

Honeywell

APT4000 Series 4-Wire Contacting Conductivity Analyzers User Manual

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Revision 2 – 09/03



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Copyright and Notices

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Revision 2 – 09/03

Warranty/Remedy

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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 APT4000CC Analyzer.

Contacts

World Wide Web

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

Honeywell Organization

Corporate

Industrial Measurement and Control

WWW Address (URL)

<http://www.honeywell.com>

<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

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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 APT4000CC is used for measurement of electrical conductivity and temperature in liquids.

Fields of application are: biotechnology, chemical industry, environment, food processing, water/waste-water treatment, and power utility measurements.

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 APT4000CC has been designed for 2-electrode conductivity sensors. It provides a second current output for temperature measurement, a PID controller (making use of the relay contacts), and a universal power supply for 24 ... 230 V AC/DC.

For CIP applications, you can switch between two parameter sets.

Trademarks

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

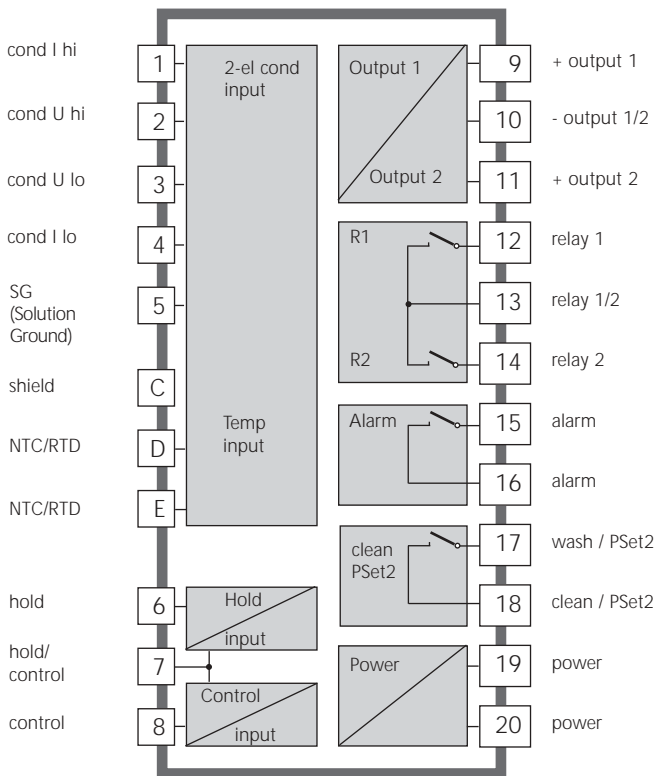
Sensocheck®

Sensoface®

VariPower®

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Overview of APT4000CC

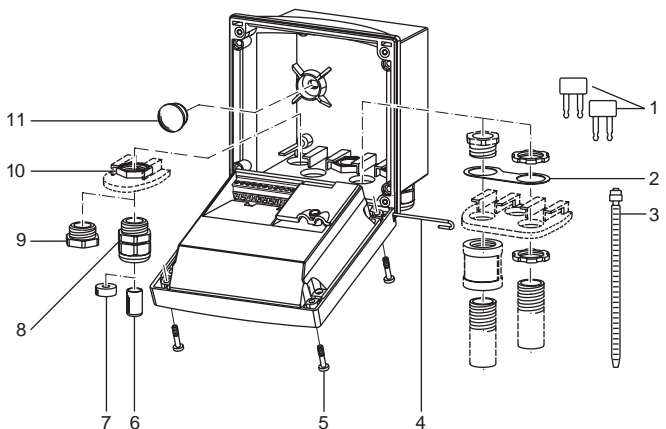


Assembly

Package contents

Check the shipment for transport damage and completeness.
The package should contain:

- Front unit of APT4000CC
- Lower case
- Bag containing small parts
- Instruction manual
- Specific test report



- | | |
|--|---|
| 1 Jumper (2 piece) | 6 Sealing inserts (1 piece) |
| 2 Washer (1 piece), for conduit mounting: place washer between enclosure and nut | 7 Rubber reducer (1 piece) |
| 3 Cable ties (3 pieces) | 8 Cable glands (3 pieces) |
| 4 Hinge pin (1 piece), insertable from either side | 9 Filler plugs (3 pieces) |
| 5 Enclosure screws (4 pieces) | 10 Hexagon nuts (5 pieces) |
| | 11 Sealing plugs (2 pieces), for sealing in case of wall mounting |

Fig. 1: Assembling the enclosure

Mounting plan

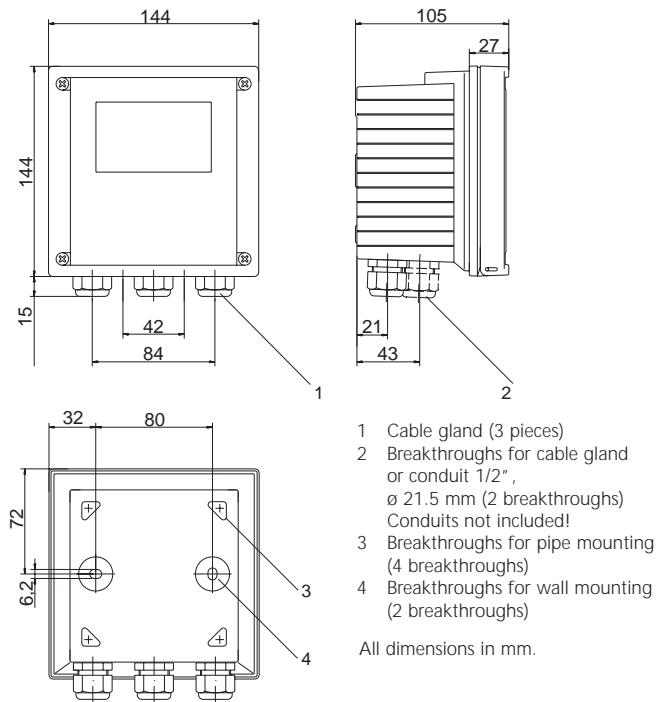
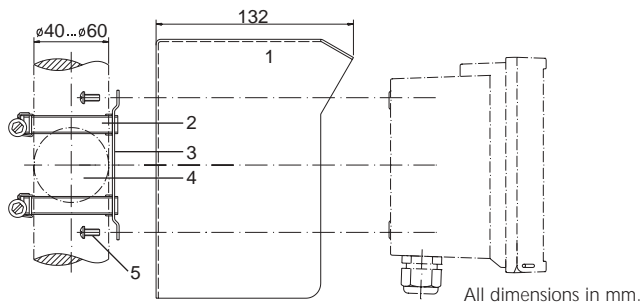


Fig. 2: Mounting plan

Pipe mounting, panel mounting



- 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

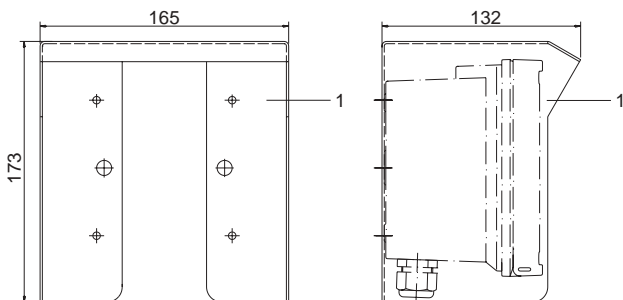
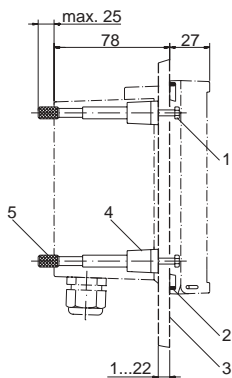


Fig. 4: 51205989-001 protective hood for wall and pipe mounting



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

All dimensions in mm.

Fig. 5: 51205990-001 panel-mount kit

Installation and connection

Information on installation

Caution!

- Installation may only be carried out 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 ... 253 V AC/DC.
- All parameters must be set by a system administrator prior to commissioning.

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

Terminal assignments

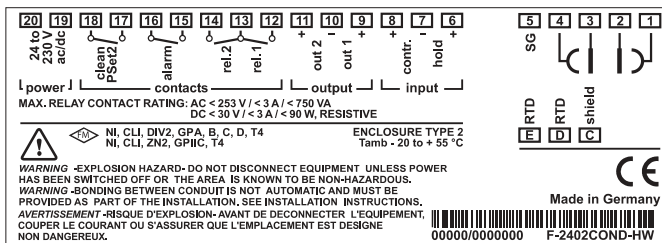
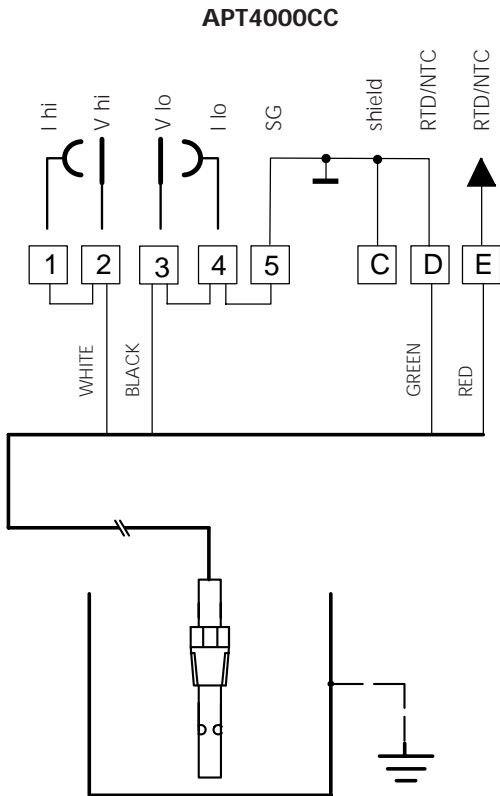


Fig. 6: Terminal assignments APT4000CC

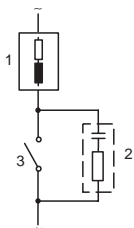
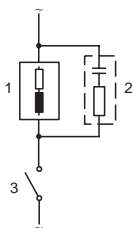
Conductivity measurement with Honeywell 2-electrode sensors



Protective wiring of switching outputs

Protective wiring of relay contacts

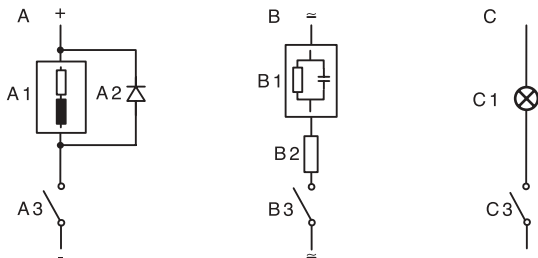
Relay contacts are subjected to electrical erosion. Especially with inductive and capacitive loads, the service life of the contacts will be reduced. For suppression of sparks and arcing, components such as RC combinations, nonlinear resistors, series resistors and diodes should be used.



