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10/07

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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 APT4000TC Analyzer.

Contacts

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

http://hpsweb.honeywell.com

Telephone
Contact us by telephone at the numbers listed below.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States and Canada</td>
<td>Honeywell 1-800-423-9883</td>
</tr>
<tr>
<td></td>
<td>1-888-423-9883 Q&amp;A Faxback</td>
</tr>
<tr>
<td></td>
<td>(TACFACS)</td>
</tr>
</tbody>
</table>

Address
Honeywell Field Solutions
512 Virginia Drive
Fort Washington, PA 19034
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**Intended use**
The APT4000TC is used for measurement of electrical conductivity and temperature in liquids using electrodeless (toroidal) sensors.
Fields of application are: biotechnology, chemical industry, environment, food processing, water/waste-water treatment. The sturdy 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 device 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®
Safety information

Be sure to read and observe the following instructions!
The device has been manufactured using state of the art technology and it complies with applicable safety regulations. When operating the device, certain conditions may nevertheless lead to danger for the operator or damage to the device.

⚠️ CAUTION

Commissioning may only be carried out by trained experts. Whenever it is likely that protection has been impaired, the device shall be made inoperative and secured against unintended operation. The protection is likely to be impaired if, for example:

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

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

⚠️ CAUTION

Before commissioning it must be proved that the device may be connected with other equipment.
Overview of APT4000TC

- receive hi
- receive lo
- drain
- send lo
- send hi
- shield
- RTD
- RTD
- HOLD
- HOLD/CONTROL
- CONTROL

Cond input

Temp input

Output 1

Output 2

+ Output 1

- Output 1/2

+ Output 2

R1

R2

Relay 1

Relay 1/2

Relay 2

Alarm

Alarm

Clean / PSet2

Clean / PSet2

Power

Power

Control input

Hold input

Clean PSet2

Power

Receive hi

Receive lo

Drain

Send lo

Send hi

Shield

RTD

RTD

Hold

Hold

Control

Clean PSet2
Assembly

Package contents
Check the shipment for transport damage and completeness. The package should contain:
- Front unit of APT4000TC
- Rear unit
- Bag containing small parts
- This instruction manual
- Specific test report

Fig.: Assembling the enclosure

1 Jumper (2 x)
2 Washer (1 x), for conduit mounting: Place washer between enclosure and nut
3 Cable tie (3 x)
4 Hinge pin (1 x), insertable from either side
5 Enclosure screw (4 x)
6 Sealing insert (1 x)
7 Rubber reducer (1 x)
8 Cable gland (3 x)
9 Filler plug (3 x)
10 Hexagon nut (5 x)
11 Sealing plug (2 x), for sealing in case of wall mounting
Mounting plan

1 Cable gland (3 pieces)
2 Knockouts for cable gland or conduit 1/2”, ø 21.5 mm (2 x)
   Conduits not included!
3 Knockouts for pipe mounting (4 x)
4 Knockouts for wall mounting (2 x)

All dimensions in mm.

Fig.: Mounting plan
Pipe mounting, panel mounting

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

Fig.: 51205988-001 pipe-mount kit

All dimensions in mm.

Fig.: 51205988-001 protective hood for wall and pipe mounting

All dimensions in mm.
1 Screw (4 x)
2 Gasket (1 x)
3 Panel
4 Span piece (4 x)
5 Threaded sleeve (4 x)

Panel cutout 138 x 138 mm (DIN 43700)

All dimensions in mm.

Fig.: 51205990-001 panel-mount kit
Installation and connection

Installation instructions

- Installation may only be carried out by trained and qualified personnel in accordance with the instruction manual and as per applicable standards and regulations.
- Be sure to observe the technical specifications and input ratings during installation.
- Be sure not to notch the conductor when stripping the insulation.
- Before connecting the device to the power supply, make sure that its voltage lies within the range 20.5 to 253V 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).

CAUTION

Be sure to observe the additionally applicable national safety instructions!

Terminal assignments

Fig.: APT4000TC terminal assignments
1) Terminals for temperature probe and outer shield
2) Terminals for toroidal conductivity sensor
3) Terminals for power supply

Fig.: Information on installation, rear side of device

**Division 2 wiring**

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

Conductivity measurement with Honeywell 5000TC toroidal conductivity sensor
The Honeywell 5000TC toroidal conductivity sensor is used to measure low to highest conductivity values. It can be used for measurements in safe areas.

Note:
For special mounting conditions of the sensor, the cell factor can vary between 4.0 and 4.5. Therefore, the user should perform a wet calibration of each new sensor to determine the exact cell factor.

Settings for Honeywell 5000TC toroidal conductivity sensor

<table>
<thead>
<tr>
<th>Temp probe</th>
<th>Menu</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CONF 1200</td>
<td>Pt 1000</td>
</tr>
<tr>
<td>Cell factor</td>
<td>CAL 1100</td>
<td>4.44</td>
</tr>
</tbody>
</table>
User interface and display

User interface

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

1. Mode code entry
2. Parameter set 2 selected
3. Temperature
4. Current output
5. Limit values
6. Alarm
7. Sensocheck
8. Calibration
9. Interval/response time
10. Wash contact
11. Measurement symbol
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
   - Configuration mode
14. Lower display
15. Manual temp indicator
16. Hold mode active
17. Waiting time running
18. Sensor data
19. Main display
20. Sensoface
# Operation: Keypad

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAL</td>
<td>Start, end calibration</td>
</tr>
<tr>
<td>CONF</td>
<td>Start, end configuration</td>
</tr>
<tr>
<td></td>
<td>Select digit position</td>
</tr>
<tr>
<td></td>
<td>(selected position flashes)</td>
</tr>
<tr>
<td>▲</td>
<td>Edit digit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENTER</td>
<td>Cal Info:</td>
</tr>
<tr>
<td></td>
<td>Display of cell factor and zero point</td>
</tr>
<tr>
<td>CONF</td>
<td>Error Info: Display of last error message</td>
</tr>
<tr>
<td></td>
<td>Start GainCheck device self-test</td>
</tr>
</tbody>
</table>

- Calibration: Continue in program flow
- Configuration: Confirm entries, next configuration step
- Measuring mode: Display output current
Safety functions

**Sensocheck, Sensoface sensor monitoring**
Sensocheck continuously monitors the sensor and its wiring. Sensocheck can be switched off (see Configuration of alarm settings).

**Sensoface** provides information on the conductivity sensor condition. The primary coil and its lines are continuously monitored for short circuits, the secondary coil and its lines are checked for open circuits. The three Sensoface indicators inform of the sensor condition.

**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: ⚠️ HOLD

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 device 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 device only returns to measuring mode after ENTER is pressed and 20 seconds have 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).

<table>
<thead>
<tr>
<th>Hold active</th>
<th>Hold inactive</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 ... 30 V AC/DC</td>
<td>0 ... 2 V AC/DC</td>
</tr>
</tbody>
</table>

Power supply 12...24 V AC/DC
Process control system (PCS)
# Configuration

In the Configuration mode you set the device parameters. The device 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.

<table>
<thead>
<tr>
<th>Configuring</th>
<th>Press CONF.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter set 1:</td>
<td>Enter mode code “1200”: <strong>Edit parameter set 1</strong> with ▶️ and ▲, confirm/proceed with ENTER.</td>
</tr>
<tr>
<td>Parameter set 2:</td>
<td>Enter mode code “1288”: <strong>Edit parameter set 2</strong> with ▶️ and ▲, confirm/proceed with ENTER.</td>
</tr>
</tbody>
</table>

**Hold**

During configuration the device remains in the Hold mode.

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, “Configuration” mode indicator 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. 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).
### 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**.

<table>
<thead>
<tr>
<th>Select menu group</th>
<th>Menu group</th>
<th>Code</th>
<th>Display</th>
<th>Select menu item</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Output 1</td>
<td>o1.</td>
<td><img src="image" alt="Output 1 Menu" /></td>
<td>Menu item 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Menu item 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>...</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Menu item ...</td>
</tr>
<tr>
<td></td>
<td>Output 2</td>
<td>o2.</td>
<td><img src="image" alt="Output 2 Menu" /></td>
<td><img src="image" alt="Temperature compensation Menu" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><img src="image" alt="Alarm settings Menu" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><img src="image" alt="Relay / Controller Menu" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><img src="image" alt="CLEAN contact / Signaling parameter set 2 Menu" /></td>
</tr>
<tr>
<td></td>
<td>Relay / Controller</td>
<td>rL.</td>
<td><img src="image" alt="Relay / Controller Menu" /></td>
<td>Previous menu group: <img src="image" alt="Up Arrow" /></td>
</tr>
<tr>
<td></td>
<td>CLEAN contact /</td>
<td>Cn.</td>
<td><img src="image" alt="CLEAN contact / Signaling parameter set 2 Menu" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Signaling parameter set 2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

*Image placeholders:* ![Output 1 Menu](image), ![Output 2 Menu](image), ![Temperature compensation Menu](image), ![Alarm settings Menu](image), ![Relay / Controller Menu](image), ![CLEAN contact / Signaling parameter set 2 Menu](image)
## Overview of configuration steps

