Type 202540

µP transmitter / controller
for
electrolytic conductivity

B 20.2540.0.1
Operating Instructions

04.07/00401714

Contents

Contents

1 General

1.1 Preface

Please read these Operating Instructions before commissioning the instrument. Keep the manual in a place that is accessible to all users at all times.

Please assist us to improve these operating instructions, where necessary.

Your suggestions will be welcome.

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All necessary settings are described in this manual. However, if any difficulties should still arise during start-up, please do not carry out any unauthorized manipulations on the instrument. You could endanger your rights under the instrument warranty!

Please contact the nearest subsidiary or the main factory in such a case.

When returning modules, assemblies or components, the rules of EN 100 015 “Protection of electrostatically sensitive components” must be observed. Use only the appropriate **ESD** packaging for transport.

Please note that we cannot accept any liability for damage caused by ESD (electrostatic discharge).

2.1 Warning signs

Danger

This symbol is used when there may be **danger to personnel** if the instructions are ignored or not followed correctly!

Caution

This symbol is used when there may be **damage to equipment or data** if the instructions are ignored or not followed correctly!

2.2 Note signs

Note

This symbol is used when your **special attention** is drawn to a remark.

see abcd

Reference

The cursive (italic) text refers to **further information** in other chapters or sections.

abc[1]

Footnote

Footnotes are remarks that **refer to specific points** in the text. Footnotes consist of two parts:

A marker in the text, and the footnote text.

The markers in the text are arranged as continuous superscript numbers.

*****

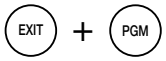
Action

This symbol indicates that an **action to be performed** is described.

The individual steps are marked by this asterisk.

Example:

* Remove crosspoint screws.
* Press the ▲ key.



Key combinations

If key symbols are shown connected by a plus sign, this means: first press and hold down the EXIT key, and then press the next key.

3 Application

3.1 Type 202540

Description

The compact microprocessor transmitter/controller, with 96 mm x 48 mm bezel and plug-in controller module, measures and controls the conductivity of aqueous solutions.

Inputs

The transmitter has two analog and two logic inputs. The first analog input is suitable for connecting conductivity electrodes with cell constants of 0.01; 0.1; 1.0; 3.0 and 10.0 [1/cm]. The second analog input can be used to connect Pt1000 or Pt1000 resistance thermometers.

Display

The instrument features two 4-digit 7-segment displays for indicating the conductivity (red) and the temperature (green). During programming, the displays provide comments on the inputs.

Outputs

The instrument has a maximum of 5 outputs

Out-put	Stan-dard	Description / configurable	Output
K1	yes	Controller / controller off, limit controller, pulse width controller, pulse frequency controller, modulating controller with P, PI, PD or PID action	Relay, make
K2	yes	Controller / controller off, limit controller, pulse width controller, pulse frequency controller, modulating controller with P, PI, PD or PID action	Relay, make
K3	Option	Analog output / proportional controller	-- / analog
K3	Option	Limit comparator	Relay, changeover contact
K4	yes	Logic output	0/5 V 0/12V
K5	Option	Analog output / proportional controller	-- / analog
K5	Option	Limit comparator	Relay, changeover contact
K5	Option	Serial interface / Profibus-DP or MODbus/ Jbus	RS422 / RS485

3.2 Operating Instructions B 20.2540.0.1

These operating instructions provide full instructions on the installation, electrical connection, commissioning, operation, parameter setting and configuration of the microprocessor transmitter/controller for electrolytic conductivity, Type 202540.0.1.

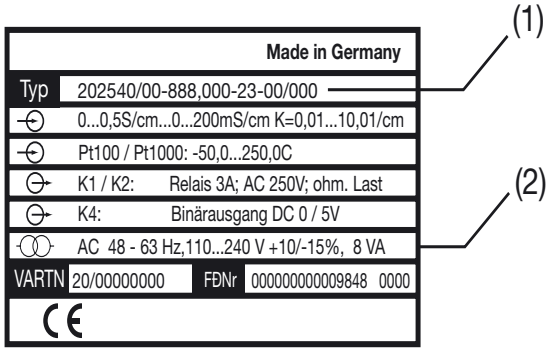
Check for completeness

You should have received at least the following:

- transmitter/controller for conductivity, Type 202540
- 2 mounting brackets
- seal (housing/panel)
- Operating Instructions B 20.2540.0.1

Nameplate

The nameplate is glued to the housing.



Explanation of the type designation (1)
⇨ Chapter 4.1 “Type designation”, page 8.

The type designation (1) contains all the factory settings, such as the controller function, the measurement inputs and extra codes. The extra codes are listed in sequence and separated by commas.

The supply voltage must correspond to the voltage given on the nameplate (2).

4 Instrument identification

4.1 Type designation

	(1)	**Basic type**
202540		Microprocessor transmitter/controller for electrolytic conductivity
	(2)	**Basic type extensions**
00		controller off[1]
10		limit controller[1]
21		pulse width controller[1]
31		pulse frequency controller[1]
	(3)	**Output I**
000		no output
310		relay, changeover contact
888		process value output, freely configurable
	(4)	**Output II**
000		no output
310		relay, changeover contact[2]
888		process value output, freely configurable[2]
	(5)	**Supply voltage**
22		20 — 53 V AC/DC ±0%, 48 — 63/0 Hz
23		110 — 240 V AC +10%/-15%, 48 — 63 Hz
	(6)	**Interface[2]**
00		no interface
54		serial interface RS422/RS485, MODbus/Jbus protocol[2]
64		Profibus-DP[2]
	(7)	**Extra codes**
000		none
015		logic output 0/12 V DC, instead of standard 0/5 V DC

Order example

(1)	**(2)**		**(3)**		**(4)[2]**		**(5)**		**(6)[2]**		**(7)**
202540/	..	-	...	,	...	-	..	-	..	/	...

[1] **Generally**, the following configurations can be freely selected by the user on **all** instruments of Type 202540:
controller off / limit controller / pulse width controller with P, PI, PD, PID control action / pulse frequency controller with P, PI, PD, PID control action / modulating controller.
The variations listed in the type designation are simply factory default settings!

[2] If output II (4) = “310” or “888”, then the interface option (6) “54” or “64” is not possible (or the other way round).

5.1 Technical data

Analog input 1

Electrode cell for conductivity measurement, with cell constant K of 0.01; 0.1; 1.0; 3.0 or 10.0 1/cm.

Deviation from characteristic: ≤ 0.5% of the measurement range.

Analog input 2

Pt100 or Pt1000 resistance thermometer, in 2-wire or 3-wire circuit, -50 to +250°C
Measurement display in °C or °F (option)
Deviation from characteristic: ≤ 0.25% of the measurement range.
Ambient temperature error: ≤ 0.1% per 10 °C

Lead compensation, analog input 2

The lead resistance can be compensated in software by a correction of the process value. This is not required if the resistance thermometer is connected in a 3-wire circuit.
Alternatively, when a resistance thermometer is connected in a 2-wire circuit, lead compensation can be provided by using an external compensation resistor.

Logic input 1

The following functions can be assigned as selected:

Key inhibit, setpoint switching, alarm stop, alarm time reset, hold, reverse hold, freeze measurement, range expansion (x10), no function for logic input 1.

Logic input 2

As for logic input 1.

Measurement and control range

Cell constants K	Measurement range		Display with configured measurement (C111)		Range (rAng)
			µS	mS	
0.01	0 — 0.500	µS/cm	0.500	– –[1]	1
0.01	0 — 2.000	µS/cm	2.000	– –[1]	2
0.01	0 — 10.00	µS/cm	10.00	– –[1]	3
0.1	0 — 5.00	µS/cm	5.000	– –[1]	4
0.1	0 — 20.00	µS/cm	20.00	– –[1]	5
0.1	0 — 100.0	µS/cm	100.0	– –[1]	6
0.1	0 — 1.00	mS/cm	1000	1.00	7
0.1	0 — 5.00	mS/cm	5000	5.00	8
1.0	0 — 50.00	µS/cm	50.00	– –[1]	9
1.0	0 — 100.0	µS/cm	100.0	– –[1]	10
1.0	0 — 1.00	mS/cm	1000	1.00	11
1.0	0 — 5.00	mS/cm	5000	5.00	12
1.0	0 — 20.00	mS/cm	– –[1]	20.00	13
1.0	0 — 100.0	mS/cm	– –[1]	100.0	14
3.0	0 — 1.00	mS/cm	1000	1.00	15
3.0	0 — 5.00	mS/cm	5000	5.00	16
3.0	0 — 30.00	mS/cm	– –[1]	30.00	17

10.0	0 — 30.00 mS/cm	– –[1]	30.00	18
10.0	0 — 200.0 mS/cm	– –[1]	200.0	19

[1] These settings are not permissible – they would cause an incorrect display

Reference temperature

25°C

Temperature display

-50 to +250°C (option °F)

Deviation from characteristic

≤ 0.25% of the measurement range

Outputs

5 outputs are available:

Output 1 / 2 relay (standard)

Make contact (n.o., can also be configured as n.c. break contact)
Contact rating: 3A, 250V AC, with resistive load
Contact life: > $5x10^5$ operations at rated load
Status indication: relay K1 => LED K1; relay K2 => LED K2

Output 4 logic output (standard)

0/5V (standard) $R_{load} \geq 250\Omega$
0/12V (option) $R_{load} \geq 650\Omega$
Status indication: LED K4

Output 3 or output 5 process value output (option)

Can be used as analog process value output or as proportional controller.

0(2) — 10V $R_{load} \geq 500\Omega$
0(4) — 20mA $R_{load} \leq 500\Omega$
electrically isolated from the inputs:
$\Delta u \leq$ 30V AC
$\Delta u \leq$ 50V DC

Output 3 or output 5 relay (option)

(changeover contact)
Contact rating: 3A, 250V AC, with resistive load
Contact life: > $5x10^5$ operations at rated load
Status indication: K3 => LED K3; K5 => no visible indication

Output 5, interface RS422 / RS485 (option)

electrically isolated;
baud rate: 4800 / 9600bps;
Protocol: MODbus/Jbus or Profibus-DP

5.1.1 General controller data

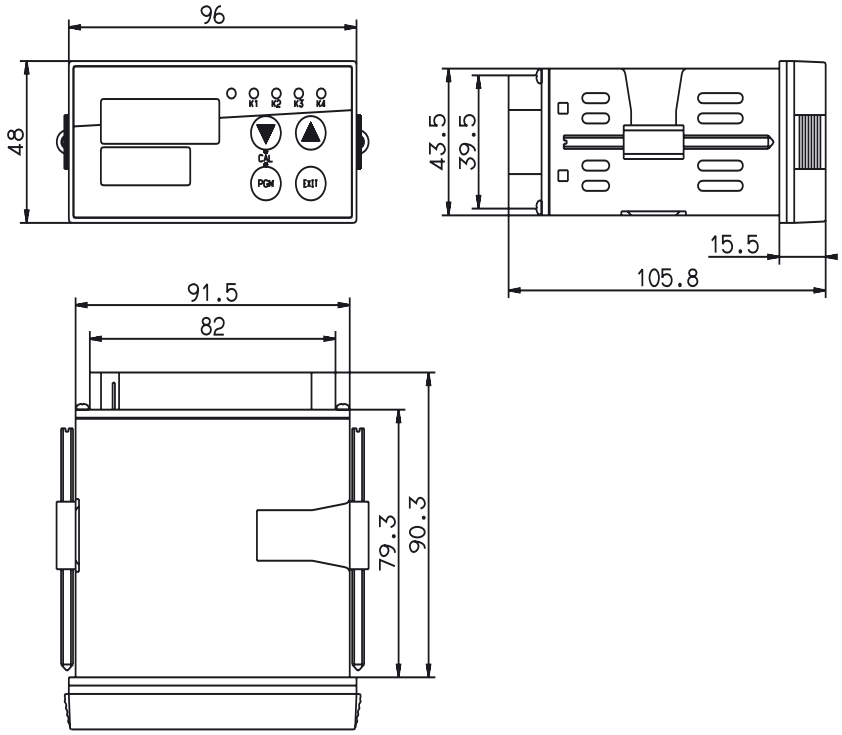
A/D converter	resolution > 15 bit
Controller type	Output 1 and output 2: limit controller and/or pulse width or pulse frequency controller, freely configurable and selectable. K3 / K5: Proportional controller
Control action	P, PI, PID or PD, freely configurable and selectable
Sampling time	210 msec
Meas. circuit monitoring	Input 1: out-of-range, sensor monitoring Input 2: out-of-range, probe short-circuit, probe break The outputs move to a defined (configurable) status.
Data backup	EEPROM
Supply voltage	110 — 240 V AC +10%/-15%, 48 — 63 Hz or 20 — 53 V AC/DC ±0%, 48 — 63/0 Hz
Power consumption	approx. 8 VA
Electrical connection	via gold-plated faston connectors to DIN 46 244/A; 4.8 mm x 0.8 mm
Permissible ambient temperature	0 to +50 °C
Permissible ambient temp. limits	-10 to +55 °C
Permissible storage temp.	-40 to +70 °C
Climatic conditions	rel. humidity ≤ 75 %, no condensation
Enclosure protection	to EN 60 529, front IP65 / back IP20
Electrical safety	to EN 61 010, clearance and creepage distances for - overvoltage category II - pollution degree 2

5 Instrument description

Electro-magnetic compatibility (EMC)	to EN 61 326
Housing	panel-mounting housing in conductive plastic to DIN 43 700, base material ABS, with plug-in controller module
Operating position	unrestricted
Weight	approx. 320 g

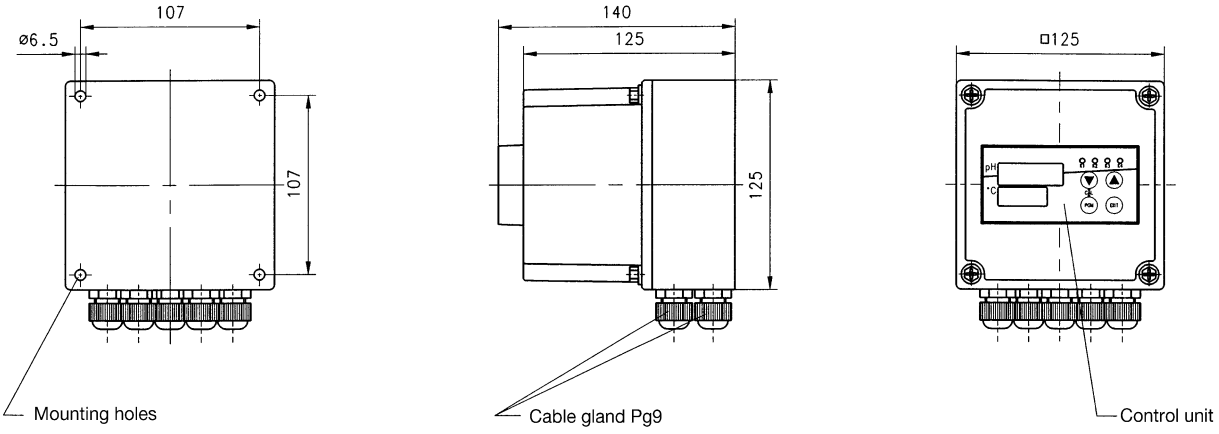
5.2 Dimensions

Type 202540/...



