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Fine Controls have been supplying process controls & instrumentation equipment since 1994, & now serves an ever expanding customer base, both in the UK & globally.

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Type 8792, 8793

Positioner

Electropneumatic positioner

Operating Instructions

Positioner Typ 8792, 8793

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General Information and Safety Instructions

CONTENTS

1. OPERATING INSTRUCTIONS

The operating instructions describe the entire life cycle of the device. Keep these instructions in a location which is easily accessible to every user and make these instructions available to every new owner of the device.

⚠ **WARNING!**

The operating instructions contain important safety information!

Failure to observe these instructions may result in hazardous situations.

▪ The operating instructions must be read and understood.

1.1. Symbols

⚠ **DANGER!**

Warns of an immediate danger!

▪ Failure to observe the warning may result in a fatal or serious injury.

⚠ **WARNING!**

Warns of a potentially dangerous situation!

▪ Failure to observe the warning may result in serious injuries or death.

⚠ **CAUTION!**

Warns of a possible danger!

▪ Failure to observe this warning may result in a medium or minor injury.

NOTE!

Warns of damage to property!

▪ Failure to observe the warning may result in damage to the device or the equipment.

indicates important additional information, tips and recommendations which are important for your safety and the flawless functioning of the device.

refers to information in these operating instructions or in other documentation.

→ designates a procedure that must be carried out.

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2. AUTHORIZED USE

Incorrect use of the positioner Type 8792 and Type 8793 can be dangerous to people, nearby equipment and the environment.

The device is designed for the open-loop control and closed-loop control of media.

- The device must not be exposed to direct sunlight.

- Pulsating direct voltage (rectified alternating voltage without smoothing) must not be used as power supply.

- During use observe the permitted data, the operating conditions and conditions of use specified in the con-tract documents and operating instructions, as described in chapter *"System Description" - "Technical Data"* in this manual and in the valve manual for the respective pneumatically actuated valve.

- The device may be used only in conjunction with third-party devices and components recommended and authorised by Bürkert.

- In view of the wide range of possible application cases, check whether the positioner is suitable for the spe-cific application case and check this out if required.

- Correct transportation, correct storage and installation and careful use and maintenance are essential for reli-able and faultless operation.

- Use the positioner Type 8792 and Type 8793 only as intended.

2.1. Restrictions

If exporting the system/device, observe any existing restrictions.

2.2. Predictable Misuse

- The positioners Type 8792 and Type 8793 must not be used in areas where there is a risk of explosion.

- Do not supply the medium connectors of the system with aggressive or flammable mediums.

- Do not supply the medium connectors with any liquids.

- Do not put any loads on the housing (e.g. by placing objects on it or standing on it).

- Do not make any external modifications to the device housings. Do not paint the housing parts or screws.

3. BASIC SAFETY INSTRUCTIONS

These safety instructions do not make allowance for any

▪ contingencies and events which may arise during the installation, operation and maintenance of the devices.

▪ local safety regulations – the operator is responsible for observing these regulations, also with reference to the installation personnel.

⚠️

Danger – high pressure!

▪ Before loosening the lines and valves, turn off the pressure and vent the lines.

Risk of electric shock!

▪ Before reaching into the device or the equipment, switch off the power supply and secure to prevent reactivation!

▪ Observe applicable accident prevention and safety regulations for electrical equipment!

Risk of burns/risk of fire if used continuously through hot device surface!

▪ Keep the device away from highly flammable substances and media and do not touch with bare hands.

General hazardous situations.

To prevent injury, ensure that:

▪ That the system cannot be activated unintentionally.

▪ Installation and repair work may be carried out by authorised technicians only and with the appropriate tools.

▪ After an interruption in the power supply or pneumatic supply, ensure that the process is restarted in a defined or controlled manner.

▪ The device may be operated only when in perfect condition and in consideration of the operating instructions.

▪ The general rules of technology apply to application planning and operation of the device.

NOTE!

Electrostatic sensitive components / modules!

The device contains electronic components which react sensitively to electrostatic discharge (ESD). Contact with electrostatically charged persons or objects is hazardous to these components. In the worst case scenario, they will be destroyed immediately or will fail after start-up.

▪ Observe the requirements in accordance with EN 61340-5-1 and 5-2 to minimise or avoid the possibility of damage caused by sudden electrostatic discharge!

▪ Also ensure that you do not touch electronic components when the power supply voltage is present!

> The positioners Type 8792 and Type 8793 were developed with due consideration given to the accepted safety rules and are state-of-the-art. Nevertheless, dangerous situations may occur.
>
> Failure to observe this operating manual and its operating instructions as well as unauthorized tampering with the device release us from any liability and also invalidate the warranty covering the devices and accessories!

4. GENERAL INFORMATION

4.1. Scope of Supply

Check immediately upon receipt of the delivery that the contents are not damaged and that the type and scope agree with the delivery note and packing list.

Generally the product package consists of:
positioner, type 8792 / 8793 and the associated operating instructions

> We will provide you with attachment kits for push drives or swivel actuators as accessories.
> For the multipole version of the positioners we will provide you with cable connectors as accessories.

If there are any discrepancies, please contact us immediately.

Germany

Contact address:

Bürkert Fluid Control Systems
Sales Center
Chr.-Bürkert-Str. 13-17
D-74653 Ingelfingen
Tel. + 49 (0) 7940 - 10 91 111
Fax + 49 (0) 7940 - 10 91 448
E-mail: info@de.buerkert.com

International

Contact addresses can be found on the final pages of these operating instructions.

And also on the internet at:

www.burkert.com ➔ Bürkert ➔ Company ➔ Locations

4.2. Warranty

This document contains no promise of guarantee. Please refer to our general terms of sales and delivery. The warranty is only valid if the positioners Type 8792 and Type 8793 are used as intended in accordance with the specified application conditions.

