TABLE OF CONTENTS pH CONTROLLER 8205

Dear Customer,

Congratulations on your purchase of our digital pH controller type 8205 .

BEFORE INSTALLING OR USING THIS PRODUCT, PLEASE TAKE OUR ADVICE AND READ THE ENTIRE MANUAL THOROUGHLY.

This will enable you to fully profit from all of the advantages offered by this product.

1.1 Unpacking and Control

Please verify that the product is complete and free from any damage. The standard delivery must include:

-1 8205 digital pH Controller
-1 Operating Instruction Manual

Compare the Type specifications on the label to the adjacent list to ensure that you have received the proper unit. If there is any loss or damage, please contact your local Bürkert subsidiary.

1.2 About this Manual

This manual does not contain any warranty statement. Please refer to our general terms of sale and delivery.
Only properly-trained staff should install and/or repair this product. If difficulties should occur at the time of installation, please contact your nearest Bürkert sales office for assistance.

1.3 User's Responsibility for Safety

Bürkert manufactures a broad range of pH controllers (compact, wall-mounted or panel versions). While each of these products is designed to operate in a wide variety of applications, it is the user's responsibility to select a controller model that is appropriate for the application, install it properly, and maintain all components. Special Warning must be paid to the chemical resistance of the controller against the fluids which are directly contacting the product.

This symbol appears in the manual to call special **warning** to instructions that affect the safe installation, function and use of the product.

1.4 Electromagnetic compatibility

This device conforms to the EMC-Directive of the Council of European Communities 89/336/EEC.
In order to comply with this directive, follow the wiring instructions.

2.1 Compact pH controller type 8205 specification

pH controller compact 4-20 mA output; 2 Relay pulse outputs; 1 relay alarm

Type compact			2 x PG 13.5	2 x G 1/2"
Controller	Gasket	Electrode	Worlwide Ident N°	N.America Ident N°
8205	FPM	GLS	426430Q	426460W
8205	FPM	STE	426431D	426461K
8205	FPM	LEI	426432E	426462L
8205	FPM	SCH	426433F	426463M
8205	FPM	HOL	426434G	426464N
8205	EPDM	GLS	426435H	426465P
8205	EPDM	STE	426436A	426466Q
8205	EPDM	LEI	426437B	426467R
8205	EPDM	SCH	426438L	426468S
8205	EPDM	HOL	426439M	426469T

pH controller compact 4-20 mA output; 2 Triac pulse outputs; 1 relay alarm

Type compact			2 x PG 13.5	2 x G 1/2"
Controller	Gasket	Electrode	Worlwide Ident N°	N.America Ident N°
8205	FPM	GLS	426440S	426470Y
8205	FPM	STE	426441P	426471M
8205	FPM	LEI	426442Q	426472N
8205	FPM	SCH	426443R	426473P
8205	FPM	HOL	426444J	426474Q
8205	EPDM	GLS	426445K	426475R
8205	EPDM	STE	426446L	426476J
8205	EPDM	LEI	426447M	426477K
8205	EPDM	SCH	426448W	426478U
8205	EPDM	HOL	426449X	426479V

pH controller compact 4-20 mA output; 2 Transistor pulse outputs; 1 relay alarm

Type compact			2 x PG 13.5	2 x G 1/2"
Controller	Gasket	Electrode	Worlwide Ident N°	N.America Ident N°
8205	FPM	GLS	426450U	426480K
8205	FPM	STE	426451R	426481G
8205	FPM	LEI	426452J	426482H
8205	FPM	SCH	426453K	426483A
8205	FPM	HOL	426454L	426484B
8205	EPDM	GLS	426455M	426485C
8205	EPDM	STE	426456N	426486D
8205	EPDM	LEI	426457P	426487E
8205	EPDM	SCH	426458Y	426488P
8205	EPDM	HOL	426459Z	426489Q

2.2 Specification pH controller type 8205 Separate

pH controller type 8205 panel version

Type	Pulse output	Power Supply	Order Nr
8205	Relays	12-30 VDC	427939K
8205	Triacs	12-30 VDC	427940Y
8205	Transistors	12-30 VDC	427941M

pH controller type 8205 wall-mounted version

Type	Pulse output	Power Supply	Order Nr
8205	Relays	12-30 VDC	427946J
8205	Triacs	12-30 VDC	427947K
8205	Transistors	12-30 VDC	427948U
8205	Relays	115-230 VAC	427951P
8205	Triacs	115-230 VAC	427952Q
8205	Transistors	115-230 VAC	427953R

pH sensor for pH controller type 8205 separate versions.
See specific pH sensor type 8200 instruction manual.

2.3 Design and Measuring Principle

Design

pH controller type 8205 compact
The pH-controller compactly combines a pH-sensor and a controller with display in a splash-proof plastic IP65 enclosure.
The sensor component consists of a replaceable combination pH-electrode, screwed into the sensor housing with screw-in threads PG 13.5. The measured signal is conveyed to the controller via a coax plug.
The Pt1000 for automatic temperature compensation is a standard feature in the sensor housing (An option without Pt1000 is available, in this case,enter the process temperature of the fluid cf §4.3.10).
The controller component converts the measured signal, displays the actual value and computes the command signals.
The output signals are provided via two PG 13.5.

pH controller type 8205 separate
The pH transmission system combines a pH sensor type 8200, and a separate pH controller type 8205 with display.

The 8205 separate controller is available in panel mounted version and in a wall-mounted plastic IP65 enclosure for connection to the pH sensor type 8200.

pH sensor type 8200
A wide range of pH sensors offers large capabilities of mounting and pH measurement.
The characteristics of electrodes are described in the 8200 Operating Manual.The Pt1000 for automatic temperature compensation is available as an option feature in pH sensor housings.

The pH sensor type 8200 for pH controller type 8205 separate version can be easily installed into pipes using our specially designed fitting system. Please refer to the pH sensor type 8200 instruction manual (Ref 428937J).

Measuring Principle

The most important part of a pH electrode is the glass membrane of pH-selective glass. When the electrode is immersed into the solution, an electrical charge caused by H-ions (H^+) generates a cell voltage between the glass membrane and the solution. This electric voltage is recorded with reference to a reference electrode, located around the pH glass electrode. The cell voltage of the combination electrode is directly proportional to the pH value (59.16 mV per pH unit at 25°C).

The controller functions in a 3-wire circuit and requires a power supply of 12...30 VDC. A relay alarm contact, and a 4...20 mA standard signal proportional to the pH or to the T° C, are available as output signals. The pulse output signals are provided by relays (standard); triacs or transistors .

Controlling Principle

The pH controller type 8205 is designed for use in static or dynamic process of pH control. The output signals control a valve (e.g.: Bürkert Type 2031) or a pump, by means of impulses which times duration or frequency is computed according to users parameters and pH value of the fluid.
(See § 4.3 Operation).

Refer to Appendix A for general characteristics of PID controllers.

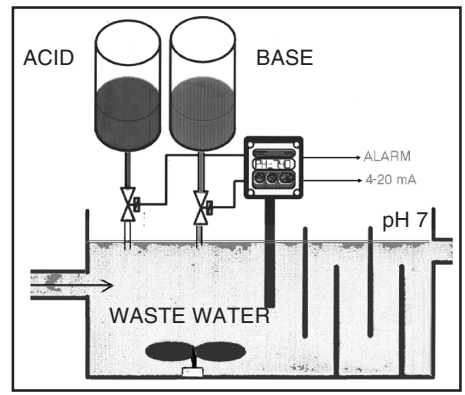


Fig. 2.1 Static process control

A) Static process: Fluid controlled in a tank, without significant flow, the control mode is proportional.

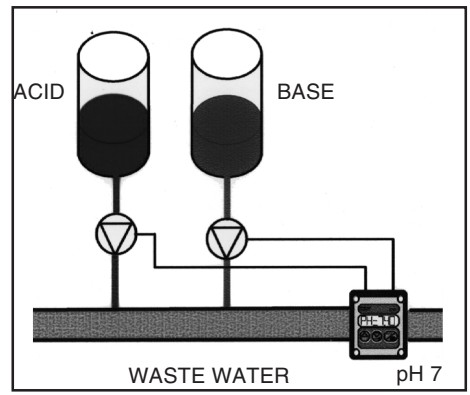


Fig. 2.2 Dynamic process control

B) Dynamic process: Fluid controlled in a pipe, or in a tank with significant flow. The control mode is PI or PID.