5.3 Optional accessories

Additional housing, no door at front, enclosure IP65, Type 2FGE-125-2/125

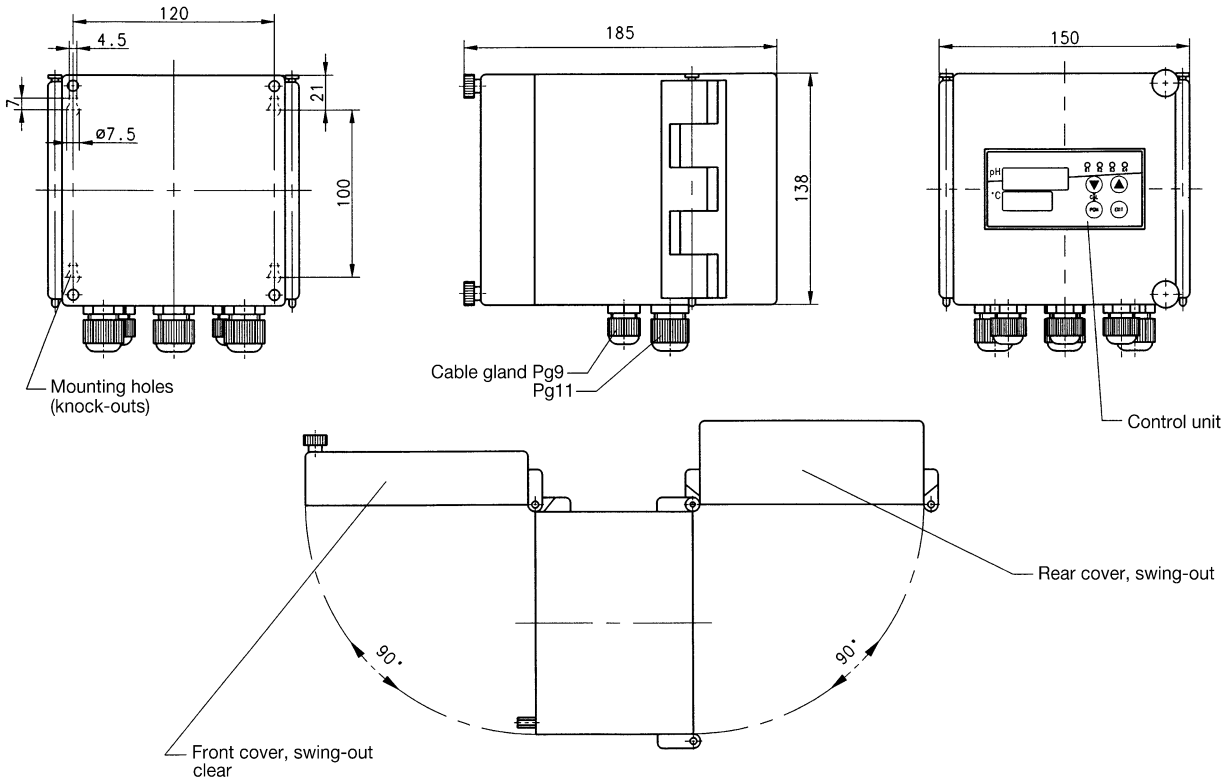


Restricted external temperature range!

The ambient temperature for the surface-mounting housing must not exceed 45°C.

5 Instrument description

Additional housing, door at front, enclosure IP65, Type 2FGE-150-2/185



Restricted external temperature range!

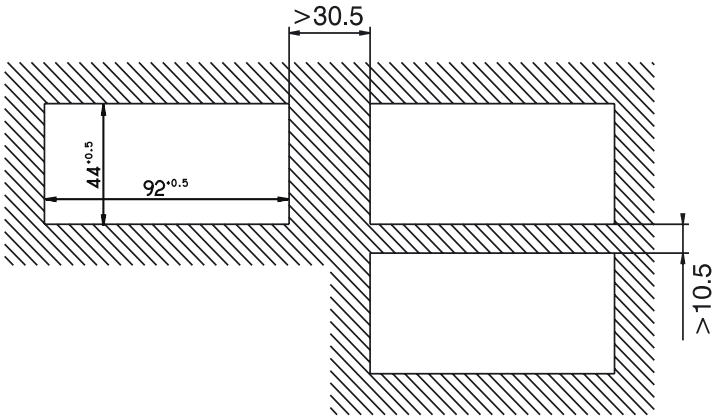
The ambient temperature for the surface-mounting housing must not exceed 45°C.

6.1 Location

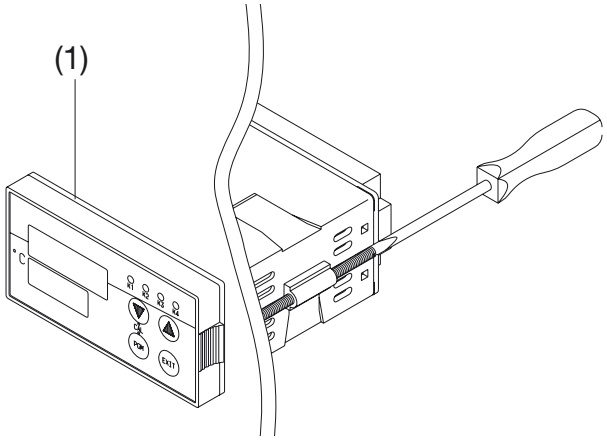
Conditions

The location should be as free from vibration as possible. Electromagnetic fields, e. g. from motors, transformers etc. should be avoided. The ambient temperature at the location can be from 0 to 50 °C, with a relative humidity of not more than 75 %.

Panel cut-out for close mounting



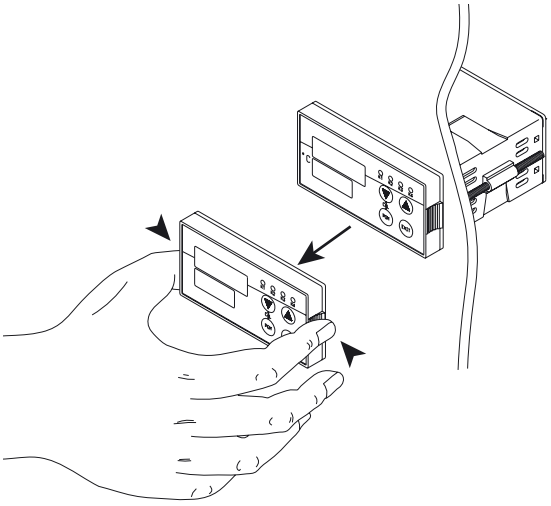
6.2 Fitting



- ✱ Fit the seal (1) that is supplied onto the body of the instrument.
- ✱ Insert the controller from the front into the panel cut-out.
- ✱ From behind the panel, slide the mounting brackets into the guides on the sides of the housing. The flat faces of the mounting brackets must lie against the housing.
- ✱ Push the mounting brackets up to the back of the panel, and tighten them evenly with a screwdriver.

6 Assembly

6.3 Removing the controller module



The controller module can be removed from its housing for servicing.

✱ Press together the ribbed surfaces at right and left and pull the controller module out of the housing.

6.4 Cleaning the front panel

The front panel can be cleaned with normal commercial washing, rinsing and cleaning agents.

It has a limited resistance to organic solvents (e.g. methylated spirits, white spirit, P1, xylol etc.).

Do not use high-pressure cleaning equipment!

7.1 Electrical connection

The electrical connection must only be carried out by properly qualified personnel

- ❏ The choice of cable, the installation and the electrical connection must conform to the requirements of VDE 0100 “Regulations on the Installation of Power Circuits with Nominal Voltages below 1000 V” or the appropriate local regulations.
- ❏ The electrical connection must only be carried out by properly qualified personnel.
- ❏ The instrument must be completely disconnected from the electrical supply if contact with live parts is possible.
- ❏ A current-limiting resistor interrupts the supply circuit in the event of a short-circuit. Any additional external fusing of the supply should not be rated below 1A (slow).
- ❏ The load must be fused for the maximum relay current, in order to prevent the contacts of the output relay becoming welded in the event of a short-circuit.
- ❏ The level of electromagnetic compatibility conforms to EN 61 326.
- ❏ Run input, output and supply cables separately and not parallel to one another.
- ❏ Sensor and interface cables should be shielded cables with twisted conductors. Do not run them close to current-carrying components or cables. Ground shielding at one end, to the TE terminal on the instrument.
- ❏ The TE terminal on the instrument must be earthed. This lead must have at least the same conductor cross-section as used for the supply cables. Grounding and earthing leads must be wired in a star configuration to a common earth point that is connected to the protective earth of the electrical supply. Do not loop earth or ground connections, i.e. do not run them from one instrument to another.
- ❏ Do not connect any additional loads to the supply terminals of the instrument.
- ❏ The instrument is not suitable for use in areas with an explosion hazard (Ex areas).
- ❏ In addition to faulty installation, incorrect settings on the controller (set-point, data of the parameter and configuration levels, internal alterations) can also interfere with the correct operation of dependent processes, or even cause damage. The setpoint that is reached should therefore be monitored for stability. Safety devices should always be provided that are independent of the controller (such as overpressure valves or temperature monitors/limiters) and only capable of adjustment by specialist personnel. Please observe the relevant safety regulations for such matters.
- ❏ The measurement inputs of the controller must not exceed a maximum potential of 30 V AC or 50 V DC against TE.
- ❏ Sensor leads should only be implemented as uninterrupted cables (**not** routed through terminal strips etc.).
- ❏ If frequent relay switching is expected (> 5/min), the system must be fitted with appropriate suppressor devices against switching interference.

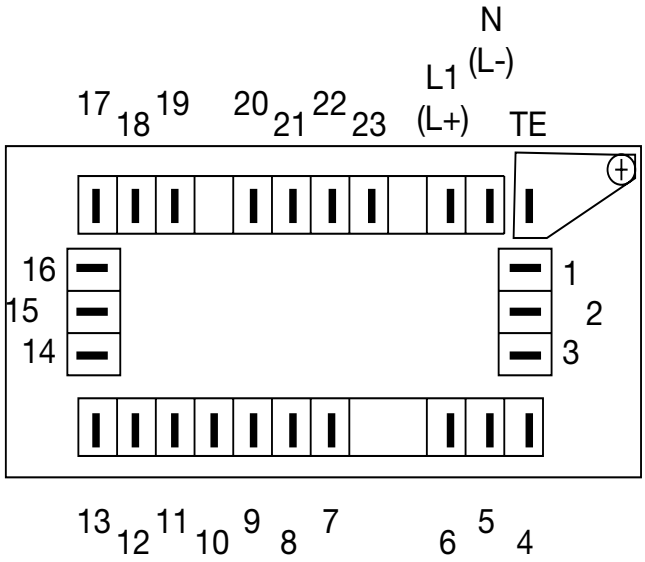
7 Installation

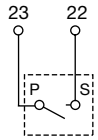
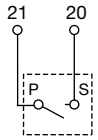
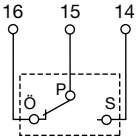
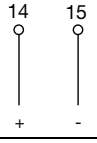
After the supply voltage has been applied, the instrument will operate according to the factory-set parameters (unless the instrument was ordered with “controller off”).

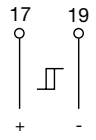
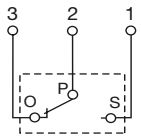
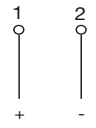
It is therefore advisable to program the instrument as required **before connecting the actuators**.

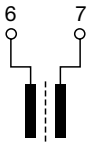
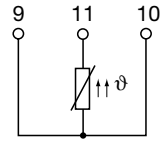
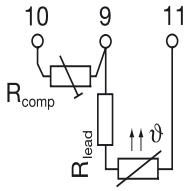
⇨ Chapter 9 “Operation”, page 22 ff.

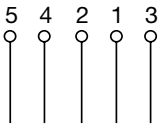
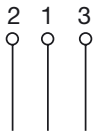
7.2 Connection diagram



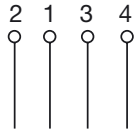
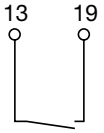
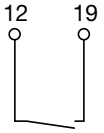
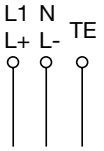
Outputs	K	Terminal assignments	Symbol
Relay 1 (K1) Status indication LED K1	1	23 common 22 make (n.o.)	
Relay 2 (K2) Status indication LED K2	2	21 common 20 make (n.o.)	
Relay 3 (K3) Status indication LED K3 **or** process value output	3	16 break (n.c.) 15 common 14 make (n.o.)	
		15 – 14 +	

Outputs	K	Terminal assignments	Symbol
Logic output 1 (K4) Status indication LED K4	4	19 – 17 +	
Relay 4 (K5) no status indication **or** process value output	5	3 break (n.c.) 2 common 1 make (n.o.)	
		2 – 1 +	

Inputs		Terminal assignments	Symbol
Conductivity cell	6 7	outer electrode inner electrode	
Resistance thermometer in 3-wire circuit	9 10 11		
Resistance thermometer in 2-wire curcuit	10 9 11		

Inputs/outputs		Terminal assignments			Symbol
Serial interface RS422 (option)	RxD	5	RxD +	Receive Data	
		4	RxD –		
	TxD	2	TxD +	Transmit Data	
		1	TxD –		
	GND	3	GND		
Serial interface RS485 (option)	+ -	2 1	TxD/RxD + TxD/RxD –		
	GND	3	GND		

7 Installation

Inputs/outputs		Terminal assignments			Symbol
Serial interface Profibus-DP (option)	VP	4	supply voltage plus, (P5V)		
	RxD/TxD-P	1	receive/transmit data positive, B conductor		
	RxD/TxD-N	2	receive/transmit data negative, A conductor		
	DGND	3	ground for data transmission		
Logic input 1		13 19			
Logic input 2		12 19			
Supply voltage see nameplate	AC/ DC	AC: L1 N TE	phase neutral technical earth	DC: L + L –	

Connection for conductivity cell

	JUMO conductivity cell		Type 202540
	Plug-in head	Fixed cable	
Outer electrode	⏚	white	6
Inner electrode	2	brown	7
Temperature compensation	1	yellow	9
	3	green	11
Link			10 + 9

8.1 Self-test

After the supply voltage has been applied, the instrument will operate according to the factory-set parameters.
(unless the instrument was ordered with “controller off”)

It is therefore advisable to program the instrument as required **before connecting the actuators**.
⇨ Chapter 9 “Operation”, page 22.

After the supply voltage has been applied

the instrument performs a self-test, during which all displays will light up.

OK

If the self-test was OK, then the instrument switches over to the measurement mode in about 10 seconds.

The measured conductivity is displayed, as is the measured temperature (if the temperature sensor has been connected and configured); the controller operates according to the factory-set parameters!

In measurement mode, manual operation, hold, and calibration can be activated, as well as the display of the software revision level and the unit (°C / °F) for the temperature input.

