15%) to 230 V AC/DC (+10%); approx. 5 VA, 2.5 W
AC: 45 to 65 Hz; Overvoltage category II, Class II

Nominal operating conditions

Ambient temperature -20 to +55 °C
Transport/Storage temp -20 to +70 °C
Relative humidity 10 to 95 % not condensing
Power supply 24 (-15%) to 230 V AC/DC (+10%)
Frequency for AC 45 to 65 Hz

EMC EN 61326
Emitted interference Class B (residential environment)
Class A for mains supply > 60 V DC

Immunity to interference Industrial environment

Explosion protection

FM: NI Class I Div 2 Group A, B, C & D, T4 Ta = 55 °C; Type 2
NI Class I Zone 2 Group IIC, T4 Ta = 55°C; Type 2

Enclosure molded enclosure made of PBT (polybutylene terephthalate)

Color Bluish gray RAL 7031

Assembly

- Wall mounting
- Pipe mounting: dia 40 to 60 mm, □ 30 to 45 mm
- Panel mounting, cutout to DIN 43 700

Sealed against panel

Dimensions H 144 mm, B 144 mm, T 105 mm

Ingress protection IP 65 / NEMA 4X

Cable glands 3 breakthroughs for cable glands M20x1.5

2 breakthroughs for NPT 1/2 " or Rigid Metallic Conduit

Weight Approx. 1 kg

*) User-defined

1) To IEC 746 Part 1, at nominal operating conditions

2) ± 1 count

3) Plus sensor error

Buffer tables

-01- 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- Merck Titrisols, Riedel Fixanals

°C	pH				
0	2.01	4.05	7.13	9.24	12.58
5	2.01	4.04	7.07	9.16	12.41
10	2.01	4.02	7.05	9.11	12.26
15	2.00	4.01	7.02	9.05	12.10
20	2.00	4.00	7.00	9.00	12.00
25	2.00	4.01	6.98	8.95	11.88
30	2.00	4.01	6.98	8.91	11.72
35	2.00	4.01	6.96	8.88	11.67
40	2.00	4.01	6.95	8.85	11.54
45	2.00	4.01	6.95	8.82	11.44
50	2.00	4.00	6.95	8.79	11.33
55	2.00	4.00	6.95	8.76	11.19
60	2.00	4.00	6.96	8.73	11.04
65	2.00	4.00	6.96	8.72	10.97
70	2.01	4.00	6.96	8.70	10.90
75	2.01	4.00	6.96	8.68	10.80
80	2.01	4.00	6.97	8.66	10.70
85	2.01	4.00	6.98	8.65	10.59
90	2.01	4.00	7.00	8.64	10.48
95	2.01	4.00	7.02	8.64	10.37

-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- Technical buffers to NIST

°C	pH				
0	1.67	4.00	7.11 ₅	10.32	13.42
5	1.67	4.00	7.08 ₅	10.25	13.21
10	1.67	4.00	7.06	10.18	13.01
15	1.67	4.00	7.04	10.12	12.80
20	1.67 ₅	4.00	7.01 ₅	10.06	12.64
25	1.68	4.00₅	7.00	10.01	12.46
30	1.68	4.01 ₅	6.98 ₅	9.97	12.30
35	1.69	4.02 ₅	6.98	9.93	12.13
40	1.69	4.03	6.97 ₅	9.89	11.99
45	1.70	4.04 ₅	6.97 ₅	9.86	11.84
50	1.70 ₅	4.06	6.97	9.83	11.71
55	1.71 ₅	4.07 ₅	6.97	9.83 *	11.57
60	1.72	4.08 ₅	6.97	9.83 *	11.45
65	1.73	4.10	6.98	9.83 *	11.45 *
70	1.74	4.13	6.99	9.83 *	11.45 *
75	1.75	4.14	7.01	9.83 *	11.45 *
80	1.76 ₅	4.16	7.03	9.83 *	11.45 *
85	1.78	4.18	7.05	9.83 *	11.45 *
90	1.79	4.21	7.08	9.83 *	11.45 *
95	1.80 ₅	4.23	7.11	9.83 *	11.45 *

* Extrapolated

-05- NIST standard buffers

°C	pH			
0	1.666	4.010	6.984	9.464
5	1.668	4.004	6.951	9.395
10	1.670	4.000	6.923	9.332
15	1.672	3.999	6.900	9.276
20	1.675	4.001	6.881	9.225
25	1.679	4.006	6.865	9.180
30	1.683	4.012	6.853	9.139
35	1.688	4.021	6.844	9.102
40	1.694	4.031	6.838	9.068
45	1.700	4.043	6.834	9.038
50	1.707	4.057	6.833	9.011
55	1.715	4.071	6.834	8.985
60	1.723	4.087	6.836	8.962
65	1.733	4.109	6.841	8.942
70	1.743	4.126	6.845	8.921
75	1.755	4.145	6.852	8.903
80	1.766	4.164	6.859	8.885
85	1.779	4.185	6.868	8.868
90	1.792	4.205	6.877	8.850
95	1.806	4.227	6.886	8.833

-06- HACH buffers
Nominal value: 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 buffers

°C	pH			
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	

Asymmetry potential

The voltage which a pH electrode provides at a pH of 7. The asymmetry potential is different for each 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 the first calibration.

Buffer solution

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

Calibration

Adjustment of the pH meter to the current electrode characteristics. The asymmetry potential and slope are adjusted. You can conduct either a one or a two-point calibration. With one-point calibration only the asymmetry potential (zero point) is adjusted.