2.4 Dimensions of the pH controller type 8205 compact

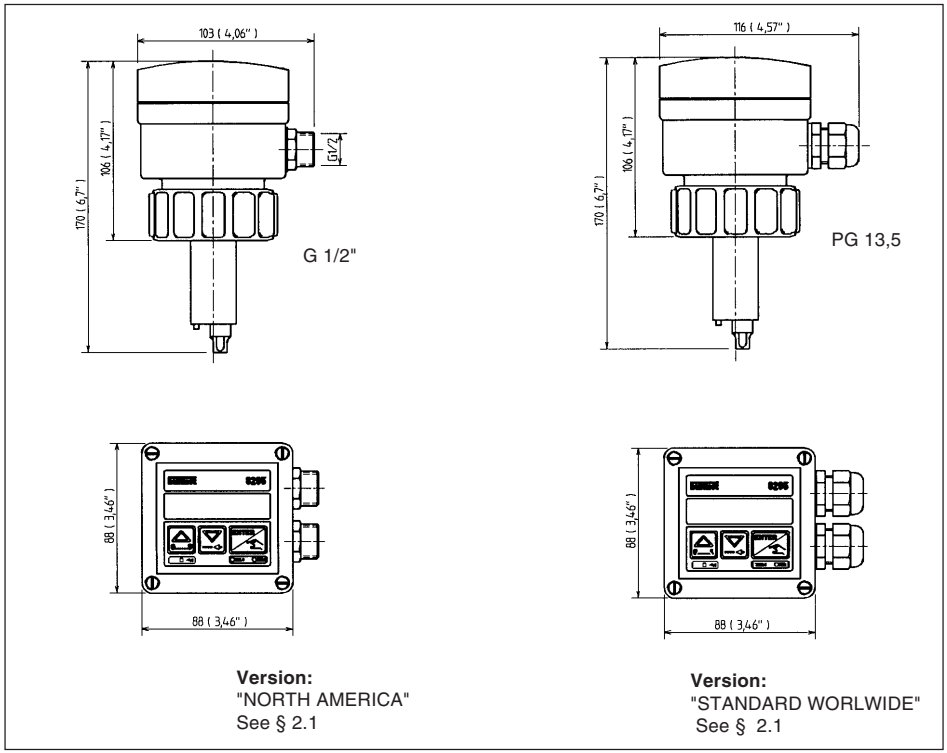


Fig. 2.3 Dimensions pH controller type 8205 compact

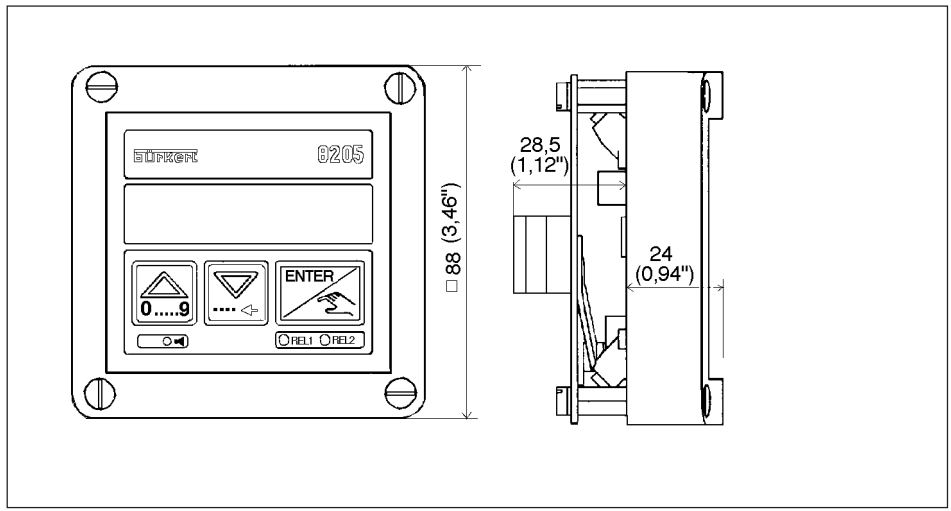


Fig 2.4 Dimensions pH controller type 8205 panel version

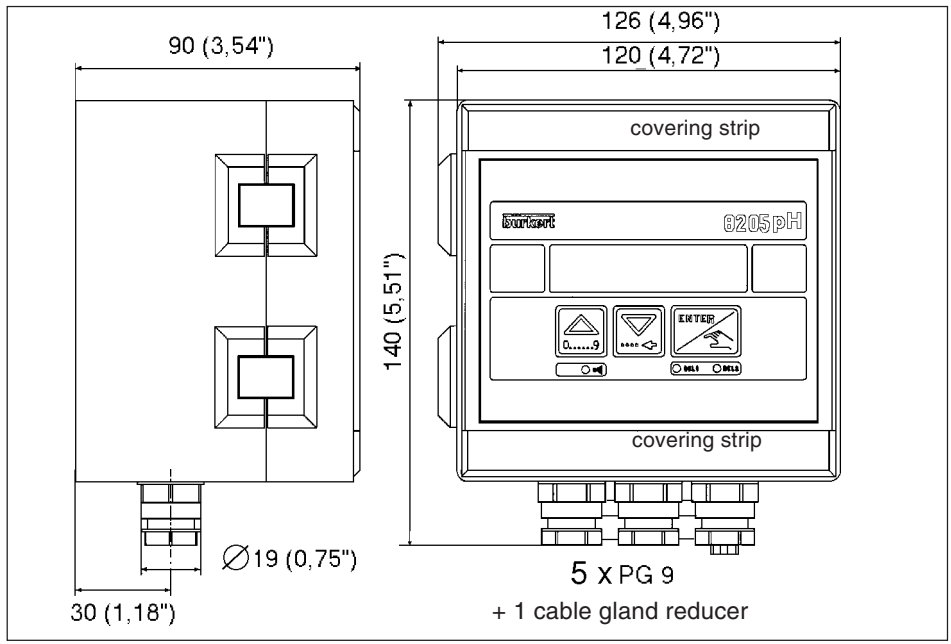


Fig 2.5 Dimensions pH controller type 8205 wall-mounted version

2.5 Technical Data 8205 pH Controller

2.5.1 pH controller type 8205 compact version specification

Ambient temperature	0 to 60°C (32 to 140°F)
Storing temperature	0 to 60°C (32 to 140°F)
Relative humidity	max 80 %
Enclosure	IP 65
Measuring range	0...14 pH
Measuring error	+/-0,2%, depending on electrode calibration
Temperature compensation	automatic (integrated Pt1000 or user parametred) reference temperature 25ºC (77°F)
Power supply:	12...30 VDC
Output signal	4...20 mA programmable ; proportional to the pH or temperature
Load	max. 1300 Ω at 30 V ; max. 1000 Ω at 24 V ; max. 550 Ω at 15 V
Display	15 x 60 mm LCD 8 digits, alphanumeric, 15 segments, 9 mm high
Relay alarm output	1 relay, 3 A, 220 V, freely adjustable
Pulse Outputs	2 frequency and time duration adjustable outputs
- Relay Pulse Output:	3 A / 250 V max ; F < 1 Hz
- Transistor Pulse Output:	300 mA / 30 V max ; F < 17 Hz
- Triac Pulse Output:	1 A / 250 V max ; F < 17 Hz
Pt1000	SS 1.4571 (Ti 316)
Control Mode	P ; PI or PID programmable
Sensor housing	PVDF ; O-rings FPM/EPDM
Electronics housing	PC ; front plate polyester

Technical Data: Electrodes	**GLS**	**STE**
Housing	glass shaft	glass shaft
Fluid pressure	0-6 bar (0-87 psi)	0-3 bar (0-44 psi)
Fluid temperature	0-90° C (32-194°F)	0-130° C (32-266°F)
Max. pressure at max. temperature	4 bar (58 psi)	2 bar (29 psi)
Diaphragm	zirkondioxide	zirkondioxide
Reference electrolyte	gel	gel

	LEI	**SCH**	**HOL**
Housing	glass shaft	glass shaft	
Fluid pressure	0-2 bar (0-29 psi)	0-2 bar (0-29 psi)	0-6 bar (0-87 psi)
Fluid temperature	0-60° C (32-140°F)	0-40° C (32-104°F)	0-90° C (32-194°F)
Max. pressure at max. temperature	2 bar (29 psi)	2 bar (29 psi)	4 bar (58 psi)
Diaphragm	3 x zirkondioxide	none	none
Reference electrolyte	KCl 3-Molar	polymerised	polymerised

2.5.2 pH controller type 8205 separate version specification

Ambient temperature	0 to 60°C (32 to 140°F)
Storing temperature	0 to 60°C (32 to 140°F)
Relative humidity	80 %
Enclosure	Wall-mounted version IP 65 ; ABS Panel version IP 20 (rear plate) ; IP65 (front plate) ; PC
Power supply:	12...30 VDC (115/220 VAC Option wall-mounted version)
Consumption:	20 mA (with triac, or transistor) ; or 80 mA (with relays)
Output signal	4...20 mA programmable ; proportional to the pH or temperature
Load	max. 1300 Ω at 30 V ; max. 1000 Ω at 24 V ; max. 550 Ω at 15 V
Display	15 x 60 mm LCD 8 digits, alphanumeric, 15 segments, 9 mm high
Relay alarm output	1 relay, 3 A, 220 V, freely adjustable
Pulse Outputs	2 frequency and time duration adjustable outputs
- Relay Pulse Output:	3 A / 250 V max ; F < 1 Hz
- Transistor Pulse Output:	300 mA / 30 V max ; F < 17 Hz
- Triac Pulse Output:	1 A / 250 V max ; F < 17 Hz
Control Mode	P ; PI or PID programmable

pH sensor type 8200 guide (see pH sensor 8200 reference manual (Ref 428937J))

Technical Data: Electrodes	**Easycontrol**	**Liq-Glas PG**
Measuring range	0-14	1-12
Housing	glass shaft	glass shaft
Fluid pressure	0-2 bar	0-2 bar
Fluid temperature	0 - +60° C	-5 - +60° C

	Metrocode	**Polilyte Std**	**Polilyte HP**
Measuring range	0-14	2-14	2-14
Housing	glass shaft	glass shaft	glass shaft
Fluid pressure	0-16 bar	0-2 bar	0-6 bar
Fluid temperature	0-+130° C	0-+40° C	0-+90° C

Temperature compensation with optional integrated Pt1000 (ref. temperature 25°C (77°F))

pH sensor type 8200 connection

Connection	Material- connection size
G 2"	PVC; PP; PVDF; SS
G1"	PVC; PP; PVDF; SS
Sanitary	SS DN40; DN50; DN65
Triclamp	SS 50,5/64

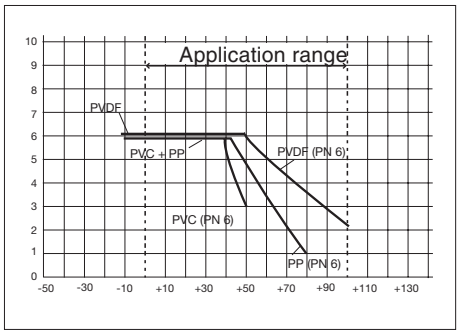
Cable for Pt1000 and pH

Length	pH	Pt1000
2 m	427024H	427110Q
5 m	427025A	427113F

3.1 Installation Guidelines

Before first electrode calibration, immerse it for 2 hours at least in buffer solution pH=7 or in a solution of KCl 3M (223,6 g/l) or in drinkwater.

Pressure-Temperature-Diagram
Mind pressure-temperature dependence according to the respective fitting materials.



Installation Guidelines
Mount the compact pH controller (or pH sensor) in vertical position (max. ±75°) into a horizontal pipe (cf fig. 3.1).
The electrode must continuously be immersed into the measuring fluid in order to protect it from drying out. The device must be protected from constant heat radiation and other environmental influences, such as direct exposure to sunlight.

3.1.2 Compact controller type 8205 installation

The pH controller can be easily installed in pipes using our specially designed fitting system. Before installation, the controller must be calibrated with buffer solutions (see § 4.2). Remove protective cap of the sensor.

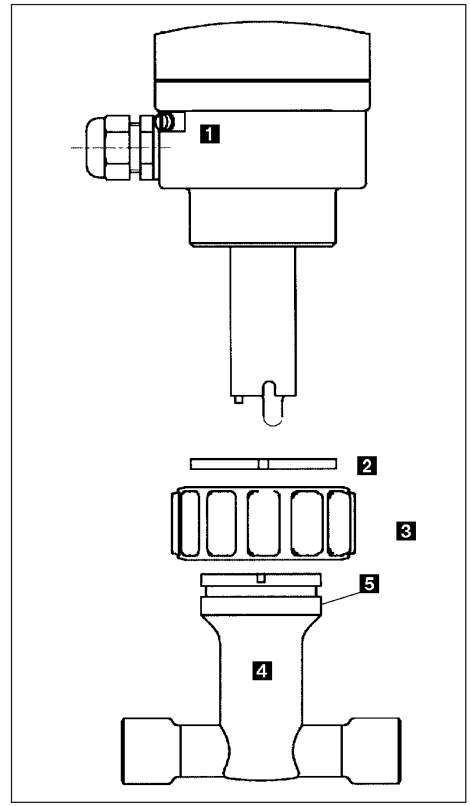


Fig. 3.1 Compact controller installation

1. The fitting **4** must be installed into the pipe according to the installation specifications in section 3.1.
2. Insert plastic nut **3** into fitting, and let plastic ring **2** snap into guide bush **5**.
3. Carefully insert the pH controller **1** into the fitting. If installed properly, the controller cannot be rotated.
4. Tighten controller housing to fitting with plastic nut **3**.

CAUTION! Plastic nut must only be tightened by hand!

3.1.3 pH controller type 8205 panel installation

For the cut-away of the front panel, follow the instructions on the enclosed delivery film. Install the controller as follows:

1. Put gasket 2 on the cover 1 and place the complete unit in the panel cut-away.

2. Screw the spacer bolts 3 on the panel fixing screws 4.

3. Insert the cable clips 10, to hold the different cables (power supply, outputs, sensor) of the controller, into plate 7.

4. If a PLC is connected to the device, set the switch SW300 (cf § 3.2)

5. Plug connector 5 on socket 6 and fasten plate 7 with screws 9 on bolts 3, tightening the lockwashers 8.

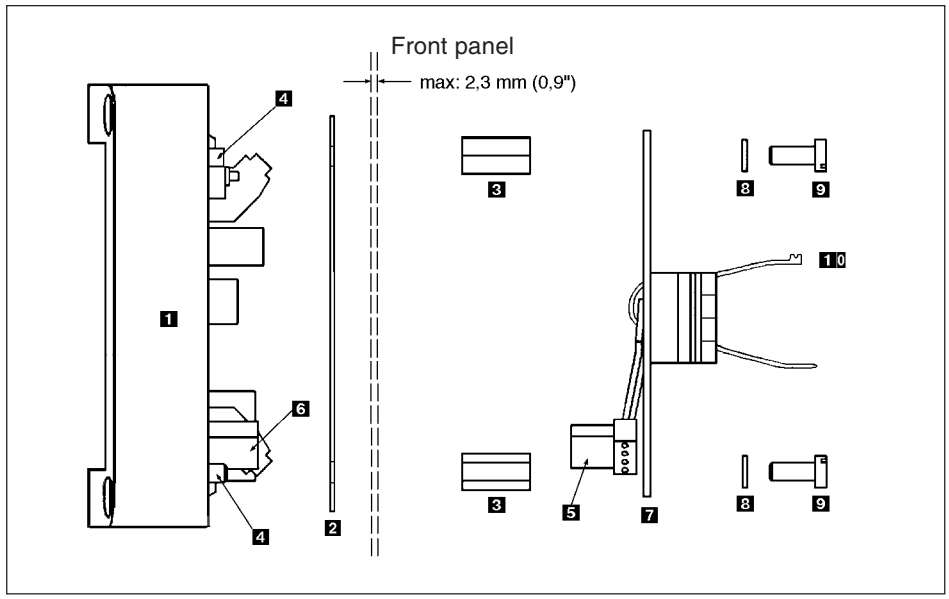


Fig 3.2 Installation pH controller type 8205 panel version

3.1.4 pH controller type 8205 Wall-mounted version installation

The pH controller in wall-mounted version has 4 fixing holes in the bottom enclosure. Remove the white blanking stripes and the cover to access to fixing holes 1.