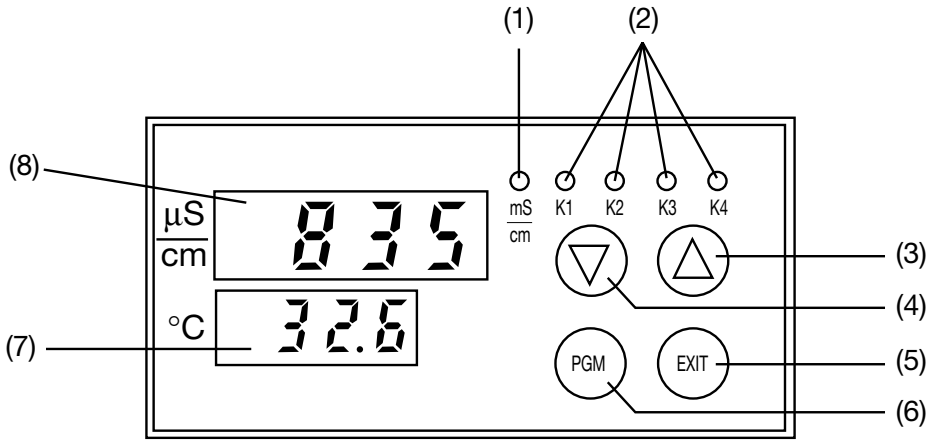
Error

If an error code (e.g. F010) or “Err” is displayed,
⇨ Chapter 22 “Warnings – Errors”, page 70 ff.

9 Operation

9.1 Basics

Displays and keys



(1)	Display: Instrument configuration changed from “µS/cm” to “mS/cm”	(6)	PGM key for selection of parameters and confirmation or entries, or for manual operation of relay K3.
(2)	Status indicators (yellow)[1] for outputs 1 to 4 LED “K1” => relay K1 LED “K2” => relay K2 LED “K3” => optional relay K3 LED “K4” => logic output K4	(7)	4-digit temperature display (LED, green, 8mm high)
(3)	Increment key for altering parameters or manual operation of relay K2	(8)	4-digit process value indication (LED, red, 13mm high)
(4)	Decrement key for altering parameters or manual operation of relay K1	(4) + (6)	“CAL”: initiate calibration (cell constant or temperature coefficient)
(5)	EXIT key to leave the levels	(3) + (5)	Initiate manual operation or hold

[1] LED K3 has no function if the instrument was ordered with process value output (output “888”).

9.2 Principle of operation

Operating modes and states

Measurement mode (normal operation)	The process value and temperature are displayed.
Self-test (after power-on)	All indicators light up; the temperature display blinks.
Manual operation	The process value display continually switches between the process value and the text “HAnd”, the temperature is displayed.
Hold operation	The process value display continually switches between the process value and the text “HoLd”, the temperature is displayed.
Operation, parameters, configuration	The temperature display shows the parameters from the various levels; the process value display shows the corresponding values and codes.
Error	The temperature display continually switches between the temperature and the error code (e.g. F010), ⇨ Chapter 22 “Warnings – Errors”, page 70 ff.

Levels

The instrument functions are arranged in four levels (see diagram on next page):

- Measurement mode
- Operating level
- Parameter level
- Configuration level

Measurement mode[1] (normal operation)

The measurements are displayed at this level. Manual operation, hold and calibration can be activated.

Operating level[1]

Setpoints, alarm tolerance, alarm delay and the limits for the limit comparators are entered and displayed at this level.

Parameter level[1]

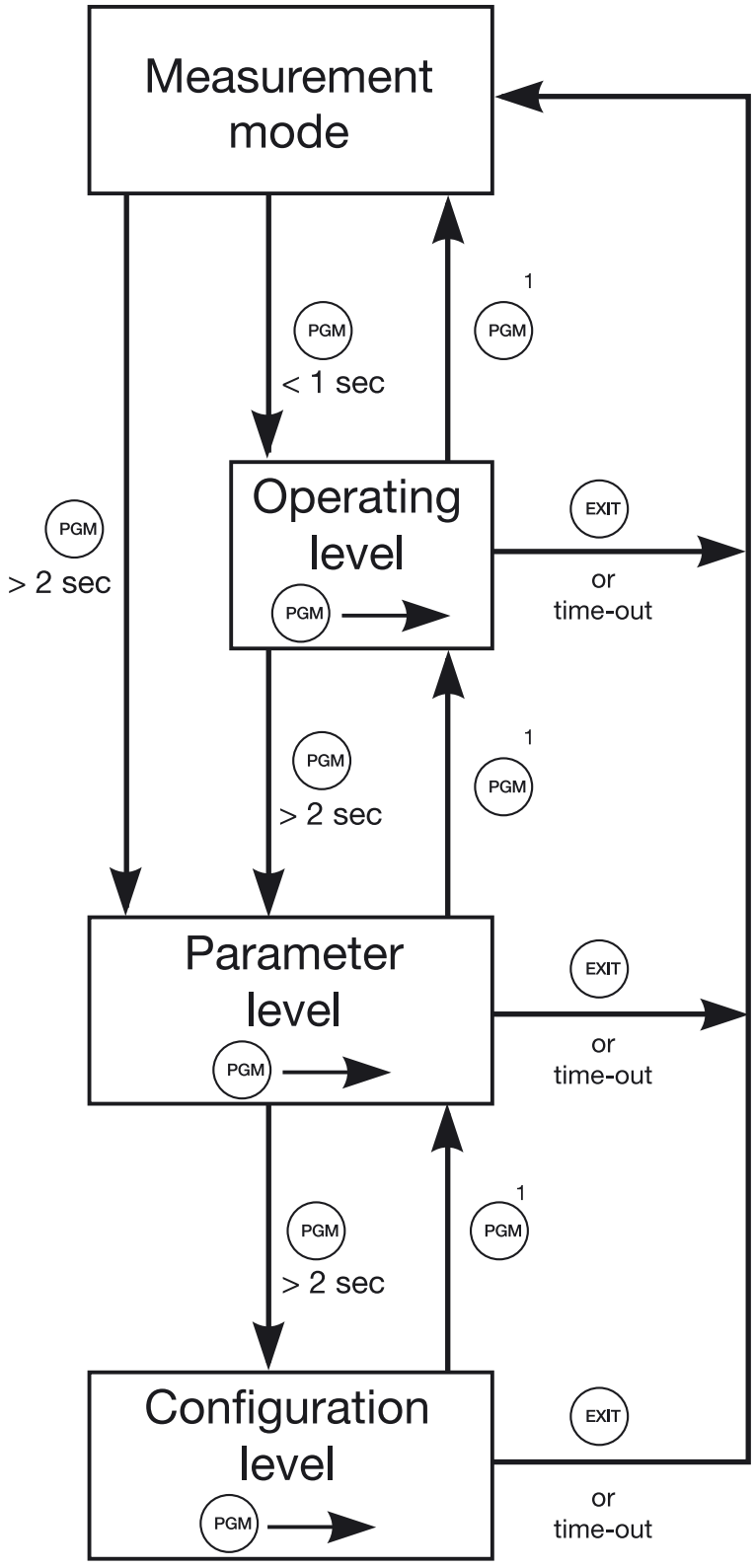
Controller parameters and other settings are programmed here.
The display of the individual parameters depends on the type of controller action.

Configuration level[1]

The basic functions of the instrument are configured at this level.

[1] Entries can only be made after the correct code word has been entered.
⇨ “Unlocking the levels”, page 26.

9.3 Operation within levels



[1] A change of level can only take place after stepping through all the parameters of the level concerned.

9.4 General

Level protection
Changes at the operating level, parameter level and configuration level can only be made after entering a code word,
⇨ “Unlocking the levels”, page 26.

The code word has been entered correctly if the decimal point in the temperature display starts to blink when a parameter has been selected for modification.

Within a level, you can step on to the next parameter by pressing the (PGM) key.

Cancel
You can change back to the measurement mode at any time, by pressing the (EXIT) key. For parameters that have been altered, but **not** confirmed by (PGM) , the changes will **not** be accepted.

Time-out
The controller will automatically return to the measurement mode if no operations are performed for about 50 seconds.
For parameters that have been altered, but **not** confirmed by (PGM) , the changes will **not** be accepted.
Exception: Time-out does not apply during calibration!

Parameter entry

The entry and alteration of parameters and setpoints is made continously. The value changes at a faster rate if the key is kept pressed for a longer time.

* Increase the value with (▲)
* Decrease the value with (▼)

The value is only altered within the permissible range of values.

* Accept the entry with (PGM) – the upper display “winks” to confirm it (the display switches off briefly)

or

* cancel with (EXIT)

Entering a configuration parameter or code word entry

* Select the digit with (▼) (digit blinks).
* Alter the code, with (▲)
* Accept the change with (PGM) – the upper display “winks” to confirm it (the display switches off briefly)

or

* cancel with (EXIT)

9 Operation

9.5 Programming

Procedure

The following procedure is recommended to avoid a “Time-out” (50 seconds without an action) while entering data:

- ✱ Fold out the last page of these operating instructions
  ⇨ Chapter 23.1 “Programming the controller”, page 72 ff.
- ✱ Enter all the changed parameter values and codes in the table
- ✱ Unlock all the affected levels, see below
- ✱ Program all the settings right through from top to bottom, in one session
- ✱ Inhibit all the levels, see below

Depending on the type of controller action that is configured, some parameters cannot be set and will therefore not be displayed.

After changing the controller type (C211), the controller parameters must be checked.
⇨ Chapter 14.1 “Settings”, page 42 ff.

Unlocking the levels

Initial condition: the instrument is in the measurement mode.

- ✱ Press the (PGM) briefly and repeatedly, until “CodE” appears in the lower display.
- ✱ Use the (▲) and (▼) keys to set the required code.

Function	Code word[1]
Enable operating level, CAL, and manual activation of “hold”	0110
Enable operating and parameter levels	0020
Enable all levels	0300
Activate edit protection	xxxx[2]

- ✱ Press the (PGM) key (confirmation) – “0000” appears in the display

The code word has been entered correctly if the decimal point in the temperature display starts to blink when a parameter has been selected for modification.

[1] Code word 0020 includes 0110; code word 0300 includes 0020 and 0110.

[2] The relevant levels remain enabled until the edit protection is reactivated, either by entering a “wrong” code word (other than 0000) or the supply voltage to the instrument is switched off and then on again.

10.1 Configuration

For an explanation of the terminology used,
⇨ Chapter 21 “Glossary”, page 63 ff.

Possible combinations

The control functions of outputs 1 and 2 can be freely combined[1]:

- Controller off
- Limit controller
- Pulse width controller
- Pulse frequency controller

1 Exception: When using a modulating controller, outputs 1 und 2 must have the same configuration.

The controller functions are determined by the following parameters:

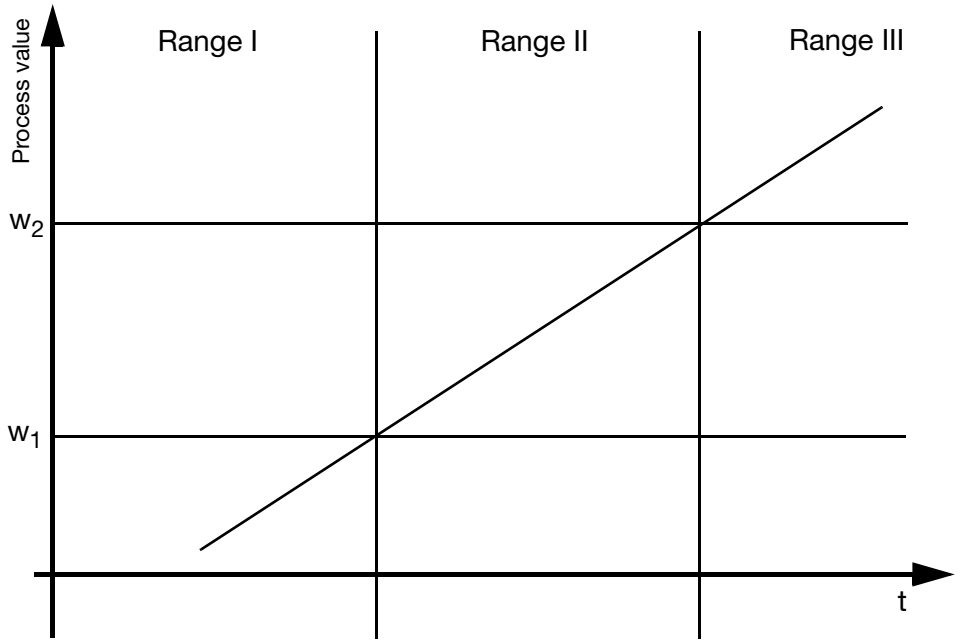
Configuration level[1]					Parameter level[2]	Operating level[3]
C211	**C212**	**C212**	**C213**	**C214**		
Controller off	– –	– –	– –	– –	– –	– –
Limit controller	MIN / MAX contact	make/break contact	– –	– –	Switching differential **HYS** Pull-in delay **Ond** Drop-out delay **Ofd**	Setpoint **SP(r)**
Pulse width controller	MIN / MAX contact	make/break contact	– –	– –	Proportional band **Pb** Derivative time **dt** Reset time **rt** Minimum ON time **tr** Pulse period **CY** Output level limit **Y1** or **Y2**	Setpoint **SP(r)**
Pulse frequency controller	MIN / MAX contact	make/break contact	– –	– –	Proportional band **Pb** Derivative time **dt** Reset time **rt** Minimum pulse length **tr** Maximum pulse frequency **Fr** Output level limit **Y1** or **Y2**	Setpoint **SP(r)**
Modulating controller	MIN / MAX contact	make/break contact	– –	– –	Proportional band **Pb** Derivative time **dt** Reset time **rt** Minimum ON time **tr** Pulse period **CY** Output level limit **Y1** or **Y2** Actuator time **tt**	Setpoint **SP(r)**
Proportional controller	MIN / MAX contact	make/break contact	Proportional controller 1	Proportional controller 2	Proportional band **Pb** Derivative time **dt** Reset time **rt** Output level limit **Y1** or **Y2**	Setpoint **SP(r)**

1 ⇨ Chapter 15.5 “Controller options - C211”, page 47 or
⇨ Chapter 15.6 “Controller outputs - C212”, page 48 or
⇨ Chapter 15.7 “Other outputs I - C213”, page 49 or
⇨ Chapter 15.8 “Other outputs II - C214”, page 50.

2 ⇨ Chapter 14 “Parameter level”, page 42 ff.

3 ⇨ Chapter 13 “Operating level”, page 41 ff.

Example break/make contact



		Range I		Range II		Range III	
		LED	contact	LED	contact	LED	contact
MIN	make contact	on	1	off	0	off	0
	break contact	on	0	off	1	off	1
MAX	make contact	off	0	off	0	on	1
	break contact	off	1	off	1	on	0

Configuration notes

Both outputs (K1 / K2) can be configured as pulse width or pulse frequency outputs (or as a combination).

Switching action K1 / K2	Setpoints w1 / w2
min / min	w1 < w2
min / max	w1 < w2
max / max	w1 > w2
max / min	w1 > w2

10.2 Controller optimization

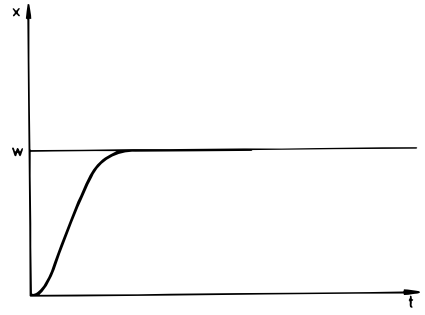
Optimum adjustment

The optimum adaptation of the controller to the control loop can be tested by recording the starting phase.

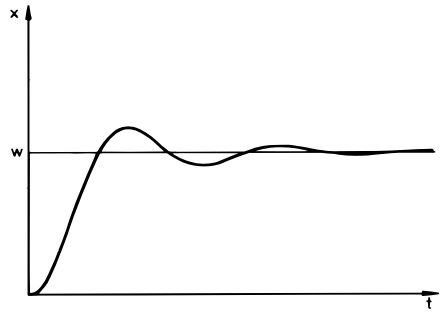
The following diagrams (referred to the PID action) indicate where the adjustments may be incorrect, and how they can be rectified.