> The warranty extends only to defects in the positioners Type 8792 and Type 8793 and their components.
>
> We accept no liability for any kind of collateral damage which could occur due to failure or malfunction of the device.

4.3. Master code

Operation of the device can be locked via a freely selectable user code. In addition, there is a non-changeable master code with which you can perform all operator control actions on the device. This 4-digit master code can be found on the last pages of these operating instructions in the chapter entitled *"Master code"*.

If required, cut out the code and keep it separate from these operating instructions.

4.4. Information on the Internet

The operating instructions and data sheets for Type 8792 and Type 8793 can be found on the Internet at:

www.burkert.com ➔ Documentation ➔ Type 8792 or Type 8793

There is also complete documentation on CD. The complete operating instructions can be ordered by quoting the following identification number: 804625

MAN 1000118577 EN Version: A Status: RL (released I freigegeben) printed: 01.09.2009

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MAN 1000118577 EN Version: A Status: RL (released I freigegeben) printed: 01.09.2009

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Description of System

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5. DESCRIPTION AND FEATURES OF THE POSITIONER

5.1. General Description

The positioner Type 8792 / 8793 is a digital, electro-pneumatic position controller for pneumatically actuated proportional valves. The device incorporates the main function groups

- Position measuring system
- Electro-pneumatic control system
- Microprocessor electronics

The position measuring system measures the current positions of the proportional valve.
The microprocessor electronics continuously compare the current position (actual value) with a set-point position value specified via the unit signal input and supplies the result to the position controller.
If there is a control difference, the electro-pneumatic control system corrects the actual position accordingly.

5.1.1. Features

- **Versions**
  The positioner features either a position control function (Type 8792) or a process control function (Type 8793).

- **Position measuring systems**
  - internal high resolution conductive plastic potentiometer or
  - external non-contact, non-wearing position measuring system (remote).

- Microprocessor-controlled electronics
  for signal processing, control and valve control.

- **Control module**
  Operation of the device is controlled by four keys. The 128x64 dot matrix graphics display enables you to display the set-point or actual value and to configure and parameterize via menu functions.

- **Control system**
  The control system consists of 2 solenoid valves and 4 diaphragm reinforcers. In single-acting actuators the working connection 2 must be sealed with a threaded plug.

- **Feedback (optional)**
  The feedback is implemented either via 2 proximity switches (initiators), via binary outputs or via an output (4 – 20 mA / 0 – 10 V).
  When the valve reaches an upper or lower position, this position can be relayed e.g. to a PLC via binary outputs. The operator can change the initiators or limit positions via control lugs.

- **Pneumatic interfaces**
  Internal thread G1/4"

- **Electrical interfaces**
  Multipole plug or cable gland

- **Housing**
  Plastic-coated aluminium housing with hinged cover and captive screws.

- **Mounting**
  on push actuator according to NAMUR recommendation (DIN IEC 534 T6) or on swivel actuator according to VDI/VDE 3845.

- **Optional**
  Remote version for DIN rail mounting or for mounting bracket

5.1.2. Combination with valve types and mounting versions

The positioner Types 8792 / 8793 can be mounted on different proportional valves. For example on valves with piston, membrane or rotary actuator. The actuators can be single-acting or double-acting.

- For single-acting actuators, only one chamber is aerated and deaerated during actuation. The generated pressure works against a spring. The piston moves until there is an equilibrium of forces between compressive force and spring force. To do this, one of the two air connections must be sealed with a threaded plug.

- For double-acting actuators the chambers on both sides of the piston are pressurised. In this case, one chamber is aerated when the other one is deaerated and vice versa. In this design, no spring is installed in the actuator.