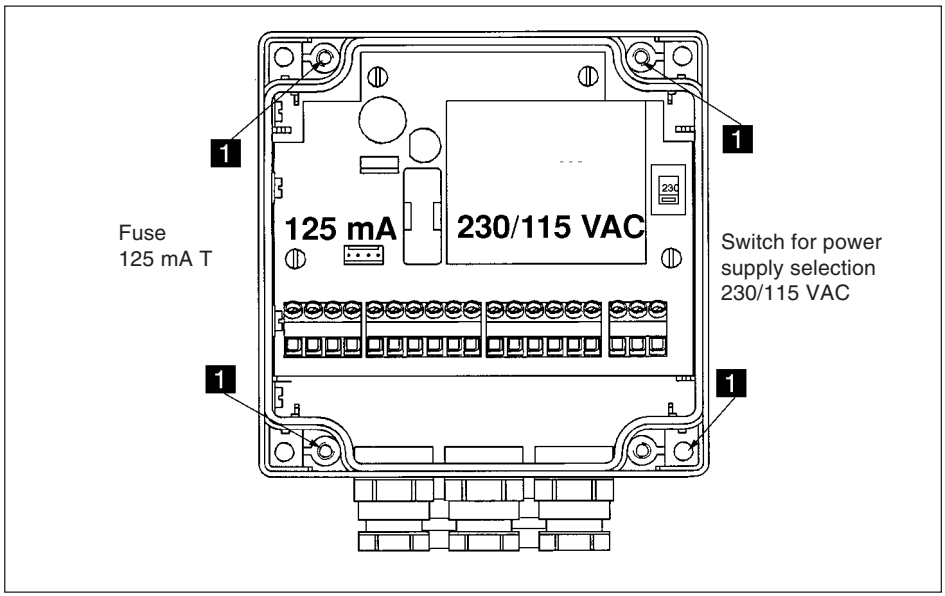


Fig 3.3 Installation pH controller type 8205 wall-mounted version

3.2 Electrical connection

3.2.1 General electrical requirements

The connecting line conducts the measuring signal and must not be installed in combination with high voltage or high frequency carrying lines. If a combined installation cannot be avoided, either keep a min. space of 30 cm (approx. 1 ft) or use shielded cables. When using shielded cables observe faultless grounding of the shield. For normal operating conditions, the 4-20 mA output, and relays signals can be transmitted by a simple cable of 0.75 mm^2. In case of doubt, always use a shielded cable.
The power supply must be of good quality (filtered and regulated).

For EMC purposes,the earth must be connected to the controller.

3.2.2 Connection pH controller type 8205 compact

The electrical wiring ensues via 2 cable glands.
Remove the cover, pull the cable through the cable gland and wire according to pin assignment (Fig. 3.3).
(**+** and **-** according to transistor signal output)

1: Current output 4...20 mA
2: L+ (12...30 VDC)
3: L- (GND)
4: Earth (earth lug)
5: Output 1 — *Base*
6: Output 1 — *Base*
7: Output 2 — *Acid*
8: Output 2 — *Acid*
9: Relay Alarm
10: Relay Alarm

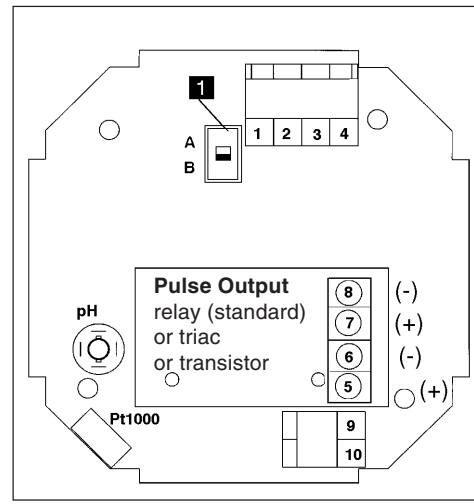


Fig. 3.4 Pin assignment of 8205 compact

Note: PLC-connection. Depending on the PLC-version, the switch **1** on the circuit board must be put to position A or B (see fig. 3.4 and fig. 3.5).

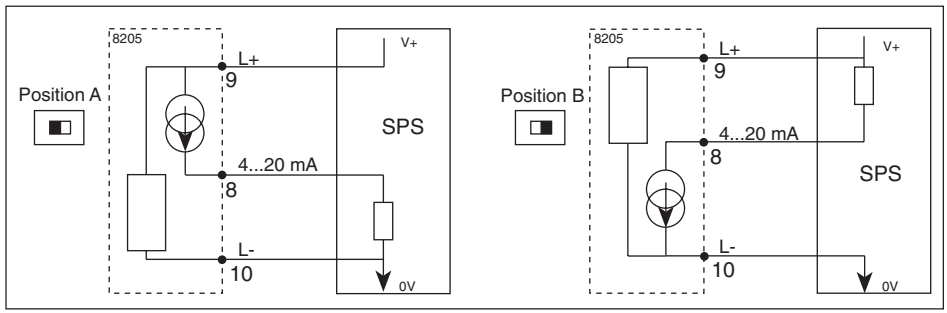


Fig. 3.5 Connection of 4-20 mA output to a PLC (Terminal type 8205 wall-mounted version)

3.2.3 pH controller type 8205 panel

The electrical wiring ensues via 2 cable glands.
Remove the cover, pull the cable through the cable gland and wire according to pin assignment (Fig. 3.6).
(+ and - according to transistor signal output)

1: Current output 4...20 mA
2: L+ (12...30 VDC)
3: L- (GND)
4: Earth (earth lug)
5: Output 1 ┐ *Base*
6: Output 1 ┘ *Base*
7: Output 2 ┐ *Acid*
8: Output 2 ┘ *Acid*
9: Relay Alarm ┐
10: Relay Alarm ┘

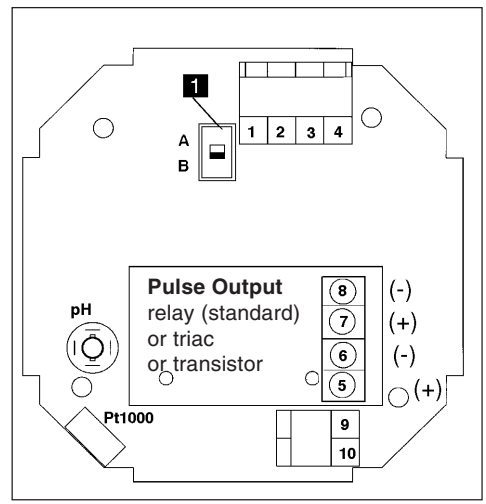


Fig 3.6 Electronic card type 8205 panel

Note: PLC-connection, depending on the PLC-version, the switch **1** on the circuit board must be set in position A or B (see Fig. 3.5 and 3.6).

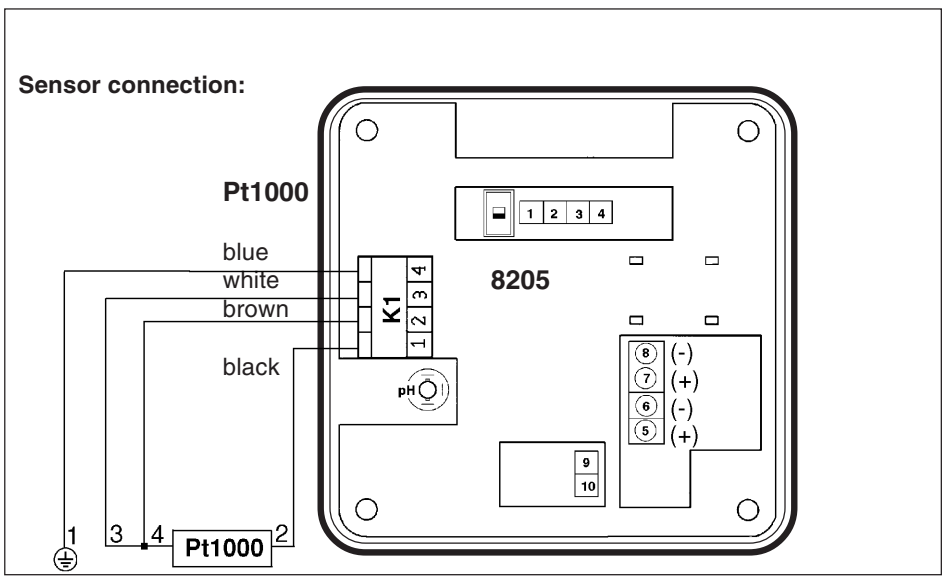


Fig 3.7 Connection card pH controller type 8205 panel

3.2.4 Electrical wiring 8205 wall-mounted 12-30 VDC

Open the cover to access to the terminals. Wire according to the following figure.

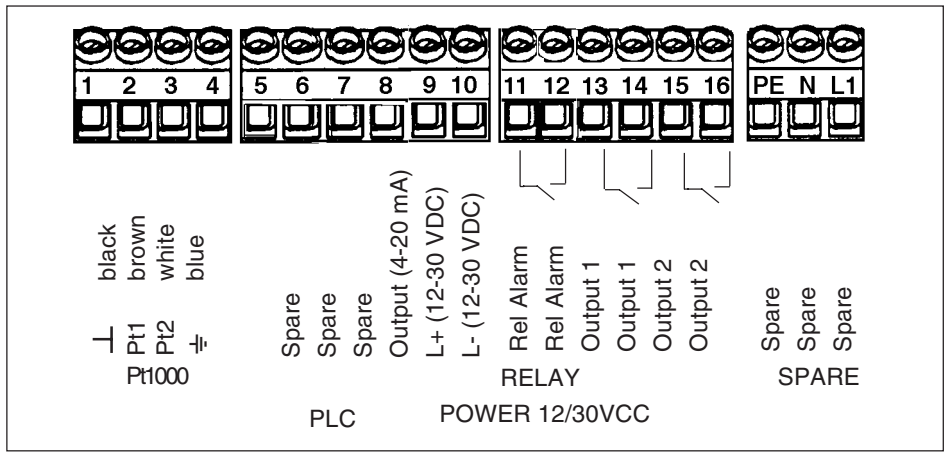


Fig 3.8 12..30 VDC Power supply

3.2.5 Electrical wiring 8205 wall-mounted 115-230 VAC

Open the cover to access to the terminals. Wire according to the following figure.

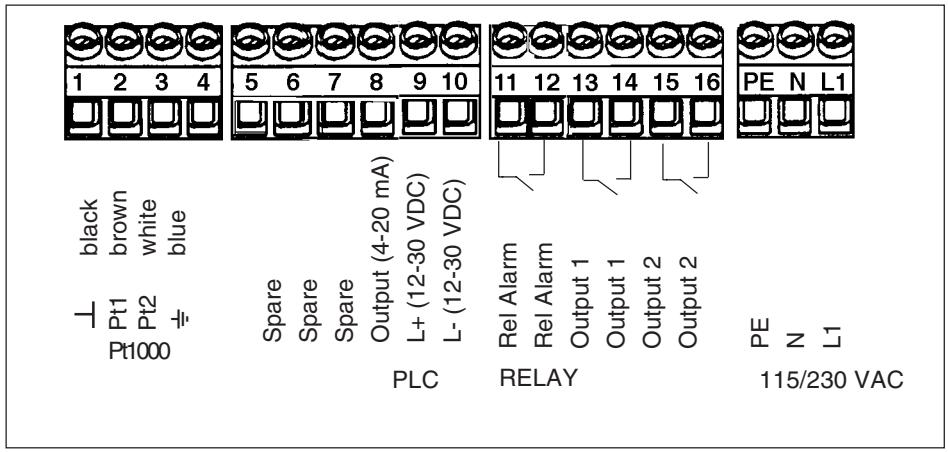


Fig 3.9 115..230 VAC Power supply

Connect the pH sensor to the coaxial connector on the electronic board.
Use the cable gland reducer for the pH cable.

⚠ Warning: Check the position of the power supply selection switch, before starting the device (fig 3.3).

The operation of the pH controller is classified according to 3 levels.

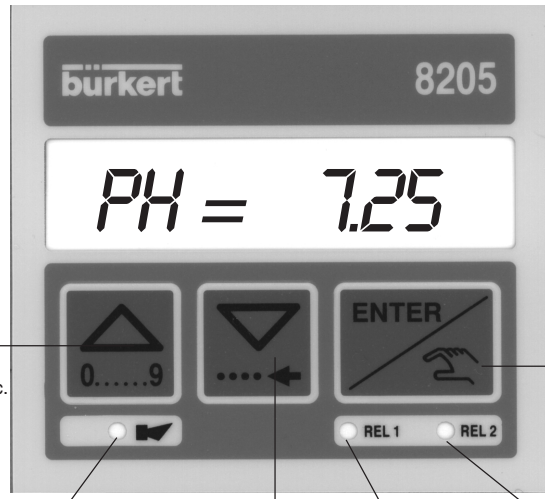
Main Menu

pH, temperature, output current, setpoint and working rates are displayed in the normal function mode.
The "*HOLD*" function and electrode calibration function ("*PH CALIB*") can be accessed in this menu. (see § 4.2)

Calibration Menu
The calibration mode allows adjustments of language, units, 4...20 mA output, output frequencies and impulse durations, pH setpoint adjustment, regulation principle (P; PI; PID), alarm thresholds, manual display selection, temperature compensation mode, and filter selection. (see § 4.3).