It can be seen that a slower control action with higher stability can be achieved by increasing either the proportional band Pb or the reset time rt.

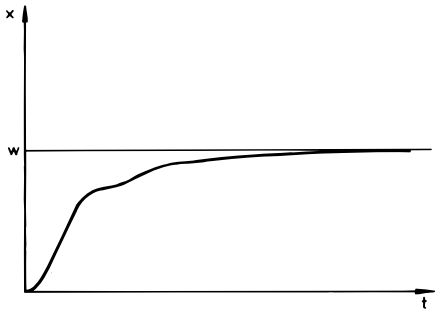
A smaller proportional band Pb and/or a shorter reset time rt will result in a control action with less damping.



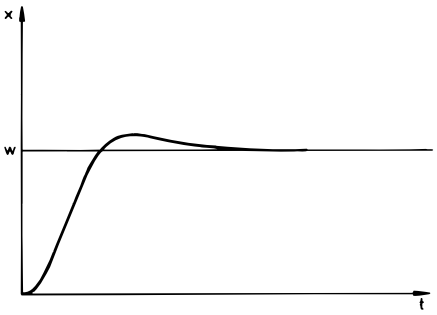
optimum



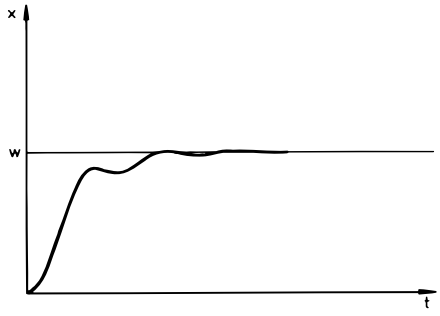
rt, dt too small



rt, dt too large



Pb too small



Pb too large

11 Conductivity measurement

11.1 Select cell constant and measurement range

Initial condition

The configuration level is unlocked,
⇨ “Unlocking the levels”, page 26 (code word 0300)

The instrument is in the measurement mode.
⇨ “Operating modes and states”, page 23.

Procedure

✱ Press the (PGM) key twice, for more than 2 seconds, to access the configuration level.
The lower display shows “C111”.

Use (▲) and (▼) keys to set the configuration code for the measurement unit:

Unit	0	X	X	X
µS/cm	0			
mS/cm	1			

✱ Press the (PGM) key (confirmation)

✱ Press (PGM) briefly and repeatedly, until “rAnG” appears in the lower display

✱ Use the (▲) and (▼) keys to set the range number for the desired combination of cell constant and measurement range

Cell constants K	Measurement range		Display with configured measurement (C111)		Range (rAng)
			µS	mS	
0.01	0 — 0.500	µS/cm	0.500	– –[1]	1
0.01	0 — 2.000	µS/cm	2.000	– –[1]	2
0.01	0 — 10.00	µS/cm	10.00	– –[1]	3
0.1	0 — 5.00	µS/cm	5.000	– –[1]	4
0.1	0 — 20.00	µS/cm	20.00	– –[1]	5
0.1	0 — 100.0	µS/cm	100.0	– –[1]	6
0.1	0 — 1.00	mS/cm	1000	1.00	7
0.1	0 — 5.00	mS/cm	5000	5.00	8
1.0	0 — 50.00	µS/cm	50.00	– –[1]	9
1.0	0 — 100.0	µS/cm	100.0	– –[1]	10
1.0	0 — 1.00	mS/cm	1000	1.00	11
1.0	0 — 5.00	mS/cm	5000	5.00	12
1.0	0 — 20.00	mS/cm	– –[1]	20.00	13
1.0	0 — 100.0	mS/cm	– –[1]	100.0[2]	14
3.0	0 — 1.00	mS/cm	1000	1.00	15
3.0	0 — 5.00	mS/cm	5000	5.00	16
3.0	0 — 30.00	mS/cm	– –[1]	30.00	17
10.0	0 — 30.00	mS/cm	– –[1]	30.00	18
10.0	0 — 200.0	mS/cm	– –[1]	200.0	19

[1] These settings are not permissible – they would cause an incorrect display.
[2] The polarization effect could cause a sizeable error in the measurement with this combination of measurement range and cell constant.

✱ Press the (PGM) key (confirmation).

✱ Press the (EXIT) key (return to the measurement mode).

For several seconds, both displays will indicate “bUSY” (upper display blinks).

Afterwards, the upper display shows the measured conductivity (if a cell with an appropriate medium for measurement is connected). If the measurement unit is configured as mS/cm, the LED for “mS/cm” lights up.

The lower display shows the temperature measured for the medium, or the manually set compensation temperature.

If an error number appears,
⇨ Chapter 22 “Warnings – Errors”, page 70.

11.2 Measurement with manual temperature compensation

Initial condition

A conductivity cell is attached to the Type 202540 transmitter,
⇨ Chapter 7.1 “Electrical connection”, page 17.

The temperature acquisition is configured as “Manual temperature compensation”,
⇨ Chapter 15.2 “Analog inputs - C111”, page 44.

The instrument is in the measurement mode.
⇨ “Operating modes and states”, page 23.

Procedure

The upper display shows the compensated conductivity value of the solution being measured.

The indicated value for the conductivity depends on the manual temperature setting, see ***Temperature setting***, **below,**
and the set (or automatically acquired) temperature coefficient (TC),
⇨ Chapter 12.3.1 “Automatic determination of the temperature coefficient, using manual temperature entry”, page 38.

The lower display shows the manually entered temperature setting.

11.3 Manual temperature entry

Initial condition

The temperature acquisition is configured as “Manual temperature compensation”,
⇨ Chapter 15.2 “Analog inputs - C111”, page 44.

The operating level is unlocked,
⇨ “Unlocking the levels”, page 26, (code word 0110)

The instrument is in the measurement mode.
⇨ “Operating modes and states”, page 23.

Procedure

✱ Press (PGM) briefly and repeatedly, until “InP2” is displayed.

Use the (▲) and (▼) keys to set the temperature that is shown

✱ Press the (PGM) key (confirmation)

✱ Press the (EXIT) key (to return to measurement mode) or cancel the entry

11.4 Measurement with automatic temperature compensation

Initial condition

The temperature acquisition has been configured as “automatic temperature compensation with Pt100 or Pt1000”,
⇨ Chapter 15.2 “Analog inputs - C111”, page 44.

The instrument is in the measurement mode.
⇨ “Operating modes and states”, page 23.

Procedure

The temperature measurement for the medium cannot be altered manually.

11.5 Compensation of falsified measurements

11.5.1 Temperature

Deviations of the indicated temperature from the actual medium temperature can be compensated by the “OFFS” setting,
⇨ Chapter 15.11 “SoL - SoH - SPL - SPH - rAnG - CELL - ALPH - LOFF - OFFS”, page 53.

11.5.2 Conductivity

The lead resistance of the connecting cable to the cell results in an indication that is too low for liquids with a high conductivity. In general, this error is not serious, but it can be compensated, if required, by the “LOFF” setting over the range 0 — 99.99 Ω ,
⇨ Chapter 15.11 “SoL - SoH - SPL - SPH - rAnG - CELL - ALPH - LOFF - OFFS”, page 53.

Example

The following example will help you to decide whether the “LOFF” setting should be used or not.

- Measurement range 0 to 100 $^{mS}/_{cm}$
- Cell constant K = 1.0 $^{1}/_{cm}$
- Connecting cable length 10 meters

With a full-scale value of 100 mS/cm, the cell has a resistance of 10 Ω..

$$R\ (\text{cell resistance}) = \frac{1.0\ ^{1}/_{cm}\ (\text{cell constant K})}{100\ ^{mS}/_{cm}\ (\text{full-scale value})} = 10\ \Omega.$$

E.g. the conductivity cable has a specific resistance of roughly 0.06 Ω/m. The lead resistance (out and return) of the cable in this example amounts to about 1.2 Ω.

The transmitter “sees” a total resistance of
cell + cable = 11.2 Ω.

Applying the formula

$$\text{Conductivity} = \frac{1.0\ {}^{1}/_{cm}\ \text{(cell constant K)}}{11.2\ \Omega\ \text{(cell resistance)}} = 89\ {}^{mS}/_{cm}$$

results in an apparent conductivity of approx. 89 $^{mS}/_{cm}$.

This corresponds to an error of about 11% of the full-scale value.

- Please use the specific resistance value of your particular conductivity cable for your calculation.

12 Calibration

12.1 Preparation

General

The cell constants of conductivity cells vary somewhat from one example to another, and also drift with use (because of deposits and wear). This results in a change of the output signal from the cell. It is therefore necessary that the user is able to compensate for the deviations of the cell constant from the nominal value, either by manual input or an automatic calibration of the relative cell constant K_{rel},
⇨ Chapter 12.2 “Relative cell constant”, page 36.

The time intervals between calibration depend on the conditions in which the cell is used.

The conductivity of a solution varies with the temperature, so both the temperature and the temperature coefficient of the solution being measured must be known. The temperature can either be measured automatically, with a Pt100 or Pt1000 temperature probe, or set manually by the user. The temperature coefficient can be determined automatically by the conductivity transmitter, or entered manually.
⇨ Chapter 12.3 “Determination of the temperature coefficient”, page 38.

Cancel

Pressing the (EXIT) key at any time changes back to the measurement mode.

Preparation for calibration

Before the first calibration, it is necessary to select the method of temperature acquisition (automatic or manual) to be used during calibration.

If subsequent calibrations are carried out with the same settings, then it will not be necessary to set the temperature acquisition again.

Select temperature acquisition method

The instrument is in the measurement mode.

* Unlock the configuration level, if necessary,
  ⇨ “Unlocking the levels”, page 26. (code word 0300).
* Press the (PGM) key twice, for more than 2 seconds, to access the configuration level.
  The lower display shows “C111”.

Use the (▲) and (▼) keys to set the configuration parameter:

Method of temperature acquisition	X X X 0
Manual temperature compensation	0
Automatic temperature compensation with Pt100	1
Automatic temperature compensation with Pt1000	2

* Press the (PGM) key (confirmation)
* Press the (EXIT) key (return to the measurement mode).

Calibration with/without "frozen process value output"

"Freezing" the process value output means that, during calibration, the output signal is held at the value that was produced immediately before calibration started. This is to avoid an uncontrolled reaction from any PLC that may be connected to the output of the transmitter.

While the process value output is frozen, the lower display shows "donE" after the last calibration step, and the upper display shows the latest measurement. The process value output remains unchanged!

After the conductivity cell has been installed once more, the (PGM) key must be pressed. The process value output is now coupled to the display again.

The factory setting is: "Calibration without frozen process value output".

Select calibration procedure

✱ The instrument is in the measurement mode.

✱ Unlock the configuration level, if necessary,
⇨ "Unlocking the levels", page 26 (code word 0300).

✱ Press the (PGM) key twice, for more than 2 seconds (but less than 4 seconds), to access the configuration level.
The lower display shows "C111".

✱ Press the (PGM) key repeatedly, until "C211" appears in the lower display.

Use the (▲) and (▼) keys to set the configuration parameter:

Calibration procedure	X	X	0	X
Calibration of the cell constant, process value output not frozen			0	
Calibration of the cell constant, process value output frozen			1	
Determination of the temperature coefficient, process value output not frozen			2	
Determination of the temperature coefficient, process value output frozen			3	

✱ Press the (PGM) key (confirmation)

✱ Press the (EXIT) key (return to the measurement mode).

12 Calibration

12.2 Relative cell constant

General

The relative cell constant K_{rel} can be used to compensate for the deviation of the real cell constant over the range from 80 to 120% of the nominal cell constant.

Manual entry

If the deviation of the cell constant from the nominal value is known, then the relative cell constant K_{rel} can be entered manually:

Initial condition

The operating level is unlocked,
⇨ “Unlocking the levels”, page 26.

The instrument is in the measurement mode.
⇨ “Operating modes and states”, page 23.

Procedure

- ✱ Press the (PGM) key twice, for more than 2 seconds, to access the configuration level.
  The lower display shows “C111”.
- ✱ Press the (PGM) key repeatedly, until “CELL” appears in the lower display.
- ✱ Use the (▲) and (▼) keys to set K_{rel} (in %).
- ✱ Press the (PGM) key (confirmation).
- ✱ Press the (EXIT) key (return to the measurement mode).

12.2.1 Automatic determination of the relative cell constant with a calibration solution

If the cell constant is not known, it can be determined and automatically stored:

You will need

- A calibration solution, with a known conductivity at the prevailing temperature.
- A thermometer, if you want to use manual compensation.
- A Pt100 or Pt1000 temperature probe (not necessary if the conductivity cell is equipped with a integrated temperature sensor), if you want to use automatic temperature compensation.

Initial condition

A conductivity cell is attached to the Type 202540 transmitter, as well as a Pt100 or Pt1000 temperature probe (if required),
⇨ Chapter 7.1 “Electrical connection”, page 17 ff.

The calibration procedure has been configured to “Calibration of the cell constant, process value output ...” – frozen or not frozen,
⇨ Chapter 15.5 “Controller options - C211”, page 47.

The instrument is in the measurement mode, see
⇨ “Operating modes and states”, page 23.

Procedure

- ✱ Unlock the instrument for calibration,
  ⇨ “Unlocking the levels”, page 26, (code word 0110)
- ✱ Immerse the sensitive portions of the cell and the temperature probe or thermometer in the calibration solution
  – wait until the temperature and conductivity measurements have stabilized.
- ✱ Press the (PGM) and (▼) keys – “CAL.1” appears in the lower display, alternating with the measured or manually set temperature.
- ✱ Use the (▲) and (▼) keys to set the indicated conductivity to the real conductivity of the calibration solution at the temperature now prevailing.
- ✱ Press the (PGM) key (saves the new cell constant and returns to the measurement mode).

12.2.2 Automatic determination of the relative cell constant with a reference instrument

If the deviation of the cell constant from its nominal value is not known, then it can be automatically determined.

You will need

A conductivity measuring instrument to serve as a reference.

The temperature coefficient of the reference instrument must be set to “0” ! If this is not possible, then the solution being measured must be tempered to the reference temperature for the reference instrument.

Initial condition

A conductivity cell is attached to the Type 202540 transmitter,
⇨ Chapter 7.1 “Electrical connection”, page 17 ff.

The calibration procedure has been configured to “Calibration of the cell constant, process value output ...” – frozen or not frozen,
⇨ Chapter 15.5 “Controller options - C211”, page 47.

The instrument is in the measurement mode.
⇨ “Operating modes and states”, page 23.

Procedure

- ✱ Unlock the instrument for calibration,
  ⇨ “Unlocking the levels”, page 26, (code word 0110)
- ✱ Immerse the sensitive portions of both cells in the calibration solution
  – wait until the measurements for both instruments have stabilized.
- ✱ Press the (PGM) and (▼) keys on the instrument – “CAL.1” appears in the lower display, alternating with the measured or manually set temperature.
- ✱ Use the (▲) and (▼) keys to set the indicated conductivity to match the value shown on the reference instrument.
- ✱ Press the (PGM) key (saves the new cell constant and returns to the measurement mode).

Manual entry of the temperature coefficient

If the temperature coefficient of the solution being measured is known, then it can be entered manually.