Two basic device versions are offered for the positioner Type 8792 / 8793; they differ in the attachment option and in the position measuring system.
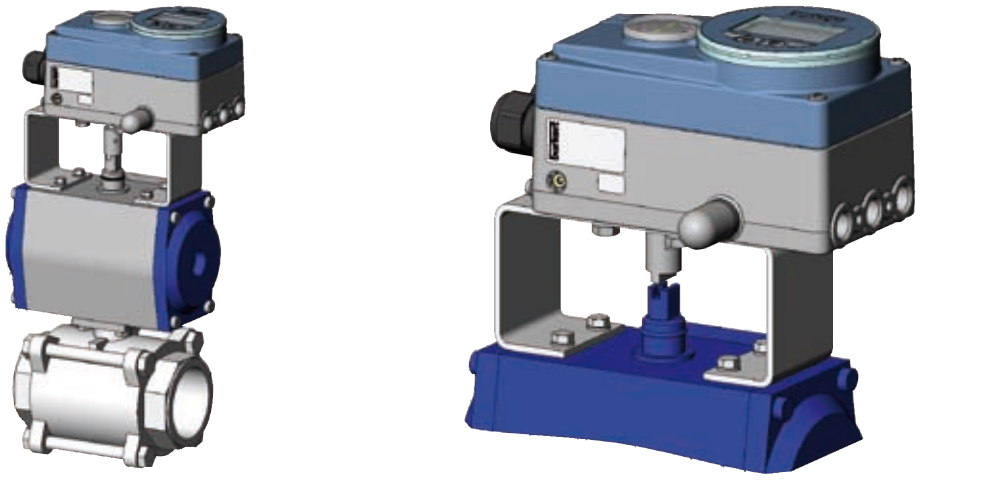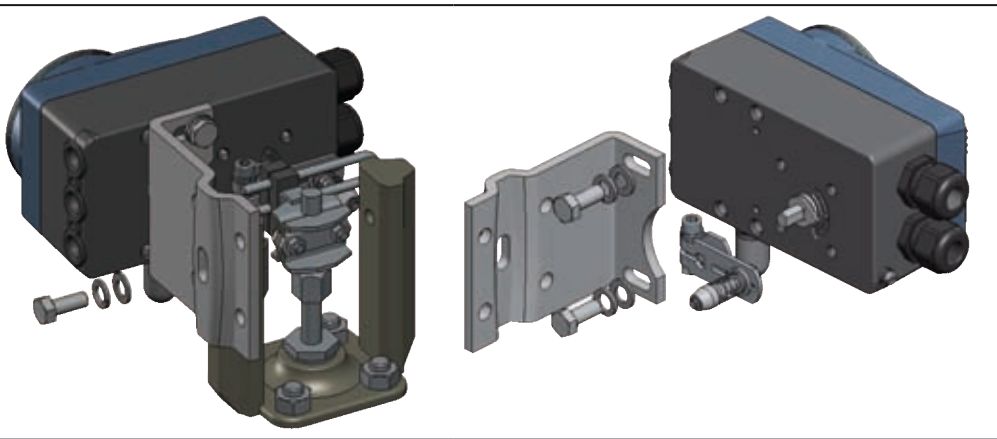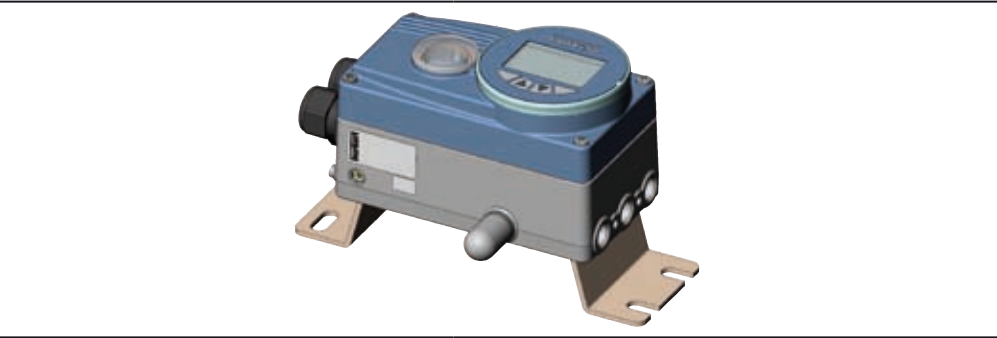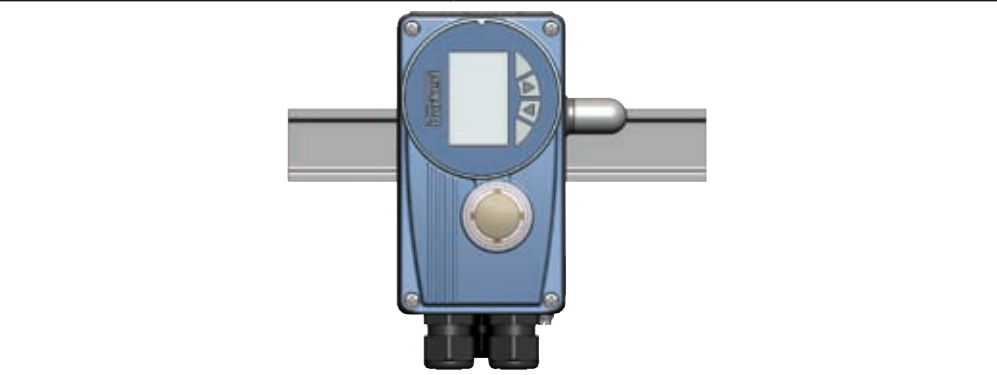
Device version 1:
An internal position measuring system is used which is designed as a rotary potentiometer. The positioner is attached directly to the actuator.

Device version 2:
An external position measuring system (linear or rotative) via a digital interface. The positioner is attached to a wall either with a DIN rail or with a mounting bracket (remote design).

5.1.3. Overview of the mounting options

Mounting on swivel drive	
Mounting with mounting bracket on a push actuator	
Remote mounting with mounting bracket	
Remote mounting with DIN rail	

Table 1: Overview of the mounting options

5.2. Designs

5.2.1. Type 8792, positioner with position control function

The position of the actuator is regulated according to the position set-point value. The position set-point value is specified by an external uniform signal (or via field bus).

5.2.2. Type 8793, positioner with process control function

The positioner Type 8793 also features a PID controller which, apart from actual position control, can also be used to implement process control (e.g. level, pressure, flow rate, temperature) in the sense of a cascade control.

The positioner Type 8793 is operated with a 128 x 64 dot matrix graphics display and a keypad with 4 keys.

The positioner is linked to a control circuit. The position set-point value of the valve is calculated from the process set-point value and the actual process value via the control parameters (PID controller). The process set-point value can be set by an external signal.

6.   STRUCTURE OF THE POSITIONER

The positioners Type 8792 and Type 8793 consist of the micro-processor controlled electronics, the position measuring system and the control system.

The appliance is designed using three-wire technology. Operation of the positioner is controlled by four keys and a 128 x 64 dot matrix graphics display.

The pneumatic control system for single-acting and double-acting actuators consists of 2 solenoid valves.