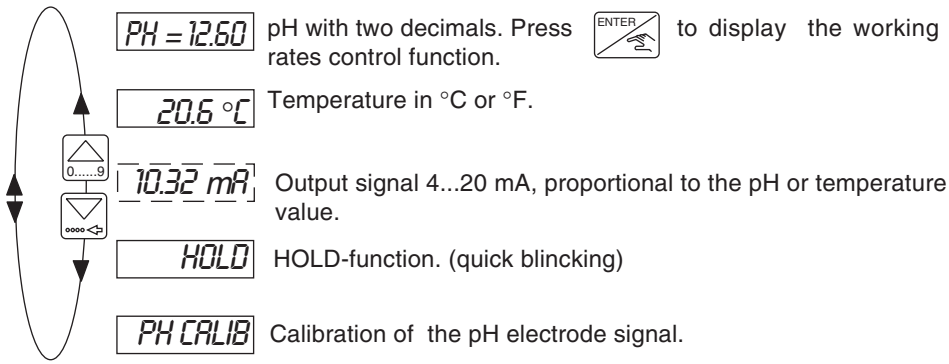
Test Menu
The test menu allows the basic setting of the controller (Offset, Span, temperature adjustment).
A pH or temperature value can be simulated via this menu, allowing the process to be tested in the "dry condition".
The display of the instantaneous electrode voltage is available. (see § 4.4)

4.1 Controller Operating and Control Elements



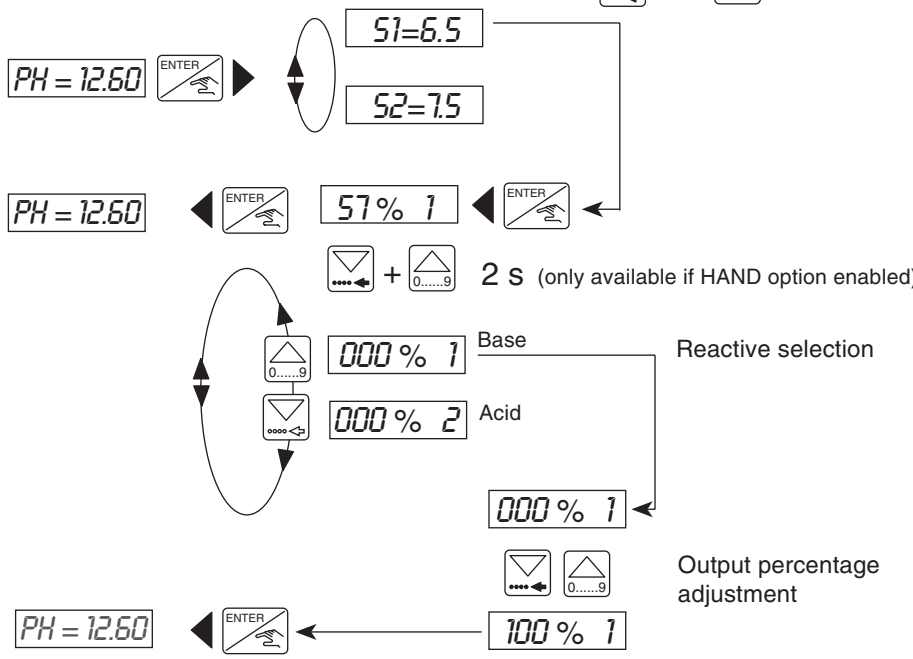
4.2 Operation Mode Display

The following process values are displayed in the display operation mode.



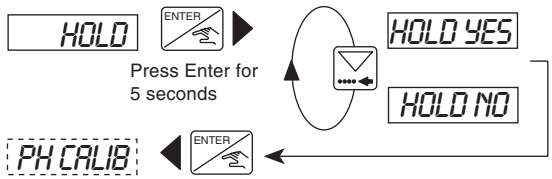
4.2.1 Working rates control function

Allow the current working rates to be checked for output 1 (Base) and output 2 (Acid). If the HAND option is enabled (see § 4.3.9) , the change of percentage rates is allowed in this sub-menu, by pressing simultaneously the keys and during 2 sec.



4.2.2 HOLD function

A continuous 4-20 mA output corresponding to the last value measured before this option was entered is generated. The relays are blocked in their last state. This allows the electrode to be cleaned without interruption of the process. The display in the operation mode is flashing and there is no access to the parameter definition or the test menu, as long as the HOLD-function is activated. To disactivate HOLD function, enter again "*HOLD*" option and confirm "*HOLD NO*".



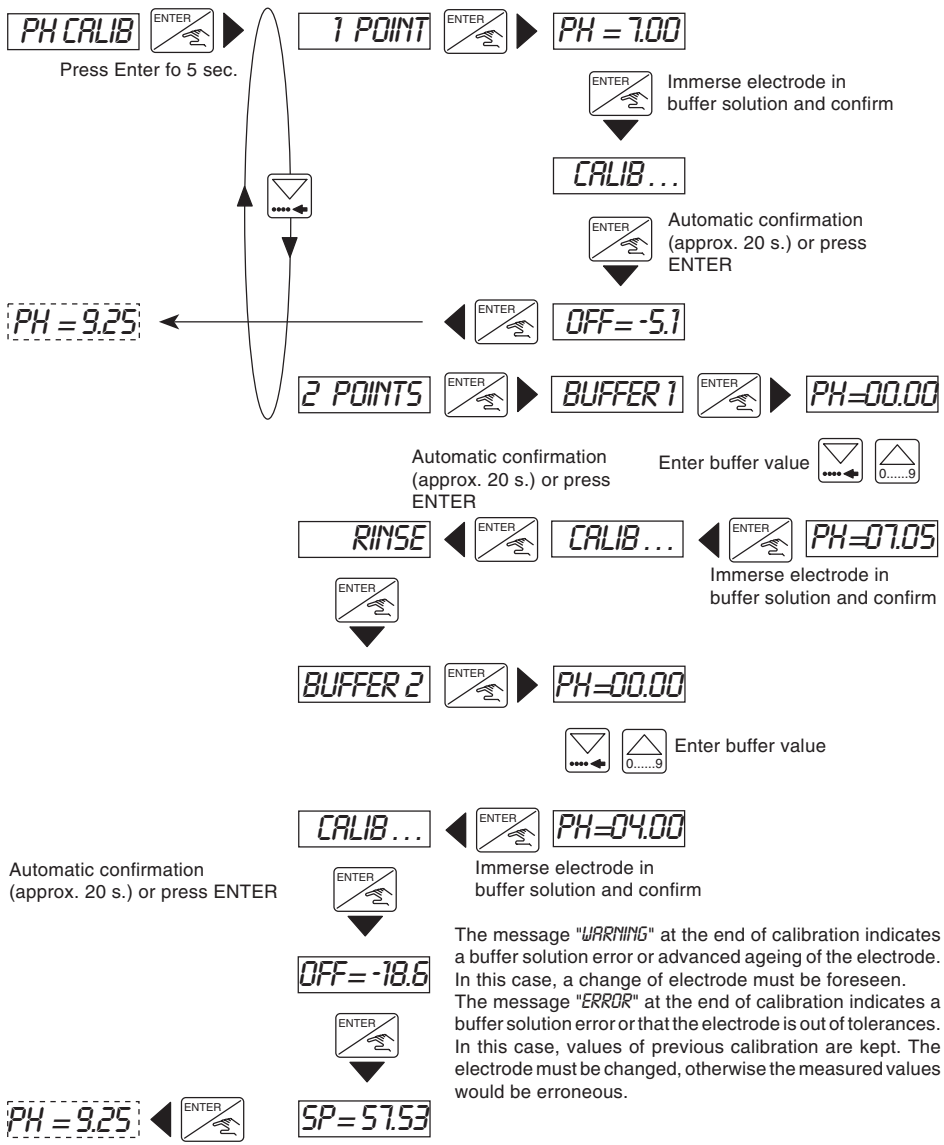
4.2.3 Calibration of pH electrode

1 or 2 measuring points calibration methods are available.

1 measuring point method: enables a quick control calibration with pH=7 buffer solution.

2 measuring points method: enables a precise calibration of zero and slope of the pH electrode. 2 buffer solutions are required. The first solution is usually pH=7. Use the second buffer solution as close as possible of the assumed final pH value. Before each calibration, clean the electrode (see §5.2). The temperatures of the buffer solutions must be equal. The pH controller must be calibrated regularly.
This maintenance procedure is very important to ensure a reliable control operation.

The frequency of calibrations depends upon the degree of contamination of the measuring fluid: in normal conditions, calibration should be repeated once a week.

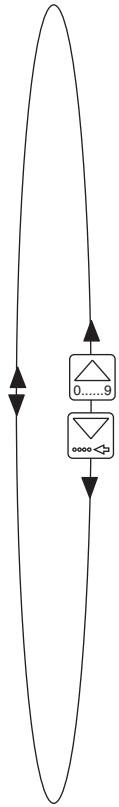


The message "WARNING" at the end of calibration indicates a buffer solution error or advanced ageing of the electrode. In this case, a change of electrode must be foreseen.
The message "ERROR" at the end of calibration indicates a buffer solution error or that the electrode is out of tolerances. In this case, values of previous calibration are kept. The electrode must be changed, otherwise the measured values would be erroneous.

To escape electrode calibration, press 0.....9 + simultaneously for 2s.
Previous calibration values are kept.

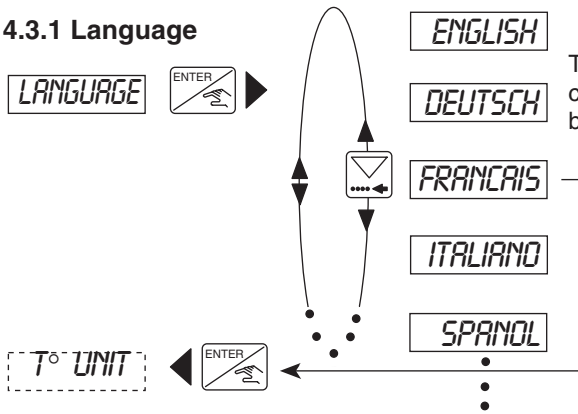
4.3 Calibration Mode: Press ▽ + ENTER simultaneously for 5 seconds

The following adjustments are set in the calibration mode display:



LANGUAGE	English, German, French, Italian, or Spanish choice.
T° UNIT	Temperature unit selection (°C; °F).
CURRENT	Adjustment of the 4...20 mA measuring range (pH or T°).
OUTPUT 1	Selection of output signal 1 (impulse duration or frequency).
OUTPUT 2	Selection of output signal 2 (impulse duration or frequency).
SETPOINT	Adjustement of 2 setpoint for pH control (high/low or high/ very high;...).
CONTROLL	Selection of the pH control mode (P; PI; PID).
ALARM	Adjustement of 2 alarm thresholds for pH or temperature (high/low or high/ very high;...).
HAND	Manual operation selection.
T° SENSOR	Selection of the temperature entry Pt1000 or Manual (without Pt1000). Entry of the simulation value.
FILTER	Damping selection. 10 different steps available.
END	Back to the operation mode and storage of new parameters.

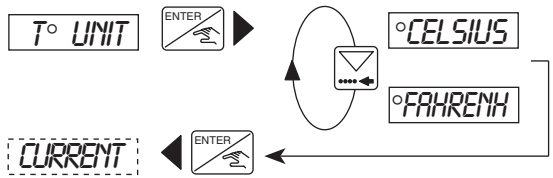
4.3.1 Language



The selected language is confirmed by the ENTER key and becomes immediately active.

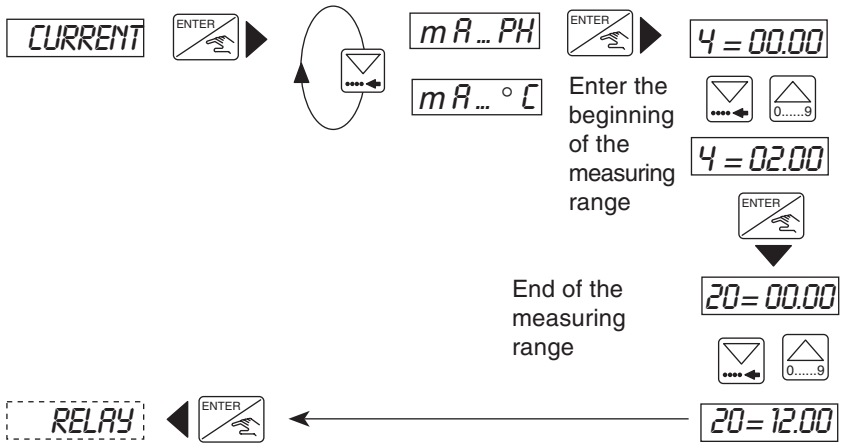
4.3.2 Temperature units

The temperature can be displayed in °Celsius or in °Fahrenheit.