Initial condition

The configuration level is unlocked,
⇨ “Unlocking the levels”, page 26, (code word 0300)

The calibration procedure has been configured to “Determination of the temperature coefficent, process value output ...” – frozen or not frozen,
⇨ “Controller options - C211”, page 47.

The instrument is in the measurement mode.
⇨ “Operating modes and states”, page 23.

Procedure

* Press the (PGM) key twice, for more than 2 seconds, to access the configuration level.
  The lower display shows “C111”.
* Press the (PGM) key repeatedly, until “ALPH” appears in the lower display.
* Use the (▲) and (▼) keys to set the temperature coefficient (in % per °C).
* Press the (PGM) key (confirmation).
* Press the (EXIT) key (return to the measurement mode).

12.3 Determination of the temperature coefficient

12.3.1 Automatic determination of the temperature coefficient, using manual temperature entry

The instrument uses non-temperature compensated measurements (TC = 0) at two different temperatures (the reference temperature of 25°C and a second temperature, usually that which will be used for later measurements) to determine the temperature coefficient of the solution being measured.

You will need

- A sample of the medium to be measured
- A tempering setup
- A thermometer

Initial condition

A conductivity cell is attached to the Type 202540 transmitter,
⇨ Chapter 7.1 “Electrical connection”, page 17 ff.

The temperature acquisition is configured as “Manual temperature compensation”,
⇨ Chapter 15.2 “Analog inputs - C111”, page 44.

The calibration procedure has been configured to “Determination of the temperature coefficent, process value output ...” – frozen or not frozen,
⇨ Chapter 15.5 “Controller options - C211”, page 47.

The instrument is in the measurement mode.
⇨ “Operating modes and states”, page 23.

Procedure

* Unlock the instrument for calibration,
  ⇨ “Unlocking the levels”, page 26, (code word 0110)
* Immerse the sensitive portions of the cell and the thermometer in the solution to be measured.
* Temper the solution to 25°C.
* Press the (PGM) and (▼) (CAL) keys.
  The upper display shows the uncompensated conductivity value for the measured solution at 25°C, alternating with “CAL1”; the lower display shows the temperature that was set manually.
* Use the (▲) and (▼) keys to set 25.0 (°C).
* Press the (PGM) key.
  The upper display shows the uncompensated conductivity value for the measured solution at the present temperature, alternating with “CAL2”.
* Temper the solution to the future working temperature.
* Use the (▲) and (▼) keys to set the future working temperature (°C).
* Press the (PGM) key.
  The upper display shows the conductivity value (compensated for 25°C) for the measurement solution at the present temperature. The lower display shows the temperature that was set before the start of calibration.

12.3.2 Automatic determination of the temperature coefficient, using automatic temperature entry

The instrument uses non-temperature compensated measurements (TC = 0) at two different temperatures (the reference temperature of 25°C and a second temperature, usually that which will be used for later measurements) to determine the temperature coefficient of the solution being measured.

You will need

- A sample of the medium to be measured
- A tempering setup
- A Pt100 or Pt1000 temperature probe (not necessary if the conductivity cell is equipped with an integrated temperature sensor).

Initial condition

A conductivity cell is attached to the Type 202540 transmitter, as well as a Pt100 or Pt1000 temperature probe (if required),
⇨ “Electrical connection”, page 17ff.

The temperature acquisition is configured as “Automatic temperature compensation”,
⇨ Chapter 15.2 “Analog inputs - C111”, page 44.

The calibration procedure has been configured to “Determination of the temperature coefficent, process value output ...” – frozen or not frozen,
⇨ Chapter 15.5 “Controller options - C211”, page 47.

12 Calibration

The instrument is in the measurement mode.
⇨ “Operating modes and states”, page 23.

Procedure

- ✱ Unlock the instrument for calibration,
  ⇨ “Unlocking the levels”, page 26, (code word 0110)
- ✱ Immerse the sensitive portions of the cell and the temperature probe in the solution to be measured.
- ✱ Temper the solution to 25°C.
- ✱ Press the (PGM) and (▼) (CAL) keys.
  The upper display shows the uncompensated conductivity value for the measured solution at 25°C, alternating with “CAL1”; the lower display shows the temperature measured by the probe.
- ✱ Press the (PGM) key.
  The upper display shows the uncompensated conductivity value for the measured solution at the present temperature, alternating with “CAL2”. The lower display shows the temperature measured by the probe.
- ✱ Temper the solution to the future working temperature.
- ✱ When the temperature display has stabilized, press the (PGM) key.
  The upper display shows the conductivity value (compensated for 25°C) for the measurement solution at the present temperature. The lower display shows the temperature measured by the probe.

13.1 Settings

Preconditions

How to access the operating level, or leave this level,
⇨ Chapter 9.2 “Principle of operation”, page 23ff.

The operating level must be unlocked,
⇨ “Unlocking the levels”, page 26, (code word 0110).

It is possible that not all of the following parameters are needed or displayed, depending on the configuration of the controller functions.

For an explanation of the terminology used,
⇨ Chapter 21 “Glossary”, page 63 ff.

How to configure controllers,
⇨ Chapter 10.1 “Configuration”, page 27 ff.

Designation	Parameter (display)	Value range	Factory setting	displayed if ... is configured	see Configuration parameter
Setpoint 1	SP(r)1	0 — 0.5µS to 0 — 200mS[1]	0.00	K1	C211
Setpoint 2	SP(r)2		1.00	K2	
Setpoint 3	SP(r)3		-0.00	Setpoint changeover	C112
Setpoint 4	SP(r)4		1.00		
Code word	CodE	4-digit	0000		
Limit LK A (K1)	SP A	corresponds to “rAnG” ⇨ “rAnG”, page 54 or -50.0 to 250.0°C	-1.00	K1	C214
Limit LK b (K2)	SP b			K2	
Limit LK C (K3)	SP C			K3	C213
Limit LK d (K4)	SP d			K4	
Limit LK E (K5)	SP E			K5	C114
Process value input 2 (temperature)	InP2	(°C)	25		C111
Alarm tolerance	AL1	corresponds to “rAnG” ⇨ “rAnG”, page 54	0	Controller alarm messages	C211 or C213
Alarm delay	AL2	0 to 9999 sec	300		

[1] depending on the configured measurement range, ⇨ “SoL - SoH - SPL - SPH - rAnG - CELL - ALPH - LOFF - OFFS”, page 53.

14 Parameter level

14.1 Settings

If it is necessary to reconfigure a number of instrument parameters,
⇨ Chapter 23.1 “Programming the controller”, page 72 ff.

Preconditions

How to access the parameter level, or leave this level,
⇨ Chapter 9.2 “Principle of operation”, page 23 ff.

The parameter level must be unlocked,
⇨ “Unlocking the levels”, page 26, (code word 0020).

It is possible that not all of the following parameters are needed or displayed, depending on the configuration of the controller functions.

For an explanation of the terminology used,
⇨ Chapter 21 “Glossary”, page 63 ff.

How to configure controllers,
⇨ Chapter 10.1 “Configuration”, page 27 ff.

Parameter	Display	Value range	Factory setting	displayed if ... is configured
Proportional band 1	Pb1	mS or µS	50% of full scale	Relay 1, pulse frequency or pulse width in C211
Proportional band 2	Pb2			Relay 2, pulse frequency or pulse width in C211
Derivative time 1	dt1	0 to 9999 sec	0 sec	Relay 1, pulse frequency or pulse width in C211
Derivative time 2	dt2			Relay 2, pulse frequency or pulse width in C211
Reset time 1 (Reset time)	rt1		0 sec	Relay 1, pulse frequency or pulse width in C211
Reset time 2 (Reset time)	rt2			Relay 2, pulse frequency or pulse width in C211
Minimum ON time 1 (for limit controller or pulse width controller) or minimum pulse width 1 (for pulse frequency controller)	tr1	0.2 to 999.9 sec	0.2	Controller 1, pulse width in C211 pulse frequency in C211
Minimum ON time 2 (for pulse width controller) or minimum pulse width 2 (for pulse frequency controller)	tr2			Relay 2, pulse width in C211 pulse frequency in C211

Parameter	Display	Value range	Factory setting	displayed if ... is configured	
Switching differential, controller 1	HYS1	0001 to 9999	2% of full scale	Relay 1, limit value	in C211
Switching differential, controller 2	HYS2			Relay 2, limit value	in C211
Switching differential, controller 3	HYS3			Relay 3, limit value	in C213
Switching differential, controller 4	HYS4			Relay 4, limit value	in C213
Switching differential, controller 5	HYS5			Relay 5, limit value	in C214
Pull-in delay 1	Ond1	0.00 to 999.9 sec	1.0	Relay 1, limit value	in C211
Pull-in delay 2	Ond2			Relay 2, limit value	in C211
Pull-in delay 3	Ond3			Relay 3, limit value	in C213
Pull-in delay 4	Ond4			Relay 4, limit value	in C213
Pull-in delay 5	Ond5			Relay 5, limit value	in C214
Drop-out delay 1	Ofd1		0.2 sec	Relay 1, limit value	in C211
Drop-out delay 2	Ofd2			Relay 2, limit value	in C211
Drop-out delay 3	Ofd3			Relay 3, limit value	in C213
Drop-out delay 4	Ofd4			Relay 4, limit value	in C213
Drop-out delay 5	Ofd5			Relay 5, limit value	in C214
Maximum pulse frequency 1	Fr1	0 to 150 pulse/min	100	Relay 1, pulse frequency	in C211
Maximum pulse frequency 2	Fr2			Relay 2, pulse frequency	in C211
Pulse period 1	CY1	1.0 to 999.9 sec	20.0	Relay 1, pulse width	in C211
Pulse period 2	CY2			Relay 2, pulse width	in C211
Output level limit Relay 1	Y1	0 to 100%	100	Relay 1, pulse frequency or pulse length	in C211
Output level limit Relay 2	Y2			Relay 2, pulse frequency or pulse length	in C211
Cell constant	C-Ab	0.01 0.10 1.00 3.00 10.0	1.00		
Filter constant	dF	0 to 100 sec	0.6		
Actuator time	tt	15 to 3000 sec	60	Modulating controller	in C211

15 Configuration level

15.1 General

The basic functions of the instrument can be displayed and/or altered at the configuration level.

If it is necessary to reconfigure a number of instrument parameters,
⇨ Chapter 23.1 “Programming the controller”, page 72 ff.

For an explanation of the terminology used,
⇨ Chapter 21 “Glossary”, page 63 ff.

How to configure controllers,
⇨ Chapter 10.1 “Configuration”, page 27 ff.

Preconditions

How to access the configuration level, or leave this level,
⇨ Chapter 9.2 “Principle of operation”, page 23 ff.

The configuration level is unlocked,
⇨ “Unlocking the levels”, page 26, (code word 0300).

15.2 Analog inputs - C111

	C111*	1	0	0	0
Unit		I	I	I	I
µS/cm		0	I	I	I
mS/cm		1	I	I	I
			I	I	I
Not used			I	I	I
			0	I	I
				I	I
Not used				I	I
				0	I
					I
Method of temperature acquisition					I
Manual temperature compensation					0
Automatic temperature compensation with Pt100					1
Automatic temperature compensation with Pt1000					2

*The factory-set parameters are shown in the position boxes.

15.3 Logic inputs... - C112

C112*	0	0	0	0
Function of logic input 1[1]	I	I	I	I
No function	0	I	I	I
Key inhibit	1	I	I	I
Alarm stop	2	I	I	I
Hold	3	I	I	I
Freeze measurement	4	I	I	I
Setpoint changeover	5	I	I	I
Range expansion (x10)	6	I	I	I
HOLD reversed	7	I	I	I
Reset alarm time	8	I	I	I
		I	I	I
Function of logic input 2[1]		I	I	I
No function		0	I	I
Key inhibit		1	I	I
Alarm stop		2	I	I
Hold		3	I	I
Freeze measurement		4	I	I
Setpoint changeover		5	I	I
Range expansion (x10)		6	I	I
HOLD reversed		7	I	I
Reset alarm time		8	I	I
			I	I
Probe break detection			I	I
No			0	I
Yes (process value < 2% of measurement range)			1	I
				I
I component of the controller				I
The I component of the controller is active between the two setpoints				0
The I component of the controller is not active between the two setpoints				1

*The factory-set parameters are shown in the position boxes.

[1] Function description ⇨ Chapter 19.1 “Functions”, page 60.

15 Configuration level

15.4 Serial interface... - C113

	C113*	0	1	0	0
Device address		I	I	I	I
Address 0		0	0	I	I
Address 1		0	1	I	I
...				I	I
Address 99		9	9	I	I
				I	I
Serial interface				I	I
MODbus / Jbus, 9600 bps, no parity				0	I
MODbus / Jbus, 9600 bps, odd parity				1	I
MODbus / Jbus, 9600 bps, even parity				2	I
MODbus / Jbus, 4800 bps, no parity				3	I
MODbus / Jbus, 4800 bps, odd parity				4	I
MODbus / Jbus, 4800 bps, even parity				5	I
					I
Response of the process value output to out-of-range or off-scale					I
Underrange	Overrange				I
0%	100%				0
0%	110%				1
approx. -10%[1]	100%				2
approx. -10%[1]	110%				3

*The factory-set parameters are shown in the position boxes.

[1] For 0 — 10V and 0 — 20mA output signals, output is approx. -4% for underrange.

15.5 Controller options - C211

	a	b		
C211*	1	1	2	0
Function K1[1]	I	I	I	I
off	0	I	I	I
Limit controller	1	I	I	I
Pulse width controller	2	I	I	I
Pulse frequency controller	3	I	I	I
Modulating controller[5]	4	I	I	I
Proportional controller	5	I	I	I
		I	I	I
Function K2[1]		I	I	I
off		0	I	I
Limit controller		1	I	I
Pulse width controller		2	I	I
Pulse frequency controller		3	I	I
Modulating controller[5]		4	I	I
Proportional controller		5	I	I
			I	I
Calibration procedure[2]			I	I
Calibration of the cell constant, process value output not frozen			0	I
Calibration of the cell constant, process value output frozen			1	I
Determination of the temperature coefficient, process value output not frozen			2	I
Determination of the temperature coefficient, process value output frozen			3	I
				I
Manual operation[3]				I
Manual operation off				0
Manual operation enabled, switched[4]				1
Manual operation enabled, only while the key is pressed				2
Simulated process value output 1				3
Simulated process value output 2				4

*The factory-set parameters are shown in the position boxes.

1 Only effective if “1” was configured in C214c and/or “1” > Controller 2 or Controller 1 was configured in C214d.
2 Function description, ⇨ Chapter 12 “Calibration”, page 34ff.
3 Function description, ⇨ Chapter 16 “Manual operation”, page 56.
4 Not possible if limit comparators have been configured.
5 If the function “K1 Modulating controller” is selected, then the function “K2 Modulating controller” must also be selected (and the other way round).

15 Configuration level

15.6 Controller outputs - C212

	C212*	0	0	1	0
Signal K1 for overrange / hold		I	I	I	I
Output level 0%		0	I	I	I
Output level 100%		1	I	I	I
Output level 50% (not for limit controllers)		2	I	I	I
Output accepted		3	I	I	I
			I	I	I
Signal K2 for overrange / hold			I	I	I
Output level 0%			0	I	I
Output level 100%			1	I	I
Output level 50% (not for limit controllers)			2	I	I
Output accepted			3	I	I
				I	I
MIN / MAX contact for K1 / K2				I	I
K1	K2				I
MIN	MIN			0	I
MIN	MAX			1	I
MAX	MIN			2	I
MAX	MAX			3	I
					I
Make / break contact					I
K1	K2				
make	make				0
make	break				1
break	make				2
break	break				3

*The factory-set parameters are shown in the position boxes.