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

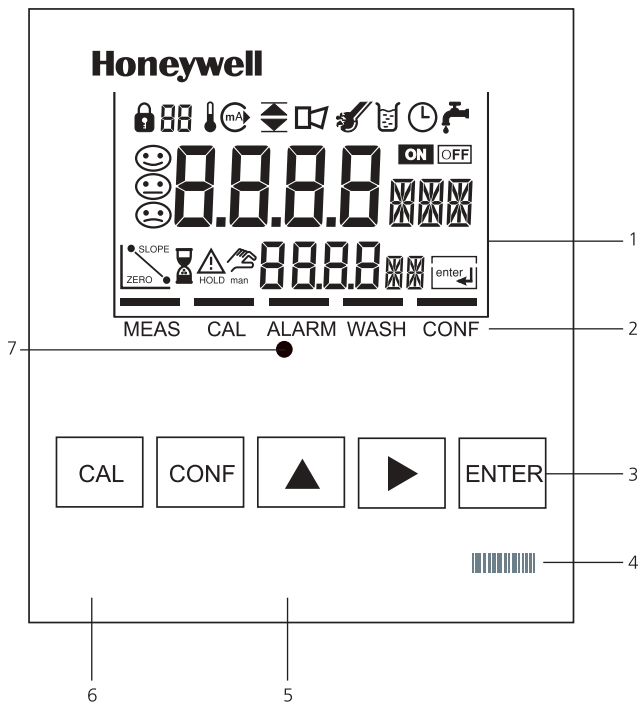
A1	Inductive load
A2	Free-wheeling diode, e.g. 1N4007 (Observe polarity)
A3	Contact
B1	Capacitive load
B2	Resistor, e.g. 8 Ohms/1W at 24V/0.3A
B3	Contact
C1	Incandescent lamp, max 60W/230V, 30W/115V
C3	Contact

Warning!

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

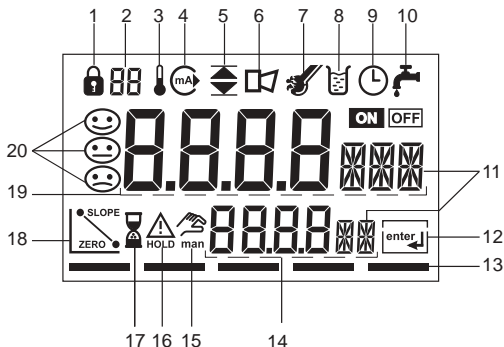
User interface and display

User interface














- | | | | |
|---|--|---|-------------------|
| 1 | Display | 3 | Keypad |
| 2 | Mode indicators (no keys), from left to right: | 4 | Coding |
| | - Measuring mode | 5 | Rating plate |
| | - Calibration mode | 6 | Model designation |
| | - Alarm | 7 | Alarm LED |
| | - Clean contact active | | |
| | - Configuration mode | | |

Display



- | | |
|---|--------------------------|
| 1 Mode code entry | 14 Lower display |
| 2 Parameter set 2 selected | 15 Manual temp indicator |
| 3 Temperature | 16 Hold mode active |
| 4 Current output | 17 Waiting time running |
| 5 Limit values | 18 Electrode data |
| 6 Alarm | 19 Main display |
| 7 Sensocheck | 20 Sensoface |
| 8 Calibration | |
| 9 Interval/response time | |
| 10 Clean 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 | |
| - Clean contact active | |
| - Configuration mode | |

Operation: Keypad

	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 cell constant
 ➔ 	Error Info, display last error message
 + 	Start GainCheck device self-test

Safety functions

Sensocheck, Sensoface sensor monitoring


Sensocheck continuously monitors the sensor and lines. Sensocheck can be switched off (Configuration, Pg 50).



Sensoface provides information on the conductivity sensor condition. Significant sensor polarization effects or an excessive cable capacitance are indicated.

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.

Safety functions

Hold mode

Display:

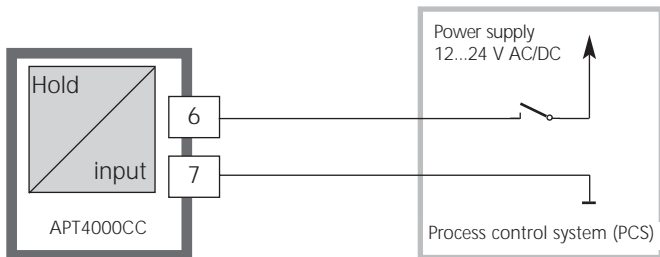


The Hold mode is a safety state during configuration and calibration. Output current is frozen (LAST) or set to a fixed value (FIX). Alarm and limit contacts are disabled.

If the calibration or configuration mode is exited, the APT4000CC 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 APT4000CC only returns to measuring mode after **ENTER** is pressed and a waiting time of 20 sec 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 device parameters. The APT4000CC can store two different parameter sets and switch between them. Sensor data and "Clean/PSet2" output are edited in parameter set 1 only. They are valid for both parameter sets.

Configuring



Press **CONF**.

Parameter set 1

Configure:



Enter mode code "1200":
Edit parameter set 1 with **▶** and **▲**, confirm/proceed with **ENTER**.

Parameter set 2

Configure:

"88" appears in the display.

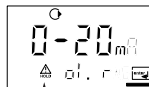


Enter mode code "1288":
Edit parameter set 2 with **▶** and **▲**, confirm/proceed with **ENTER**.

Hold



During configuration the APT4000CC remains in the Hold mode.



Hold icon

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 sec. The incorrect parameters cannot be stored. Input must be repeated.

End

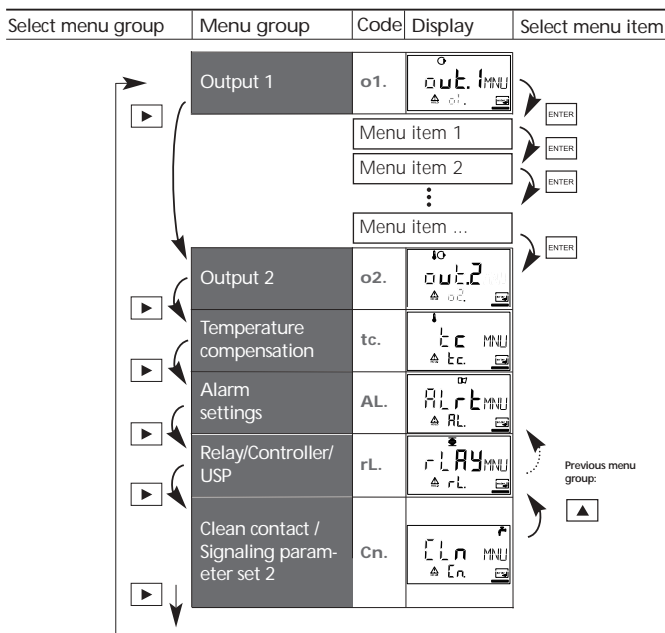


End with **CONF**. The measured value and Hold are displayed alternately, "enter" flashes. End Hold mode with **ENTER**. The display shows the measured value. The output current remains frozen for another 20 sec (Hold icon on, "hourglass" flashes).

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
out1	Output 1	
o1.	Sensor selection *	2-electrode / 4-electrode
	Select measured variable	μS , mS/cm , $\text{M}\Omega\text{-cm}$, SAL, Conc, USP
	Select solution (Conc) see Pg 102	NaCl HCl NaOH H_2SO_4 HNO_3
	Codes:	-01- -02- -03- -04- -05-
	Select current range	0-20 mA / 4-20 mA
	Characteristic (not for SAL, Conc, USP)	Linear LIN / Logarithmic LOG (LIN)
	LIN: Enter current beginning	XXX.X (000.0 mS)
	Enter current end	XXX.X (100.0 mS)
	LOG: Enter current beginning	in decades: 0.1...1000 mS (0.1 mS)
	Enter current end	in decades: 0.1...1000 mS (100 mS)
Time constant of output filter	0000 ... 0120 SEC (0000 SEC)	
22 mA signal for error messages	ON / OFF	
Signal behavior during Hold	LAST / FIX	
FIX: Enter fixed value	000.0 ... 021.0 mA (021.0 mA)	
out2	Output 2	
o2.	Select temperature unit	°C / °F
	Selection of temperature probe *	Pt100/Pt1000/ NTC 8.55k /NTC 30k
	Select current range	0-20 mA / 4-20 mA
	Enter current beginning	XXX.X (000.0 °C)
	Enter current end	XXX.X (100.0 °C)
	Time constant of output filter	0000 ... 0120 SEC (0000 SEC)
	Temp error signaled by 22 mA	ON / OFF
	Signal behavior during Hold	LAST / FIX
	FIX: Enter fixed value	000.0 ... 021.0 mA (021.0 mA)
	tc	Temperature compensation
tc.	Temperature compensation selection	OFF / Lin / nLF / NaCl / HCl / NH_3
	Lin: Input of temp coefficient	00.00 ... 19.99 %/ K (02.00%/K)
ALrt	Alarm settings	
AL.	Select Sensocheck	ON / OFF
	Enter alarm delay	0000 ... 0600 SEC (0010 SEC)
	LED in Hold mode	ON / OFF

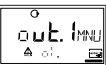
Code	Menu	Selection
rLAY	Relay 1/2: Limits, controller, USP function	
rL.	Select limit function / Controller / USP	LIMIT / CtROL / USP
	L1. Select contact function Select contact response Enter switching point Enter hysteresis Enter delay	Lo / Hi N/O / N/C XXX.X (000.0 mS) XXX.X (001.0 mS) 0000 ... 9999 SEC (0010 SEC)
	L2. Select contact function Select contact response Enter switching point Enter hysteresis Enter delay Enter controller setpoint	Lo / Hi N/O / N/C XXX.X (100.0 mS) XXX.X (001.0 mS) 0000 ... 9999 SEC (0010 SEC) XXX.X (050.0 mS)
	Ct. Enter neutral zone (P) Controller gain K _p (I) Reset time T _r (D) Rate time T _o Controller PLC: Pulse length PFC: Pulse frequency Select Hold behavior	XXX.X (001.0 mS) 0010 ... 9999 % (0100 %) 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
	U1. Enter reduced USP factor Select contact response Enter delay	0010 ... 0100 % (0100 %) N/O / NC 0000 ... 9999 SEC (0000 SEC)
	U2. Select contact response Enter delay	N/O / N/C 0000 ... 9999 SEC (0000 SEC)
	CIn	Contact Clean / PSet2
Cn.	Select as Clean contact / Signal for parameter set 2 *	rinse / PSet2
	rinse Rinsing interval * Rinse duration * Contact response *	000.0 ... 999.9 h (000.0 h) 0000 ... 1999 SEC (0060 SEC) N/O / N/C

* These parameters are only edited in parameter set 1.
They are valid for both parameter sets.