<table>
<thead>
<tr>
<th>Code</th>
<th>Menu</th>
<th>Selection / Default</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>out1</strong></td>
<td><strong>Output 1</strong></td>
<td><strong>(Factory setting bold print)</strong></td>
</tr>
<tr>
<td>o1.</td>
<td>Sensor selection *</td>
<td>5000 TC / other</td>
</tr>
<tr>
<td></td>
<td>other*: Entry of cell factor</td>
<td>xx.xxx c</td>
</tr>
<tr>
<td></td>
<td>Enter transfer ratio</td>
<td>xxx.xx</td>
</tr>
<tr>
<td></td>
<td>Select measuring frequency</td>
<td>8 kHz / 12 kHz</td>
</tr>
<tr>
<td></td>
<td>Select temperature probe</td>
<td>Pt100 / Pt1000 / NTC100</td>
</tr>
<tr>
<td></td>
<td>Select measured variable</td>
<td>mS/cm, S/m, Conc, SAL</td>
</tr>
<tr>
<td></td>
<td>Select solution (Conc)</td>
<td>NaCl, HCl, NaOH, H₂SO₄, HNO₃ (Code 01 ... 10) (see meas. ranges)</td>
</tr>
<tr>
<td></td>
<td>Select current range</td>
<td>0-20 mA / 4-20 mA</td>
</tr>
<tr>
<td></td>
<td>Characteristic (not for SAL, Conc)</td>
<td>Linear / Logarithmic</td>
</tr>
<tr>
<td></td>
<td>LIN: Enter current start</td>
<td>000.0 mS (xxx.x mS)</td>
</tr>
<tr>
<td></td>
<td>Enter current end</td>
<td>100.0 mS (xxx.x mS)</td>
</tr>
<tr>
<td></td>
<td>LOG: Enter current start</td>
<td>0.1 mS (in decades: 0.1...1000)</td>
</tr>
<tr>
<td></td>
<td>Enter current end</td>
<td>100 mS (in decades: 0.1...1000)</td>
</tr>
<tr>
<td></td>
<td>Time constant of output filter</td>
<td>0 sec (0 ... 120 sec)</td>
</tr>
<tr>
<td></td>
<td>22 mA signal for error messages</td>
<td>ON / OFF</td>
</tr>
<tr>
<td></td>
<td>Signal behavior during HOLD</td>
<td>Last / Fix</td>
</tr>
<tr>
<td></td>
<td>Fix: Enter fixed value</td>
<td>021.0 mA (000.0 ... 21.0 mA)</td>
</tr>
</tbody>
</table>

<p>| <strong>out2</strong> | <strong>Output 2</strong> | |
| o2. | Select temperature unit | °C / °F |
| | Select current range | 0 - 20 mA / 4 - 20 mA |
| | Enter current start | 000.0 °C (xxx.x °C) |
| | Enter current end | 100.0 °C (xxx.x °C) |
| | Time constant of output filter | 0 sec (0 ... 120 sec) |
| | 22 mA signal for temp error | ON / OFF |
| | Signal behavior during HOLD | LAST / FIX |
| | Fix: Enter fixed value | 21.0 mA (00.0 ... 21.0 mA) |</p>
<table>
<thead>
<tr>
<th>Code</th>
<th>Menu</th>
<th>Selection / Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>tc.</td>
<td>Temperature compensation</td>
<td>OFF / Lin / nLF</td>
</tr>
<tr>
<td></td>
<td>Lin: Enter temperature coefficient</td>
<td>02.00 %/K (xx.xx %/K)</td>
</tr>
<tr>
<td>AL.</td>
<td>Alarm settings</td>
<td>ON / OFF</td>
</tr>
<tr>
<td></td>
<td>Select Sensocheck</td>
<td>0010 s (xxxx s)</td>
</tr>
<tr>
<td></td>
<td>Enter alarm delay</td>
<td>ON / OFF</td>
</tr>
<tr>
<td></td>
<td>LED in HOLD mode</td>
<td></td>
</tr>
<tr>
<td>rLAY</td>
<td>Relay 1/2: Limit values, controller</td>
<td>LiMIT / CtROL / USP</td>
</tr>
<tr>
<td>rL.</td>
<td>Select limit function / controller</td>
<td>Lo / Hi</td>
</tr>
<tr>
<td></td>
<td>Select contact function</td>
<td>N/O / N/C</td>
</tr>
<tr>
<td></td>
<td>Select contact response</td>
<td>001.0 mS (xxxx)</td>
</tr>
<tr>
<td></td>
<td>Enter switching point</td>
<td>0010 s (xxxx)</td>
</tr>
<tr>
<td></td>
<td>Enter hysteresis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enter delay</td>
<td></td>
</tr>
<tr>
<td>L1.</td>
<td>Select contact function</td>
<td>001.0 mS (xxxx)</td>
</tr>
<tr>
<td></td>
<td>Select contact response</td>
<td>0100 % (xxxx %)</td>
</tr>
<tr>
<td></td>
<td>Enter switching point</td>
<td>0000 sec (xxxx sec)</td>
</tr>
<tr>
<td></td>
<td>Enter hysteresis</td>
<td>0000 sec (xxxx sec)</td>
</tr>
<tr>
<td></td>
<td>Enter delay</td>
<td>060/min (xxxx/min)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y Last / Y Off</td>
</tr>
<tr>
<td>L2.</td>
<td>Select contact function</td>
<td>001.0 mS (xxxx)</td>
</tr>
<tr>
<td></td>
<td>Select contact response</td>
<td>0100 % (xxxx %)</td>
</tr>
<tr>
<td></td>
<td>Enter switching point</td>
<td>0000 sec (xxxx sec)</td>
</tr>
<tr>
<td></td>
<td>Enter hysteresis</td>
<td>0000 sec (xxxx sec)</td>
</tr>
<tr>
<td></td>
<td>Enter delay</td>
<td>060/min (xxxx/min)</td>
</tr>
<tr>
<td>Ct.</td>
<td>Enter neutral zone</td>
<td>0010 s (xxxx sec)</td>
</tr>
<tr>
<td></td>
<td>(P) Controller gain Kp</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(I) Reset time TR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(D) Rate time TD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controller type</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PLC: Pulse length</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PFC: Pulse frequency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Select HOLD behavior</td>
<td></td>
</tr>
<tr>
<td>Cln</td>
<td>Contact CLEAN / PSet2</td>
<td>rinse / PSet2</td>
</tr>
<tr>
<td>Cn.</td>
<td>(Select Cleaning / Parameter set signaling)*</td>
<td>rinse / PSet2</td>
</tr>
<tr>
<td></td>
<td>Rinse interval</td>
<td>000.0 h (xxx.x h)</td>
</tr>
<tr>
<td></td>
<td>Rinse duration</td>
<td>0060 sec (xxxx sec)</td>
</tr>
<tr>
<td></td>
<td>Contact response</td>
<td>N/O / N/C</td>
</tr>
</tbody>
</table>

* These parameters are only edited in parameter set 1. They are valid for both parameter sets.
Configuration
Output 1
Select sensor type

1 Press CONF key.
2 Enter mode code 1200.
3 Select Output 1 menu group using arrow keys. All items of this menu group are indicated by the code “o1.”
4 Press ENTER to select menu, edit with arrow keys (see Pg 27). Confirm (and proceed) with ENTER.
5 End: Press CONF, then ENTER.

Sensor selection
Select process variable
Select solution (Conc)
Select 0-20 / 4-20 mA
Characteristic: LIN / LOG
Enter current start
Enter current end
Set output filter
22 mA in the case of error
Hold mode
<table>
<thead>
<tr>
<th>Code</th>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>o1.</td>
<td><img src="image" alt="1200" /></td>
<td>Select configuration (Press CONF.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>After correct input a welcome text (CONF) is displayed for approx. 3 sec.</td>
<td>For parameter set 1: Enter mode code “1200” (Select position with ▲ arrow key and edit number with ▲ key. When the display reads “1200”, press ENTER to confirm.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="1288" /></td>
<td>For parameter set 2: Enter mode code “1288” (Select position with ▲ arrow key and edit number with ▲ key. When the display reads “1288”, press ENTER to confirm.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Hold" /></td>
<td>Device is in the Hold mode (HOLD icon is on).</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Sensor" /></td>
<td>Select sensor*: Select with arrow key ▲. Proceed with ENTER.</td>
<td>5000 TC (5000 TC/other)</td>
</tr>
</tbody>
</table>

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

* These parameters are only edited in parameter set 1. They are valid for both parameter sets.
Configuration
Output 1
Select sensor and temperature probe

1 Press **CONF** key.
2 Enter mode code **1200**.
3 Select **Output 1** menu group using arrow keys. All items of this menu group are indicated by the code “o1.”
4 Press **ENTER** to select menu, edit with arrow keys (see Pg 29).
   Confirm (and proceed) with **ENTER**.
5 End: Press **CONF**, then **ENTER**.

---

Sensor selection

- Select process variable
- Select solution (Conc)
- Select 0-20 / 4-20 mA
- Characteristic: LIN / LOG
- Enter current start
- Enter current end
- Set output filter
- 22 mA in the case of error
- Hold mode
<table>
<thead>
<tr>
<th>Code</th>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
</table>
| o1.  | ![Display](image1) | With **other** selected, the sensor parameters are entered separately:  
- Enter cell factor:  
  (Select position with ▶ key and edit number with ◀ key).  
  Proceed with **ENTER**  
- Enter transfer ratio.  
  Proceed with **ENTER**. | **12 KHZ**  
(8 KHZ 12 KHZ) |
|      | ![Display](image2) | ![Display](image3) | ![Display](image4) |
|      | ![Display](image5) | ![Display](image6) | ![Display](image7) |
|      | ![Display](image8) | ![Display](image9) | ![Display](image10) |
|      | ![Display](image11) | ![Display](image12) | ![Display](image13) |

**Note**: When **other** is called once more, the last sensor parameters are displayed and can be edited.

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

* These parameters are only edited in parameter set 1. They are valid for both parameter sets.
Configuration
Output 1
Select process variable

1. Press **CONF** key.
2. Enter mode code **1200**.
3. Select **Output 1** menu group using arrow keys. All items of this menu group are indicated by the code “o1.”
4. Press **ENTER** to select menu, edit with arrow keys (see Pg 31). Confirm (and proceed) with **ENTER**.
5. End: Press **CONF**, then **ENTER**.