15.7 Other outputs I - C213

		a	b	c	d
	C213*	8	0	3	0
Function of output 3 (relay 3 or proportional output)		I	I	I	I
No function		0	I	I	I
Hold	(relay only)	1	I	I	I
Alarm pulse contact	(relay only)	2	I	I	I
Alarm steady contact	(relay only)	3	I	I	I
MAX temperature limit comparator	(relay only)	4	I	I	I
MIN temperature limit comparator	(relay only)	5	I	I	I
MAX conductivity limit comparator	(relay only)	6	I	I	I
MIN conductivity limit comparator	(relay only)	7	I	I	I
Process value conductivity	(analog output only)	8	I	I	I
Process value temperature	(analog output only)	9	I	I	I
Proportional controller 1	(only with analog output)[1]	A	I	I	I
Proportional controller 2	(only with analog output)[1]	b	I	I	I
			I	I	I
Signal for output 3 (analog output only)[2]			I	I	I
0 — 20 mA			0	I	I
4 — 20 mA			1	I	I
0 — 10 V			2	I	I
2 — 10 V			3	I	I
20 — 0 mA			4	I	I
20 — 4 mA			5	I	I
10 — 0 V			6	I	I
10 — 2 V			7	I	I
				I	I
Function of output 4 (logic output)				I	I
No function				0	I
Hold				1	I
Alarm pulse contact				2	I
Alarm steady contact				3	I
MAX temperature limit comparator				4	I
MIN temperature limit comparator				5	I
MAX conductivity limit comparator				6	I
MIN conductivity limit comparator				7	I
					I
Alarm monitoring of relays K1 and K2 [3]					I
K1 /	K2				
monitored	monitored				0
monitored	not monitored				1
not monitored	monitored				2
not monitored	not monitored				3

*The factory-set parameters are shown in the position boxes.

[1] The corresponding settings must be made in C211 (5xxx or x5xx), and also: SoL1/2 = 0 and SoH1/2 = 100.
[2] Only effective if configuration in C213a is “8”, “9”, “A” or “b”.
[3] A monitored relay contact (K1 /K2) triggers an alarm if the alarm tolerance + alarm delay time is exceeded,
⇨ Chapter 21 “Glossary”, page 63 ff.

15.8 Other outputs II - C214

		a	b	c	d
	C214*	**0**	**0**	**1**	**1**
Function of output 5 (relay 4 or analog output)		I	I	I	I
No function		0	I	I	I
Hold	(relay only)[2]	1	I	I	I
Alarm pulse contact	(relay only)[2]	2	I	I	I
Alarm steady contact	(relay only)[2]	3	I	I	I
MAX temperature limit comparator	(relay only)[2]	4	I	I	I
MIN temperature limit comparator	(relay only)[2]	5	I	I	I
MAX conductivity limit comparator	(relay only)[2]	6	I	I	I
MIN conductivity limit comparator	(relay only)[2]	7	I	I	I
Process value conductivity	(analog output only)	8	I	I	I
Process value temperature	(analog output only)	9	I	I	I
Proportional controller 1	(only with analog output)[3]	A	I	I	I
Proportional controller 2	(only with analog output)[3]	B	I	I	I
			I	I	I
Signal for output 5[1]			I	I	I
0 — 20 mA			0	I	I
4 — 20 mA			1	I	I
0 — 10 V			2	I	I
2 — 10 V			3	I	I
20 — 0 mA			4	I	I
20 — 4 mA			5	I	I
10 — 0 V			6	I	I
10 — 2 V			7	I	I
				I	I
Function of output 2				I	I
No function				0	I
Controller 2[4]				1	I
Alarm pulse contact[5]				2	I
Alarm steady contact[5]				3	I
MAX temperature limit comparator[5]				4	I
MIN temperature limit comparator[5]				5	I
MAX conductivity limit comparator[5]				6	I
MIN conductivity limit comparator[5]				7	I

	I
Function of output 1	I
No function	0
Controller 1[6]	1
Alarm pulse contact[7]	2
Alarm steady contact[7]	3
MAX temperature limit comparator[7]	4
MIN temperature limit comparator[7]	5
MAX conductivity limit comparator[7]	6
MIN conductivity limit comparator[7]	7

*The factory-set parameters are shown in the position boxes.

1 Only effective if configuration in C214a is “8”, “9”, “A” or “b”.
2 No optical status indication.
3 The corresponding settings must be made in C211 (5xxx or x5xx), and also: SoL1/2 = 0 and SoH1/2 = 100.
4 Enter the desired controller function in C211a.
5 The corresponding setting must be made in C211 (x0xx).
6 Enter the desired controller function in C211b.
7 The corresponding setting must be made in C211 (0xxx).

15 Configuration level

15.9 Response for HOLD / Overrange - C215

C215*	**0**	**0**	**0**	**0**
No function	I	I	I	I
	0	I	I	I
		I	I	I
K5		I	I	I
Inactive		0	I	I
Active		1	I	I
			I	I
K4			I	I
Inactive			0	I
Active			1	I
				I
K3				I
Inactive				0
Active				1

*The factory-set parameters are shown in the position boxes.

15.10 Process value output for conductivity - C311

C311*	**5**	**0**		
Bilinear characteristic	I	I	I	I
0%	0	0		
1%	0	1		
...				
99%	9	9		

*The factory-set parameters are shown in the position boxes.

15.11 SoL - SoH - SPL - SPH - rAnG - CELL - ALPH - LOFF - OFFS

SoL

Standard signal scaling of the analog process value output.

Start value of the range for standard signals of the process value output.

SoL1 -> Output K3
SoL2 -> Output K5

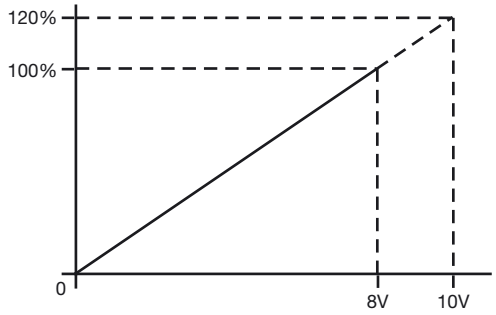
Value range
depending on configuration 0 — 0.5µS to 0 — 200mS[1] -50.0 to +250.0°C
Factory setting: 0.00

[1] depending on the configured measurement range

Example 1:
0 — 20 mA should correspond to **10 — 150 mS**
-> SoL = **10.0**0 / SoH = **150.0**

Example 2:
0— 20 mA should correspond to **-10** to +**40**°C
-> SoL = **-10.00** / SoH = **40.00**

Example 3:
0 — 100% of the controller output should correspond to **0** — 8 V of the output signal (but the standard output signal of the controller is 0 — 10 V)
-> SoL = **0** / SoH = **120**



SoH

Standard signal scaling of the analog process value output.

End value of the range for standard signals of the process value output.

SoH1 -> Output K3
SoH2 -> Output K5

For value ranges and factory settings, see “SoL” above.

SPL

Setpoint limiting for controller setpoints.

This parameter is used to define the lower limit setting for the controller setpoints SPr1/2/3/4.

SPH

Setpoint limiting for controller setpoints.

This parameter is used to define the upper limit setting for the controller setpoints SPr1/2/3/4.

rAnG

Range number, derived from the combination of cell constant and desired measurement range.

Cell constant K	Measurement range		Display with configured measurement (C111)		Range (rAng)
			µS	mS	
0.01	0 — 0.500	µS/cm	0.500	– –[1]	1
0.01	0 — 2.000	µS/cm	2.000	– –[1]	2
0.01	0 — 10.00	µS/cm	10.00	– –[1]	3
0.1	0 — 5.00	µS/cm	5.000	– –[1]	4
0.1	0 — 20.00	µS/cm	20.00	– –[1]	5
0.1	0 — 100.0	µS/cm	100.0	– –[1]	6
0.1	0 — 1.00	mS/cm	1000	1.00	7
0.1	0 — 5.00	mS/cm	5000	5.00[2]	8
1.0	0 — 50.00	µS/cm	50.00	– –[1]	9
1.0	0 — 100.0	µS/cm	100.0	– –[1]	10
1.0	0 — 1.00	mS/cm	1000	1.00	11
1.0	0 — 5.00	mS/cm	5000	5.00	12
1.0	0 — 20.00	mS/cm	– –[1]	20.00	13
1.0	0 — 100.0	mS/cm	– –[1]	100.0[2]	14
3.0	0 — 1.00	mS/cm	1000	1.00	15
3.0	0 — 5.00	mS/cm	5000	5.00	16
3.0	0 — 30.00	mS/cm	– –[1]	30.00	17
10.0	0 — 30.00	mS/cm	– –[1]	30.00	18
10.0	0 — 200.0	mS/cm	– –[1]	200.0	19

[1] These settings are not permissible – they would cause an incorrect display
[2] The polarization effect could cause a sizeable error in the measurement with this combination of measurement range and cell constant.

CELL

The relative cell constant K_{rel} [%] can be used to compensate for the deviation of the cell constant from the nominal value (0.01; 0.1; 1.0; 3.0; 10.0) over the range from 80 to 120%.

ALPH

Temperature coefficient [% per °C] of the measured solution.

Value range 0.00 — 5.50% per °C

The conductivity of a solution varies with the temperature, so for correct measurement both the temperature and the temperature coefficient of the solution being measured must be known.

The temperature coefficient can be determined automatically by the conductivity transmitter, or entered manually.
⇨ “Determination of the temperature coefficient”, page 38.

LOFF

Compensation of the lead resistance

Value range 0.00 — 99.99 Ω.

The lead resistance of the connecting cable to the cell can result in an incorrect indication for liquids with a high conductivity.

This error can be compensated by the setting for “LOFF”.

✱ Detach the connecting cable from the conductivity cell and the instrument.

✱ Measure the loop resistance of the connecting cable (out and return leads => short it at one end).

✱ Enter the measured resistance [Ω] in “LOFF”.

⇨ Chapter 11.5 “Compensation of falsified measurements”, page 32.

OFFS

Process value correction for temperature

The process value correction can be used to correct the measured value of the temperature input, either upwards or downwards.

Value range -199.9 to +199.9°C or °F
Factory setting: 0°C

Example:

Measured value	Offset	Displayed value
34.7°C	+0.3°C	35.0°C
35.3°C	-0.3°C	35.0°C

If the process value correction is made via the parameter “OFFS”, then no compensation resistance is needed
⇨ Chapter 7 “Installation”, page 17 ff.

16 Manual operation

Description

In manual operation, outputs K1, K2 and K3 can be operated by hand, independently of the controller.

Manual operation is only possible if it has been configured first.
⇨ Chapter 15.5 “Controller options - C211”, page 47.

The output level limiting is effective during manual operation (except for limit controllers).

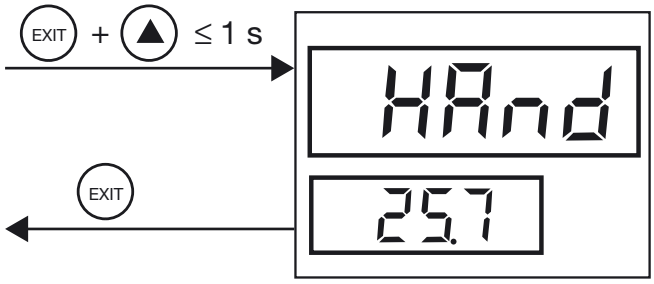
Initial condition

The instrument is in the measurement mode.

16.1 Manual operation for outputs K1, K2 or K3

Activate

In manual operation, outputs K1, K2 and K3 can be operated by hand.



✱ Press keys EXIT + ▲ for less than 1 second – this starts “Manual operation 1”. The upper LED display switches between the momentary value and the text “HAnd”, the lower display shows the present temperature.

✱ Activate or deactivate a particular output, see table

Key	Output
▼	K1[1]
▲	K2[1]
PGM	K3[2]

✱ Return to measurement mode, with EXIT

1 Output level will be 0 / 100% for a proportional controller.
2 Only while the key is pressed. Only if the third relay is fitted (“Output 310”, ⇨ Chapter 4.1 “Type designation”, page 8).

16.2 Simulated process value output

Setting

When “Simulated process value output” has been configured,
⇨ Chapter 15.5 “Controller options - C211”, page 47,
the upper display shows “HAnd” alternately with 50.0 (%).

✱ Use ▼ to reduce the signal at the process value output in 10% steps,
use ▲ to increase the signal at the process value output in 10% steps,

Example: Output signal 0 — 20 mA,
intended simulated output signal 8 mA
=> Setting 40%

17 Hold

17.1 Hold controller

Description

When “Hold” is activated, the relay outputs take up the status defined in the configuration parameters “Controller outputs” – C212 and “Response to HOLD / Overrange” – C215,
⇨ Chapter 15.6 “Controller outputs - C212”, page 48.
⇨ Chapter 15.9 “Response for HOLD / Overrange - C215”, page 52.

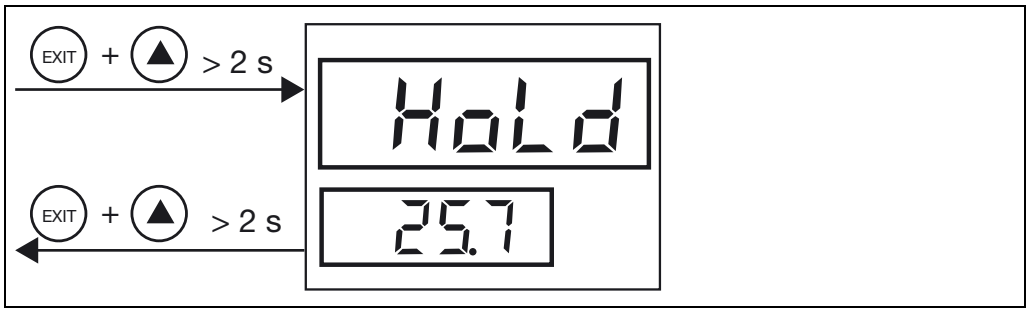
Any alarm delay time that may be running is set to “0”, but no alarm is produced.

Initial condition

The operating level is unlocked,
⇨ “Unlocking the levels”, page 26. (0110).

The instrument is in the measurement mode.

Activate “Hold” (manual)



✱ ▲ Press + EXIT for longer than 2 seconds (but less than 4 seconds)

The upper LED display shows “HoLd” alternately with the momentary measurement

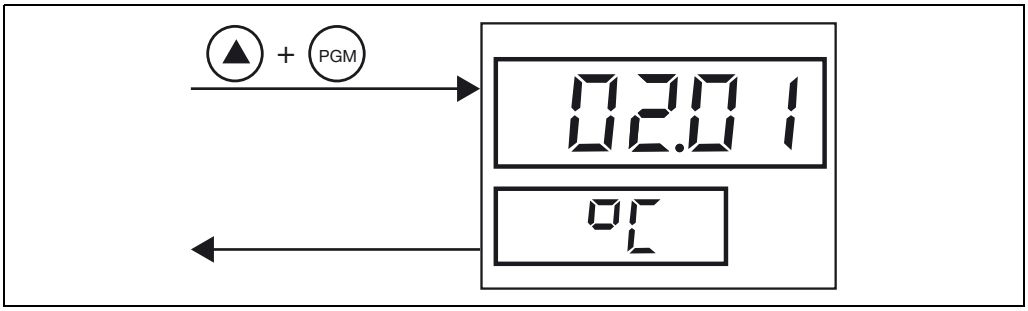
✱ Return to measurement mode by pressing ▲ + EXIT for longer than 2 seconds (but less than 4 seconds)

The controller outputs K1, K2 and K3 (depending on the instrument version and configuration) are set according to the configuration of C212.