6.1.   Representation
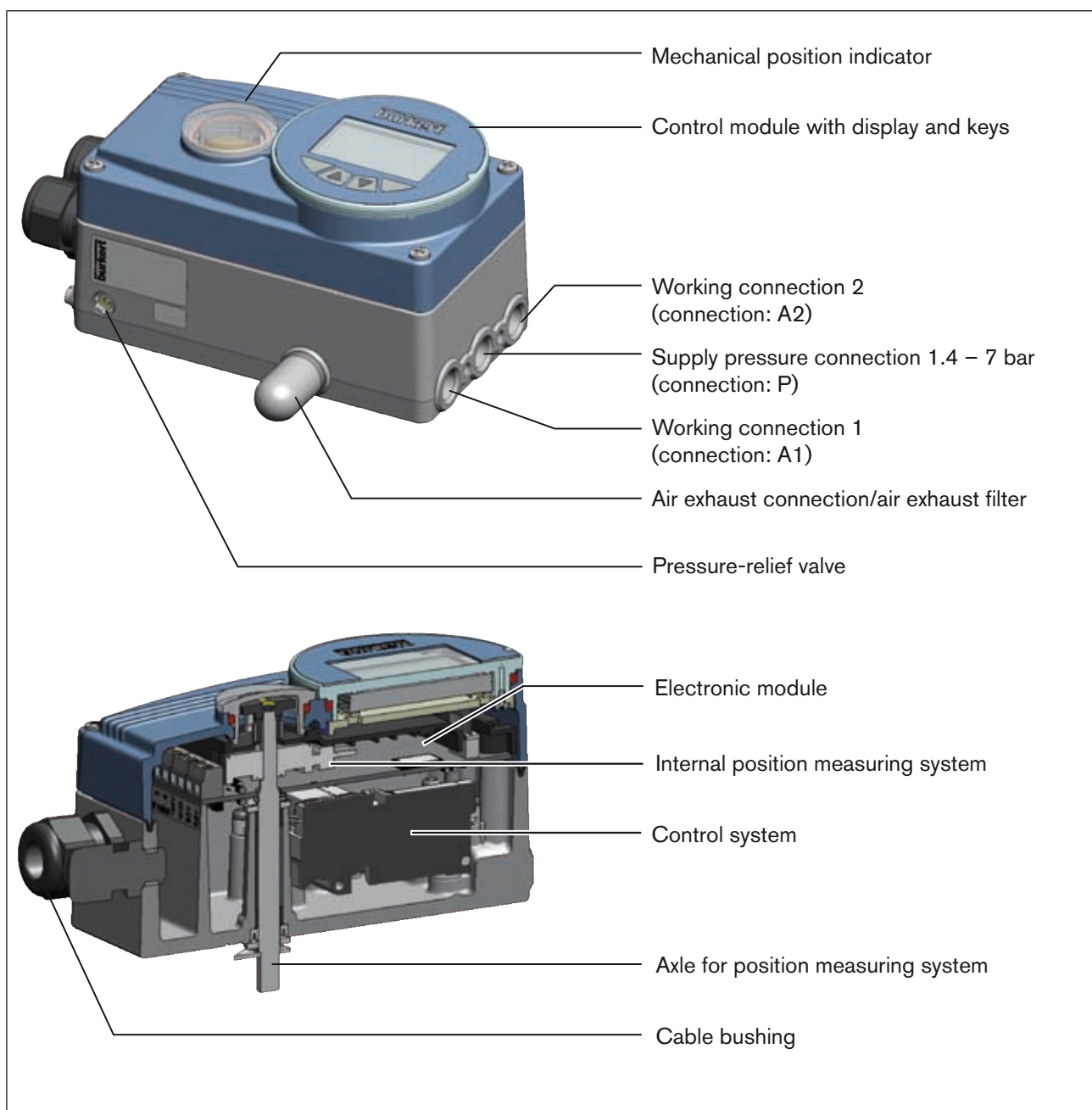
Fig. 1:   Structure, positioner type 8792 / 8793

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6.2. Function diagram

6.2.1. Diagram illustrating single-acting actuator

The black lines in *Fig. 2:* specify the function of the position controller circuit in Type 8792.