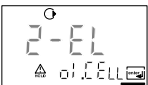
Configuration

Output 1

Select sensor type

Menu group	Code	Display	Select menu item
Output 1	o1.		Sensor selection
			Select measured variable
			Select solution (Conc)
			Select 0-20 / 4-20 mA
			Characteristic: LIN / LOG
			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 .)	
	 <p>After correct input a welcome text (CONF) is displayed for approx. 3 sec</p>	For parameter set 1: Enter mode code "1200" (Select position using ► arrow key and edit number using ▲. When the display reads "1200", press ENTER to confirm.)	
	 <p>After correct input a welcome text (CONF) is displayed for approx. 3 sec</p>	For parameter set 2: Enter mode code "1288" (Select position using ► arrow key and edit number using ▲. When the display reads "1288", press ENTER to confirm.)	
		The APT4000CC is in Hold mode (Hold icon is on).	
		Select 2-electrode sensor Proceed with ENTER	2-EL (2-EL/4-EL)


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

*) This configuration is only edited in parameter set 1.
It is valid for both parameter sets.


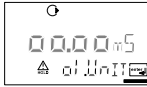



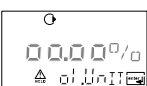
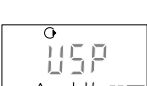
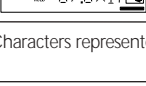

Configuration

Output 1

Select measured variable

Menu group	Code	Display	Select menu item
Output 1	o1.		Sensor selection
			Select measured variable
			Select solution (Conc)
			Select 0-20 / 4-20 mA
			Characteristic: LIN / LOG
			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
01.		Select measured variable:	000.0 mS
		Select with arrow key Proceed with ENTER	(0.000 μ S 00.00 μ S (USP)
		Conductivity:	000.0 μ S 0000 μ S 0.000 mS 00.00 mS 000.0 mS
		<ul style="list-style-type: none"> • 0.000 ... 9.999 μS/cm • 00.00 ... 99.99 μS/cm • 000.0 ... 999.9 μS/cm • 0.000 ... 9.999 mS/cm • 00.00 ... 99.99 mS/cm • 000.0 ... 999.9 mS/cm • 0.000 ... 9.999 S/m • 00.00 ... 99.99 S/m 	0.000 S/m 00.00 S/m
		Resistivity:	00.00 M Ω
		• 00.00 ... 99.99 M Ω -cm	0.00 SAL
		Salinity (SAL):	00.00 %
		• 0.0 ... 45.0 ‰ (0 ... 35 °C)	USP)
		Concentration (Conc):	
		• 0.00 ... 9.99 % by wt	
		USP – automatic range	
		• 00.00 ... 99.99 μ S/cm	



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

Configuration

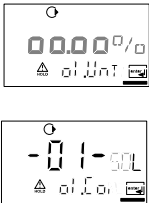
Output 1

Concentration measurement:

Select process solutions

Menu group	Code	Display	Select menu item
Output 1	o1.		
			Sensor selection
			Select measured variable
			Select solution (Conc)
			Select 0-20 / 4-20 mA
			Characteristic: LIN / LOG
			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.		<p>Only with 00.00 % Conc, you can select the process solution:</p> <p>Select with ► key</p> <ul style="list-style-type: none"> -01- NaCl (0.00 ... 9.99 % by wt) (0 ... 120 °C) -02- HCl (0.00 ... 9.99 % by wt) (-20 ... 50 °C) -03- NaOH (0.00 ... 9.99 % by wt) (0 ... 100 °C) -04- H₂SO₄ (0.00 ... 9.99 % by wt) -17 ... 110 °C) -05- HNO₃ (0.00 ... 9.99 % by wt) (-17 ... 50 °C) <p>Proceed with ENTER</p>	<p>-01-SOL</p> <p>(-01-SOL -02-SOL -03-SOL -04-SOL -05-SOL)</p>

Concentration measurement

For the solutions listed above, the APT4000CC can determine the substance concentration from the measured conductivity and temperature values in % by wt. The measurement error is made up of the sum of measurements errors during conductivity and temperature measurement and the accuracy of the concentration curves stored in the APT4000CC (see Pg 102).


We recommend to calibrate the APT4000CC together with the sensor. For exact temperature measurement, you should perform a temperature probe adjustment. For measuring processes with rapid temperature changes, a separate temperature probe with fast response should be used. When measuring processes such as dilution or intensification of CIP solutions (Clean-In-Place), it is helpful to switch between the parameter sets for measuring the process medium and for measuring the CIP solution.

Configuration





Output 1

Output current range. LIN/LOG curve

Current beginning / end

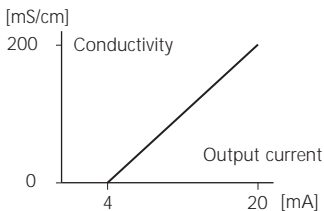
Menu group	Code	Display	Select menu item
Output 1	o1.		Sensor selection
			Select measured variable
			Select solution (Conc)
			Select 0-20 / 4-20 mA
			Characteristic: LIN / LOG
			Enter current beginning
			Enter current end
			Set output filter
			22 mA in the case of error
			Hold mode

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

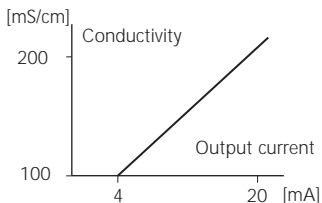
Code	Display	Action	Choices
01.		Set output current range Select with ► key Proceed with ENTER	4-20 mA (0-20mA/ 4-20 mA)
		Select output characteristic Select with ► key Proceed with ENTER (Step omitted for % (Conc) or SAL)	LIN (LIN / LOG)
	 	With LIN selected: • Enter current beginning Enter lower end of scale Select with ► key, edit number with ▲ key, proceed with ENTER key. • Enter current end Enter upper end of scale Proceed with ENTER	000.0 mS (XXX.X mS) 100.0 mS (XXX.X mS)

Assignment of measured values: Current beginning and current end

Example 1: Range 0...200 mS/cm



Example 2: Range 100...200 mS/cm
Advantage: Higher resolution in range of interest




Configuration



Output 1

Output current range. LOG characteristic

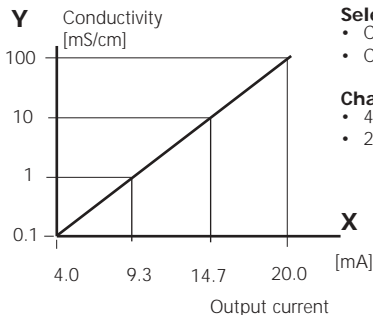
Current beginning/end

Menu group	Code	Display	Select menu item
Output 1	o1.		Sensor selection
			Select measured variable
			Select solution (Conc)
			Select 0-20 / 4-20 mA
			Characteristic: LOG
			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
01.		With LOG selected: <ul style="list-style-type: none"> • Enter lower end of scale (= current beginning) Select with ► key, edit number with ▲ key, proceed with ENTER key.	0.1 mS (0.1 mS 1.0 mS 10 mS 100 mS 1000 mS)
		<ul style="list-style-type: none"> • Enter upper end of scale (= current end) Select with ► key, edit number with ▲ key, proceed with ENTER key.	100 mS (0.1 mS 1.0 mS 10 mS 100 mS 1000 mS)

Example: Measurement range over 3 decades



Selection: **0-20/4-20mA**

- Current beginning: 4 mA
- Current end: 20 mA


Characteristic: **LOG**

- 4 mA 0.1 mS/cm
- 20 mA 100 mS/cm

Configuration

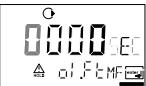
Output 1

Time constant of output filter

Menu group	Code	Display	Select menu item
Output 1	o1.		ENTER
			Sensor selection
			Select measured variable
			Select solution (Conc)
			Select 0-20 / 4-20 mA
			Characteristic: LIN / LOG
			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
01.		Time constant of output filter Default setting: 0 sec (inactive). To specify a time constant: Select with ► key, edit number with ▲ key, proceed with ENTER key.	0000 SEC (0000 ... 0120 SEC)

Time constant of output filter (attenuation)

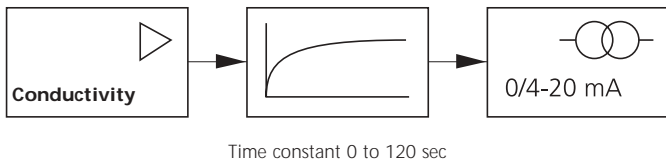
To smoothen the current output, a low-pass filter with adjustable filter time constant can be switched on. When there is a jump at the input (100 %), the output level is 63 % after the time constant has been reached.

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

If the time constant is set to 0 sec, 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

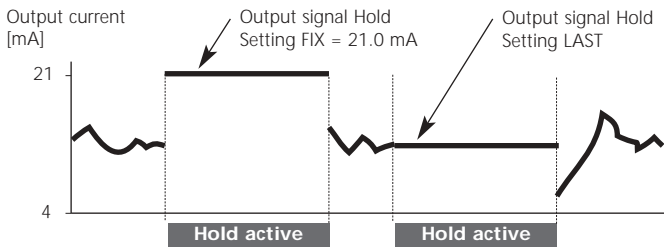
Output current during Error and Hold.

Menu group	Code	Display	Select menu item
Output 1	o1.		Sensor selection
			Select measured variable
			Select solution (Conc)
			Select 0-20 / 4-20 mA
			Characteristic: LIN / LOG
			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 ► arrow key. Proceed with ENTER	OFF (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 ► arrow key. Proceed with ENTER	LAST (LAST / FIX)
	 	Only with FIX selected: Enter current which is to flow at the output during Hold Select position with ► key, edit number with ▲ key, proceed with ENTER key.	021.0 mA (000.0 ... 021.0 mA)

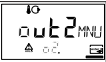
Output signal for Hold:



Configuration

Output 2

Temperature unit and probe, output current.

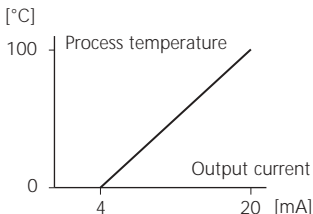
Menu group	Code	Display	Select menu item
Output 2	o2.		<ul style="list-style-type: none">Select °C/°FSelect temp probeSelect 0-20 / 4-20 mAEnter current beginningEnter current endSet output filter22 mA for temp errorHold mode

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

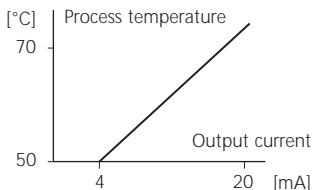
Code	Display	Action	Choices
o2.		Specify temperature unit Select with ► arrow key Proceed with ENTER	°C (°C / °F)
		Select temperature probe * Select with ► arrow key Proceed with ENTER	8.55 NTC (100 PT 1000 PT 30 k NTC)
		Set output current range Select with ► arrow key Proceed with ENTER	4 - 20 mA (4 - 20 mA/ 0 - 20 mA)
		Current beginning: Enter lower end of scale. Select with ►, edit number with ▲, proceed with ENTER .	000.0 °C (XXX.X °C)
		Current end: Enter upper end of scale. Select with ►, edit number with ▲, proceed with ENTER .	100.0 °C (XXX.X °C)

Process temperature: Current beginning and end

Example 1: Range 0 to 100 °C



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




*) These parameters are only edited in parameter set 1.
They are valid for both parameter sets.