Sensor selection

Select process variable
Select solution (Conc)
Select 0-20 / 4-20 mA
Characteristic: LIN / LOG
Enter current start
Enter current end
Set output filter
22 mA in the case of error
Hold mode
<table>
<thead>
<tr>
<th>Code</th>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td></td>
<td>Select process variable:</td>
<td>000.0 mS</td>
</tr>
<tr>
<td></td>
<td>(0.000 mS 00.00 mS 000.0 mS 0000 mS 0.000 S/m 00.00 S/m 00.00 SAL 00.00 % (Conc))</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Select with ▶ arrow key Proceed with <strong>ENTER</strong>.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conductivity:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 0.000 ... 9.999 mS/cm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 00.00 ... 99.99 mS/cm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 000.0 ... 999.9 mS/cm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 0000 ... 1999 mS/cm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 0.000 ... 9.999 S/m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 00.00 ... 99.99 S/m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Salinity (SAL):</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 0.0 ... 45.0 % (0 ... 35 °C)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concentration (Conc):</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 0.00 ... 9.99 % by wt</td>
<td></td>
</tr>
</tbody>
</table>

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

Output 1
Concentration measurement: Select solution

1 Press **CONF** key.
2 Enter mode code **1200**.
3 Select **Output 1** menu group using arrow keys. All items of this menu group are indicated by the code “o1.”
4 Press **ENTER** to select menu, edit with arrow keys (see Pg 33). Confirm (and proceed) with **ENTER**.
5 End: Press **CONF**, then **ENTER**.

Sensor selection

Select process variable

Select solution (Conc)

Select 0-20 / 4-20 mA

Characteristic: LIN / LOG

Enter current start

Enter current end

Set output filter

22 mA in the case of error

Hold mode
<table>
<thead>
<tr>
<th>Code</th>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td><img src="image" alt="Code 01 Display" /></td>
<td>Only with 00.00 % Conc can you select the process solution: Select with ➤ arrow key</td>
<td>-01-SOL (-01-SOL -02-SOL -03-SOL -04-SOL -05-SOL -06-SOL -07-SOL -08-SOL -09-SOL -10-SOL)</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Code 02 Display" /></td>
<td>-01- NaCl (0 ... 26 % by wt) -02- HCl (0 ... 18 % by wt) -03- NaOH (0 ... 14 % by wt) -04- H₂SO₄ (0 ... 30 % by wt) -05- HNO₃ (0 ... 30 % by wt) -06- H₂SO₄ (92 ... 99 % by wt) -07- HCl (22 ... 29 % by wt) -08- HNO₃ (35 ... 36 % by wt) -09- H₂SO₄ (32 ... 84 % by wt) -10- NaOH (18 ... 50 % by wt)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Code 06 Display" /></td>
<td>Proceed with ENTER</td>
<td></td>
</tr>
</tbody>
</table>

**Concentration curves / ranges**

(See Appendix: Concentration curves / ranges)

The concentration curves of many substances show a maximum. This means that if the substance concentration continues to increase and the temperature remains constant, the conductivity will drop. Therefore, a one-to-one correlation of values is only possible in defined ranges. These partial ranges must be selected as measurement ranges in the configuration.

Example:
Measurement ranges for sulphuric acid

![Concentration curves](image)
Configuration

Output 1

Output current range. LIN/LOG characteristic
LIN characteristic: Current start / end

1. Press CONF key.
2. Enter mode code 1200.
3. Select Output 1 menu group using arrow keys. All items of this menu group are indicated by the code “o1.”
4. Press ENTER to select menu, edit with arrow keys (see Pg 35).
   Confirm (and proceed) with ENTER.
5. End: Press CONF, then ENTER.
### Assignment of measured values:
#### Current start and current end

<table>
<thead>
<tr>
<th>Example 1:</th>
<th>Example 2: Range 100...200 mS/cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range 0...200 mS/cm</td>
<td>Advantage: Higher resolution in range of interest</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>[mS/cm]</th>
<th>[mS/cm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>200</td>
</tr>
</tbody>
</table>

Conductivity: 200 - 0

Output current: 4 - 20 mA

---

### Table: Output Characteristics

<table>
<thead>
<tr>
<th>Code</th>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td><img src="image1.png" alt="Display Image" /></td>
<td>Set output current range&lt;br&gt; Select with ▶ arrow key.&lt;br&gt; Proceed with <strong>ENTER</strong></td>
<td><strong>4-20 mA</strong>&lt;br&gt;(0 - 20 mA 4 - 20 mA)</td>
</tr>
<tr>
<td></td>
<td><img src="image2.png" alt="Display Image" /></td>
<td>Select output characteristic&lt;br&gt; Select with ▶ arrow key.&lt;br&gt; Proceed with <strong>ENTER</strong>&lt;br&gt;(Step omitted for % (Conc) and SAL)</td>
<td><strong>LIN</strong>&lt;br&gt;(LIN / LOG)</td>
</tr>
<tr>
<td></td>
<td><img src="image3.png" alt="Display Image" /></td>
<td>With <strong>LIN</strong> selected:&lt;br&gt; • Enter current start&lt;br&gt; (lower end of scale).&lt;br&gt; Select with ▶ key, edit number with ▲ key, proceed with <strong>ENTER</strong>.&lt;br&gt; • Enter current end&lt;br&gt; (upper end of scale).&lt;br&gt; Proceed with <strong>ENTER</strong></td>
<td><strong>000.0 mS</strong>&lt;br&gt;(xxx.x mS) <strong>100.0 mS</strong>&lt;br&gt;(xxx.x mS)</td>
</tr>
</tbody>
</table>
Configuration

Output 1

Output current range. LIN/LOG characteristic
LOG characteristic: Current start / end

1. Press CONF key.
2. Enter mode code 1200.
3. Select Output 1 menu group using arrow keys. All items of this menu group are indicated by the code “o1.”
4. Press ENTER to select menu, edit with arrow keys (see Pg 37). Confirm (and proceed) with ENTER.
5. End: Press CONF, then ENTER.

Sensor selection
Select process variable
Select solution (Conc)
Select 0-20 / 4-20 mA
Characteristic: LIN / LOG
Enter current start
Enter current end
Set output filter
22 mA in the case of error
Hold mode
<table>
<thead>
<tr>
<th>Code</th>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
</table>
| o1.  | ![Display](image) | With LOG selected:  
• Enter current start (lower end of scale).  
Select with ▼ key, edit number with ▲ key, proceed with ENTER. | 0.1 mS  
(0.001 mS  
0.01 mS  
1.0 mS  
10 mS  
100 mS  
1000 mS) |
|      | ![Display](image) | • Enter current end (upper end of scale).  
Select with ▼ key, edit number with ▲ key.  
Proceed with ENTER | 100 mS  
(0.001 mS  
0.01 mS  
1.0 mS  
10 mS  
100 mS  
1000 mS) |

**Example: Measurement range over 3 decades**

<table>
<thead>
<tr>
<th>Y</th>
<th>Conductivity [mS/cm]</th>
<th>Selection: 0-20/4-20mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td></td>
<td>• Current start: 4 mA</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>• Current end: 20 mA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>X</th>
<th>Output current [mA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td>9.3</td>
</tr>
<tr>
<td>14.7</td>
<td>20.0</td>
</tr>
</tbody>
</table>

**Characteristic: LOG**  
• 4 mA  0.1 mS/cm  
• 20 mA  100 mS/cm
Configuration
Output 1
Time constant of output filter

1 Press CONF key.
2 Enter mode code 1200.
3 Select Output 1 menu group using arrow keys. All items of this menu group are indicated by the code “01.”
4 Press ENTER to select menu, edit with arrow keys (see Pg 39).
   Confirm (and proceed) with ENTER.
5 End: Press CONF, then ENTER.

Sensor selection
Select process variable
Select solution (Conc)
Select 0-20 / 4-20 mA
Characteristic: LIN / LOG
Enter current start
Enter current end
Set output filter
22 mA in the case of error
Hold mode
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 at 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.

1 Press CONF key.
2 Enter mode code 1200.
3 Select Output 1 menu group using arrow keys. All items of this menu group are indicated by the code “01.”
4 Press ENTER to select menu, edit with arrow keys (see Pg 41). Confirm (and proceed) with ENTER.
5 End: Press CONF, then ENTER.

Sensor selection
- Select process variable
- Select solution (Conc)
- Select 0-20 / 4-20 mA
- Characteristic: LIN / LOG
- Enter current start
- Enter current end
- Set output filter
- 22 mA in the case of error
- Hold mode
<table>
<thead>
<tr>
<th>Code</th>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>[Image] 22 mA signal for error message Select with ▶ arrow key. Proceed with <em>ENTER</em></td>
<td>OFF (OFF ON)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[Image] 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 <em>ENTER</em></td>
<td>LAST (LAST FIX)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[Image] Only with FIX selected: Enter current which is to flow at the output during HOLD. Select position with ▶ arrow key and edit number with ▲ key. Proceed with <em>ENTER</em></td>
<td>021.0 mA (00.0 ... 21.0 mA)</td>
<td></td>
</tr>
</tbody>
</table>

**Output signal for HOLD:**

Output current [mA]

Output signal for HOLD Setting FIX = 21.0 mA

Output signal HOLD Setting LAST

HOLD active

HOLD active
Configuration
Temperature compensation
Select temperature compensation

1. Press CONF key.
2. Enter mode code 1200.
3. Select Temperature compensation menu group using arrow keys. All items of this menu group are indicated by the code “tc.”
4. Press ENTER to select menu, edit with arrow keys (see Pg 43). Confirm (and proceed) with ENTER.
5. End: Press CONF, then ENTER.
<table>
<thead>
<tr>
<th>Code</th>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>tc.</td>
<td></td>
<td>Select temperature compensation (not for SAL, CONC)</td>
<td><strong>OFF</strong> (OFF LIN nLF)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>OFF:</strong> Temperature compensation switched off. Select with ▼ key, proceed with <strong>ENTER</strong>.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>LIN:</strong> Linear temperature compensation with entry of temperature coefficient and reference temperature.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>NLF:</strong> Temperature compensation for natural waters to EN 27888</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only with linear temperature compensation (LIN) selected: Enter temperature coefficient. Select position with ▼ key and edit number with ▲ key. Proceed with <strong>ENTER</strong></td>
<td>02.00%/K (XX.XX%/K)</td>
</tr>
</tbody>
</table>
1. Press CONF key.
2. Enter mode code 1200.
3. Select **Alarm settings** menu group using arrow keys. All items of this menu group are indicated by the code “AL.”.
4. Press ENTER to select menu, edit with arrow keys (see Pg 45).
   Confirm (and proceed) with ENTER.
5. 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 Error messages and Configuration Output 1/Output 2).