The grey part of the diagram indicates the additional function of the superimposed process control circuit in Type 8793.
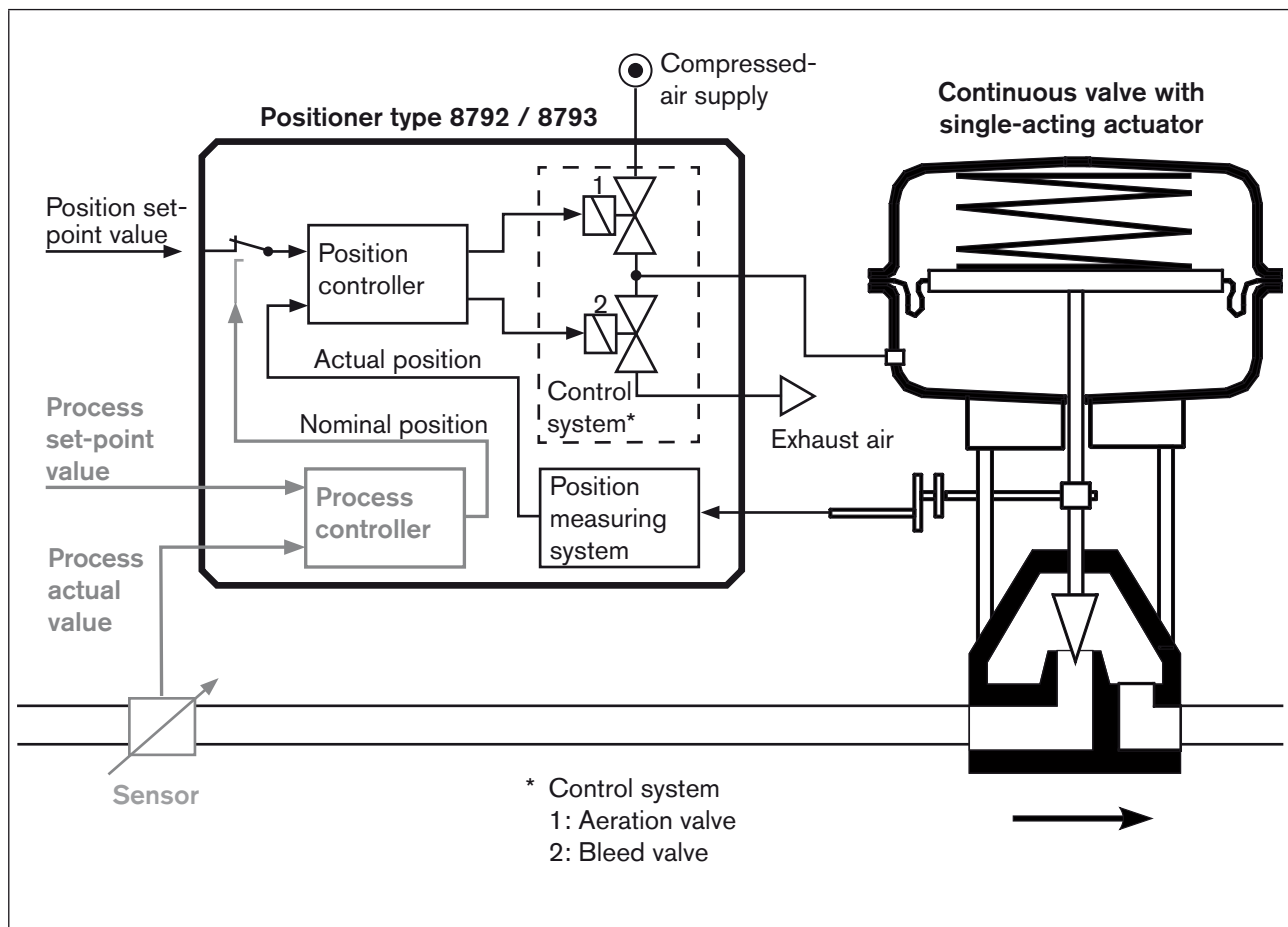
Fig. 2:   *Structure, positioner type 8792 / 8793*

The remote design has the position measuring system situated outside the positioner directly on the proportional valve and is connected to the latter by a cable.

7.   TYPE 8792 WITH POSITION CONTROLLER FUNCTION

The position measuring system records the current position (*POS*) of the pneumatic actuator. The position controller compares this actual position value with the set-point value (*CMD*) which is specified as a norm signal. If there is a control difference (Xd1), the actuator is aerated and deaerated via the control system. In this way the position of the actuator is changed until control difference is 0. Z1 represents a disturbance variable.
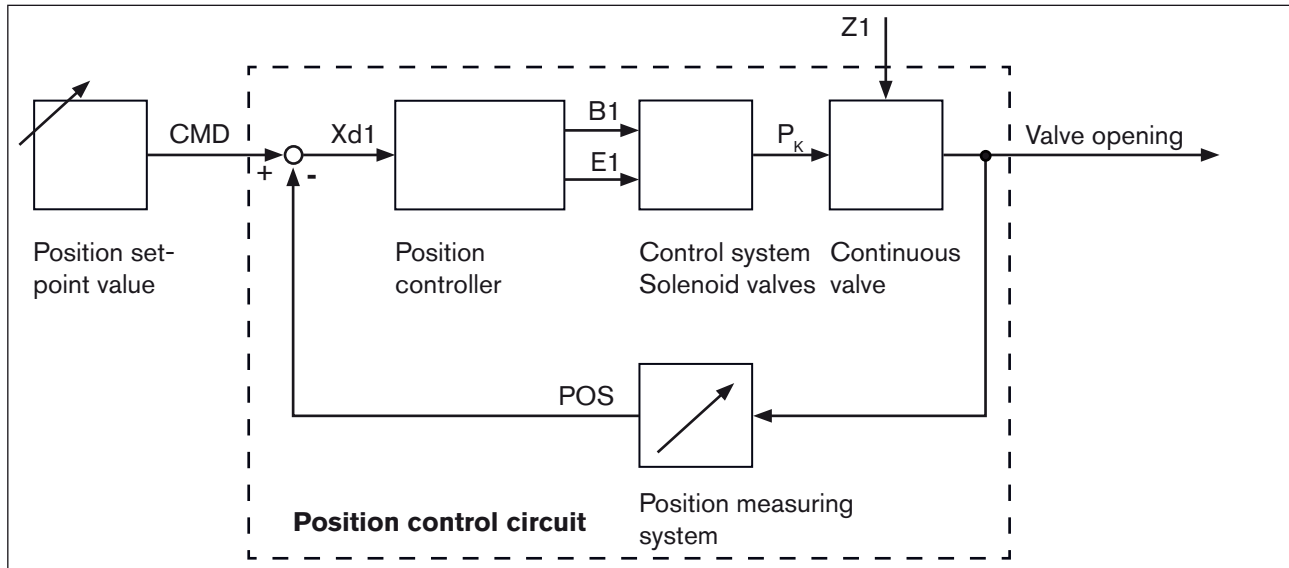
Fig. 3:   Position control circuit in Type 8792