4.3.3 Output Current

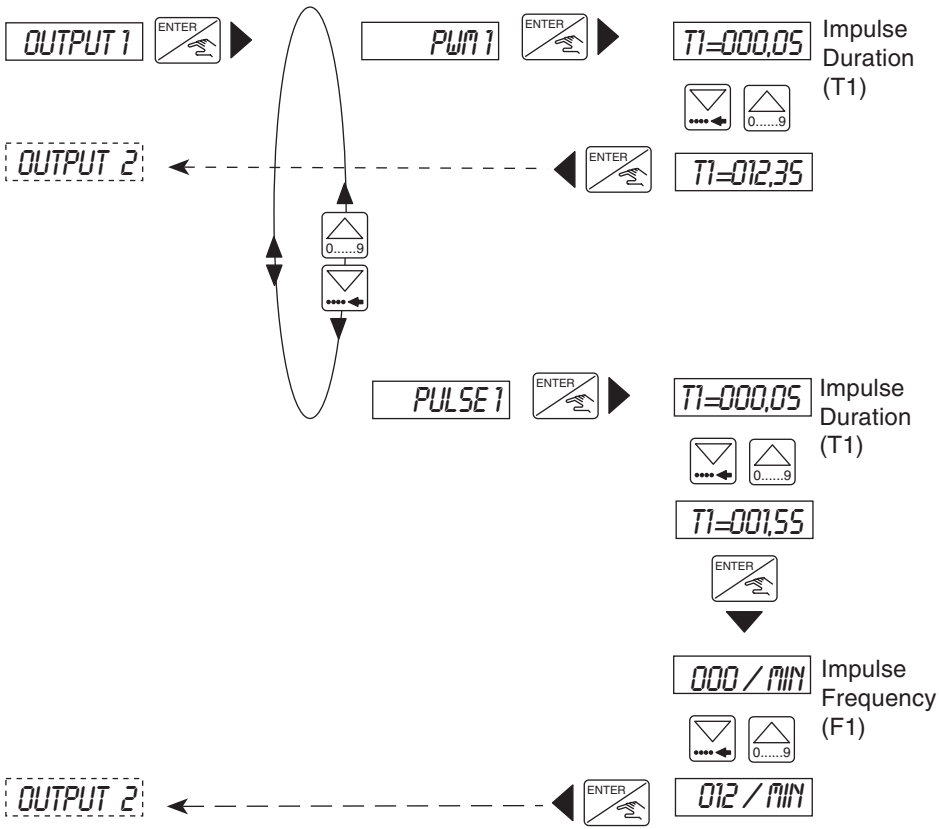
Enter the measuring range corresponding to the 4...20 mA output. First select the unit pH or T°current then, enter the limit values . E.g. 2 to 12 pH associated to 4...20 mA. The beginning of the measuring range might be larger than the end of it, e.g. 2 to 12 pH corresponds to 20...4 mA (inverted output signal).



! If the beginning of the measuring range equals the end of it, there will be no display of the current value in the operation mode display (§4.2)

4.3.4 Output 1 (Base)

Select the controller output 1 logic signal.
Impulse time selection (PULSE 1)
Set the duration of each impulse and the maximum frequency of the output signal.
Impulse frequency selection (PWM1)
Set the frequency of the logic output signal activation.

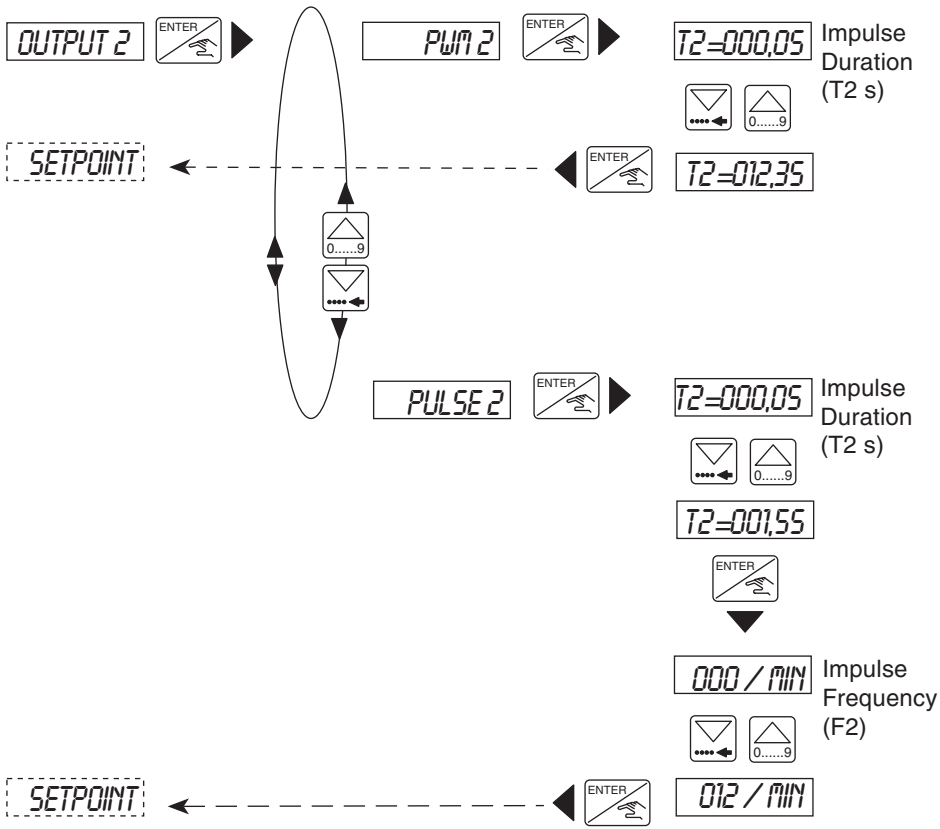


(T1 (s)+0,02 (s)) x F1 < 60
Internal checking of this condition is provided. If this is not, the program returns to T1 selection until complying with the required condition.

! If the pulse output is provided by a relay; set F1 < 60. (cf § 2.5)

4.3.5 Output 2 (Acid)

Select the controller output 2 logic signal.
Impulse time selection (PULSE 2)
Set the duration of each impulse and the maximum frequency of the output signal.
Impulse frequency selection (PWM2)
Set the frequency of the logic output signal activation.



(T2(s)+ 0,02(s)) x F2 < 60
Internal checking of this condition is provided. If this is not, the program returns to T2 selection until complying with the required condition.

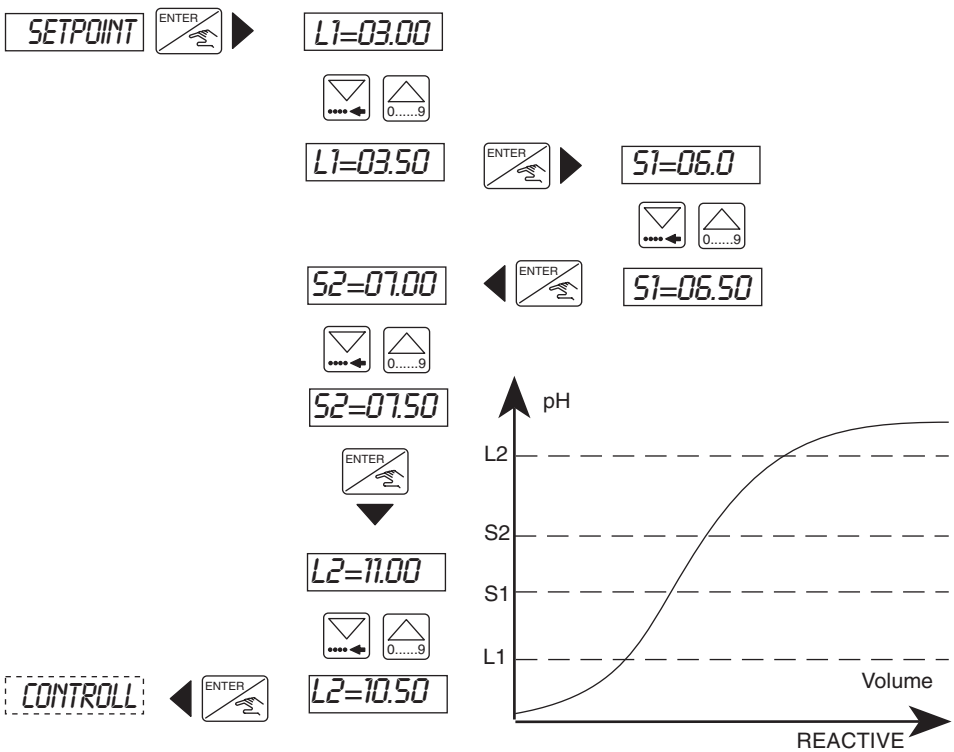
! If the pulse output is provided by a relay; set F2 < 60. (cf § 2.5)

4.3.6 Setpoint Adjustment

Select the pH curve setpoints.

L1<L2 and S1<=S2 (1)
Limit 1 (L1) Set the low bow of the pH curve.
Setpoint 1 (S1)
Set low limit of the pH regulation curve

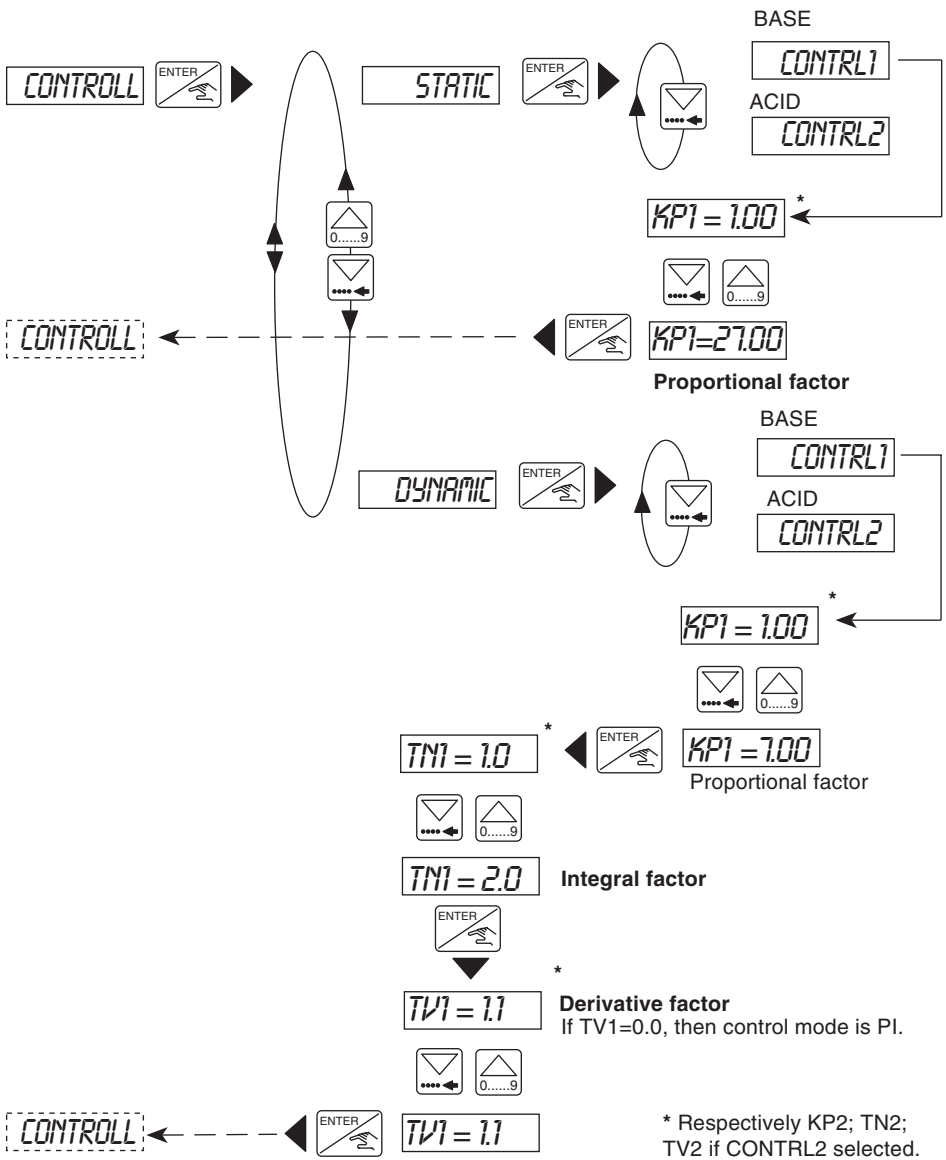
Setpoint 2 (S2)
Set the high limit of the pH regulation curve.
Limit 2 (L2)
Set the high bow of the pH curve



If the condition (1) is not fullfilled, the menu points on L1=3.00. Valuble values have to be selected, before leaving the menu.