The operating behavior of the alarm contact is shown in the Operating states table.

The **alarm delay** acts on the LED, the 22 mA signal, and the alarm contact.
Configuration
Limit function
Relay 1

1. Press CONF key.
2. Enter mode code 1200.
3. Select **Limit function** menu group using arrow keys. All items of this menu group are indicated by the code “rL.”
4. Press ENTER to select menu, edit with arrow keys (see Pg 47).
   Confirm (and proceed) with ENTER.
5. End: Press CONF, then ENTER.
Use of relays:
Limit function (LiMIT)
Controller (CtROL)
Select with ▶ key, proceed with ENTER

**Note:**
Selecting CtROL leads to Controller menu group Ct.

**Code | Display | Action | Choices**
--- | --- | --- | ---
**rL.** | ![Display](image) | Use of relays:
Limit function (LiMIT)
Controller (CtROL)
Select with ▶ key, proceed with ENTER | LiMIT (LiMit CtROL)

**L1.** | ![Display](image) | For limit 1 function, see Pg 49. Select with ▶ key, proceed with ENTER. | Lo (Hi)

| ![Display](image) | Limit 1 contact response
N/O: normally open contact
N/C: normally closed contact
Select with ▶ key.
Proceed with ENTER | N/O (NO N/C)

| ![Display](image) | Limit 1 switching point
Select with ▶ key, edit number with ▲ key. Proceed with ENTER | 000.0 mS (xxxx)

| ![Display](image) | Limit 1 hysteresis
Select with ▶ key, edit number with ▲ key. Proceed with ENTER | 001.0 mS (xxxx)

| ![Display](image) | 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 ... 9999 sec)
Configuration
Limit function
Relay 2

1. Press **CONF** key.
2. Enter mode code **1200**.
3. Select **Limit function** menu group using arrow keys. All items of this menu group are indicated by the code “rL.”
4. Press **ENTER** to select menu, edit with arrow keys (see Pg 49). Confirm (and proceed) with **ENTER**.
5. End: Press **CONF**, then **ENTER**.

### Menu Groups

- **L1.** Relay 1 menu group
  - Contact function
  - Contact response
  - Enter switching point
  - Enter hysteresis
  - Delay
- **L2.** Controller menu group
- **Ct.** Controller menu group
<table>
<thead>
<tr>
<th>Code</th>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>L2.</td>
<td><img src="image1.png" alt="Image" /></td>
<td>For limit 2 function, see Fig. below. Select with ▶ key, proceed with <strong>ENTER</strong></td>
<td><strong>Hi</strong> (Lo)</td>
</tr>
<tr>
<td></td>
<td><img src="image2.png" alt="Image" /></td>
<td>Limit 2 contact response N/O: normally open contact N/C: normally closed contact Select with ▶ key, proceed with <strong>ENTER</strong></td>
<td><strong>N/O</strong> (N/O N/C)</td>
</tr>
<tr>
<td></td>
<td><img src="image3.png" alt="Image" /></td>
<td>Limit 2 switching point Select with ▶ key, edit number with ▲ key. Proceed with <strong>ENTER</strong></td>
<td><strong>100.0 mS</strong> (xxxx mS)</td>
</tr>
<tr>
<td></td>
<td><img src="image4.png" alt="Image" /></td>
<td>Limit 2 hysteresis Select with ▶ key, edit number with ▲ key. Proceed with <strong>ENTER</strong></td>
<td><strong>001.0 mS</strong> (xxxx mS)</td>
</tr>
<tr>
<td></td>
<td><img src="image5.png" alt="Image" /></td>
<td>Limit 2 delay The contact is activated with delay (deactivated without delay) Select with ▶ key, edit number with ▲ key. Proceed with <strong>ENTER</strong></td>
<td><strong>0010 sec</strong> (0 ... 9999 sec)</td>
</tr>
</tbody>
</table>

**Limit Lo**
- Hysteresis + Switching point
- Contact
- Signal

**Limit Hi**
- Switching point Hysteresis -
- Contact
- Signal
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 characteristic diagram](image)

- **Setpoint**
- **Controller output** $Y_p$ [%]
- **Neutral zone** $Y_p = 0$
- **Controller gain** (Gradient) $K_C$
- **Relay 1**
- **Relay 2**
- **mS/cm**
Controller equations

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 \( Y_P \)

\[ Y_P = \frac{\text{Setpoint} - \text{Meas. value}}{\text{Meas. range}} \times K_C \]

with:

- \( Y_P \): Proportional action
- \( T_R \): Reset time [s]
- \( T_D \): Rate time [s]
- \( K_C \): Controller gain [%]

Neutral zone (\( Y=0 \))

Tolerated deviation from desired value.

With the setting “1 mS/cm”, for example, a deviation of \( \pm 0.5 \) mS/cm from the desired value does not activate the controller.

Proportional action (Gradient \( K_C [%] \))

![Graph showing proportional action with different controller gain values (K_C)](chart.png)

Controller output \( Y \) vs. Deviation \( X_w \)

- \( K_C = 500 \% \)
- \( K_C = 200 \% \)
- \( K_C = 100 \% \)
- \( K_C = 50 \% \)

(Process variables: mS/cm, S/m, SAL)
1 Press **CONF** key.
2 Enter mode code **1200**.
3 Select **Limit function** menu group using arrow keys. All items of this menu group are indicated by the code “rL.”
4 Press **ENTER** to select menu, edit with arrow keys (see Pg 53). Confirm (and proceed) with **ENTER**.
5 End: Press **CONF**, then **ENTER**.

### Limit function

#### Relay 1 menu group

- **L1.**
  - **Relay 1 menu group**
  - **Controller setpoint**
  - Enter neutral zone
  - (P) Controller gain
  - (I) Reset time TR
  - (D) Rate time TD
  - Pulse length / Pulse frequency controller
  - PLC: Pulse length
  - PFC: Pulse frequency
  - HOLD behavior

#### Relay 2 menu group

- **L2.**
  - **Relay 2 menu group**

#### Temp compensation

- **Ct.**
  - **Controller setpoint**
  - Enter neutral zone
  - (P) Controller gain
  - (I) Reset time TR
  - (D) Rate time TD
  - Pulse length / Pulse frequency controller
  - PLC: Pulse length
  - PFC: Pulse frequency
  - HOLD behavior
<table>
<thead>
<tr>
<th>Code</th>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ct.</td>
<td><img src="image.png" alt="Setpoint" /></td>
<td>Setpoint Select with ▼ key, edit number with ▲ key. Proceed with ENTER</td>
<td>050.0 mS (xxxx)</td>
</tr>
<tr>
<td></td>
<td><img src="image.png" alt="Neutral zone (dead band)" /></td>
<td>Neutral zone (dead band) Select with ▼ key, edit number with ▲ key. Proceed with ENTER</td>
<td>001.0 mS (xxxxx)</td>
</tr>
<tr>
<td></td>
<td><img src="image.png" alt="Controller: P-action component" /></td>
<td>Controller: P-action component Select with ▼ key, edit number with ▲ key. Proceed with ENTER</td>
<td>0100 % (xxxx %)</td>
</tr>
<tr>
<td></td>
<td><img src="image.png" alt="Controller: I-action component" /></td>
<td>Controller: I-action component (reset time) Select with ▼ key, edit number with ▲ key. Proceed with ENTER</td>
<td>0000 sec (xxxx sec)</td>
</tr>
<tr>
<td></td>
<td><img src="image.png" alt="Controller: D-action component" /></td>
<td>Controller: D-action component (rate time) Select with ▼ key, edit number with ▲ key. Proceed with ENTER</td>
<td>0000 sec (xxxx sec)</td>
</tr>
<tr>
<td></td>
<td><img src="image.png" alt="Pulse length / Pulse frequency" /></td>
<td>Pulse length / Pulse frequency Select with ▼ key. Proceed with ENTER</td>
<td>PLC (PFC)</td>
</tr>
<tr>
<td></td>
<td><img src="image.png" alt="PLC: Pulse length" /></td>
<td>PLC: Pulse length Select with ▼ key, edit number with ▲ key. Proceed with ENTER</td>
<td>0010 sec (xxxx sec)</td>
</tr>
<tr>
<td></td>
<td><img src="image.png" alt="PFC: Pulse frequency" /></td>
<td>PFC: Pulse frequency Select with ▼ key, edit number with ▲ key. Proceed with ENTER</td>
<td>0060/min (xxxx /min)</td>
</tr>
<tr>
<td></td>
<td><img src="image.png" alt="Behavior during HOLD" /></td>
<td>Behavior during HOLD Select with ▼ key. Proceed with ENTER.</td>
<td>Y Last (Y Off/ Y Last)</td>
</tr>
</tbody>
</table>
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**

![Diagram showing pulse frequency controller output signals](image-url)
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 µF / 630 V
   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!
Configuration
Controlling a rinsing probe or signaling parameter set 2

1. Press **conf** key.
2. Enter mode code **1200**.
3. Select **Contact CLEAN / PSet2** menu using arrow keys. All items of this menu group are indicated by the code “Cln.”
4. Press **enter** to select menu, edit with arrow keys (see Pg 59).
   Confirm (and proceed) with **enter**.
5. End: Press **conf**, then **enter**.
<table>
<thead>
<tr>
<th>Code</th>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
</table>
| Cn.  | ![display](image) | Function selection*:
Control of rinsing probe (rinse)
Signaling selected parameter set 2
Select with ‣, proceed with enter | rinse
(rinse / PSet2)
For PSet2:
see Pg 60 |
| rinse | ![display](image) | Rinsing interval *
Select with ‣, edit number with ▲, proceed with enter | 000.0 h
(www.x h) |
|       | ![display](image) | Rinse duration *
Select with ‣, edit number with ▲, proceed with enter | 0060 sec
(wwwx x sec) |
|       | ![display](image) | Contact response*
N/O: normally open contact
N/C: normally closed contact
Select with ‣, proceed with enter | N/O
(N/O NC) |

* 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 time 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.