Configuration

Output 2

Time constant of output filter.

Menu group	Code	Display	Select menu item
Output 2	o2.		Select °C/°F
			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 sec (inactive). To specify a time constant: Select position with ► key, edit number with ▲ key, proceed with ENTER key.	0000 SEC (0000 ... 0120 SEC)

Time constant of output filter (attenuation)

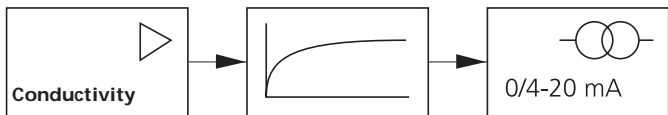
To smoothen the current output 2, a low-pass filter with adjustable filter time constant can be switched on. When there is a jump at the input (100 %), the output level is 63 % after the time constant has been reached.

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

If the time constant is set to 0 sec (default), the current output follows the input.

Note:

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




Time constant 0 to 120 sec

Configuration

Output 2

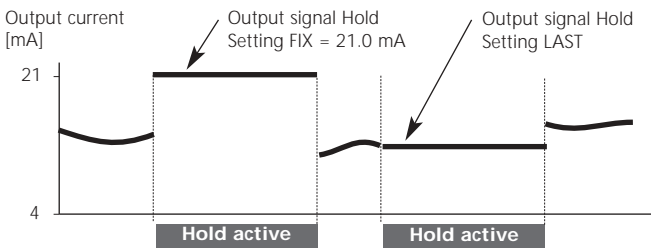
Temperature error. Output current during Hold.

Menu group	Code	Display	Select menu item
Output 2	o2.		Select °C/°F
			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 ► arrow key. Proceed with ENTER	OFF (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 ► arrow key. Proceed with ENTER	LAST (LAST / FIX)
	 	Only with FIX selected: Enter current which is to flow at the output during Hold Select position with ► key, edit number with ▲ key, proceed with ENTER key.	021.0 mA (000.0 ... 021.0 mA)


Output signal for Hold:



Configuration








Temperature compensation

Selecting temperature compensation

Menu group	Code	Display	Select menu item
Temperature compensation	tc.		Selecting temperature compensation



The diagram shows a sequence of steps. A table lists the menu group 'Temperature compensation' with code 'tc.'. To the right, a simulated LCD display shows 'tc' and 'MENU' with a cursor on 'tc'. An arrow labeled 'ENTER' points from the display to a dark grey box containing the text 'Selecting temperature compensation'.

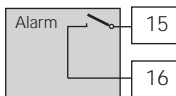
End:
Press CONF, then ENTER

Code	Display	Action	Choices
tc.		Select temp compensation (not for USP) OFF: Temperature compensation switched off Select with ► key. Proceed with ENTER	OFF (OFF LIN nLF nACL HCL nH3)
		LIN: Linear temperature compensation with entry of temperature coefficient and reference temperature	
		nLF: Temperature compensation for natural waters to EN 27888	
		NaCl (nACL): Temperature compensation for ultrapure water with NaCl traces	
		HCl (HCL): Temperature compensation for ultrapure water with HCl traces	
		NH3 (nH3): Temperature compensation for ultrapure water with NH ₃ traces	
		Only with linear temperature compensation (LIN) selected: Enter temperature coefficient. Select with ► key, edit number with ▲ key, proceed with ENTER key.	

Configuration

Alarm settings

Menu group	Code	Display	Select menu item
Alarm settings	AL.		 Select Sensocheck
			Delay
			LED in Hold mode
			End: Press CONF, then ENTER






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 41, 47, 84).

The operating behavior of the alarm contact is shown on Pg 86.



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 sensor properties) Select with ► key. Proceed with ENTER .	OFF (ON / OFF)								
		Alarm delay Select with ►, edit number with ▲, proceed with ENTER .	0010 SEC (0000 ... 0600 SEC)								
		LED in Hold mode Select with ► key. Proceed with ENTER . LED state: <table border="1" data-bbox="394 796 806 906"> <thead> <tr> <th>Configuration</th> <th>Alarm</th> <th>Hold</th> </tr> </thead> <tbody> <tr> <td>ON</td> <td>on</td> <td>flashes</td> </tr> <tr> <td>OFF</td> <td>flashes</td> <td>off</td> </tr> </tbody> </table>	Configuration	Alarm	Hold	ON	on	flashes	OFF	flashes	off
Configuration	Alarm	Hold									
ON	on	flashes									
OFF	flashes	off									









Configuration

Limit function

Use of relays. Settings for relay 1

Menu group	Code	Display	Select menu item
Relay/Controller/ USP	rL.		Use of relays
			L1. Contact function
			Contact response
			Enter switching point
			Enter hysteresis
			Delay
			L2. Relay 2 menu group
			Ct. Controller menu group
			U1 USP: Relay 1
			U2 USP: Relay 2




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

Code	Display	Action	Choices
rL.	  	<p>Use of relays:</p> <ul style="list-style-type: none"> • Limit function (LiMIT) • Controller (CtROL) • USP function <p>Select with ► key. Proceed with ENTER.</p> <p>Note: Selecting</p> <ul style="list-style-type: none"> • CtROL leads to Controller menu Ct. • USP leads to relay for USP menu U1 U2 	<p>LiMIT</p> <p>(LiMIT CtROL USP)</p>
L1.		<p>For function principle, see Pg 55. Select with ► key. Proceed with ENTER.</p>	<p>Lo (Lo/Hi)</p>
		<p>Limit 1 contact response N/O: normally open contact N/C: normally closed contact Select with ► key. Proceed with ENTER.</p>	<p>N/O (N/O N/C)</p>
		<p>Limit 1 switching point Select with ►, edit number with ▲, proceed with ENTER.</p>	<p>000.0 mS (XXX.X mS)</p>
		<p>Limit 1 hysteresis Select with ►, edit number with ▲, proceed with ENTER.</p>	<p>001.0 mS (XXX.X mS)</p>
		<p>Limit 1 delay The contact is activated with delay (deactivated without delay) Select with ►, edit number with ▲, proceed with ENTER.</p>	<p>0010 SEC (0000 ... 9999 SEC)</p>

Configuration

Limit function

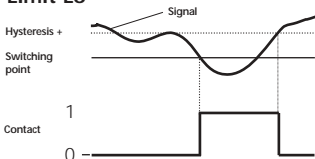
Settings for relay 2

Menu group	Code	Display	Select menu item
Relay/Controller/ USP	rL.		Use of relays
			L1. Relay 1 menu group
			L2. Contact function
			Contact response
			Enter switching point
			Enter hysteresis
			Delay
			Ct. Controller menu group
			U1 USP: Relay 1
			U2 USP: Relay 2

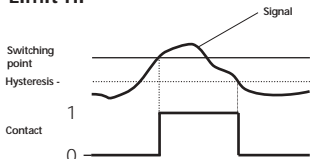
End:
Press **CONF**, then **ENTER**

Code	Display	Action	Choices
L2.		Select Limit 2 (see Fig. below). Select with ► key. Proceed with ENTER .	Hi (Hi/Lo)
		Limit 2 contact response N/O: normally open contact N/C: normally closed contact Select with ► key. Proceed with ENTER .	N/O (N/O N/C)
		Limit 2 switching point Select with ►, edit number with ▲, proceed with ENTER .	100.0 mS (XXX.X mS)
		Limit 2 hysteresis Select with ►, edit number with ▲, proceed with ENTER .	001.0 mS (XXX.X mS)
		Limit 2 delay The contact is activated with delay (deactivated without delay) Select with ►, edit number with ▲, proceed with ENTER .	0010 SEC (0000 ... 9999 SEC)

Limit Lo



Limit Hi



Configuration

Controller (for description see Pg 80 and the following)

Setpoint. Neutral zone.

Menu group	Code	Display	Select menu item
Relay/Controller/ USP	rL.		Use of relays
			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
			U1 USP: Relay 1
			U2 USP: Relay 2




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

Code	Display	Action	Choices
Ct.		Setpoint Select with ►, edit number with ▲, proceed with ENTER .	050.0 mS (XXX.X mS)
		Neutral zone (dead band) Select with ►, edit number with ▲, proceed with ENTER .	001.0 mS (XXX.X mS)
		Controller: Proportional action Select with ►, edit number with ▲, proceed with ENTER .	0100 % (0010 ... 9999 %)
		Controller: Integral (reset time) Select with ►, edit number with ▲, proceed with ENTER .	0000 SEC (0000 ... 9999 SEC)
		Controller: Derivative (rate time) Select with ►, edit number with ▲, proceed with ENTER .	0000 SEC (0000 ... 9999 SEC)
		Pulse length / Pulse frequency Select with ► key. Proceed with ENTER .	PLC (PLC / PFC)
		PLC: Pulse length Select with ►, edit number with ▲, proceed with ENTER .	0010 SEC (0001 ... 0600 SEC)
		PFC: Pulse frequency Select with ►, edit number with ▲, proceed with ENTER .	0060 /min (0001 ... 0180 /min)
		Behavior during Hold Select with ► key. Proceed with ENTER .	Y LAST (Y Off/ Y LAST)

Configuration

Setting of relays for USP function

Menu group	Code	Display	Select menu item
Relay/Controller/ USP	rL		Use of relays
			L1. Relay 1 menu group
			L2. Relay 2 menu group
			Ct. Controller menu group
			U1 Enter USP factor
			Contact response relay 1
			Delay relay 1
			U2 Contact response relay 2
			Delay relay 2


→




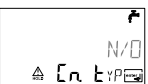
End:
Press **CONF**, then **ENTER**

Code	Display	Action	Choices
U1		With USP function selected, relays 1 and 2 are used for USP function (see Pg 90) USP must have been selected as measured variable. For function of relay 1, see Pg 91. Enter reduced USP factor 10 ... 100%	0100 % (0010 ... 0100 %)
		Select: Contact response relay 1 N/O: normally open contact N/C: normally closed contact Select with ► key. Proceed with ENTER .	N/O (N/O N/C)
		Enter delay. Select with ►, edit number with ▲, proceed with ENTER .	0000 SEC (XXXX SEC)
U2		For function of relay 2, see Pg 91. Select contact response N/O: normally open contact N/C: normally closed contact Select with ► key. Proceed with ENTER .	N/O (N/O N/C)
		Enter delay. Select with ►, edit number with ▲, proceed with ENTER .	000 SEC (XXXX SEC)

Configuration

Control of rinsing probe or Signaling parameter set 2

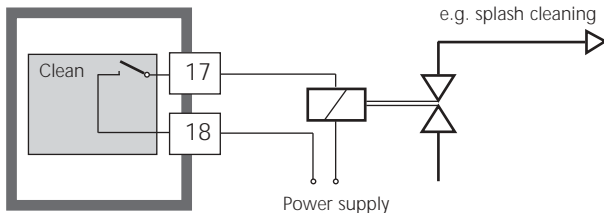
Menu group	Code	Display	Select menu item
Contact: Clean / PSet2	CIn		Select Clean / PSet2 Rinsing interval Rinse duration Contact response

Code	Display	Action (Rinsing probe)	Choices
Cn.		Function selection *: <ul style="list-style-type: none"> Control of rinsing probe (rinse) Signaling parameter set 2 active Select with ► key. Proceed with ENTER .	rinse (rinse / PSet2) Choices PSet2: see next page
rinse		Rinsing interval * Select with ►, edit number with ▲, proceed with ENTER .	000.0 h (xxx.x h)
		Rinse duration * Select with ►, edit number with ▲, proceed with ENTER .	0060 SEC (0000 ... 1999 SEC)
		Select contact response * N/O: normally open contact N/C: normally closed contact Select with ► key. Proceed with ENTER .	N/O (N/O N/C)

*) These parameters are only edited in parameter set 1. They are valid for both parameter sets.