The output level limiting is effective during “Hold” (except for limit controllers).

After configuration as limit comparator(s), outputs K1, K2, K3, K4 and K5 (depending on the instrument version and configuration) are set according to the configuration of C212 and C215.

18.1 Display software version and temperature unit



✱ Display the software version and unit for temperature with ▲ + PGM

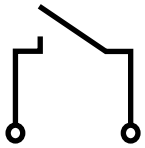
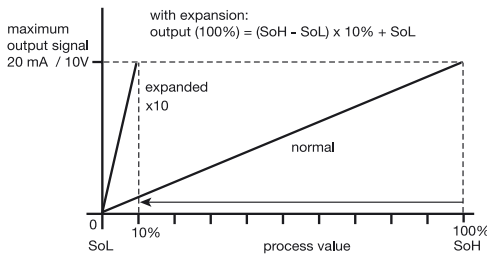
The software version is shown in the upper display.

The unit (lower display can be either °C or °F, (standard is °C; a conversion to °F can only be carried out at the factory).

19 Logic inputs

19.1 Functions

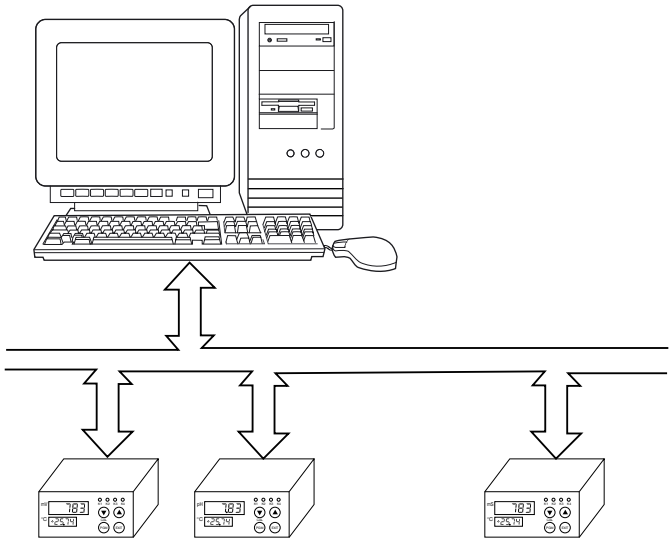
Setting the functions of the logic inputs,
see "Configuration level / logic inputs...– C112", page 36.

Status of the logic input		
Key inhibit	The transmitter/controller can be operated from the keys on the front panel.	The transmitter/controller can **not** be operated from the keys on the front panel.
Alarm stop	Alarm signals are generated at the configured output.	The alarm contact is deactivated – the LED for the configured alarm output blinks.
Reset alarm time	Alarm signals are generated at the configured output.	The alarm contact is deactivated. Any alarm delay that has started to run will be set to zero and held.
Hold	Controller active	Hold, ⇨ Chapter 17 "Hold", page 58.
Hold inverse	Hold, ⇨ Chapter 17 "Hold", page 58.	Controller active
Measurement freeze	The measured process value for the first measurement variable is displayed.	The measured process value for the first measurement variable is frozen. ⇨ Chapter 12 "Calibration", page 34 ff.
Setpoint changeover	Setpoint pair 1 (SP1 and SP 2) is active. **Display at operating level:** SPr1 SPr2 SP 3 SP 4	Setpoint pair 2 (SP3 and SP 4) is active. **Display at operating level:** SP 1 SP 2 SPr3 SPr4
Range expansion (x10)	Process value output is linear between SoL and SoH	Process value 0 — 10% of full scale is scaled up to 0 — 100% of the process value output. 

20.1 MODbus /Jbus

This interface can be used to integrate the controller into a data network. The following applications, for instance, can be implemented:

- Process visualization
- Plant/system control
- Recording / data logging



The bus system is designed around the master-slave concept. A master computer can communicate with up to 31 controllers or other devices (slaves). The interface is a serial interface using the RS422 or RS485 standards.

The following data protocols may be used:

- MODbus /Jbus protocol

This interface can only be retrofitted at the factory.

20 Interface

20.2 Profibus-DP

Fieldbus

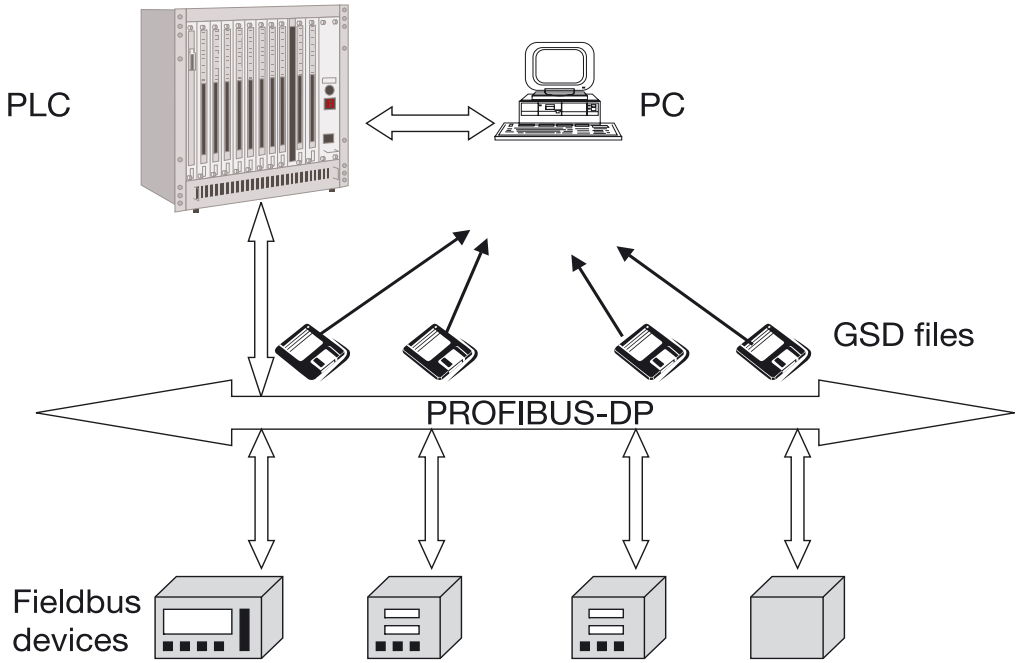
The Profibus-DP interface can be used to integrate the controller into a fieldbus system operating according to the Profibus-DP standard. This Profibus version is especially designed for communication between automation systems and decentral peripheral devices at the field level, and optimized for speed.

Data transmission

The data transmission is made serially, using the RS485 standard.

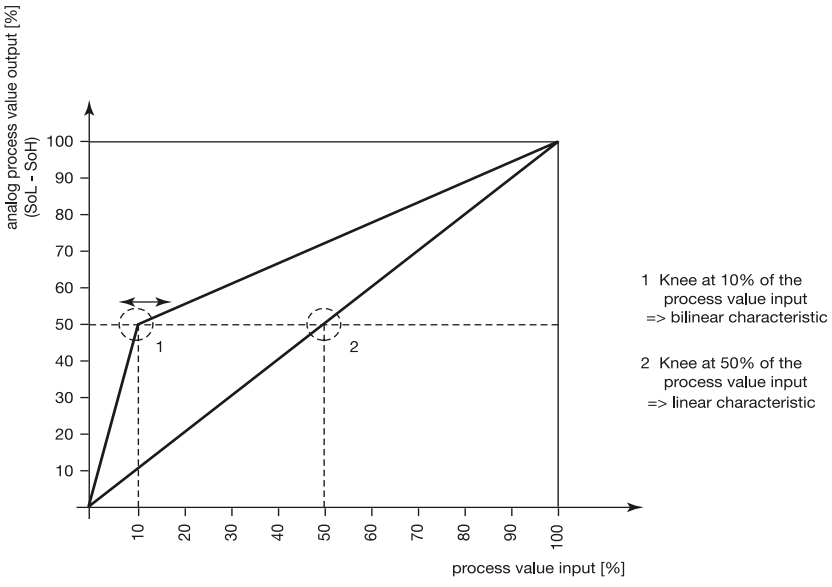
GSD generator

GSD generator, the project-planning tool that is supplied with the package (GSD = Gerätestammdaten, i.e. basic device data), is used to make a selection of device characteristics for the controller to create a standardized GSD file that is used to integrate the controller into the fieldbus system.

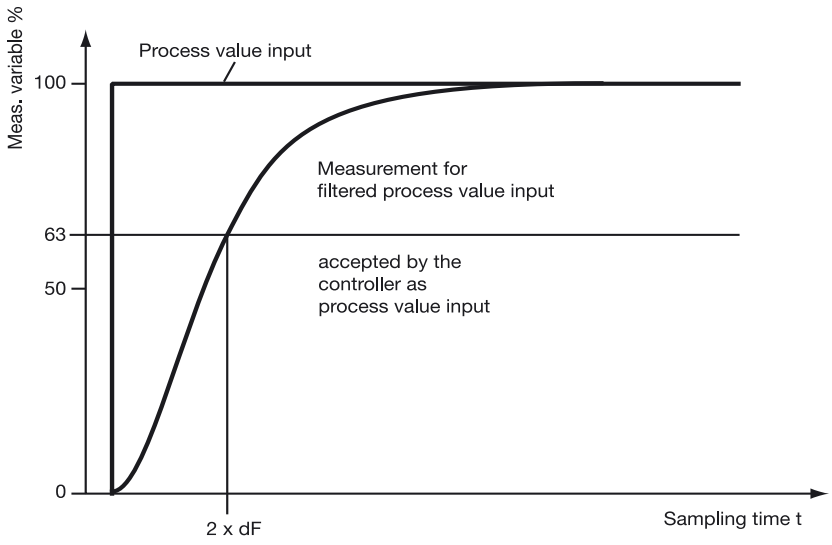


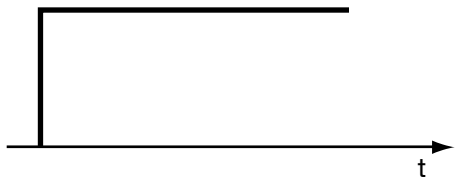
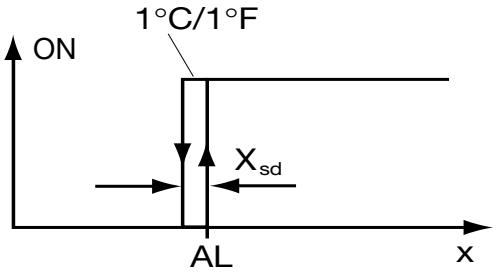
For a detailed description, see the PROFIBUS-DP Interface Description B70.3560.2.1

Parameters which apply to both output K1 and K2 (e.g tAb1 or tAb2) are only explained once.

Term	Parameter	Explanation
Actuator time	tt	The value for this parameter must be taken from the specific data for the actuator device (e.g. an actuator valve).
Alarm contact		With limit control, the active time of the outputs K1 or K2 can be monitored ***(dosing monitoring)***. If the active time exceeds an adjustable value (***Alarm delay AL2***), then the alarm contact is activated. With pulse width or pulse frequency control, the size of the control deviation is monitored. If the control deviation exceeds the adjustable ***Alarm tolerance AL1***, and remains outside this tolerance for longer than the ***Alarm delay AL2***, then the alarm contact is activated.
Alarm delay	AL2	If the control deviation exceeds the adjustable ***Alarm tolerance AL1***, and remains outside this tolerance for longer than the adjustable Alarm delay AL2, then the alarm contact is activated.
Alarm tolerance	AL1	If the process value goes above or below the value of setpoint plus or minus alarm tolerance (x > SPr..+AL1 or x < SPr..-AL1) and remains outside these limits for longer than the ***Alarm delay AL2***, then the alarm contact is activated. The alarm tolerance is only active if pulse width or pulse frequency control has been configured, ⇨ Chapter 15.5 “Controller options - C211”, Page 47. If limit control is configured, then the values for the alarm tolerance will be ignored.
Bilinear output	C311	This function has the effect that a small or large input signal produces a disproportionate analog process value output signal. The knee-point of the characteristic can be shifted along the dotted 50% (output) line. The factory setting of 50% (input) produces a straight-line characteristic. 

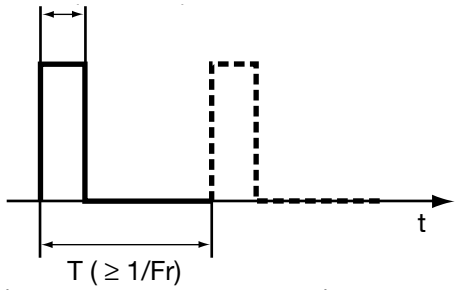
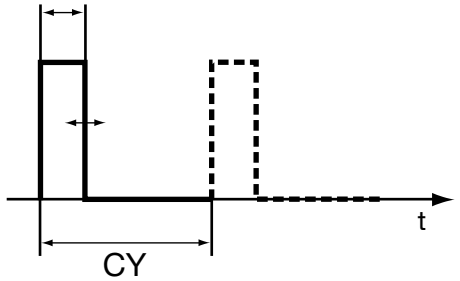
21 Glossary

Term	Parameter	Explanation
Break contact / make contact	C212	Break contact: As long as the switching condition **is not** fulfilled, the corresponding output is active (closed). Make contact: As long as the switching condition **is** fulfilled, the corresponding output is active (closed).
Cell constant	C-Ab	This shows the value that the attached conductivity cell should have. The value is derived from the selected rAnG number (combination of cell constant and measurement range).
Code word	CodE	After the supply voltage has been applied, all levels are protected against accidental or unauthorized editing. If parameter settings have to be altered, the levels must be unlocked by entering a code word. A code word is also required to be able to calibrate the electrode. It is not necessary to remove the protection against editing if you just want the check the settings.
Derivative time	dt	This determines the differential component of the controller output signal. If the derivative time is set to “0”, then the control response has no differential component.
Dosing monitoring	C213	Defines whether the output K1 and / or K2 is/are monitored by the alarm contact (see also under “Alarm contact”).
Drop-out delay	OFd	The time required for the corresponding relay contact to return to the inactive status when the switching condition is no longer fulfilled. Brief excursions above or below the setpoint will be ignored by the controller.
Filter constant	df	The setting of this parameter is used to filter out interference or input signals which would provoke undesirable reaction in the controller. The filter is a 2nd order digital filter. 
Hysteresis	HYS	see ***Switching differential***

Term	Parameter	Explanation
Limit controller	C211	A single-setpoint controller with ***pull-in*** and/or ***drop-out delay***. 
Logic input 1 / 2	C112	see “Logic inputs”, page 45.
Make contact / break contact	C212	Make contact: As long as the switching condition **is** fulfilled, the corresponding output is active (closed). Break contact: As long as the switching condition **is not** fulfilled, the corresponding output is active (closed).
MAX limit comparator	C211 SP A SP b SP C SP d SP E	SP A ... E defines the switching point. Function: The output has the “active” status when the process value is **above** the limit value.  SP A ... E are only visible at the operating level, when at least one limit comparator has been configured. Assignment: SP A is affected by: HYS1, Ond1 and OfD1 SP b is affected by: HYS2, Ond2 and OfD2 SP C is affected by: HYS3, Ond3 and OfD3 SP d is affected by: HYS4, Ond4 and OfD4 SP E is affected by: HYS5, Ond5 and OfD5
MIN / MAX contact	C212	MIN contact: The controller output is active if the process value is below the setpoint. MAX contact: The controller output is active if the process value is above the setpoint. For further explanation, ⇨ Chapter 10 “Controller”, Page 27ff.
Minimum ON time	tr	With a limit controller, pulse width controller, or modulating controller. The value selected is determined by the technical requirements of the equipment operated by the controller (solenoid valves, dosing pumps etc.).