<table>
<thead>
<tr>
<th>Parameter set 1 selected</th>
<th>Parameter set 2 selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Select parameter set. Press <strong>conf</strong>, enter code 7654. Select with ▼ key, edit number with ▲ key, proceed with <strong>enter</strong>. Wrong settings change the measurement properties! If an invalid code is entered, the device returns to measuring mode.</td>
<td><img src="image" alt="Action" /></td>
</tr>
</tbody>
</table>

| ![Select](image) | Select:  
- Parameter set 1 (MAN)  
- Parameter set 2 (MAN)  
- Automatic switchover via Control input (Ctr-EXT)  
Select with ▼, proceed with **enter** | ![Select](image) |

| ![CTr](image) | 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. | ![CTr](image) |

---

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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, **Ctr-EXT** is set during configuration.

<table>
<thead>
<tr>
<th>Display</th>
<th>Action</th>
<th>Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Control input" /></td>
<td>With Control input <strong>Ctr-EXT</strong> selected: You can switch between the parameter sets by applying an external signal to the Control input see below.</td>
<td></td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Code Parameter</th>
<th>Default setting</th>
<th>Code Parameter</th>
<th>Default setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>o1. Sensor selection *</td>
<td>5000 TC</td>
<td>rL. Relay function</td>
<td>Limit</td>
</tr>
<tr>
<td>o1. Process variable</td>
<td>000.0 mS</td>
<td>L1. Contact function</td>
<td>Lo</td>
</tr>
<tr>
<td>o1. Conc solution</td>
<td>-01-</td>
<td>L1. Contact response</td>
<td>N/O</td>
</tr>
<tr>
<td>o1. 0/4-20 mA</td>
<td>4-20 mA</td>
<td>L1. Switching point</td>
<td>000.0 mS</td>
</tr>
<tr>
<td>o1. Characteristic</td>
<td>LIN</td>
<td>L1. Hysteresis</td>
<td>001.0 mS</td>
</tr>
<tr>
<td>o1. Current start (LIN)</td>
<td>000.0 mS</td>
<td>L1. Delay</td>
<td>0010 s</td>
</tr>
<tr>
<td>o1. Current end (LIN)</td>
<td>100.0 mS</td>
<td>L2. Contact function</td>
<td>Hi</td>
</tr>
<tr>
<td>o1. Current start (LOG)</td>
<td>0.1 mS</td>
<td>L2. Contact response</td>
<td>N/O</td>
</tr>
<tr>
<td>o1. Current end (LOG)</td>
<td>100 mS</td>
<td>L2. Switching point</td>
<td>100.0 mS</td>
</tr>
<tr>
<td>o1. Hold behavior</td>
<td>Last</td>
<td>L2. Hysteresis</td>
<td>001.0 mS</td>
</tr>
<tr>
<td>o1. Fix current</td>
<td>021.0 mA</td>
<td>L2. Delay</td>
<td>0010 s</td>
</tr>
<tr>
<td>o1. Filter time</td>
<td>0 s</td>
<td>Ct. Setpoint</td>
<td>050.0 mS</td>
</tr>
<tr>
<td>o2. Unit ºC / ºF</td>
<td>ºC</td>
<td>Ct. Neutral zone</td>
<td>001.0 mS</td>
</tr>
<tr>
<td>o2. 0/4...20mA</td>
<td>4-20 mA</td>
<td>Ct. P action</td>
<td>0100 %</td>
</tr>
<tr>
<td>o2. Current start</td>
<td>000.0 ºC</td>
<td>Ct. I action</td>
<td>0000 s</td>
</tr>
<tr>
<td>o2. Current end</td>
<td>100.0 ºC</td>
<td>Ct. D action</td>
<td>0000 s</td>
</tr>
<tr>
<td>o2. Filter time</td>
<td>0 s</td>
<td>Ct. PLC/PFC controller</td>
<td>PLC</td>
</tr>
<tr>
<td>o2. 22mA signal</td>
<td>OFF</td>
<td>Ct. Pulse length</td>
<td>0010 s</td>
</tr>
<tr>
<td>o2. Hold behavior</td>
<td>Last</td>
<td>Ct. Pulse frequency</td>
<td>0060 /min</td>
</tr>
<tr>
<td>o2. Fix current</td>
<td>021.0 mA</td>
<td>Ct. Hold behavior</td>
<td>Last</td>
</tr>
<tr>
<td>tc. Temp compensation</td>
<td>OFF</td>
<td>Cn. Rinse/ PSet2 *</td>
<td>rinse</td>
</tr>
<tr>
<td>tc. Temp coefficient</td>
<td>02.00%/K</td>
<td>Cn. Rinsing interval *</td>
<td>000.0 h</td>
</tr>
<tr>
<td>AL. Sensocheck</td>
<td>OFF</td>
<td>Cn. Rinse duration *</td>
<td>0060 s</td>
</tr>
<tr>
<td>AL. Alarm delay</td>
<td>0010 s</td>
<td>Cn. Contact response*</td>
<td>N/O</td>
</tr>
<tr>
<td>AL. LED Hold</td>
<td>OFF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* These parameters are only edited in parameter set 1. They are valid for both parameter sets.
## Parameter set - individual settings

<table>
<thead>
<tr>
<th>Code Parameter</th>
<th>Setting</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>o1. Sensor selection</td>
<td>P1 (conf 1200)</td>
<td></td>
<td>P2 (conf 1288)</td>
</tr>
<tr>
<td>o1. Process variable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o1. Solution (Conc)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o1. 0/4-20 mA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o1. Characteristic (LIN/LOG)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o1. Current start</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o1. Current end</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o1. Filter time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o1. 22 mA signal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o1. Hold behavior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o1. Fix current</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o2. Unit °C / °F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o2. 0/4 ...20 mA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o2. Current start</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o2. Current end</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o2. Filter time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o2. 22mA signal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o2. Hold behavior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o2. Fix current</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tc. Temperature compensation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tc. Temperature coefficient</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AL. Sensocheck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AL. Alarm delay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AL. LED Hold</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Code Parameter</td>
<td>Setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P1 (conf 1200)</td>
<td>P2 (conf 1288)</td>
<td></td>
</tr>
<tr>
<td>rL. Relay function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1. Contact function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1. Contact response</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1. Switching point</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1. Hysteresis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1. Delay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2. Contact function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2. Contact response</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2. Switching point</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2. Hysteresis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2. Delay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ct. Setpoint</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ct. Neutral zone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ct. P action</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ct. I action</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ct. D action</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ct. PLC/PFC controller</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ct. Pulse length</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ct. Pulse frequency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ct. Hold behavior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cn Rinse / PSet2*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Cn Rinsing interval*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Cn Rinse duration*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Cn Contact response*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

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

Calibration adjusts the device to the sensor.

<table>
<thead>
<tr>
<th>Activate</th>
<th><strong>CAL</strong></th>
<th>Activate with <strong>CAL</strong></th>
</tr>
</thead>
</table>
| Enter mode code: | ![Display](image) | • Entry of cell factor 1100  
• With calibration solution 0110  
• Product calibration 1105  
• Temp probe adjustment 1015  
Select with ▶ key, edit number with ▲ key, proceed with **ENTER** key  
(End with **CAL ENTER**.) |

| Hold | ![HOLD icon](image) | 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 | ![Err icon](image) | 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** key 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 can be performed by:
- Entry of cell factor
- Determining the cell factor with a known calibration solution taking account of the temperature
- Product calibration
- Zero calibration in air or with calibration solution
- Temperature probe adjustment

NOTICE

If measurements are taken in containers with $A < 110 \text{ mm}$, be sure to choose a container with the same cross-section and the same material (metal/plastic) for calibration.

NOTICE

- All calibration procedures must be performed by trained personnel. Incorrectly set parameters may go unnoticed, but change the measuring properties.
- When another sensor is used, its sensor data (cell factor, transfer ratio, measuring frequency, temperature probe) must be entered in the configuration menu before calibration.
- Each time a new sensor is connected, the device must be calibrated.
## Calibration by input of cell factor

Input of cell factor with simultaneous display of conductivity and temperature (without temperature compensation)

<table>
<thead>
<tr>
<th>Display</th>
<th>Action</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Display" /></td>
<td><strong>Press CAL key, enter code 1100</strong> Select with ▶ key, edit number with ▲ key, proceed with <strong>ENTER</strong>.</td>
<td>If an invalid code is entered, the device returns to measuring mode.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Display" /></td>
<td>Ready for calibration Remove and clean sensor</td>
<td>Display (3 sec) Device in Hold mode, measured value frozen. Sensoface inactive.</td>
</tr>
<tr>
<td><img src="image3.png" alt="Display" /></td>
<td>Enter cell factor: Select with ▶ key, edit number with ▲ key. Conductivity and temperature are alternately displayed during the input (lower display). Confirm entry with <strong>ENTER</strong>.</td>
<td></td>
</tr>
<tr>
<td><img src="image4.png" alt="Display" /></td>
<td>The entered cell factor and zero point are displayed. Confirm with <strong>ENTER</strong>.</td>
<td></td>
</tr>
<tr>
<td>Display</td>
<td>Action</td>
<td>Remark</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Conductivity and temperature are displayed. The measured value is shown in the main display alternately with “Hold”; “enter” flashes. Press <strong>ENTER</strong> to end calibration.</td>
<td>After end of calibration, the outputs remain in Hold mode for approx. 20 sec.</td>
</tr>
</tbody>
</table>
## Calibration with calibration solution

Be sure to use known calibration solutions and the respective temperature-corrected conductivity values (see Appendix: Calibration solutions). During the calibration procedure the temperature should be kept constant.