7.1. Schematic representation of the position control

Fig. 4:   Schematic representation of position control

7.2.   Properties of the position controller software

Position controller with additional function	
Additional function	**Effect**
Sealing function *CUTOFF*	Valve closes tight outside the control range. Specification of the value (in %), from which the actuator is completely deaerated (when 0%) or aerated (when 100%).
Stroke limit *X.LIMIT*	Mechanical valve piston movement only within a defined stroke range
Signal range splitting *SPLTRNG*	Splitting of the uniform signal range to two or more positioners
Correction line to adjust the operating characteristic *CHARACT*	The process characteristic can be linearized
Insensitivity range *X.CONTROL*	The position controller is initially actuated from a control difference to be defined
Effective sense of direction of the controller set-point value *DIR.CMD*	Reversal of the effective sense of direction of the set-point value
Safety position *SAFEPOS*	Definition of the safety position
Limiting the control speed *X.TIME*	Input of the opening and closing time for the entire stroke
Effective directional sense of the actuator drive *DIR.ACT*	Adjustment of the effective sense of direction between aeration state of the actuator and the actual position
Signal level error detection *SIG.ERROR*	Check the input signals for sensor break. Warning output on the display and start up of the safety position (if selected)
Binary input *BINARY. IN*	Switch over AUTOMATIC-MANUAL or Start up of the safety position
Analogue feedback (option) *OUTPUT*	Status signal set-point or actual value
2 binary outputs (option) *OUTPUT*	Output of two selectable binary values
User calibration *CAL.USER*	Change to the factory calibration of the signal input

Table 2:   Properties of the position controller software. Position controller with additional function.

Hierarchical control concept for easy control on the following levels	
Additional function	**Effect**
Process control	On this level switch between AUTOMATIC and MANUAL mode.
Configuration and Parameterization	On this level specify certain basic functions during start-up and, if required, configure additional functions

Table 3:   Properties of the position controller software. Position controller with additional function; hierarchical control concept.

8. TYPE 8793 WITH PROCESS CONTROLLER FUNCTION

If the positioner Type 8793 is operated with process controller function, the position control mentioned in chapter 7. becomes the subordinate auxiliary control circuit; this results in a cascade control. The process controller in the main control circuit of the positioner has a PID function. The process set-point value (*SP*) is specified as set-point value and compared with the actual value (*PV*) of the process variable to be controlled. The position measuring system records the current position (*POS*) of the pneumatic actuator. The position controller compares this actual position value with the set-point value (*CMD*), which is determined by the process controller. If there is a control difference (Xd1), the actuator is aerated and deaerated via the control system. In this way the position of the actuator is changed until control difference is 0. Z2 represents a disturbance variable.
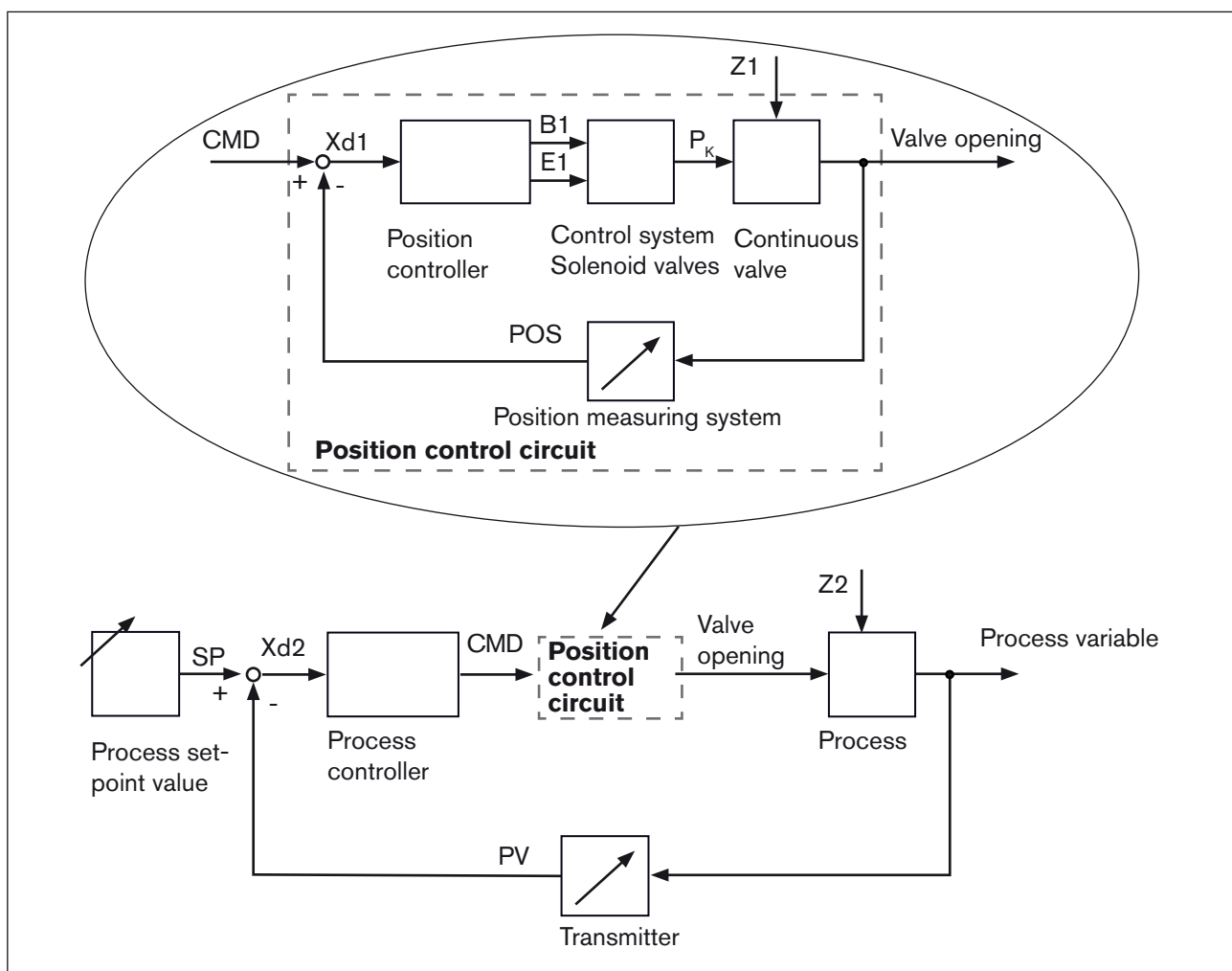