Calimatic

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

Combination electrode

Combination of glass and reference electrode in one body.

DURAFET

DURAFET combination pH/ORP electrodes consist of an ISFET measuring electrode, a reference electrode, and a temperature probe.

DURAFET cap adapter

Adapter integrated in the protective cap of the DURAFET electrode. Here, the signal of the pH-sensitive FET is converted to voltage corresponding to the signal of a glass electrode. This voltage is led to the pH input of the analyzer and is processed further as usual. The adapter is directly supplied from the analyzer.

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. Then a display test is also conducted and the software version displayed.

MEREDIAN	MEREDIAN combination pH/ORP electrodes consist of a glass or metallic measuring electrode, a reference electrode, and a temperature probe. They include a permanent reference junction and gel fill for maintenance-free operation.
Mode code	Preset four-digit number to select certain modes.
One-point calibration	Calibration with which only the asymmetry potential (zero point) is taken into account. The previous slope value is retained. Only one buffer solution is required for a one-point calibration.
pH electrode system	A pH electrode system consists of a glass and a reference electrode. If they are combined in one body, they are referred to as 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. The resulting information is indicated by the Sensoface smileys. Sensocheck can be switched off.

Sensoface	Provides information on the electrode condition. The zero point, slope, and response time are evaluated. In addition, the Sensocheck information is indicated.
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
Zero adjustment	Basic adjustment of the DURAFET electrode to ensure reliable Sensoface information.

22 mA signal for error message 39, 45, 50, 86

Alarm settings 50

 Alarm contact 50, 86, 97

 Alarm delay 51

Assembly 8

Automatic cleaning system 85

 Configuration 59

Buffer tables 102

Cal Info 79

Calibration 64

 Automatic calibration 68

 Data entry of premeasured electrodes 72

 Error messages 88

 Manual calibration 70

 ORP calibration 76

 Product calibration 74

Calibration probe 59

Calimatic 68

Configuration steps 30

Configuration: Alarm settings 50

Configuration: Calibration mode 48

 Select calibration mode 49

Configuration: Controller 56

Configuration: Output 1 32

 Current range 35

 Measurement procedure 32

 Output current during Error 38

 Output signal during Hold 39

 Select electrode type 32

 Time constant of output filter 36

Configuration: Output 2 40

 Current range 41

 Output current during Hold 44

 Temperature error 44

 Temperature probe 41

 Temperature unit 40

 Time constant of output filter 42

Configuration: Relay 1 52

Configuration: Relay 2 54

Configuration: Rinsing and calibration probes 58

 Lock cleaning (calibration) 59

Configuration: Temperature compensation 46

 Temp detection during measurement 47

 Temperature compensation of process medium 47

Controller 82

 Configuration 56

 Controller equations 83

 Controller test 81

Current source 80

Diagnostics functions 79

 Controller test 81

 Display of calibration data 79

 Display of electrode potential 79

 Display of last error messages 79

 Display of output currents 79

 Relay test (manual test of contacts) 80

 Specify current at output 1/ 2 80

Display 23

DURAFET electrode 109

 Calibration 66

 Configuration 33

 Wiring 16

 Zero adjustment 65

Err 28






Error info	79
Error messages	86
Glossary	108
Hold mode	26
External activation	27
LED in Hold mode	51
Installation	12
Intended use	6
ISFET electrode	33, 65
Keypad	24
Limit function (LiMIT)	53
Measurement	78
MEREDIAN electrode	110
Wiring	17
Mounting plan	9
Operating states	90
ORP measurement	33
Typical wirings	18
Output current range	35
Output filter	37, 43
Output signal for Hold	39, 45
Overview	7
Package contents	8
Panel mounting	10
Panel-mount kit	11, 94
Parameter set - user settings	62
Parameter set 1/2 (Defaults)	60
pH calibration	65
PID controller	82
Pipe mounting	10
Pipe-mount kit	10, 94
Product calibration	74

Product line and accessories	94
Protective hood	10, 94
Protective wiring	20
Pulse frequency controller (PFC)	84
Pulse length controller (PLC)	84
Relay 1	52
Relay 2	54
Relay test	80
Rinsing system	85
Configuration	58
Safety functions	25
Safety information	5
Division 2 wiring	13
Installation	12
Self test	25
Sensocheck	51, 92
Sensoface	92
Sensor monitor	79
Specifications	95
Temperature compensation	46
Temperature probe adjustment	78
Temperature probe selection	40
Terminal assignments	12
Time constant output filter	37, 43
Trademarks	6
User interface	22
Warranty	2
Wiring examples	15
DURAFET II electrode	16
MEREDIAN electrode	17
ORP measurement	18
pH measurement, general	14
Zero adjustment	66









Mode codes

The mode codes allow fast access to the functions.

Calibration

Key + Code	Description
 0000	Cal Info Display of asymmetry potential and slope
 1001	Zero adjustment of a nominal zero point
 1100	Calibration Adjustment of asymmetry potential and slope (electrode)
 1105	Product calibration Adjustment of asymmetry potential (product)
 1015	Adjusting temp probe

Configuration

Key + Code	Description
 0000	Error Info Display last error and erase
 1200	Configuring
 2222	Sensor monitor Display of uncorrected electrode potential (mV)
 7654	Parameter set 1/2 Selecting parameter set
 5555	Current source 1 Output current 1 specified
 5556	Current source 2 Output current 2 specified
 5557	Relay test Manual test of contacts
 5559	Manual controller Manual specification of controller output