<table>
<thead>
<tr>
<th>Display</th>
<th>Action</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Press <strong>CAL</strong> key, enter code 0110. Select with ▼ key, edit number with ▲ key, proceed with <strong>ENTER</strong>.</td>
<td>If an invalid code is entered, the device returns to measuring mode.</td>
</tr>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Ready for calibration. Remove and clean sensor.</td>
<td>Display (3 sec) Device in Hold mode, measured value frozen. Sensoface inactive.</td>
</tr>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Immerse sensor in calibration solution. Enter the temperature-corrected conductivity value of the calibration solution: Select with ▼ key, edit number with ▲ key. Cell factor and temperature are alternately displayed in the lower display. Confirm entry with <strong>ENTER</strong>.</td>
<td>When there has not been an entry for 6 sec, the lower display alternately shows the conductivity and temperature value.</td>
</tr>
<tr>
<td>Display</td>
<td>Action</td>
<td>Remark</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td><img src="display.png" alt="Display" /></td>
<td>The determined cell factor and zero point are displayed. Confirm cell factor with <strong>ENTER</strong>.</td>
<td></td>
</tr>
<tr>
<td><img src="display.png" alt="Display" /></td>
<td>Conductivity and temperature are displayed. The measured value is shown in the main display alternately with “Hold”; “enter” flashes. Press <strong>ENTER</strong> to end calibration.</td>
<td>After end of calibration, the outputs remain in Hold mode for approx. 20 sec.</td>
</tr>
</tbody>
</table>
**Product calibration**

Calibration by sampling

The measurement process is only interrupted briefly. During product calibration the sensor remains in the process. Calibration is without TC correction!

**Procedure:** During sampling the currently measured value is stored in the device. The device 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 measured sample value is then entered in the device. The new cell factor 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.

<table>
<thead>
<tr>
<th>Display</th>
<th>Action</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Display" /></td>
<td><strong>Product calibration step 1:</strong> Press <strong>CAL</strong> key, enter code 1105. (Press ▶ key to select position, enter number using ▲ key, confirm with <strong>ENTER</strong>.)</td>
<td>If an invalid code is entered, the device returns to measuring mode.</td>
</tr>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Display (approx. 3 sec)</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Take sample and store value. Proceed with <strong>ENTER</strong></td>
<td>Now the sample can be measured in the lab.</td>
</tr>
</tbody>
</table>
From the flashing CAL mode indicator you see that sample calibration has not been terminated.

**Measuring mode:**

Until the sample value is determined and can be entered, the device 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 sample value. The new cell factor is calculated. Confirm with **ENTER**.

The new cell factor and zero point are displayed. Confirm 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.
# Zero calibration in air

<table>
<thead>
<tr>
<th>Display</th>
<th>Action</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Press <strong>CAL</strong> key, enter code 1001. Select with ▷ key, edit number with ▲ key, proceed with <strong>ENTER</strong>.</td>
<td>The device is in the Hold mode. If an invalid code is entered, the device returns to measuring mode.</td>
</tr>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Ready for calibration Remove and clean sensor. (Sensor must be dry!)</td>
<td>Display (3 sec)</td>
</tr>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Modify the zero point until zero is displayed as conductivity value in the lower display. Select with ▷ key, edit number with ▲ key. If required, change the sign of the zero point. Press <strong>ENTER</strong> to confirm the zero point.</td>
<td>When there has not been an entry for 6 sec, the lower display alternately shows the conductivity and temperature value.</td>
</tr>
<tr>
<td>Display</td>
<td>Action</td>
<td>Remark</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td><img src="image1.png" alt="Display Image 1" /></td>
<td>The cell factor and zero point are displayed. Press <strong>ENTER</strong> to confirm the calibration data. Conductivity and temperature are displayed. Place sensor in process.</td>
<td></td>
</tr>
<tr>
<td><img src="image2.png" alt="Display Image 2" /></td>
<td>The measured value is shown in the main display alternately with “Hold”; “enter” flashes. End calibration with <strong>ENTER</strong>.</td>
<td>After end of calibration, the outputs remain in Hold mode for approx. 20 sec.</td>
</tr>
</tbody>
</table>
### Zero calibration with calibration solution

Calibration solution with low conductivity

<table>
<thead>
<tr>
<th>Display</th>
<th>Action</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Press <strong>CAL</strong> key, enter code 1001. Select with ▶ key, edit number with ▼ key, proceed with <strong>ENTER</strong>.</td>
<td>The device is in the Hold mode. If an invalid code is entered, the device returns to measuring mode.</td>
</tr>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Ready for calibration Remove and clean sensor</td>
<td>Display (3 sec)</td>
</tr>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Immerse sensor in calibration solution. Modify the value until the lower display shows the conductivity value of the calibration solution. Press <strong>ENTER</strong> to confirm calibration.</td>
<td>When there has not been an entry for 6 sec, the lower display alternately shows the conductivity and temperature value.</td>
</tr>
<tr>
<td><img src="image" alt="Display" /></td>
<td>The cell factor and zero point are displayed. Press <strong>ENTER</strong> to confirm the calibration data.</td>
<td></td>
</tr>
<tr>
<td>Display</td>
<td>Action</td>
<td>Remark</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td><img src="image.png" alt="Display" /></td>
<td>Conductivity and temperature are displayed. Remove the sensor from the calibration solution and clean it. Place sensor in process.</td>
<td></td>
</tr>
<tr>
<td>The measured value is shown in the main display alternately with “Hold”. “enter” flashes. End calibration with <strong>ENTER</strong>.</td>
<td>After end of calibration, the outputs remain in Hold mode for approx. 20 sec.</td>
<td></td>
</tr>
</tbody>
</table>
## Temperature probe adjustment

<table>
<thead>
<tr>
<th>Display</th>
<th>Action</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Activate calibration (Press <strong>CAL</strong>, enter 1015) Select with ‣ key, edit number with ▲ key, proceed with <strong>ENTER</strong>.</td>
<td>Wrong settings change the measurement properties! If an invalid code is entered, the device returns to measuring mode.</td>
</tr>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Ready for calibration</td>
<td>Display (approx. 3 sec) The device is in the Hold mode.</td>
</tr>
<tr>
<td><img src="image" alt="Display" /></td>
<td>Measure the temperature of the process medium using an external thermometer. Enter measured temperature value: Select with ‣ key, edit number with ▲ key, proceed with <strong>ENTER</strong>. End adjustment with <strong>ENTER</strong>. HOLD will be deactivated after 20 sec.</td>
<td>Default: Value of secondary display.</td>
</tr>
</tbody>
</table>

## Measurement

<table>
<thead>
<tr>
<th>Display</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Display" /></td>
<td>In the measuring mode the main display shows the configured process variable (conductivity [mS/cm, S/m] or resistivity [MΩ·cm] or concentration [% by wt] or salinity [SAL]) and the lower display the temperature. During calibration you can return to measuring mode by pressing the <strong>CAL</strong> key, during configuration by pressing <strong>CONF</strong>, then <strong>ENTER</strong>.</td>
</tr>
</tbody>
</table>
# Diagnostics functions

<table>
<thead>
<tr>
<th>Display</th>
<th>Remark</th>
</tr>
</thead>
</table>
| ![Display of output currents](image1.png) | **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 device returns to measuring mode. |
| ![Display of calibration data](image2.png) | **Display of calibration data**  
*(Cal Info)* Press CAL while in measuring mode and confirm code 0000.  
The current cell factor is shown in the main display,  
the zero point in the secondary display.  
After 20 sec the device returns to measuring mode. *(Immediate return at pressing ENTER.)* |
| ![Sensor monitor for validation](image3.png) | **Sensor monitor for validation**  
of sensor and complete measured-value processing.  
Loop a defined sensing resistor (e.g. $R = 100 \, \Omega$) through the sensor as shown in the figure.  
Press the CONF key and enter code 2222.  
The sensor monitor displays the directly measured resistance and the temperature.  
If there is a significant difference between resistor value and display,  
the sensor and its transmission behavior should be checked.  
Press ENTER to return to measurement.  
**Caution:** The device does not automatically go to Hold mode. |
| ![Display of last error message](image4.png) | **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).* |
**Diagnostics functions**

These functions are used for testing the connected peripherals.

<table>
<thead>
<tr>
<th>Display</th>
<th>Remark</th>
</tr>
</thead>
</table>
| ![Display](image1.png) | **Specify current at output 1**  
**(current source 1)**  
- Press **CONF**, enter code 5555  
The current indicated in the main display for output 1 can be edited.  
Select with ▼ key, edit number with ▲ key, proceed with **ENTER**. The actually measured current is shown in the secondary display. The device is in the Hold mode. Press **ENTER** to return to measurement (Hold remains active for another 20 sec). |
| ![Display](image2.png) | **Specify current at output 2**  
**(current source 2)**  
- Press **CONF**, enter code 5556  
The current indicated in the main display for output 2 can be edited.  
Select with ▼ key, edit number with ▲ key, proceed with **ENTER**. The actually measured current is shown in the secondary display. The device is in the Hold mode. Press **ENTER** to return to measurement. |
| ![Display](image3.png) | **Relay test (manual test of contacts)**  
- Press **CONF**, enter code 5557  
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):  
1st digit: R1  
2nd digit: R2  
3rd digit: AL  
4th digit: CLN  
Function test using arrow keys – see left column.  
When exiting the function (**ENTER**), the relays are set corresponding to the measured value. |
**Controller test (manual specification of controller output)**

- Press CONF, enter code 5559.

After function activation “Ctrl” is displayed for approx. 3 sec. With controller turned off, “OFF” is displayed in addition, then return to measuring mode.

The function is used to start up control loops or check the actuators. For bumpless changeover to automatic operation (exiting this function), configure an I-action component (reset time).

Specify value:
Select with ▶ key, edit number with ◄ key, proceed with ENTER.