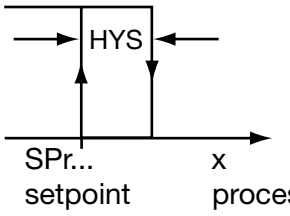
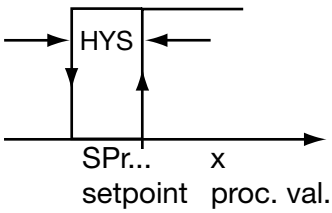
21 Glossary

Term	Parameter	Explanation
MIN temperature limit comparator	C211 SP A ... E	SP A ... E defines the switching point. Function: The output has the “active” status when the process value is **below** the limit value. For explanation, see “Max limit comparator”.
Modulating controller	C211	A modulating controller can move a motor actuator in steps to any position from 0 — 100% of the actuator range. A modulating controller can, for instance, be used to operate actuator valves.
Output level limit	Y1 Y2	Defines the maximum output level that can be produced by the corresponding relay, for a pulse width or pulse frequency controller
Proportional band	Pb	The range over which the output signal from a pulse width or pulse frequency controller is proportional to the control deviation. Beyond the proportional band, the controller will output the signal defined by the ***output level limit Y1 or Y2*** .
Proportional controller	C211 C213 C214	In a proportional controller there is a continuous signal (i.e. a current or voltage) on the output. This signal can take on any intermediate value between a start value and an end value. Depending on the configuration of the instrument, this proportional signal can be in the range 0 — 10 V, 0 — 20 mA or 4 — 20 mA. Proportional controllers are used, for example, to control actuator valves.
Process value x		The signal that is fed to the controller from the conductivity cell.
Process value input 2 (temperature)	C111	With automatic temperature acquisition (using a Pt100 or Pt1000 temperature probe), the measured temperature is shown in the lower display.
Pull-in delay	Ond	The time required for the corresponding relay contact to be activated when the switching condition is fulfilled. Brief excursions above or below the setpoint will be ignored by the controller.
Pulse contact / steady contact	C213	The behavior of an alarm contact. <u>Pulse contact:</u> The alarm output remains active for approx. 1 second, even if the switching condition (cause) of the alarm remains present for a longer time. The LED (for the output that was defined as the alarm output) blinks until the switching condition (the cause) of the alarm is no longer present. <u>Steady contact:</u> The alarm output remains active until the switching condition (the cause) of the alarm is no longer present. The LED blinks for the output that was defined as the alarm output.

Term	Parameter	Explanation
Pulse frequency	Fr	Maximum pulse frequency (only for a pulse frequency controller) The value selected is determined by the technical requirements of the equipment operated by the controller (solenoid valves, dosing pumps etc.). The value is limited by the ***minimum pulse width***: Pulse frequency [1/min]< (60 / minimum ON time [sec])
Pulse frequency controller	C211	The repetition rate of the pulses depends on the output level and the controller parameters: ***proportional band Pb***, ***derivative time dt***, ***reset time rt***, ***pulse frequency Fr*** and ***output level limits Y1 or Y2*** . The output signal from a pulse frequency controller can, for instance, be used to operate magnetic dosing pumps. tr (constant)  (depends on output level)
Pulse period	CY	This value is the period within which the pulse width modulation occurs (only for a pulse width or modulating controller). The value is limited by the ***minimum ON time***, see above: Pulse period [sec]> minimum ON time [sec])
Pulse width	tr	For pulse frequency control, otherwise as ***minimum ON time***
Pulse width controller	C211	The width of the pulses depends on the output level and the controller parameters: ***proportional band Pb***, ***derivative time dt***, ***reset time rt***, ***pulse period CY*** and ***output level limits Y1 or Y2***. The output signal from a pulse width controller can, for instance, be used to operate solenoid valves. t_{ON} (independent of output level ≥ tr)  (constant)

21 Glossary

Term	Parameter	Explanation
Reset time (Reset time)	rt	Integral time constant – controller parameter in a PI or PID controller. The value determines the speed with which the control deviation is integrated. If the reset time is set to “0”, then the control response has no integral component.
Setpoint 1	SP(r)1	The given value that should be achieved by the control loop (referring to output K1). The setpoint pair that is fed to the controller is identified in the parameter display by (r). See also ***Setpoint changeover*** Example for the active setpoint pair 1 => SPr1, SPr2 and SP 3, SP 4. for the active setpoint pair 2 => SP 1, SP 2 and SPr3, SPr4.
Setpoint 2	SP(r)2	As for ***setpoint 1***, referring to output K2
Setpoint 3	SP(r)3	Refers to output K1. For explanation see ***setpoint 1***. ☞ Only with activated ***setpoint changeover***
Setpoint 4	SP(r)4	Refers to output K2. For explanation see ***setpoint 1***. ☞ Only with activated ***setpoint changeover***
Setpoint changeover	C112	If setpoint changeover is configured for one of the ***logic inputs***, then setpoint pair 1 is active if the logic input is inactive, i.e. the controller uses the setpoints 1 and 2 (SPr1 and SPr2) for operation. If the logic input is active, then setpoint pair 2 is active, i.e. the controller uses the setpoints 3 and 4 (SPr3 and SPr4) for operation. Active setpoints are identified by an “r” in the parameter name (SPr1 and SPr2 as well as SP3 and SP4 if setpoint pair 1 is active).
Setpoint limiting	SPH	Setpoint limiting for controller setpoints. This parameter is used to define the upper limit setting for the controller setpoints SPr1/2/3/4.
Setpoint limiting	SPL	Setpoint limiting for controller setpoints. This parameter is used to define the lower limit setting for the controller setpoints SPr1/2/3/4.

Term	Parameter	Explanation
Steady contact / pulse contact	C213	The behavior of an alarm contact. Steady contact: The alarm output remains active until the switching condition (the cause) of the alarm is no longer present. The LED blinks for the output that was defined as the alarm output. Pulse contact: The alarm output remains active for approx. 1 second, even if the switching condition (cause) of the alarm remains present for a longer time. The LED (for the output that was defined as the alarm output) blinks until the switching condition (the cause) of the alarm is no longer present.
Switching condition		The process value goes above or below the setpoint. The switching condition is also dependent on the settings “Break contact / make contact” and “MIN / MAX contact.
Switching differential (also ***hysteresis***)	HYS	In a limit controller, this is the deviation of the process value from the setpoint that is required to trigger the switching of the control contact in response to a falling or rising process value. Limit controller MAX contact make contact  Limit controller MIN contact make contact 

22 Warnings – Errors

22.1 Messages

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Warning / Error	Cause / behavior / action
F010	Alarm tolerance overrun/underrun and alarm delay time for the controller has elapsed. Relays K1 / K2 behave as defined by the configuration C212, ⇨ Chapter 15.6 “Controller outputs - C212”, page 48. Check process value. Check controller parameters.
F022	Underrange. Controller goes to “Hold”, ⇨ Chapter 17 “Hold”, page 58. Check configured setpoints, ⇨ Chapter 13.1 “Settings”, page 41. Check electrode / cable / connector.
F023	Overrange. Controller goes to “Hold”, ⇨ Chapter 17 “Hold”, page 58. Check configured setpoints, ⇨ Chapter 13.1 “Settings”, page 41.
F024	With automatic temperature acquisition, a temperature was measured below -50°C or above +250°C. Controller goes to “Hold”, ⇨ Chapter 17 “Hold”, page 58. Check the connection to the resistance thermometer, ⇨ Chapter 7.1 “Electrical connection”, page 17ff.
F030	Process value output (SoL) went below the minimum value (only if output 3 and / or 5 were configured as the process value output (C213 or C214)). Check the setting, ⇨ Chapter 15.11 “SoL - SoH - SPL - SPH - rAnG - CELL - ALPH - LOFF - OFFS”, page 53.
F031	Process value output (SoL) went above the maximum value (only if output 3 and / or 5 were configured as the process value output (C213 or C214)). Check the setting, ⇨ Chapter 15.11 “SoL - SoH - SPL - SPH - rAnG - CELL - ALPH - LOFF - OFFS”, page 53.
F050	Parameter limits swapped for process value output: SoL is higher than SoH (only if output 3 and / or 5 were configured as the process value output (C213 or C214)). Check the setting, ⇨ Chapter 15.11 “SoL - SoH - SPL - SPH - rAnG - CELL - ALPH - LOFF - OFFS”, page 53.

Warning / Error	Cause / behavior / action
F053	Incorrect setpoint combination. Precondition: Both controllers must be configured as pulse width or pulse frequency controllers. The controller contacts must be configured as MIN/MIN or MAX/MAX, ⇨ Chapter 15.6 “Controller outputs - C212”, page 48. Cause: With MIN/MIN there will be an error message if w1 > w2. There is **no** error message if w1 < w2. With MAX/MAX there will be an error message if w1 < w2. There is **no** error message if w1 > w2. This also applies to the second pair of setpoints, if setpoint changeover is configured.
F060	Minimum ON time (tr1) is longer than the pulse period 1 (CY1) (only if controller 1 is configured as a pulse width controller), or Minimum ON time (tr1) is longer than 1/60 of the pulse frequency 1 (Fr1) (only if controller 1 is configured as a pulse frequency controller), ⇨ Chapter 14.1 “Settings”, page 42ff.
F061	Minimum ON time 2 (tr2) is longer than the pulse period 2 (CY2) (only if controller 2 is configured as a pulse width controller), or Minimum ON time (tr2) is longer than 1/60 of the pulse frequency 2 (Fr2) (only if controller 2 is configured as a pulse frequency controller), ⇨ Chapter 14.1 “Settings”, page 42ff.
Err	The calibration of the relative cell constant or the determination of the temperature coefficient for the medium being measured was terminated with an error. The old data are retained. Cause: The relative cell constant (either as set or as determined during the calibration) is outside the permissible range (80 — 120%), or The temperature coefficient for the medium being measured (either as set or as determined during the calibration) is outside the permissible range. (0 — 5.5% per °C) Corrective action: A fresh, correct calibration, ⇨ Chapter 12 “Calibration”, page 34ff or Enter the relative cell constant or temperature coefficient for the medium being measured, using the keys to alter a digit up and down, and then confirming with the (PGM) key, ⇨ Chapter 12.2 “Relative cell constant”, page 36 or ⇨ Chapter 12.2.2 “Automatic determination of the relative cell constant with a reference instrument”, page 37.

Errors F010 to F031 and “Err” trigger an alarm; the configured alarm output will switch and the corresponding LED will blink.

With errors F022 to F024 and “Err”, the controller also goes to the “HoLd” condition, ⇨ Chapter 17 “Hold”, page 58.

The alarm relay does not switch as a result of one of the warnings F050 to F061, but the corresponding LED will blink.

23 Appendix

23.1 Programming the controller

Configuration

If a number of instrument parameters have to be modified in the instrument, then it is advisable to note them in the table below, and then modify these parameters in the sequence given.

The following list shows the maximum number of parameters that can be altered.

Depending on the type and configuration, your instrument may not show some of the listed parameters.

Code words to unlock the individual levels,
⇨ "Unlocking the levels", page 26.

Para-meter	Explanation	Factory setting	New setting	see page
Configuration level				
C111	Analog inputs	1000		44
C112	Logic inputs / probe / supply	0000		45
C113	Serial interface	0100		46
C211	Controller options	1120		47
C212	Controller outputs	0010		48
C213	Other outputs I	8030		49
C214	Other outputs II	0011		50
C215	Response for HOLD / Overrange	0000		52
C311	Process value output Lf	5000		
SoL1	Scaling of the standard signal – start value K3	0.00		53
SoL2	Scaling of the standard signal – start value K5	0.00		
SoH1	Scaling of the standard signal – end value K3	1.00		
SoH2	Scaling of the standard signal – end value K5	1.00		
SPL	Lower setpoint limit for controller setpoints – SP(r)1	0.00		
SPH	Upper setpoint limit for controller setpoints – SP(r)1	1.00		
rAnG	Range number			54
CELL	Relative cell constant	100.0		
ALPH	Temperature coefficient	2.30		
LOFF	Compensation of lead resistance to conductivity cell	0.50		55
OFFS	Process value correction for temperature	0.0		
Parameter level				
Pb1	Proportional band 1	0.50		42
Pb2	Proportional band 2	0.50		
dt1	Derivative time 1 [s]	0		
dt2	Derivative time 2 [s]	0		
rt1	Reset time 1 [s]	0		
rt2	Reset time 2 [s]	0		
tr1	Minimum ON time 1 [s]	0.2		
tr2	Minimum ON time 2 [s]	0.2		

Para-meter	Explanation		Factory setting	New setting	see page
HYS1	Switching differential 1		0.30		43
HYS2	Switching differential 2		0.30		
HYS3	Switching differential 3		0.30		
HYS4	Switching differential 4		0.30		
HYS5	Switching differential 5		0,30		
Ond1	Pull-in delay 1	[s]	1.0		
Ond2	Pull-in delay 2	[s]	1.0		
Ond3	Pull-in delay 3	[s]	1.0		
Ond4	Pull-in delay 4	[s]	1.0		
Ond5	Pull-in delay 5	[s]	1.0		
OFd1	Drop-out delay 1	[s]	0.2		
OFd2	Drop-out delay 2	[s]	0.2		
OFd3	Drop-out delay 3	[s]	0.2		
OFd4	Drop-out delay 4	[s]	0.2		
OFd5	Drop-out delay 5	[s]	0.2		
Fr1	Maximum pulse frequency 1	[imp/min]	100		
Fr2	Maximum pulse frequency 2	[imp/min]	100		
CY1	Pulse period 1	[s]	20		
CY2	Pulse period 2	[s]	20		
Y1	Output level limit for K1	[%]	100		
Y2	Output level limit for K2	[%]	100		
C-Ab	Cell constant	[s]	1.00		
dF	Filter constant	[s]	0.6		
tt	Actuator time	[s]	60		
Operating level					
SP(r)1	1st Setpoint for contact K1		0.00		41
SP(r)2	1st Setpoint for contact K2		1.00		
SP(r)3	2nd Setpoint for contact K1		0.00		
SP(r)4	2nd Setpoint for contact K2		1.00		
CodE	Code word to unlock the levels		s. p. 26		
SP A	Limit SP A (K1)		-50		
SP b	Limit SP b (K2)		-50		
SP C	Limit SP C (K3)		-50		
SP d	Limit SP d (K4)		-50		
SP E	Limit SP E (K5)		-50		
InP2	Temperature display for compensation (°C)		25.0		
AL1	Alarm tolerance		0.00		
AL2	Alarm delay (sec)		300		