Controlling a rinsing probe

The "Clean" contact can be used to connect a simple rinsing probe. Rinse duration and rinsing interval are defined during configuration. Contact response can be set as N/O, N/C.

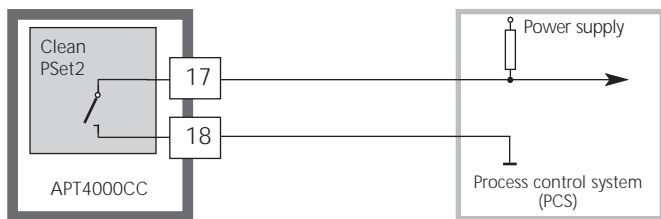


Signaling parameter set 2



Depending on the selected parameter set, the relay is active or inactive. The signal can be used for superordinated process control systems.

Parameter set 2 is indicated by "88" in the upper left corner of the display.



	Parameter set 1 selected
	Parameter set 2 selected




Power supply:


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

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

Selecting parameter set 1/2

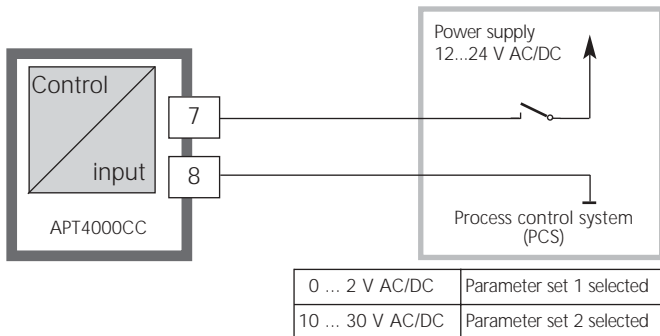
Manually or via a signal at the Control input

Display	Action	Choices
 <p>After correct input a welcome text (CONF) is displayed for approx. 3 sec</p>	Select parameter set Press CONF , enter code 7654 Select with ▶ , edit number with ▲ , proceed with ENTER . Wrong settings change the measurement properties! If an invalid code is entered, the APT4000CC returns to measuring mode.	
	Select: <ul style="list-style-type: none">• Parameter set 1 (MAN)• Parameter set 2 (MAN)• Automatic switchover via Control input (Ctr-XT) Select with ▶ key. Proceed with ENTER .	-1- (-1- MAN -2-MAN Ctr-EXT) Ctr-EXT: see next page →
	With -1- or -2- selected: Since the complete device configuration is changed in one step, there is a security prompt (No/Yes). Note: When pressing ENTER directly, the selection is not stored. Activation of parameter set 2 is indicated by "88" in the upper left corner of the display.	

Display	Action	Choices
	With Control input Ctrl-EXT selected: You can switch between the parameter sets by applying an external signal to the Control input, see below.	

External switchover of parameter sets

The parameter set can be selected from outside by sending a signal to the Control input (e.g. from the process control system). To do so, **Ctrl-EXT** is set during configuration.



Note:

Parameter set 2 is indicated by "88" in the upper left corner of the display.

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.

<u>Code. Parameter</u>	<u>Default setting</u>	<u>Code. Parameter</u>	<u>Default setting</u>
o1. Sensor selection *	2-EL	L1. Contact function	Lo
o1. Process variable	000.0 mS	L1. Contact response	N/O
o1. Conc solution	-01-	L1. Switching point	000.0 mS
o1. 0/4-20 mA	4-20 mA	L1. Hysteresis	001.0 mS
o1. Characteristic	LIN	L1. Delay	0010 sec
o1. Current start (LIN)	000.0 mS	L2. Contact function	Hi
o1. Current end (LIN)	100.0 mS	L2. Contact response	N/O
o1. Current start (LOG)	0.1 mS	L2. Switching point	100.0 mS
o1. Current end (LOG)	100 mS	L2. Hysteresis	001.0 mS
o1. Filter time	0 sec	L2. Delay	0010 sec
o1. 22mA signal	OFF	Ct. Setpoint	050.0 mS
o1. Hold behavior	LAST	Ct. Neutral zone	001.0 mS
o1. FIX current	021.0 mA	Ct. P action	0100 %
o2. Unit °C / °F	°C	Ct. I action	0000 sec
o2. Temp probe *	Pt 100	Ct. D action	0000 sec
o2. 0/4...20mA	4-20 mA	Ct. PLC/PFC controller	PLC
o2. Current start	000.0 °C	Ct. Pulse length	0010 sec
o2. Current end	100.0 °C	Ct. Pulse frequency	0060 /min
o2. Filter time	0 sec	Ct. Hold behavior	LAST
o2. 22mA signal	OFF	U1 USP factor	100 %
o2. Hold behavior	LAST	U1 Contact response	N/O
o2. FIX current	021.0 mA	U1 Delay	0000 sec
tc. Temp compensation	OFF	U2 Contact response	N/O
tc. Temp coefficient	02.00%/K	U2 Delay	0000 sec
AL. Sensocheck	OFF	Cn. Rinse/ PSet2 *	rinse
AL. Alarm delay	0010 sec	Cn. Rinsing interval *	000.0 h
AL. LED Hold	OFF	Cn. Rinse duration*	0060 sec
		Cn. Contact type *	N/O

*) These parameters are only edited in parameter set 1. They are valid for both parameter sets.

Parameter set – user settings

Code. Parameter	Setting	
	P1 (CONF 1200)	P2 (CONF 1288)
o1. Sensor	_____	*
o1. Process variable	_____	_____
o1. Solution (Conc)	_____	_____
o1. 0/4-20 mA	_____	_____
o1. Characteristic (LIN/LOG)	_____	_____
o1. Current start (LIN)	_____	_____
o1. Current end (LIN)	_____	_____
o1. Current start (LOG)	_____	_____
o1. Current end (LOG)	_____	_____
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 start	_____	_____
o2. Current end	_____	_____
o2. Filter time	_____	_____
o2. 22mA signal	_____	_____
o2. Hold behavior	_____	_____
o2. FIX current	_____	_____
tc. Temp compensation	_____	_____
tc. Temp coefficient	_____	_____
AL. Sensocheck	_____	_____
AL. Alarm delay	_____	_____
AL. LED Hold	_____	_____

Code. Parameter	Setting	
	P1 (CONF 1200)	P2 (CONF 1288)
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	_____	_____
U1 USP factor	_____	_____
U1 Contact response	_____	_____
U1 Delay	_____	_____
U2 Contact response	_____	_____
U2 Delay	_____	_____
Cn Rinse / PSet2 *	_____	*
Cn Rinsing interval *	_____	*
Cn Rinse duration *	_____	*
Cn Contact response *	_____	*

*) These parameters are only edited in parameter set 1.
They are valid for both parameter sets.

Calibration

Calibration adjusts the APT4000CC to the sensor.

Activate

CAL

Activate with **CAL**



Enter mode code:

- Input of cell constant 1100
- With calibration solution 0110
- Product calibration 1105
- Temp probe adjustment 1015

Select with **▶**, edit number with **▲**, proceed with **ENTER**. (End with **CAL ENTER**.)

Hold



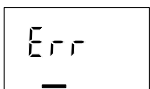
During calibration the APT4000CC remains in the Hold mode.



Hold icon

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, "Calibration" mode indicator 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

CAL

ENTER

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).

Information on calibration

Calibration adapts the meter to the conductivity sensor.

Calibration can be performed by:







- Input of cell constant (e.g. for ultrapure-water sensors)
- Determining the cell constant with a known calibration solution
- Sampling (product calibration)
- Temperature probe adjustment


Note:

- All calibration procedures must be performed by trained personnel.
- Incorrectly set parameters may go unnoticed, but change the measuring properties.

Calibration by input of cell constant





Input of cell constant with simultaneous display of conductivity and temperature



Display	Action	Remark
	Press CAL key, enter code 1100 Select with ▶ , edit number with ▲ , proceed with ENTER .	The APT4000CC is in the Hold mode. If an invalid code is entered, the APT4000CC returns to measuring mode.
	Ready for calibration	Display (3 sec)
   	<p>Enter the PRODUCT of the Cell Constant and Cell Calibration Factor found on the sensor. i.e. Constant 0.01 x Factor 1.07. Enter 0.0107.</p> <p>Select with ▶, edit number with ▲, proceed with ENTER.</p> <p>A change in the cell constant also changes the conductivity value.</p> <p>Press ENTER to confirm cell constant.</p>	<p>The lower display shows the conduc- tivity value.</p> <p>(When there has not been an entry for 6 sec, the lower display alternately shows the conduc- tivity and tempera- ture value.)</p>

Display	Action	Remark
 The image shows a digital display with two lines. The top line shows a smiley face icon on the left, followed by the number '10.03' and the unit 'mS'. The bottom line shows a triangle icon on the left, followed by the number '26.3' and the unit '°C'. There are also some small icons on the right side of the bottom line.	The APT4000CC now displays the conductivity and temperature.	
	The measured value is shown in the main display alternately with "Hold". "enter" flashes. End calibration with ENTER .	After end of calibration, the outputs remain in Hold mode for approx. 20 sec.