The device is in Hold mode.
Press ENTER to return to measurement (Hold remains active for another 20 sec).

**Controller output 0 to +100 %: Relay 1 active**

- **Momentary controller output** (adjusted value has not been stored yet)
## Operating states

<table>
<thead>
<tr>
<th>Operating state</th>
<th>Out 1</th>
<th>Out 2</th>
<th>Rel. 1/2 Controller</th>
<th>Rel. 1/2 Limit value</th>
<th>Cleaning contact</th>
<th>Alarm contact</th>
<th>LED</th>
<th>Time out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cal Info (CAL) 0000</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>Error Info (CONF) 0000</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Zero point (CAL) 1001</td>
<td></td>
<td>✅</td>
<td>✅</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration (CAL) 1100</td>
<td></td>
<td>✅</td>
<td>✅</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Calibration (CAL) 0110</td>
<td></td>
<td>✅</td>
<td>✅</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Temp adjustment (CAL) 1015</td>
<td></td>
<td>✅</td>
<td>✅</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Product cal 1 (CAL) 1105</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Product cal 2 (CAL) 1105</td>
<td></td>
<td>✅</td>
<td>✅</td>
<td></td>
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<td></td>
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<tr>
<td>Conf par set 1 (CONF) 1200</td>
<td></td>
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<td></td>
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<tr>
<td>Conf par set 2 (CONF) 1288</td>
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<td></td>
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<tr>
<td>Parameter set 1/2 (CONF) 7654</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Time out</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20 sec</td>
</tr>
<tr>
<td></td>
<td>20 sec</td>
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<tr>
<td></td>
<td>20 min</td>
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<tr>
<td></td>
<td>20 min</td>
</tr>
<tr>
<td></td>
<td>20 min</td>
</tr>
<tr>
<td>Operating state</td>
<td>Out 1</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Sensor monitor (CONF) 2222</td>
<td></td>
</tr>
<tr>
<td>Current source 1 (CONF) 5555</td>
<td></td>
</tr>
<tr>
<td>Current source 2 (CONF) 5556</td>
<td></td>
</tr>
<tr>
<td>Relay test (CONF) 5557</td>
<td></td>
</tr>
<tr>
<td>Manual controller (CONF) 5559</td>
<td></td>
</tr>
<tr>
<td>Cleaning function</td>
<td></td>
</tr>
<tr>
<td>HOLD input</td>
<td></td>
</tr>
</tbody>
</table>

Explanation:  
- **grey**: active  
- **black**: as configured (Last/Fix or Last/Off)
### Error messages (Error codes)

<table>
<thead>
<tr>
<th>Error</th>
<th>Display</th>
<th>Problem Possible causes</th>
<th>Alarm contact</th>
<th>Red LED</th>
<th>Out 1 (22 mA)</th>
<th>Out 2 (22 mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERR 01</td>
<td>Measured value flashes</td>
<td><strong>Sensor</strong></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Wrong cell factor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Measurement range violation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• SAL &gt; 45 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sensor connection or cable defective</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERR 02</td>
<td>Measured value flashes</td>
<td><strong>Unsuitable sensor</strong></td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conductance range &gt; 3000 mS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERR 98</td>
<td>“Conf” flashes</td>
<td><strong>System error</strong></td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Configuration or calibration data defective; completely reconfigure and recalibrate the device. Memory error in device program</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERR 99</td>
<td>“FAIL” flashes</td>
<td><strong>Factory settings</strong></td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EEPROM or RAM defective</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>This error message only occurs in the case of a total defect. The device must be repaired and recalibrated at the factory.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERR 03</td>
<td>Temperature probe symbol</td>
<td><strong>Temperature probe</strong></td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Open or short circuit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temperature range exceeded</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>Display (flashes)</td>
<td>Problem Possible causes</td>
<td>Alarm contact</td>
<td>Red LED</td>
<td>Out 1 (22 mA)</td>
<td>Out 2 (22 mA)</td>
</tr>
<tr>
<td>-------</td>
<td>------------------</td>
<td>-------------------------</td>
<td>---------------</td>
<td>---------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
</tbody>
</table>
| ERR 11 | mA | **Current output 1**  
Current below 0 (3.8) mA | x | x | x |
| ERR 12 | mA | **Current output 1**  
Current above 20.5 mA | x | x | x |
| ERR 13 | mA | **Current output 1**  
Span too small / too large | x | x | x |
| ERR 21 | mA | **Current output 2**  
Current below 0 (3.8) mA | x | x | x |
| ERR 22 | mA | **Current output 2**  
Current above 20.5 mA | x | x | x |
| ERR 23 | mA | **Current output 2**  
Span too small / too large | x | x | x |
| ERR 33 | | **Sensocheck:**  
Primary coil  
Secondary coil | x | x | x |
| ERR 34 | | **Sensocheck:**  
Temperature outside conversion tables (TC, conc, SAL) | Sensoface active | Sensoface active | Sensoface active |
Sensoface

The little smiley in the display (Sensoface) alerts to sensor problems (defective sensor, defective cable). 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 primary coil and its lines for short circuits and the secondary coil and its lines for 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 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 device be calibrated.
<table>
<thead>
<tr>
<th>Display</th>
<th>Problem</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>🌡️</td>
<td>Sensor defect</td>
<td>🙁 Short circuit in primary coil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Open circuit in secondary coil (also see Error messages Err 33 and Err 34).</td>
</tr>
<tr>
<td>🌠</td>
<td>Temperature error</td>
<td>😞 Temperature outside range for TC, conc, SAL</td>
</tr>
</tbody>
</table>
### Product line and accessories

#### Devices

**Toroidal Conductivity Analyzer**

<table>
<thead>
<tr>
<th>Order No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>APT4000TC-E00</td>
</tr>
</tbody>
</table>

#### Mounting accessories

- Pipe-mount kit 51205988-001
- Panel-mount kit 51205990-001
- Protective hood 51205989-001
Specifications

**Cond input**
Input for toroidal conductivity sensor, e.g. 5000TC

**Display ranges**
- Conductivity: 0.000 ... 1999 mS/cm
- Concentration: 0.00 ... 100.0 % by wt
- Salinity: 0.0 ... 45 % (0 ... 35 °C)

**Measurement ranges***
- Conductivity: 0.000 ... 9.999 mS/cm
- Concentration: 0.000 ... 9.999 % by wt
- Salinity: 0.00 ... 9.999 S/m

**Response time (T_{90})**
Approx. 2 s

**Meas. error**
< 1% meas. val. + 0.005 mS

**Temperature compensation***
(Reference temp 25 °C)
- **(OFF)** Without
- **(Lin)** Linear characteristic 00.00 ... 19.99 %/K
- **(NLF)** Natural waters to EN 27888 (0 .. 35°C)

**Concentration determination**

**Operating modes***
- **-01-** NaCl 0.00 ... 9.99 % by wt (0 ... 100 °C)
- **-02-** HCl 0.00 ... 9.99 % by wt (0 ... 50 °C)
- **-03-** NaOH 0.00 ... 9.99 % by wt (0 ... 100 °C)
- **-04-** H₂SO₄ 0.00 ... 9.99 % by wt (0 ... 110 °C)
- **-05-** HNO₃ 0.00 ... 9.99 % by wt (0 ... 50 °C)
- **-06-** H₂SO₄ 92 ... 99 % by wt (-17 ... 115 °C)
- **-07-** HCl 22 .. 39 % by wt (-20 ... 50 °C)
- **-08-** HNO₃ 35 ... 96 % by wt (-20 ... 50 °C)
- **-09-** H₂SO₄ 32 ... 84 % by wt (-17 ... 115 °C)
- **-10-** NaOH 18 ... 50 % by wt (0 ... 100 °C)

See Concentration curves in the Appendix.
Sensor standardization

Operating modes

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

Permitted cell factor 00.100 ... 19.999
Permitted transfer ratio 01.00 ... 199.99
Permitted zero offset ±0.5 mS/cm

Sensor monitoring

Sensocheck

- Monitoring of primary and lines for short circuit
- Monitoring of secondary and lines for open circuit

Sensoface

Provides information on the sensor condition (evaluation of zero point, Sensocheck)

Sensor monitor

Sensor monitor for validation of sensor and complete measured-value processing (display: resistance / temperature)

Temperature input *

Pt100 / Pt1000 / NTC 100 kohms
2-wire connection, adjustable

Ranges

Pt100/Pt1000 -20 .. +200 °C (-4 ... +392 °F)
NTC100 kohms -20 .. +130 °C (-4 ... 266 °F)

Resolution 0.1 °C / 1 °F

Meas. error\(^1,2,3\) 0.5 K
(< 1K for Pt100; < 1K for NTC > 100°C)
Specifications

**HOLD input**
- Function: Switches device to HOLD mode
- Switching voltage
  - 0 ... 2 V (AC/DC)  Hold inactive
  - 10 ... 30 V (AC/DC)  Hold active
- Galv. separated (OPTO coupler)

**CONTROL input**
- Function: Switch-over to second parameter set
- Switching voltage
  - 0 ... 2 V (AC/DC)  Parameter set 1
  - 10 ... 30 V (AC/DC)  Parameter set 2
- Galv. separated (OPTO coupler)

**Output 1**
- 0/4 ... 20 mA, max. 10 V, floating
  (galv. connected to output 2)
- Measured variable*: Conductivity, concentration, or salinity
- Characteristic: Linear or logarithmic
- Overrange *: 22 mA in the case of error messages
- Output filter * (attenuation): Low-pass, filter time constant 0 ... 120 sec
- Measurement error 1): < 0.3% current value + 0.05 mA
- Start/end of scale: As desired within range
- Min. span
  - LIN: 5 % of selected range
  - LOG: 1 decade

**Output 2**
- 0/4 ... 20 mA, max. 10 V, floating
  (galv. connected to output 1)
- Process variable: Temperature
- Overrange *: 22 mA in case of temp error messages
- Output filter * (attenuation): Low-pass, filter time constant 0 ... 120 sec
- Measurement error 1): < 0.3% current value + 0.05 mA
- Start/end of scale *
  - -20 ... 200 °C / -4 ... 392 °F
- Admissible span
  - 20 ... 320 K (36 ... 608 °F)