4.3.7 Control Mode

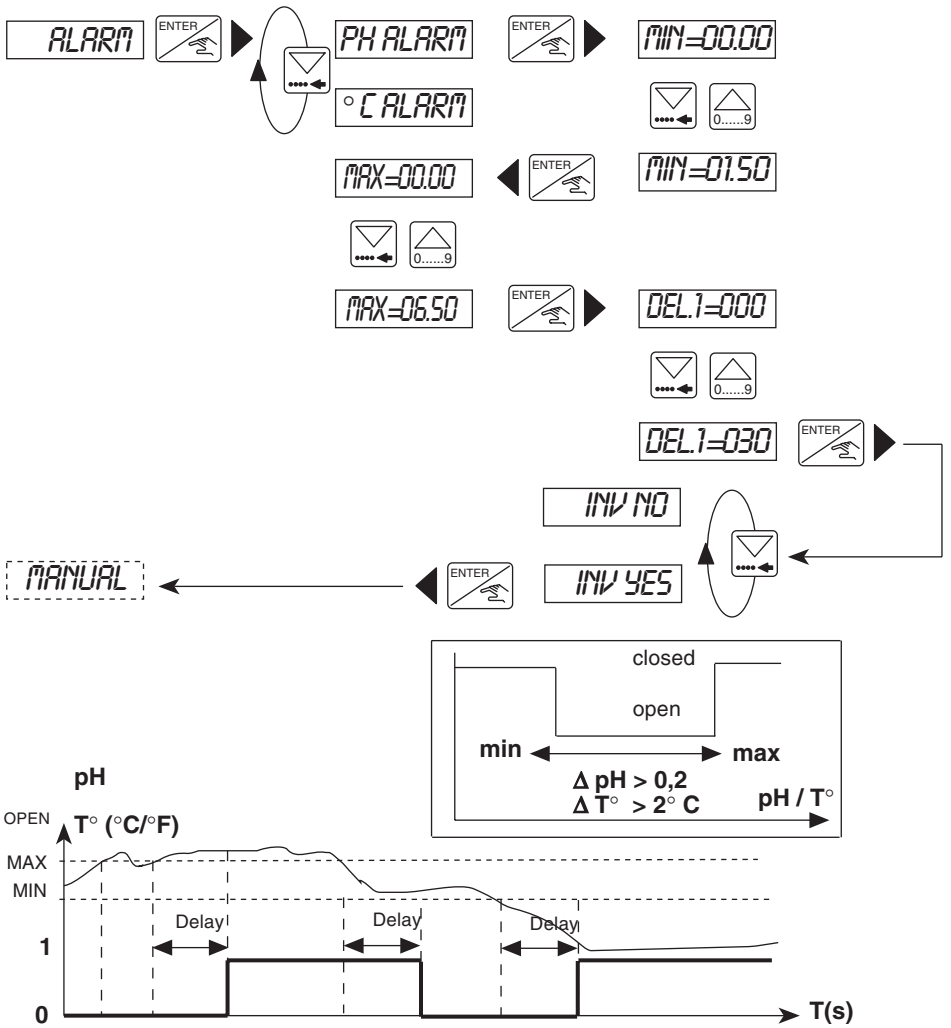
Selection of Control Mode (static or dynamic) and corresponding calculation parameters for P; PI; or PID functions (Pleas refr to appendix A1).



4.3.8 Alarm Threshold Selection

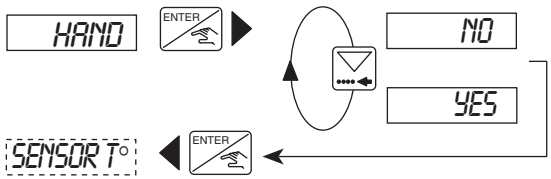
2 thresholds are set for the relay Alarm: MIN and MAX. Options to invert the relays and set a delay between 0 and 999 seconds are available. The delay prevents the relay from too fast activation, e.g. when time for homogenization is required (measurements in tanks with agitator). If the pH(or T°) exceeds a threshold, the controller awaits the delay before activating the relay. No alarm will be provided, if the measured pH(or T°) returns to a normal value before the delay is elapsed.

⚠ **Caution!** The following condition must be maintained MIN ≤ MAX; and Δ pH> 0,2 (or Δ T° > 2°C) .



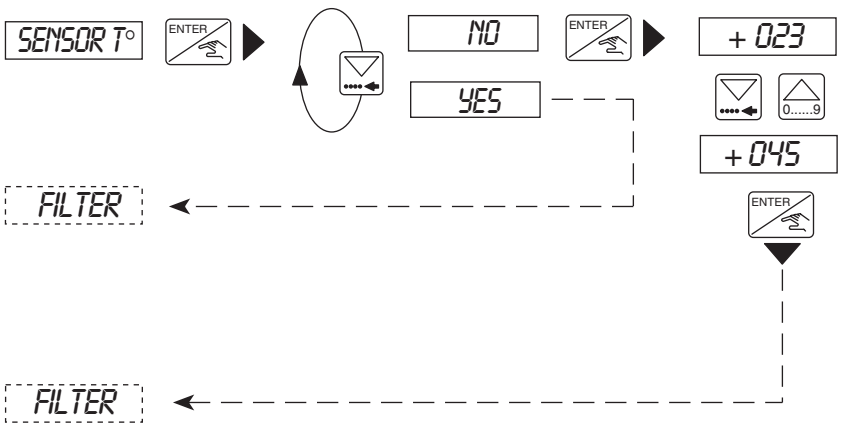
4.3.9 Hand Display Selection

Select the Hand display mode to allow the manual entry of percentages values of base and acid outputs.



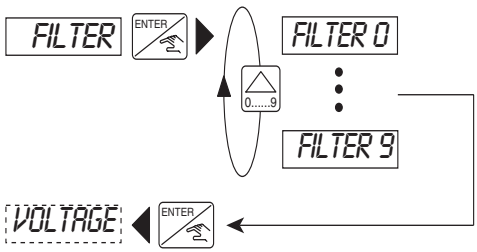
4.3.10 Temperature CompensationMode

If the Pt1000 is not used for temperature acquisition, select SENSOR NO and enter the temperature of the fluid.



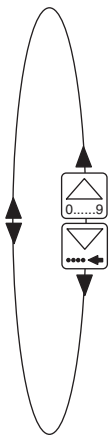
4.3.11 Filter Function

The damping is set in this sub-menu, which prevents display and output current fluctuations. There are 10 steps available. However, the first step ("FILTER 0") has no damping function.



4.4 Test Menu: Press 0.....9 ENTER simultaneously for 5 seconds

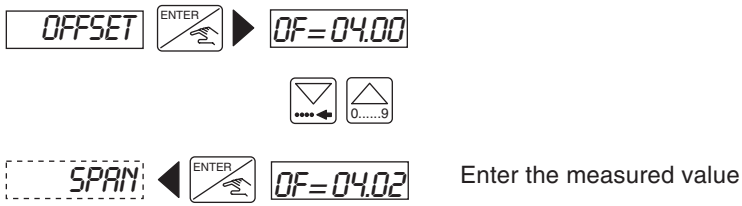
The following compensations and controls are carried through in the Test menu:



OFFSET	Zero point compensation (4 mA).
SPAN	Span compensation (20 mA).
T° ADJUST	Temperature value correction. The outputs are reacting according to this input.
SIMUL	pH or temperature value to be simulated. The outputs are reacting according to this input.
VOLTAGE	Electrode voltage display.
END	Return to the operation mode and storage of new parameters for OFFSET and SPAN and T° adjustment. If one of the values is erroneous, the device points on "OFFSET", and new values must be entered.

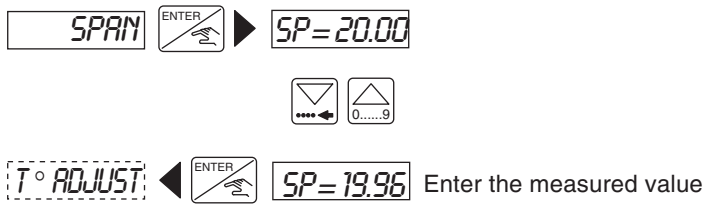
4.4.1 Offset-Compensation

In order to check and modify the basic setting of 4 mA, connect an ammeter in the output circuit. Press ENTER when "*OFFSET*" is displayed, the controller generates 4 mA. If the measured value is different from 4 mA, enter the measured value as offset value.



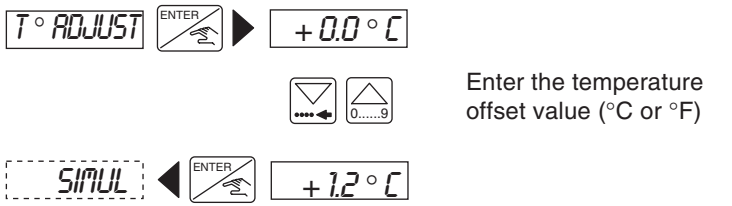
4.4.2 Span-Compensation

Check and modify the basic setting of 20 mA. The procedure is identical to the Offset-compensation. The controller generates 20 mA, if the ENTER key is pressed when "*OFFSET*" is displayed. Correct the span value by entering the measured value if necessary.



4.4.3 Temperature adjustment

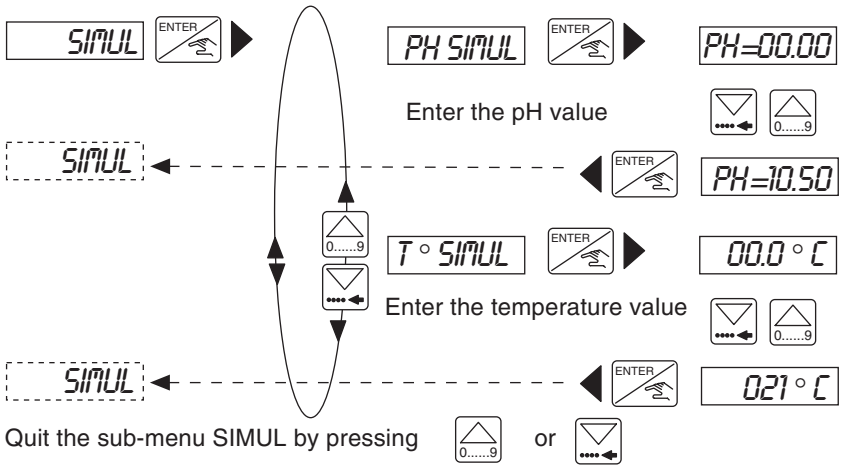
The temperature value issued from the Pt1000 can be corrected. Enter the required offset of temperature (within the limit +/- 5°C), then valid. The temperature unit is as selected in previous parameter menu. The selected temperature value influences the computed pH value.



The temperature adjustment remains active until another value is entered.
The temperature adjustment is not valid with manual temperature compensation mode.

4.4.4 pH Simulation

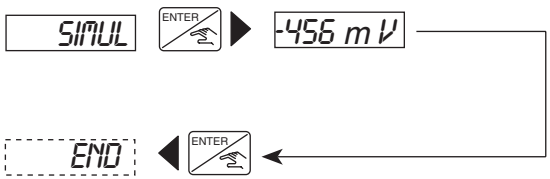
A pH (or T°) value can be simulated in this menu, allowing the user to test his system without any liquid. The simulated value influences the current and pulse outputs and the alarm relay.



The simulation remains active until the user enters another sub-menu.

4.4.5 Display of electrode voltage

Display of the instantaneous value of the electrode voltage.



5 MAINTENANCE

5.1 Replacement of the pH electrode (compact controller only)

pH-electrodes have a limited service life, depending upon many parameters, such as the chemical composition of the handled fluid, temperature, pressure, etc.