Calibration with calibration solution

Input of temperature-corrected value of calibration solution with simultaneous display of cell constant

Display	Action	Remark
	<p>Press CAL key, enter code 0110</p> <p>Select with ▶, edit number with ▲, proceed with ENTER.</p>	<p>The APT4000CC is in the Hold mode.</p> <p>If an invalid code is entered, the APT4000CC returns to measuring mode.</p>
	<p>Ready for calibration</p> <p>Dismount and clean sensor</p>	<p>Display (3 sec)</p>
	<p>Immerse sensor in calibration solution.</p> <p>Determine the temperature-corrected conductivity value of the calibration solution from the corresponding table (see Pg 100 and the following).</p>	<p>When there has not been an entry for 6sec, the lower display alternately shows the cell constant and temperature value.</p>
 	<p>Enter value of calibration solution.</p> <p>Select with ▶, edit number with ▲, proceed with ENTER.</p> <p>Press ENTER to confirm the calibration data.</p>	<p>The cell constant and temperature are alternately displayed in lower display during the input.</p>

Display	Action	Remark
 <p>The LCD display shows a smiley face icon, the number 0.10326, and the word CELL. There are also several small icons around the display.</p>	<p>The determined cell constant is displayed. Confirm with ENTER.</p>	
 <p>The LCD display shows a smiley face icon, the number 10.83 mS, and 26.3. There are also several small icons around the display.</p>	<p>The APT4000CC now displays the conductivity and temperature.</p>	
	<p>Clean sensor and re-place it in the process. The measured value is shown in the main display alternately with "Hold". "enter" flashes. End calibration with ENTER.</p>	<p>After end of calibration, the outputs remain in Hold mode for approx. 20 sec.</p>

Notes:

- Be sure to use known calibration solutions and the respective temperature-corrected conductivity values.
(see "Calibration solutions" Pg. 100 and the following).
- During the calibration procedure the temperature must be kept constant.

Product calibration

Calibration by sampling




For product calibration the measured variable is used as configured: Conductivity ($\mu\text{S}/\text{cm}$, mS/cm , S/m), resistivity ($\text{M}\Omega\cdot\text{cm}$). During product calibration the sensor remains in the process. The measurement is only interrupted briefly.





Calibration is without TC correction.

Procedure: During sampling the currently measured value is stored in the APT4000CC. The APT4000CC 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. The lab value is then entered in the APT4000CC. The new cell constant is calculated from these two values.

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 1st step: Press CAL key, enter code 1105. (Select position with ▶ key, edit number with ▲ key, proceed with ENTER key.)	If an invalid code is entered, the APT4000CC returns to measuring mode.
		Display (approx. 3 sec)
	Take sample and store value. Proceed with ENTER	The sample is measured in the lab or directly on the site.





Display	Action	Remark
	<p>Measuring mode:</p> <p>From the flashing CAL mode indicator you see that sample calibration has not been terminated.</p>	<p>While the sample value is determined, the APT4000CC is in measuring mode.</p>
	<p>Product calibration 2nd step: When the sample value has been determined, call up the product calibration once more (CAL, code 1105).</p>	<p>Display (approx. 3 sec)</p>
	<p>Enter lab value. The new cell constant is calculated.</p>	
	<p>The new cell constant is displayed. Confirm with ENTER.</p>	<p>New calibration: Press CAL.</p>
	<p>The measured value is shown in the main display alternately with "Hold". "enter" flashes. End with ENTER.</p>	<p>After end of calibration, the outputs remain in Hold mode for approx. 20 sec.</p>

Temperature probe adjustment

Display	Action	Remark
	<p>Activate calibration (Press CAL, enter 1015)</p> <p>Select position with ► key, edit number with ▲ key, proceed with ENTER key.</p>	<p>Wrong settings change the measurement properties! If an invalid code is entered, the APT4000CC returns to measuring mode.</p>
	<p>Ready for calibration</p>	<p>APT4000CC is in the Hold mode (Display for approx. 3 sec)</p>
	<p>Measure the temperature of the process medium using an external thermometer. Enter measured temperature value: Select with ► key, edit number with ▲ key, proceed with ENTER key. End adjustment with ENTER. Hold will be deactivated after 20 sec.</p>	<p>Default: Current value of secondary display.</p>










Measurement

Display	Remark
	<p>In the measuring mode the main display shows the configured process variable (conductivity, resistivity, salinity), the lower display shows the temperature. During calibration you can return to measuring mode by pressing the CAL key, during configuration by pressing CONF (waiting time for measured-value stabilization approx. 20 sec).</p>

Display	Remark
	<p>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 APT4000CC returns to measuring mode.</p>
	<p>Display of calibration data (Cal Info) Press CAL while in measuring mode and confirm code 0000. The current cell constant is shown in the main display. After 20 sec the APT4000CC returns to measuring mode (immediate return at pressing ENTER).</p>
	<p>Sensor monitor for validation of sensor and complete measured-value processing. Press CONF while in measuring mode and enter code 2222. The measured resistance is shown in the main display, the measuring temperature in the lower display. Press ENTER to return to measurement.</p>
	<p>Display of last error message (Error Info) Press CONF while in measuring mode and confirm 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).</p>

Diagnostics functions

These functions are used for testing the connected peripherals.

Display	Action / Remarks
 	<p>Specify current for output 1 (current source 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 key.</p> <p>The actually measured current is shown in the secondary display. The APT4000CC is in Hold mode. Press ENTER to return to measurement (Hold remains active for another 20 sec).</p>
 	<p>Specify current for output 2 (current source 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 ▶, edit number with ▲, proceed with ENTER. The actually measured current is shown in the secondary display. The APT4000CC is in Hold mode. Press ENTER to return to measurement.</p>
   Select a relay  Test 0/1  Return to measurement	<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> <ol style="list-style-type: none">1. Digit: R12. Digit: R23. Digit: AL4. Digit: CLN <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
<div data-bbox="104 239 298 344"> </div> <div data-bbox="104 365 298 472"> </div> <p data-bbox="101 482 275 529">Controller characteristic</p> <div data-bbox="101 548 304 758"> </div> <p data-bbox="101 768 275 851">The arrows indicate which relay (valve) is active:</p> <ul data-bbox="104 865 301 1058" style="list-style-type: none"> ▲ Relay 2 active (Meas. value > setpoint) ▼ Relay 1 active (Meas. value < setpoint) <div data-bbox="104 1076 298 1215"> </div>	<p data-bbox="319 234 847 301">Controller test (manual specification of controller output)</p> <ul data-bbox="319 305 702 334" style="list-style-type: none"> • Press CONF, enter code 5559 <p data-bbox="319 339 930 462">After function activation "Ctrl" is displayed for approx. 3 sec. With controller turned off, "OFF" is displayed in addition, then return to measuring mode.</p> <p data-bbox="319 472 899 529">The function is used to start up control loops or check the actuators.</p> <p data-bbox="319 536 940 629">For bumpless changeover to automatic operation (exiting this function), configure an I-action component (reset time).</p> <p data-bbox="319 665 484 694">Specify value:</p> <p data-bbox="319 701 923 758">Select with ►, edit number with ▲, proceed with ENTER.</p> <p data-bbox="319 801 868 893">The APT4000CC is in Hold mode. Press ENTER to return to measurement (Hold remains active for another 20 sec).</p> <p data-bbox="319 929 871 958">Controller output -100 to 0 %: Relay 2 active</p> <p data-bbox="319 1029 878 1058">Controller output 0 to +100 %: Relay 1 active</p> <p data-bbox="319 1179 909 1236">Momentary controller output (adjusted value has not been stored yet)</p>

Controller functions

PID controller

P controller

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

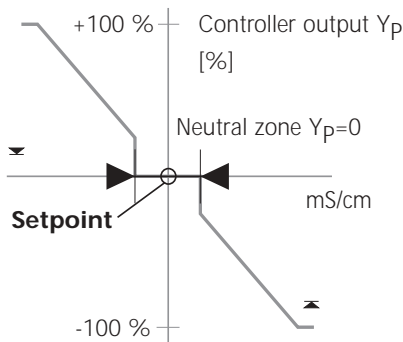
PI controller

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

$$Y_P = \frac{\text{Setpoint} - \text{Meas. value}}{\text{Meas. range}} * K_C$$

with:

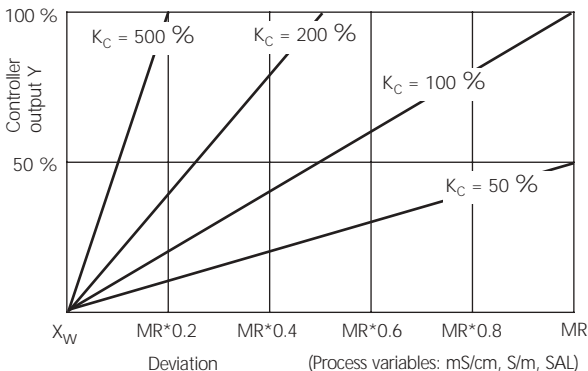
Y_P Proportional action
 T_R Reset time [sec]
 T_D Rate time [sec]
 K_C Controller gain [%]

Neutral zone (Y=0)

Tolerated deviation from setpoint.

With the setting "1mS/cm" a deviation of ± 0.5 mS/cm from the desired value does not activate the controller.

Proportional action (Gradient K_C [%])



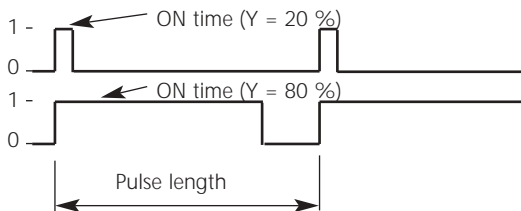
Controller functions

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

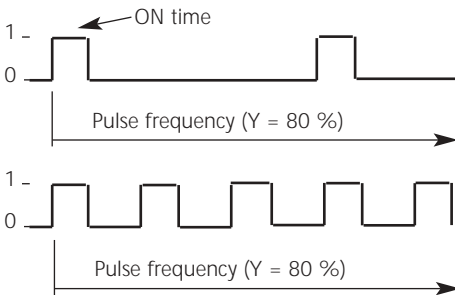


Pulse frequency controller (PFC)


The pulse frequency controller is used to operate a frequency-controlled actuator (metering pump). 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



Error messages (Error Codes)

Errors	Display	Problem Possible causes	Alarm contact	Red LED	Out 1 (22mA)	Out 2 (22mA)
ERR 01	Measured value flashes	Sensor <ul style="list-style-type: none"> • Wrong cell constant • Measurement range violation • SAL > 45 ‰ • Sensor connection or cable defective 	X	X	X	
ERR 02	Measured value flashes	Unsuitable sensor Conductance range > 3500 mS	X	X	X	
ERR 98	" Conf " flashes	System error Configuration or calibration data defective. Completely reconfigure and recalibrate the APT4000CC. 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 APT4000CC must be repaired and recalibrated at the factory.	X	X	X	X
ERR 03		Temperature probe Open or short circuit Temperature range exceeded	X	X	X	X

Errors	Symbol (flashes)	Problem Possible causes	Alarm contact	Red LED	Out 1 (22mA)	Out 2 (22mA)
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 33		Sensocheck: Wrong or defective sensor / Polarization effects at the sensor / cable too long or defective / plug defective	x	x	x	
		<ul style="list-style-type: none"> Temperature outside conversion tables (TC, Conc, SAL) 	Sensoface active see Pg 89			

Operating states

Operating state	Out 1	Out 2	Rel.1/2 Controller	Rel.1/2 Limit value	Clean contact	Alarm contact	LED	Time out
Measurement								
Cal Info (CAL) 0000								20 s
Error Info (CONF) 0000								20 s
Calibration (CAL) 1100								
Calibration (CAL) 0110								
Temp adjustment (CAL) 1015								
Product cal 1 (CAL) 1105								
Product cal 2 (CAL) 1105								
Conf par set 1 (CONF) 1200								20 min
Conf par set 2 (CONF) 1288								20 min
Parameter set 1/2 (CONF) 7654								20 min

Operating state	Out 1	Out 2	Rel.1/2 Controller	Rel.1/2 Limit value	Clean contact	Alarm contact	LED	Time out
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
Clean function	■	■	■		■			
Hold input	■	■	■					

Explanation:



active



as configured (LAST/FIX or LAST/Off)

Sensoface

The little smiley in the display (Sensoface) provides information about the sensor condition (defects, maintenance required, cable capacitance too high).