Fig. 5:   Signal flow plan of process controller
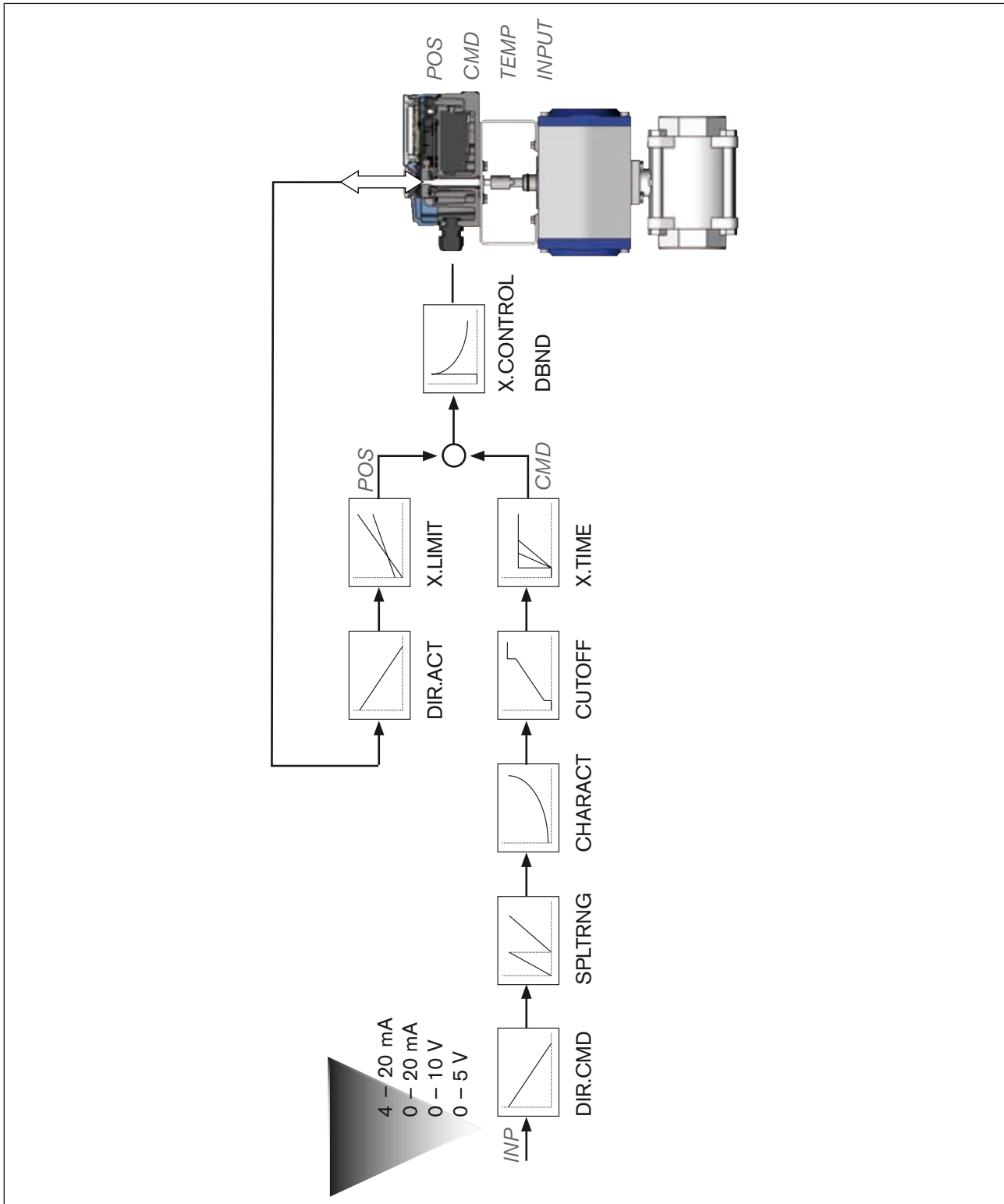
8.1. Schematic representation of process control
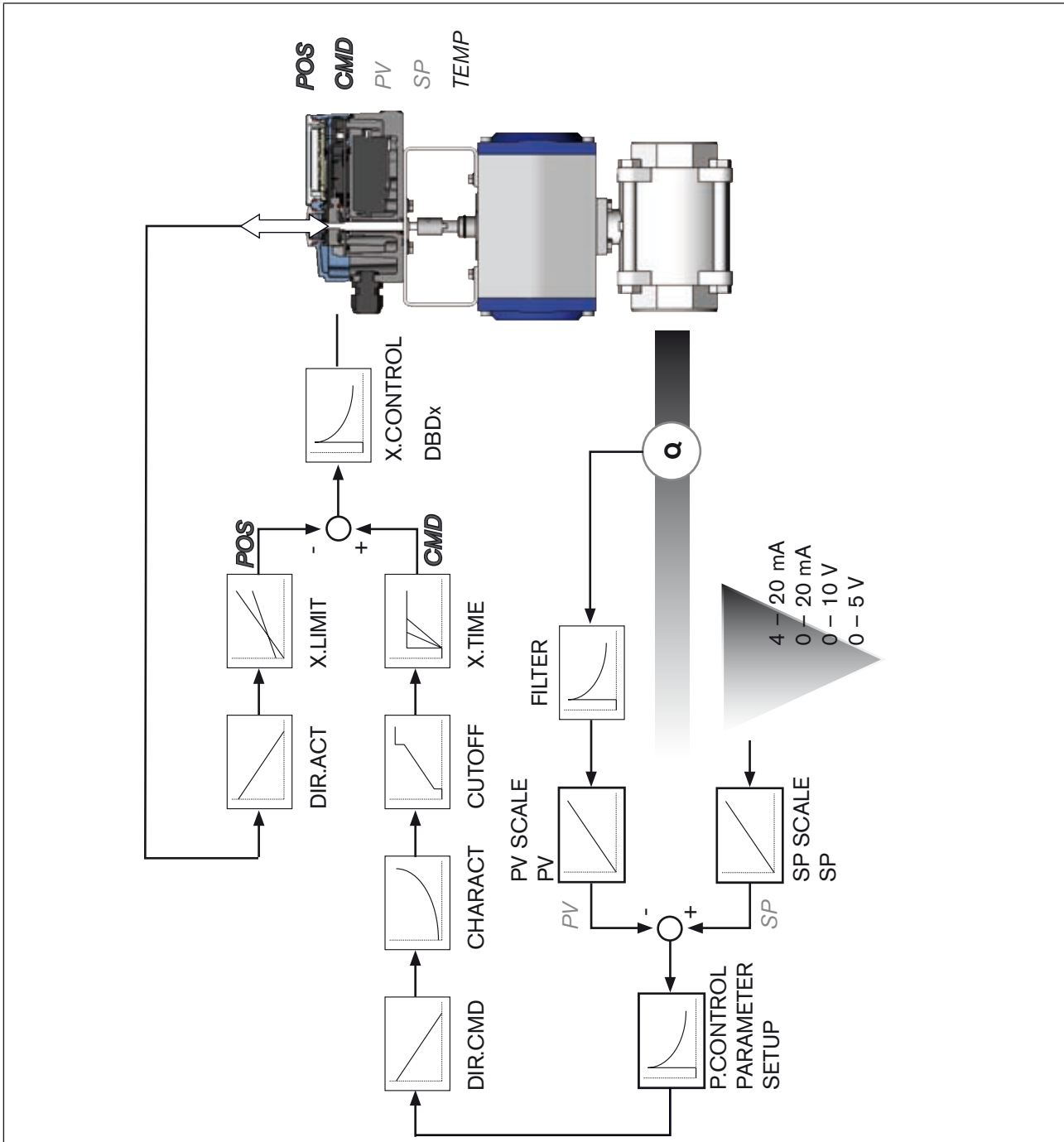
Fig. 6: *Schematic representation of process control*