The electrode must be replaced if it shows visible damage (broken glass, fractures, etc.) or if the messages "WARNING" or "ERROR" are displayed at the end of calibration.
For replacement, proceed as follows:

1. Disconnect supply voltage and make sure that there is no pressure on pipe or tank.

2. Remove the controller from the pipe or submersion assembly.

3. Unscrew the cover and open it slightly.

4. Pull out connectors **1** and **2**.

5. Pull sensor assembly **3** out of the enclosure.

6. Screw electrode out of assembly **3** with SW17 wrench.

7. Screw new electrode into assembly and tighten with SW17 wrench. Reassemble in reverse order.
   Torque of the electrode 2 N.m

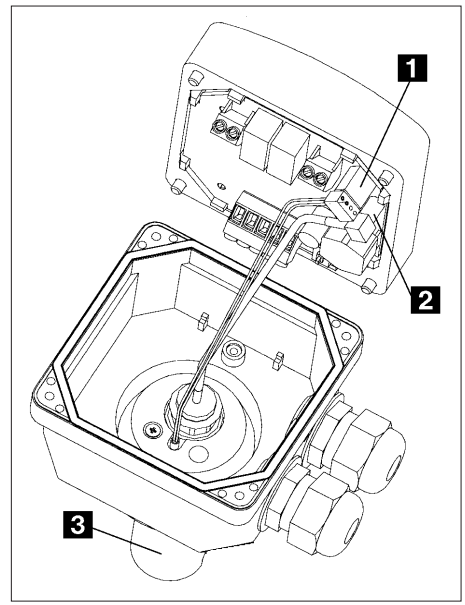


Fig. 5.1 Replacement of pH electrode

5.2 Storing and Cleaning of the Electrode

When not in operation, the electrode should be stored in a 3 molar potassium chloride solution (223,6 g/l), providing a regenerative effect. Is there no such solution available, normal tap water will also do for short measuring interruptions of max. 2 - 3 days. The electrode must not be stored in distilled or deionisized water, which may be used for rinsing purposes only!
Experience has shown, that the majority of failures in pH electrode measurements and long response times originate from contaminated electrodes or diaphragms. Since the contamination is subject to the application, there is no general detergent available yet. The following detergents, however, can be recommended for most application cases:
-Greasy or oily deposits must be removed with a tenside-containing agent.
-Chalky deposits and metal hydroxide layers require diluted hydrochloric acid (10%).
-Sulphide-containing deposits (purification systems) are removed with a detergent mixture of diluted hydrochloric acid (10%) and saturated pepsin.
-For very slow pH-electrodes dip the electrode for 1 minute into a 2% HF and 5% HCL solution and rinse thoroughly.

Observe safety regulations, when handling acid-containing solutions. Always rinse electrode with deionisized water and leave for approx. 10 minutes in a 3 molar potassium chloride solution or in tap water.

5.3 Error messages

"*ERROR*" on the display (except in electrode calibration function) indicates that calibration data are lost. By pressing ENTER, the user access to operation menu but the device works with the factory settings (see §5.4). The controller needs re-calibration. If this message recurs, please return the controller to your supplier.

Temperature: If "----° C" or "----° F" is displayed, temperature is out of range (-40...+150) or connection with Pt 1000 is interrupted. In this case "*PH* = --" is displayed. For the outputs (current and relays) pH=0 is fixed.

pH values out of range: pH>14 or pH<0, "*PH* = --" is displayed. For the outputs (current and relays) pH=14, respectively pH=0, are fixed.

Electrode voltage: >+575 mV ou <-575 mV. "*PH* = --" and "---- *mV*" are displayed. For the outputs (current and relays) pH=0, respectively pH=14, are fixed.

Power failure: In case of power failure, the display turns off, 4-20 mA and pulse output to 0, alarm relays open. When the power supply is turned on , the controller is set to the previous configuration and the measure goes on.

5.4 Factory-setting of pH controller type 8205 at delivery

Language:		English	**Controller:**	**Type : PID**	
Temperature Unit:		°C	Proportional	KP1: 1.0	KP2: 1.0
4-20 mA Output:		**pH**	Integer	TN1: 1.0	TN2: 1.
	4 mA:	00.00	Derivative	TV1: 1.1	TV2: 1.1
	20 mA:	00.00			
Output1:	**Type Pulse**		**Alarm:**	**Type pH**	
	Time 1:	0		MIN:	00.00
	Freq 1:	0		MAX:	00.00
	Period 1:	0 (*PWM1*)		DEL1:	000
Output2:	**Type Pulse**			INV:	No
	Time 2	0			
	Freq 2:	0	MANUAL:	Yes	
	Period 2:	0 (*PWM2*)	Pt1000:	Yes	
			Filter:	Filter 2	
Setpoint:	Limit1:	3.00			
	Set1:	6.00			
	Set2:	8.00			
	Limit2:	11.00			

5.5 Spare Parts List pH controller type 8205

5.5.1 Spare Parts pH controller type 8205 compact

Position	Specification	Order-No.
1	Complete sensor housing with ring, union nut and two flat seals.	425526B
2	Cover with screws, sheeting and printed circuit board Controller with relay output, software.	426490M
	Cover with screws, sheeting and printed circuit board Controller with triac output, software.	426491A
	Cover with screws, sheeting and printed circuit board Controller with transistor output, software.	426492B
3	PG 13.5 Worldwide version	418339Q
4	PG 13.5 North America version (G 1/2 ")	418340M
5	Ring	619205L
6	Union nut	619204K
7	pH electrode 0...90°C, 0...6 bar LEI (cf §2.4)	418341A
	pH electrode 0...40°C, 0...2 bar SCH	418343C
	pH electrode 0...90°C, 0...6 bar HOL	420101Z
8	pH electrode 0...90°C, 0...6 bar GLS	634505Y
9	pH electrode 0...130°C, 0...3 bar STE	634506Z
10	Electrode housing with Pt 1000 stainless steel	418889Z
	Electrode housing with Pt 1000 titanium	418890W
11	FPM seal kit	425554P
	EPDM seal kit	425555Q
12	Operating instructions manual (D, GB, F)	426493C
13	Buffer solution pH= 4, 250 ml	418540E
	Buffer solution pH= 7, 250 ml	418541T
	Buffer solution pH= 9, 250 ml	418542U
	Buffer solution pH= 10, 250 ml	418543V
	Storage solution for electrodes (KCl 3M)	418557T

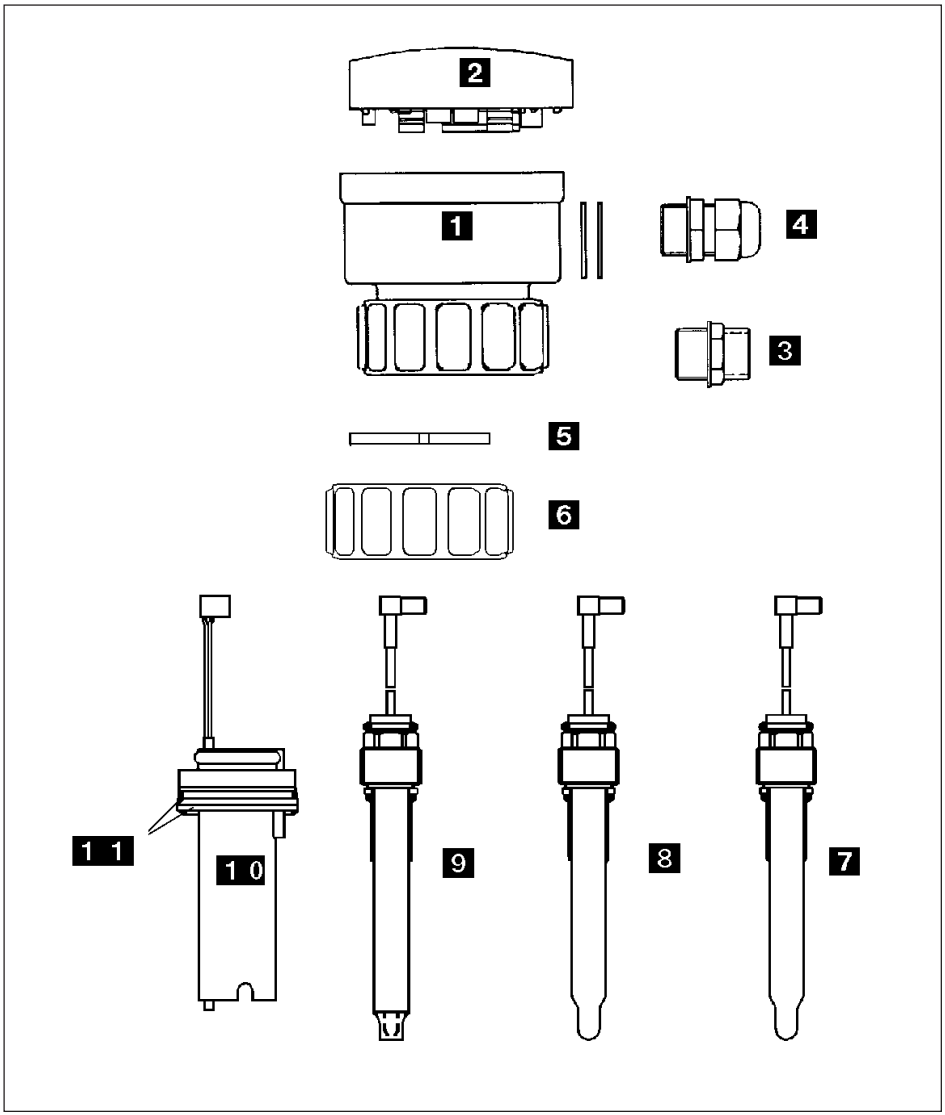


Fig. 5.2 Spare parts explosion drawing pH controller type 8205 compact version

5.5.2 Spare parts pH controller type 8205 panel version

Item	Designation	Order Nr
1	Cover with screws, front panel and electronic card with relays, and software.	426490M
2	Cover with screws, front panel and electronic card with triacs, and software	426491A
2	Cover with screws, front panel and electronic card with transistors, and software.	426492B
3	Gasket	419350Q
4	Protective plate	427100X
5	Mounting accessories (screws, lockwashers, spacer bolts, cable clips)	418388A
	Instruction manual	426493C

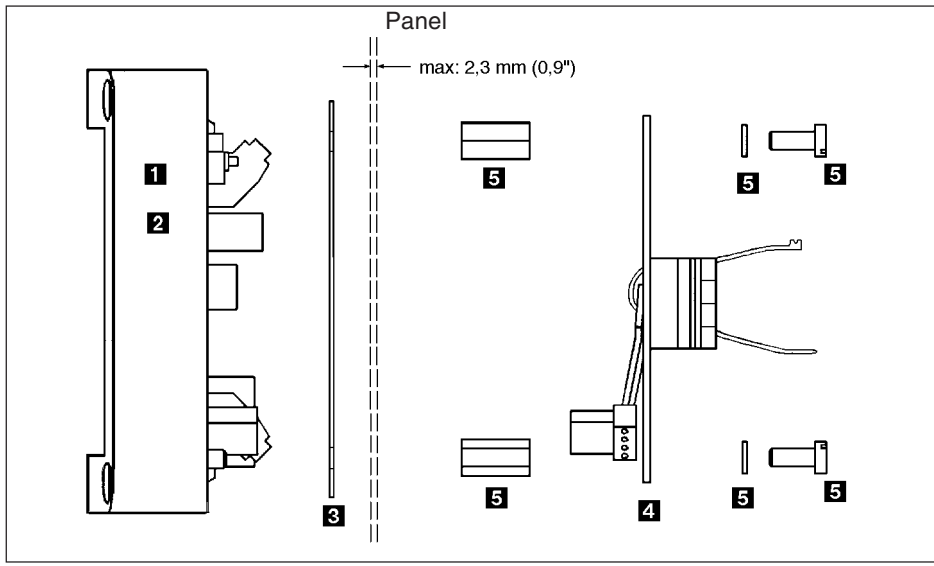


Fig 5.3 Spare parts explosion drawing pH controller type 8205 panel version

5.5.3 Spare parts pH controller type 8205 wall mounted

Item	Designation	Order Nr
6	Electronic card 8205 wall-mounted with relays and software.	426987B
7	Electronic card 8205 wall-mounted with transistors and software.	426488L
7	Electronic card 8205 wall-mounted with triacs and software.	426989M
8	Power card 12...30 VDC Power card 230/115 VAC	426976P 426975N
9	Connection cable between power card and electronic card	420403Y
10	Complete IP65 enclosure	418389B
	Instruction manual	426493C

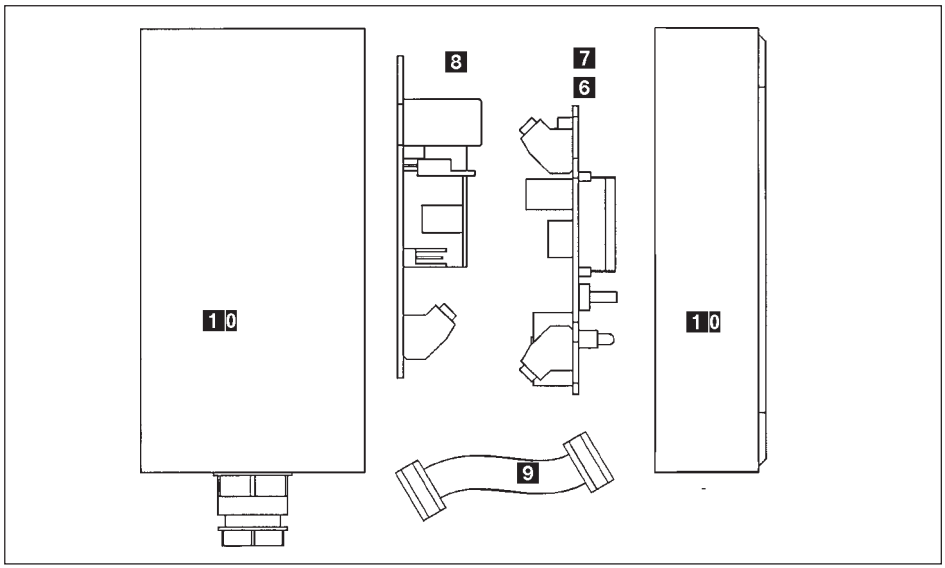


Fig 5.4 Spare Parts Explosion Drawing pH controller type 8205 wall-mounted

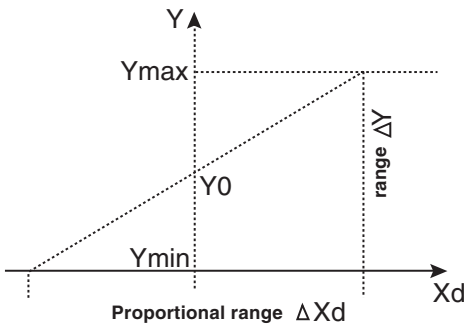
A1: Characteristics of PID controllers

A PID controller has a proportional, an integral and a differential component (P, I and D components).