It alerts to significant sensor polarization or excessive cable capacitance e.g. caused by an unsuitable cable or a cable that is too long. 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 sensor and its wiring.





Sensocheck can be switched off.

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 a 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”). To reset the Sensoface indicator, the defect must be remedied and the APT4000CC be calibrated.

Display	Problem	Status
	Sensor defect	 Wrong or defective sensor Significant polarization of sensor Excessive cable capacitance (also see error message Err 33, Pg 84).
	Temperature error	 Temperature outside range for TC, conc, SAL

Note:

When very fast response times (t_{90}) are required, e.g. when detecting separation layers, Sensocheck should be switched off (see "Specifications" Pg 94).

USP function

According to the "USP" directive (U.S. Pharmacopeia), Section 645 "Water Conductivity", the conductivity of pharmaceutical waters can be monitored online. To do so, the conductivity is measured without temperature compensation and is compared with limit values (see "Temperature/conductivity table as per USP" on Pg 91).

The water is usable if the conductivity is below the USP limit. For higher conductivities, further test steps must be performed according to the directive.

To increase safety the USP limit value can be reduced in the APT4000CC.

To do so, a factor (%) is entered.

Configuration steps

- **out1** menu group:

When USP function has been selected, the measurement range is fixed to 00.00 ... 9.99 μ S/cm. Temperature compensation is switched off. Temperature is monitored (see Pg 31).

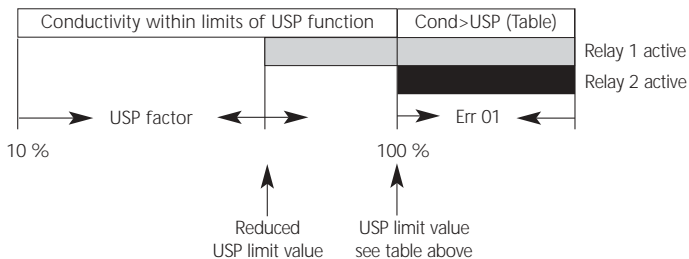
- In the **rL.** menu group select USP as limit function.
Relays 1 and 2 can now be used as USP limit contacts (see Pg 52).
- Reduced limit contact **U1** (Relay 1):
Enter USP factor (reduced limit, configurable in the range 10 % ... 100 %).
Set contact response for relay 1.
Set delay time (see Pg 59).
- Limit contact **U2**
Set contact response for relay 2.
Set delay time (see Pg 59).

Temperature/conductivity table as per USP

Temp in °C	Conductivity in $\mu\text{S/cm}$	Temp in °C	Conductivity in $\mu\text{S/cm}$
0	0.6	55	2.1
5	0.8	60	2.2
10	0.9	65	2.4
15	1.0	70	2.5
20	1.1	75	2.7
25	1.3	80	2.7
30	1.4	85	2.7
35	1.5	90	2.7
40	1.7	95	2.9
45	1.8	100	3.1
50	1.9		

Limits for USP function

Limit contact response U1 (Relay 1) and U2 (Relay 2)



Product line and accessories

Devices

Order No.

Contacting Conductivity Analyzer

APT4000CC-E00

Mounting accessories

Pipe-mount kit

51205988-001

Panel-mount kit

51205990-001

Protective hood

51205989-001

Specifications

Conductivity input

Meas. range

Input for 2-electrode sensors

Conductivity 0.2 $\mu\text{S} \cdot \text{cm}$ to 1000 $\text{mS} \cdot \text{cm}$

Ranges ¹⁾

Conductivity 0.000 ... 9.999 $\mu\text{S}/\text{cm}$
00.00 ... 99.99 $\mu\text{S}/\text{cm}$
000.0 ... 999.9 $\mu\text{S}/\text{cm}$
0000 ... 9999 $\mu\text{S}/\text{cm}$
0.000 ... 9.999 mS/cm
00.00 ... 99.99 mS/cm
000.00 ... 999.9 mS/cm

0.000 ... 9.999 S/m
00.00 ... 99.99 S/m

Resistivity 00.00 ... 99.99 $\text{M}\Omega \cdot \text{cm}$

Concentration 0.00 ... 9.99 % by wt

Salinity 0.0 ... 45 ‰ (0 ... 35 °C)

Response time (T_{90})

< 1 sec (Sensocheck off)

< 3 sec (Sensocheck on)

Measurement error ^{1,2,3)}

< 1 % meas. val. +0.4 $\mu\text{S} \cdot \text{cm}$

Concentration determination

Operating modes ²⁾

-01- NaCl 0.00 ... 9.99% by wt (0 ... 60°C)

-02- HCl 0.00 ... 9.99% by wt (-20 ... 50°C)

-03- NaOH 0.00 ... 9.99% by wt (0 ... 100°C)

-04- H₂SO₄ 0.00 ... 9.99% by wt (-17 ... 110°C)

-05- HNO₃ 0.00 ... 9.99% by wt (-17 ... 50°C)

See graphs on Pg 102 and the following.

Sensor standardization

Operating modes

- Input of cell constant with simultaneous display of conductivity and temperature
- Input of conductivity of calibration solution with simultaneous display of cell constant and temperature
- Product calibration
- Temperature probe adjustment

Adm. cell constant

00.0050 ... 19.9999 cm^{-1}

Sensor monitoring

Sensocheck

Polarization detection and monitoring of cable capacitance

Sensoface

Provides information on the sensor condition (Sensocheck)

Sensor monitor

Direct display of measured values from sensor for validation (resistance / temperature)

USP function

Water monitoring in the pharmaceutical industry (USP) with possibility to enter a limit value (%)
Output via relay contact

Temperature input ^{*)}

	Pt100 / Pt1000/ NTC 30 k Ω / NTC 8.55 k Ω (Betatherm) 2-wire connection, adjustable
Ranges	Pt100 / Pt1000: -20 ... +200 °C (-4 ... +392 °F) NTC 30 k Ω -20 ... +150 °C (-4 ... +302 °F) NTC 8.55 k Ω -10 ... +130 °C (+14 ... +266 °F)
Resolution	0.1 °C / 1 °F
Measurement error ^{1,2,3)}	0.5 K (<1 K for Pt100; <1 K for NTC >100 °C)

Temperature compensation ^{*)}

(Reference temp 25 °C)

- (OFF)** none
- (Lin)** Linear characteristic 00.00 ... 19.99 %/K
- (NLF)** Natural waters to EN 27888
- (nACL)** Ultrapure water with NaCl traces
(0 ... 120°C)
- (HCL)** Ultrapure water with HCl traces (0...120°C)
- (nH3)** Ultrapure water with NH₃ traces (0...120°C)

Specifications

Hold input

Function

Switching voltage

Galv. separated (OPTO coupler)

Switches APT4000CC to Hold mode

0 ... 2 V (AC/DC) inactive

10 ... 30 V (AC/DC) active

CONTROL input

Function

Switching voltage

Galv. separated (OPTO coupler)

Switch-over to second parameter set

0 ... 2 V (AC/DC) Parameter set 1

10 ... 30 V (AC/DC) Parameter set 2

Output 1

Measured variable ¹⁾

Characteristic

Overrange ¹⁾

Output filter ¹⁾

Measurement error ¹⁾

Start/end of scale

Min. span

0/4 ... 20 mA, max. 10 V, floating
(galv. connected to output 2)

Conductivity, resistivity, concentration,
or salinity

Linear or logarithmic

22 mA in the case of error messages

Low-pass, filter time constant 0 ... 120 sec

< 0.3 % current value + 0.05 mA

As desired within range

LIN: 5 % of selected range

LOG: 1 decade

Output 2

Process variable

Overrange ¹⁾

Output filter ¹⁾

Meas. error ¹⁾

Start/end of scale ¹⁾

Adm. span

0/4 ... 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 ... 120 sec

< 0.3 % current value + 0.05 mA

-20 to 200 °C / -4 ... 392 °F

20 ... 320 K (36 to 608 °F)

Alarm contact

Contact ratings

Contact response

Alarm delay

Relay contact, floating

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

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

N/C (fail-safe type)

0000 ... 0600 sec

Limit values

	Output via relay contacts R1, R2 (see PID process controller)
	Contacts R1, R2 floating but inter-connected
Contact ratings *)	AC < 250 V / < 3 A / < 750 VA DC < 30 V / < 3 A / < 90 W
Contact response *)	N/O or N/C
Delay *)	0000 ... 9999 sec
Switching points *)	As desired within range
Hysteresis *)	0 ... 50 % full scale

PID process controller

	Output via relay contacts R1, R2 (see limit values)
Setpoint *)	As desired within range
Neutral zone *)	As desired within range
Proportional action *)	Controller gain K_C : 0010 ... 9999 %
Integral action *)	Reset time T_R : 0000 ... 9999 sec (0000 sec = no integral action)
Derivative action *)	Rate time T_D : 0000 ... 9999 sec (0000 sec = no derivative action)
Controller type *)	Pulse length or pulse frequency controller
Pulse period *)	0001 ... 0600 sec, min. ON time 0.5 sec (pulse length controller)
Max. pulse frequency *)	0001 ... 0180 min ⁻¹ (pulse frequency controller)

Clean function / Parameter set 2 *)

Clean / PSet2	Relay contact, floating, for controlling a rinsing probe or signaling that 2nd parameter set is active
Contact ratings	AC < 250 V / < 3 A / < 750 VA DC < 30 V / < 3 A / < 90 W
Contact response	N/O when signaling parameter set 2 N/O or N/C when used as Clean contact *)
Rinsing interval *)	000.0 ... 999.9 h (000.0 h = Clean function switched off)
Rinse duration *)	0000 ... 1999 sec

Specifications

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 Sensoface)
	5 status bars "MEAS", "CAL", "ALARM", "CLEAN", "CONF"
	18 further icons for configuration and messages
Alarm indication	Red LED in case of alarm or Hold, user defined

Keypad

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 sensor signal (resistance/temperature)
Relay test	Manual control of the four switching contacts

Parameter sets *)