**Alarm contact**
- Relay contact, floating
- Contact ratings
  - AC< 250 V / < 3 A / < 750 VA
  - DC< 30 V / < 3 A / < 90 W
- Contact response: N/C (fail-safe type)
- Alarm delay: 0000 ... 0600 sec
**Limit values**

- Output via relay contacts R1, R2
- 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 specification**

- Within selected range

**Neutral zone**

- Max. 50 % of selected 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)

---

**Cleaning function / Parameter set 2**

**Clean / PSet2**

- Relay contact, floating, for controlling a rinsing probe or signaling parameter set 2

**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 cleaning contact*

**Rinsing interval**

- 000.0 ... 999.9 h
  (000.0 h = cleaning function switched off)

**Rinse duration**

- 0000 ... 1999 sec
## Specifications

<table>
<thead>
<tr>
<th><strong>Display</strong></th>
<th>LC display, 7-segment with icons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main display</td>
<td>Character height 17 mm, unit symbols 10 mm</td>
</tr>
<tr>
<td>Secondary display</td>
<td>Character height 10 mm, unit symbols 7 mm</td>
</tr>
<tr>
<td>Sensoface</td>
<td>3 status indicators (friendly, neutral, sad smiley)</td>
</tr>
<tr>
<td>Mode indicators</td>
<td>5 mode indicators “meas”, “cal”, “alarm”, “cleaning”, “config”</td>
</tr>
<tr>
<td>Alarm indication</td>
<td>Red LED in case of alarm or HOLD, user defined</td>
</tr>
</tbody>
</table>

| **Keypad** | 5 keys: [CAL] [CONF] [ ▼ ] [ ▲ ] [ENTER] |

<table>
<thead>
<tr>
<th><strong>Service functions</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Current source</td>
<td>Current specifiable for output 1 and 2 (00.00 to 22.00 mA)</td>
</tr>
<tr>
<td>Manual controller</td>
<td>Controller output entered directly (start of control process)</td>
</tr>
<tr>
<td>Device self-test</td>
<td>Automatic memory test (RAM, FLASH, EEPROM)</td>
</tr>
<tr>
<td>Display test</td>
<td>Display of all segments</td>
</tr>
<tr>
<td>Last Error</td>
<td>Display of last error occurred</td>
</tr>
<tr>
<td>Sensor monitor</td>
<td>Validation of sensor and complete measured-value processing (display: resistance / temperature)</td>
</tr>
<tr>
<td>Relay test</td>
<td>Manual control of the four switching contacts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Parameter sets</strong></th>
<th>Two selectable and configurable parameter sets for different process phases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Switchover via CONTROL input or manually</td>
</tr>
<tr>
<td></td>
<td>Signaling via relay contact PSet2</td>
</tr>
</tbody>
</table>

| **Data retention** | Parameters and calibration data > 10 years (EEPROM) |

| **Protection against electric shock** | Safe electrical isolation of all extra-low-voltage circuits against mains by double insulation to EN 61010-1 |

<table>
<thead>
<tr>
<th><strong>Power supply</strong></th>
<th>24 (-15%) ... 230 V AC/DC (+10%); approx. 5 VA; 2.5 W</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AC: 45 ... 65 Hz; Overvoltage category II, Class II</td>
</tr>
</tbody>
</table>
**Nominal operating conditions**

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

**EMC**  
EN 61326  
Emitted interference Class B (residential area)  
Immunity to interference Class A for mains > 60 V DC

**Explosion protection**

**FM:**  
NI Class I Div 2 Group A, B, C & D, T4  
Ni Class I Zone 2-Group IIC, T4  
Ta = 55 °C; Type 2  
Class I Div 2 Groups A, B, C and D, T4  
Ex nA IIC T4

**CSA:**

**Enclosure**

Molded enclosure made of PBT (polybutylene terephthalate)

Color Bluish gray RAL 7031

Mounting

- Wall mounting
- Pipe mounting: Ø 40 ... 60 mm,  
  □ 30 ... 45 mm
- Panel mounting: cutout 138 x 138 mm  
  (DIN 43700)
- Sealed against panel

Dimensions H 144 mm, W 144 mm, D 105 mm

Ingress protection IP 65 / NEMA 4X

Cable glands 3 knockouts for cable glands M20x1.5  
2 knockouts 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)

<table>
<thead>
<tr>
<th>Temperature [°C]</th>
<th>Concentration $^1$</th>
<th>0.01 mol/l</th>
<th>0.1 mol/l</th>
<th>1 mol/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>0.776</td>
<td>7.15</td>
<td>65.41</td>
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<tr>
<td>5</td>
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<td>0.896</td>
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<td>74.14</td>
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<td>10</td>
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<td>1.020</td>
<td>9.33</td>
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<td>15</td>
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<td>1.147</td>
<td>10.48</td>
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<td>1.173</td>
<td>10.72</td>
<td>94.41</td>
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<td>17</td>
<td></td>
<td>1.199</td>
<td>10.95</td>
<td>96.31</td>
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<td>18</td>
<td></td>
<td>1.225</td>
<td>11.19</td>
<td>98.22</td>
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<td>19</td>
<td></td>
<td>1.251</td>
<td>11.43</td>
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<td>1.278</td>
<td>11.67</td>
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<td>1.332</td>
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<td>1.638</td>
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<td>36</td>
<td></td>
<td></td>
<td>15.64</td>
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---

$^1$ 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)

<table>
<thead>
<tr>
<th>Temperature [°C]</th>
<th>Concentration 0.01 mol/l ¹)</th>
<th>Concentration 0.1 mol/l ¹)</th>
<th>Concentration Saturated ²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.631</td>
<td>5.786</td>
<td>134.5</td>
</tr>
<tr>
<td>1</td>
<td>0.651</td>
<td>5.965</td>
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<tr>
<td>2</td>
<td>0.671</td>
<td>6.145</td>
<td>142.7</td>
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<tr>
<td>3</td>
<td>0.692</td>
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<td>146.9</td>
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<tr>
<td>4</td>
<td>0.712</td>
<td>6.510</td>
<td>151.2</td>
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<tr>
<td>5</td>
<td>0.733</td>
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<td>6</td>
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<td>7.447</td>
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<td>0.839</td>
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<td>0.927</td>
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<td>0.950</td>
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<td>0.972</td>
<td>8.816</td>
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<td>0.995</td>
<td>9.018</td>
<td>211.2</td>
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<td>1.111</td>
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<td>1.135</td>
<td>10.258</td>
<td>241.1</td>
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<td>1.159</td>
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<td>1.281</td>
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<td>272.1</td>
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<td>1.306</td>
<td>11.773</td>
<td>277.4</td>
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<td>31</td>
<td>1.331</td>
<td>11.995</td>
<td>282.7</td>
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<td>32</td>
<td>1.357</td>
<td>12.220</td>
<td>288.0</td>
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<td>33</td>
<td>1.382</td>
<td>12.445</td>
<td>293.3</td>
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<td>1.408</td>
<td>12.673</td>
<td>298.7</td>
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<td>35</td>
<td>1.434</td>
<td>12.902</td>
<td>304.1</td>
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<tr>
<td>36</td>
<td>1.460</td>
<td>13.132</td>
<td>309.5</td>
</tr>
</tbody>
</table>

¹ Data source: Test solutions calculated according to DIN IEC 746-3
² Data source: K. H. Hellwege (Editor), H. Landolt, R. Börnstein: Zahlenwerte und Funktionen ..., volume 2, part. volume 6
Concentration measurement

Concentration ranges

<table>
<thead>
<tr>
<th>Substance</th>
<th>Concentration ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaCl</td>
<td>0-26 % by wt (0 °C)</td>
</tr>
<tr>
<td></td>
<td>0-28 % by wt (100 °C)</td>
</tr>
<tr>
<td></td>
<td>-01-</td>
</tr>
<tr>
<td>HCl</td>
<td>0-18 % by wt (-20 °C)</td>
</tr>
<tr>
<td></td>
<td>0-18 % by wt (50 °C)</td>
</tr>
<tr>
<td></td>
<td>-02-</td>
</tr>
<tr>
<td>NaOH</td>
<td>0-13 % by wt (0 °C)</td>
</tr>
<tr>
<td></td>
<td>0-24 % by wt (100 °C)</td>
</tr>
<tr>
<td></td>
<td>-03-</td>
</tr>
<tr>
<td>H2SO4</td>
<td>0-26% by wt (-17°C)</td>
</tr>
<tr>
<td></td>
<td>0-37% by wt (110°C)</td>
</tr>
<tr>
<td></td>
<td>-04-</td>
</tr>
<tr>
<td>HNO3</td>
<td>0-30 % by wt (-20 °C)</td>
</tr>
<tr>
<td></td>
<td>0-30 % by wt (50°C)</td>
</tr>
<tr>
<td></td>
<td>-05-</td>
</tr>
</tbody>
</table>

For the solutions listed above, the device 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 device.

We recommend to calibrate the device 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.
Concentration curves

-01- Sodium chloride solution NaCl

Concentration measurement not possible in this range.

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

-02- Hydrochloric acid HCl
-07-

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

Concentration measurement not possible in this range.

Conductivity in dependence on substance concentration and process temperature for hydrochloric acid (HCl)
Concentration measurement not possible in this range.

Conductivity in dependence on substance concentration and process temperature for sodium hydroxide solution (NaOH)
Concentration in dependence on substance concentration and process temperature for sulfuric acid (H$_2$SO$_4$)

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

Concentration measurement not possible in this range.

Conductivity in dependence on substance concentration and process temperature for sulfuric acid (H$_2$SO$_4$)
Conductivity in dependence on substance concentration and process temperature for nitric acid (HNO₃)

Concentration measurement not possible in this range.
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**Configuration**

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