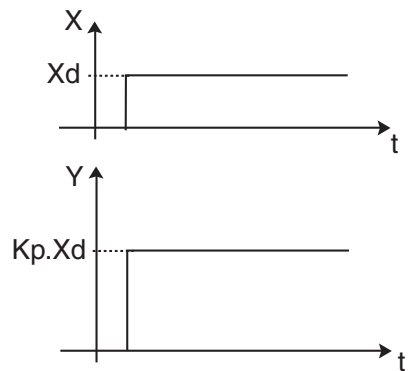
P component :

Function : **Y = Kp • Xd**

Kp is the proportional action coefficient. It results from the ratio of the manipulating range ΔY to the proportional range ΔXd.



Characteristic



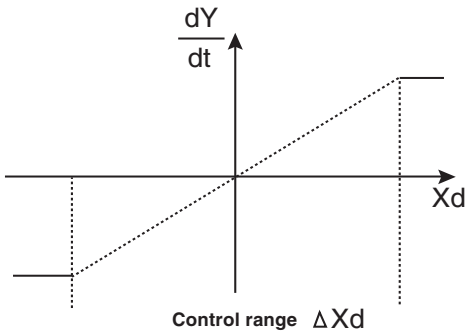
Step response

Characteristics :
Theoretically, a pure P controller operates without delay, i. e. it is fast and therefore dinamically favorable. It has a lasting system deviation, i. e. it does not balance out the effects of disturbances completely and is therefore relatively unfavorable from the static point of view.

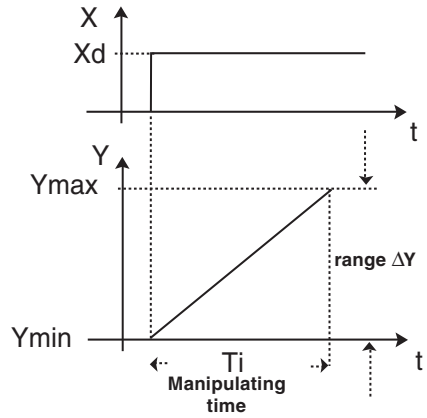
I component :

Function : **Y = $\int$ Xd dt**

Ti ist the integration or manipulating time. This is the time that elapses before the manipulated variable has passed through the complete manipulating range.



Characteristic



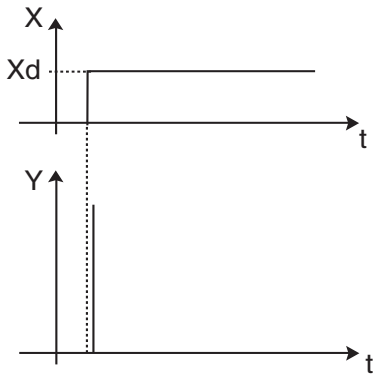
Step response

Characteristics :
A pure I controller eliminates the effects of occuring disturbances completely. Therefore, it has a favorable static response. Owing to its finite manipulating speed, it operates more slowly than the P controller and tends to oscillate. Therefore, it is relatively unfavorable from the dynamic point of view.

D component :

Function : **Y= Kd**

Kd ist the derivative action coefficient.
The higher Kd is, the stronger the D influence is.



Step response

Characteristics :
A controller with a D component reacts to changes in the controlled variable and is accordingly capable of dissipating occurring deviations faster.

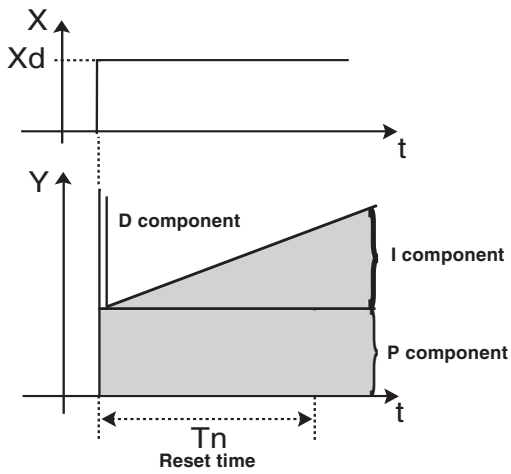
Supperposition of P-, I- and D components:

$$Y = Kp\ Xd + \frac{1}{Ti} \int Xd\ dt + Kd\ \frac{d\ Xd}{dt}$$

Where $Kp \bullet Ti = Tn$ and $\frac{Kd}{Kp} = Tv$, results with regard to ***functioning of the PID controller:***

$$Y = Kp\ (Xd + \frac{1}{Tn} \int Xd\ dt + Tv\ \frac{d\ Xd}{dt})$$

Kp : ***Proportional action coefficient / gain***
Tn : ***Reset time*** (the time needed to achieve the same manipulated variable change by the I component as is produced as the result of the P component).
Tv : ***Derivative action time*** (the time to achieve a specific manipulated variable on the basis of the D component earlier than when using a pure P controller).



Step response of the PID controller

A2: Rules for adjusting PID controllers

The litterature on control systems specifies a series of adjustment rules with which a favorable adjustment of controller parameters can be achieved experimentally. To avoid bad adjustments, the conditions under which the respective adjustment rules have been elaborated must always be observed. In addition to the characteristics of the controlled system and of the controller itself, it is important to know whether it is intented to balance out a disturbance change or a command variable change.

Adjustment rules according to Ziegler and Nichols (oscillation method)

When using this method, controller parameters are adjusted on the basis of the control loop's response at the stability limit. In doing so, the controller parameters are adjusted so as to ensure that the control loop begins to oscillate. A conclusion as to a favorable adjustment of the controller parameters is reached from critical characteristic values occurring in this case. It goes without saying that, when using this method, it must be possible to bring the control loop to oscillation.

Method:
- Set the controller as a P controller (i.e. Tn = 999, Tv = 0), initially selecting a low Kp value.
- Set the required setpoint.
- Increase Kp until the controlled variable oscillates continuously without attenuation (see following figure).

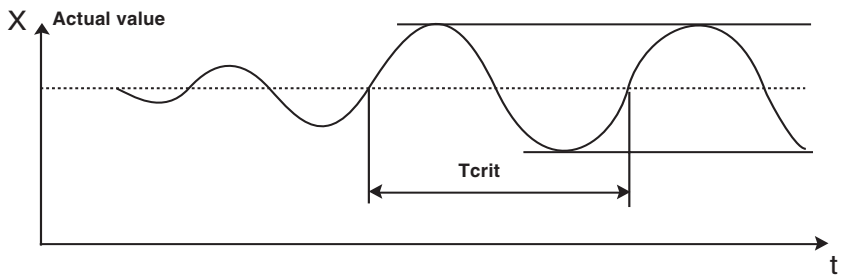


Figure : **Progression of the control variable at the stability limit**

The proportional action coefficient set at the stability limit is referred as Kcrit. The resulting oscillation period is referred to as Tcrit.

On the basis of Kcrit and Tcrit, the controller parameters can then be calculated in accordance with the following table:

Parameter settings according to Ziegler und Nichols :

Controller type	Parameter settings		
P controller	Kp = 0,5 Kcrit		
P controller	Kp = 0,45 Kcrit	Tn = 0,85 Tcrit	
P controller	Kp = 0,6 Kcrit	Tn = 0,5 Tcrit	Tv = 0,12 Tcrit

The Ziegler and Nichols adjustment rules were determined for P systems with a time delay of the first order and a dead time. However, they apply only to controllers with a disturbance response, but not to controllers with a command response.

Adjustment rules according to Chien, Hrones and Reswick (manipulated variable methode):

When using this method, the controller parameters are adjusted on the basis of the control system's transition response. A 100% change in the manipulated variable is output. The time Tu and Tg are derived from the progression of the actual value of the control variable (following figure). Ks is the proportional action coeffficient of the control system.

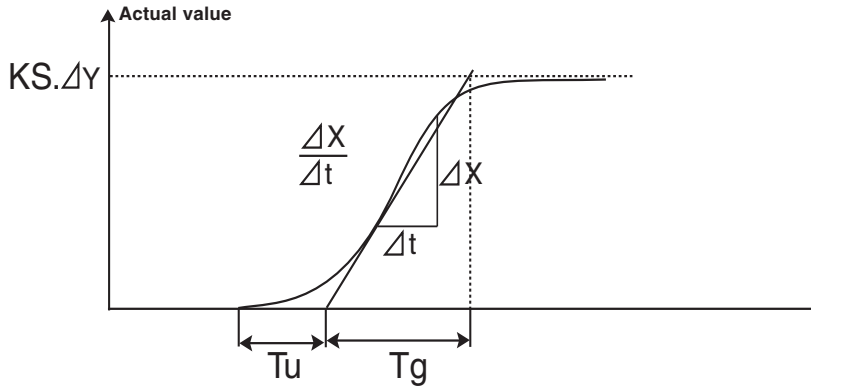


Figure : **Progression of the controlled variable after a manipulated variable change ΔY**

Method :

- Set the controller to MANUAL mode.
- Output a manipulated variable change and record the controlled variable with a recorder.
- Switch off in good time if you encounter critical progressions (e. g. a risk of overheating) (Pay attention to the fact that, in thermally inert systems, the actual value of the controlled variable may increase further switching off).

The following table lists the settings for the controller parameters depending on Tu, Tg and Ks for command and disturbance response and for an aperiodic control operation as well as a control operation with 20% overshoot. They apply to systems with a P response, with a dead time and with a delay of the 1st order.

Parameter settings according to Chien, Hrones and Reswick :

Controller type	Parameter settings			
	Aperiodic control operation (0% overshoot)		Control operation with 20% overshoot	
	Command	Disturbance	Command	Disturbance
P controller	$KP = 0{,}3 \frac{Tg}{Tu \bullet Ks}$	$Kp = 0{,}3 \frac{Tg}{Tu \bullet Ks}$	$Kp = 0{,}7 \frac{Tg}{Tu \bullet Ks}$	$Kp = 0{,}7 \frac{Tg}{Tu \bullet Ks}$
PI controller	$Kp = 0{,}35 \frac{Tg}{Tu \bullet Ks}$ $Tn = 1{,}2\ Tg$	$Kp = 0{,}6 \frac{Tg}{Tu \bullet Ks}$ $Tn = 4 \bullet Tu$	$Kp = 0{,}6 \frac{Tg}{Tu \bullet Ks}$ $Tn = Tg$	$Kp\ 0{,}7 \frac{Tg}{Tu \bullet Ks}$ $Tn = 2{,}3 \bullet Tu$
PID controller	$Kp = 0{,}6 \frac{Tg}{Tu \bullet Ks}$ $Tn = Tg$ $Tv = 0{,}5 \bullet Tu$	$Kp = 0{,}95 \frac{Tg}{Tu \bullet Ks}$ $Tn = 2{,}4 \bullet Tu$ $Tv = 0{,}42 \bullet Tu$	$Kp = 0{,}95 \frac{Tg}{Tu \bullet Ks}$ $Tn = 1{,}35 \bullet Tg$ $Tv = 0{,}47 \bullet Tu$	$Kp = 1{,}2 \frac{Tg}{Tu \bullet Ks}$ $Tn = 2 \bullet Tu$ $Tv = 0{,}42 \bullet Tu$

As shown in the figure of the previous page, the proportional action coefficient Ks of the control system can be calculated by way of the increase in the inflectional tangent, i. e. by way of $\Delta Xd / \Delta t$ (ΔY: manipulated variable change)

$$Ks = \frac{\Delta X \bullet Tg}{\Delta t \bullet \Delta Y}$$

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