Two selectable parameter sets for different process phases
Switchover via CONTROL input or manually
Signaling via relay contact PSet2

Data retention

Parameters and calibration data > 10 years (EEPROM)

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
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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	<ul style="list-style-type: none">• 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

Calibration solutions

Potassium chloride solutions

(Conductivity in mS/cm)

Temperature	Concentration *)		
[°C]	0.01 mol/l	0.1 mol/l	1 mol/l
0	0.776	7.15	65.41
5	0.896	8.22	74.14
10	1.020	9.33	83.19
15	1.147	10.48	92.52
16	1.173	10.72	94.41
17	1.199	10.95	96.31
18	1.225	11.19	98.22
19	1.251	11.43	100.14
20	1.278	11.67	102.07
21	1.305	11.91	104.00
22	1.332	12.15	105.94
23	1.359	12.39	107.89
24	1.386	12.64	109.84
25	1.413	12.88	111.80
26	1.441	13.13	113.77
27	1.468	13.37	115.74
28	1.496	13.62	
29	1.524	13.87	
30	1.552	14.12	
31	1.581	14.37	
32	1.609	14.62	
33	1.638	14.88	
34	1.667	15.13	
35	1.696	15.39	
36		15.64	

*) Data source: K. H. Hellwege (Editor), H. Landolt, R. Börnstein:
Zahlenwerte und Funktionen ..., volume 2, part. volume 6

Sodium chloride solutions

(Conductivity in mS/cm)

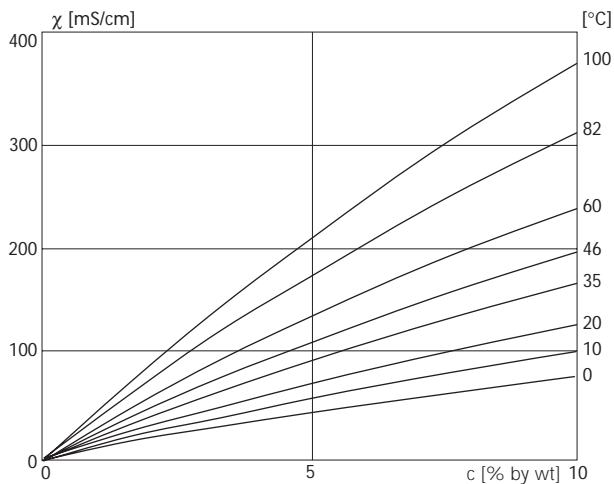
Temperature [°C]	Concentration		
	0.01 mol/l ^{*)}	0.1 mol/l ^{*)}	saturated ^{**)}
0	0.631	5.786	134.5
1	0.651	5.965	138.6
2	0.671	6.145	142.7
3	0.692	6.327	146.9
4	0.712	6.510	151.2
5	0.733	6.695	155.5
6	0.754	6.881	159.9
7	0.775	7.068	164.3
8	0.796	7.257	168.8
9	0.818	7.447	173.4
10	0.839	7.638	177.9
11	0.861	7.831	182.6
12	0.883	8.025	187.2
13	0.905	8.221	191.9
14	0.927	8.418	196.7
15	0.950	8.617	201.5
16	0.972	8.816	206.3
17	0.995	9.018	211.2
18	1.018	9.221	216.1
19	1.041	9.425	221.0
20	1.064	9.631	226.0
21	1.087	9.838	231.0
22	1.111	10.047	236.1
23	1.135	10.258	241.1
24	1.159	10.469	246.2
25	1.183	10.683	251.3
26	1.207	10.898	256.5
27	1.232	11.114	261.6
28	1.256	11.332	266.9
29	1.281	11.552	272.1
30	1.306	11.773	277.4
31	1.331	11.995	282.7
32	1.357	12.220	288.0
33	1.382	12.445	293.3
34	1.408	12.673	298.7
35	1.434	12.902	304.1
36	1.460	13.132	309.5

*) Data source: Test solutions calculated according to DIN IEC 746-3

**) Data source: K. H. Hellwege (Editor), H. Landolt, R. Börnstein:
Zahlenwerte und Funktionen ..., volume 2, part. volume 6

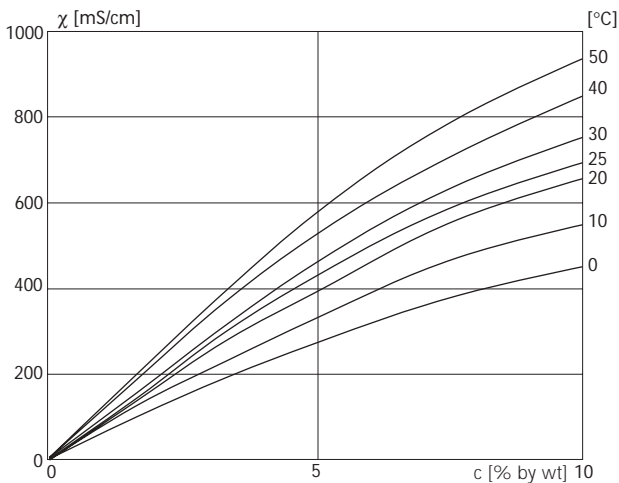
Concentration curves

-01- Sodium chloride solution NaCl



Conductivity in dependence on substance concentration and process temperature for sodium chloride solution (NaCl)

-02- Hydrochloric acid solution HCl

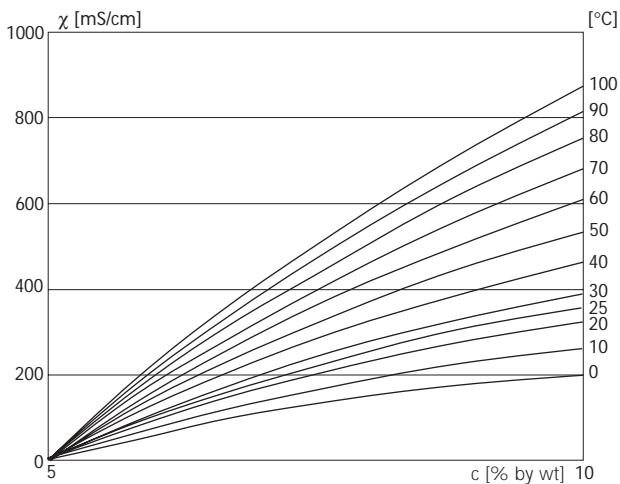


Conductivity in dependence on substance concentration and process temperature for hydrochloric acid (HCl)

Source: Haase/Sauermann/Dücker; Z. phys. Chem. New Edition, Vol. 47 (1965)

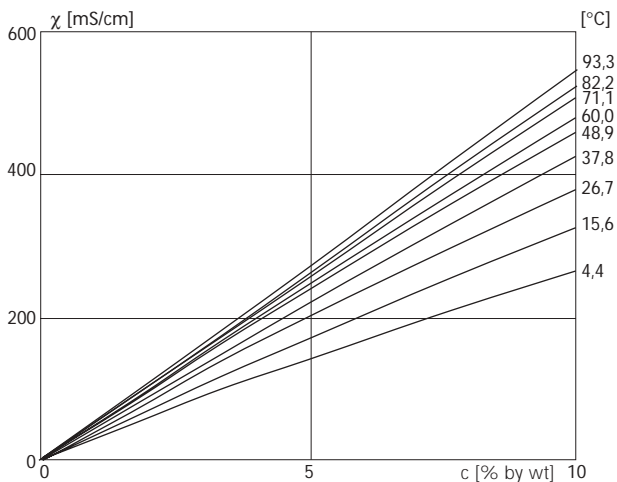
Concentration curves

-03- Sodium hydroxide solution NaOH



Conductivity in dependence on substance concentration and process temperature for sodium hydroxide solution (NaOH)

-04- Sulfuric acid H_2SO_4

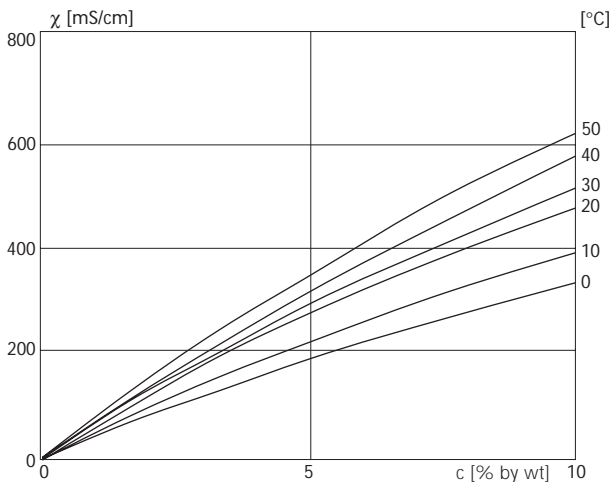


Conductivity in dependence on substance concentration and process temperature for sulfuric acid (H_2SO_4)

Source: Darling; Journal of Chemical and Engineering Data; Vol. 9 No. 3, July 1964

Concentration curves

-05- Nitric acid HNO_3



Conductivity in dependence on substance concentration and process temperature for nitric acid (HNO_3)

Source: Haase/Sauermann/Dücker; Z. phys. Chem. New Edition, Vol. 47 (1965)

Glossary

Conductance Conductance G [S] = $1 / R$ [Ω]

Conductivity Conductivity χ [S/cm] = G [S] · c [1/cm]

Conductivity sensor The APT4000CC allows connection of 2-electrode sensors. The cell constant of the sensor in use must be entered or be determined using a calibration solution taking account of the temperature. A special device variant (APT4000TC) is provided for toroidal (electrodeless) sensors.

Temperature coefficient With temperature compensation activated, the measured value is calculated to the value at the reference temperature (25 °C) using the temperature coefficient.

Temperature compensation Calculates the measured conductivity value for a reference temperature.

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Mode codes

The mode codes allow fast access to the functions

Calibration

Key + Code	Description
<input type="checkbox"/> CAL 0000	Cal Info Display of cell constant
<input type="checkbox"/> CAL 0110	Calibration by entry of solution
<input type="checkbox"/> CAL 1100	Calibration by entry of cell constant
<input type="checkbox"/> CAL 1105	Product calibration
<input type="checkbox"/> CAL 1015	Adjusting temp probe

Configuration

Key + Code	Description
<input type="checkbox"/> CONF 0000	Error Info Display of last error
<input type="checkbox"/> CONF 1200	Configuring parameter set 1
<input type="checkbox"/> CONF 1288	Configuring parameter set 2
<input type="checkbox"/> CONF 2222	Sensor monitor Display resistance and temp.
<input type="checkbox"/> CONF 7654	Parameter set 1/2 Switchover internal / external
<input type="checkbox"/> CONF 5555	Current source 1 Output current 1 specified
<input type="checkbox"/> CONF 5556	Current source 2 Output current 2 specified
<input type="checkbox"/> CONF 5557	Relay test Manual test of contacts
<input type="checkbox"/> CONF 5559	Manual controller Manual specification of controller output