8.2. Properties of the position controller software

Additional function	Effect
Position controller with additional function	
Correction line to adjust the operating characteristic *CHARACT*	The process characteristic can be linearized
Sealing function *CUTOFF*	Valve closes tight outside the control range. Specification of the value (in %), from which the actuator is completely deaerated (when 0%) or aerated (when 100%).
Effective sense of direction of the controller set-point value *DIR.CMD*	Reversal of the effective sense of direction of the set-point value
Effective directional sense of the actuator drive *DIR.ACT*	Adjustment of the effective sense of direction between aeration state of the actuator and the actual position
Stroke limit *X.LIMIT*	Mechanical valve piston movement only within a defined stroke range
Limiting the control speed *X.TIME*	Input of the opening and closing time for the entire stroke
Insensitivity range *X.CONTROL*	The position controller is initially actuated from a control difference to be defined
Safety position *SAFEPOS*	Definition of the safety position
Signal level error detection *SIG.ERROR*	Check the input signals for sensor break. Warning output on the display and start up of the safety position (if selected)
Binary input *BINARY. IN*	Switch over AUTOMATIC-MANUAL or Start up of the safety position
Analogue feedback and/or binary outputs (option) *OUTPUT*	Status signal set-point or actual value Output of 2 configurable binary signals
User calibration *CAL.USER*	Change to the factory calibration of the signal input

Table 4: Properties of the process controller software. Position controller with additional function

Process controller with the following setting options	
Process controller *P.CONTROL*	PID - Process controller is activated
Adjustable parameters *P.CONTROL - PARAMETER*	Parameterization of the process controller Proportional coefficient, reset time, hold-back time and operating point
Scalable inputs *P.CONTROL - SETUP*	Configuration of the process controller - Selection of the sensor input - Scaling of process actual value and process set-point value Selection of the set-point value defaults
Automatic sensor detection or manual sensor setting *P.CONTROL - SETUP - PV INPUT*	Sensor types Pt100 and 4 – 20 mA are automatically detected or can be set manually via the operating menu
Selection of the nominal value specification *P.CONTROL - SETUP - SP INPUT*	Set-point value specification either via uniform signal input or via keys
Process characteristic linearization *P.Q'LIN*	Function for automatic linearization of the process characteristics
Process controller optimization *P.TUNE*	Function for automatic optimization of the process controller parameters

Table 5:   Properties of the process controller software. Properties of process controller.

Hierarchical **control concept for easy control on the following levels**	
Process control	On this level switch between AUTOMATIC and MANUAL mode.
Configuration and Parameterization	On this level specify certain basic functions during start-up and, if required, configure additional functions

Table 6:   Properties of the process controller software. Hierarchical control concept

9.   INTERFACES OF THE POSITIONER

Inputs for position or
process set-point value
4 – 20 mA
0 – 20 mA
0 – 10 V
0 – 5 V

Input for process
actual value*
4 – 20 mA
frequency
Pt 100

Binary input

24 V DC

Positioner

Inputs

Supply

Outputs

Operation

2 binary outputs
24 V PNP

Initiator 1 / Initiator 2
24 V PNP NO

Analogue feedback
4 – 20 mA
0 – 10 V

Note:
Optional inputs and outputs are illustrated by dotted lines
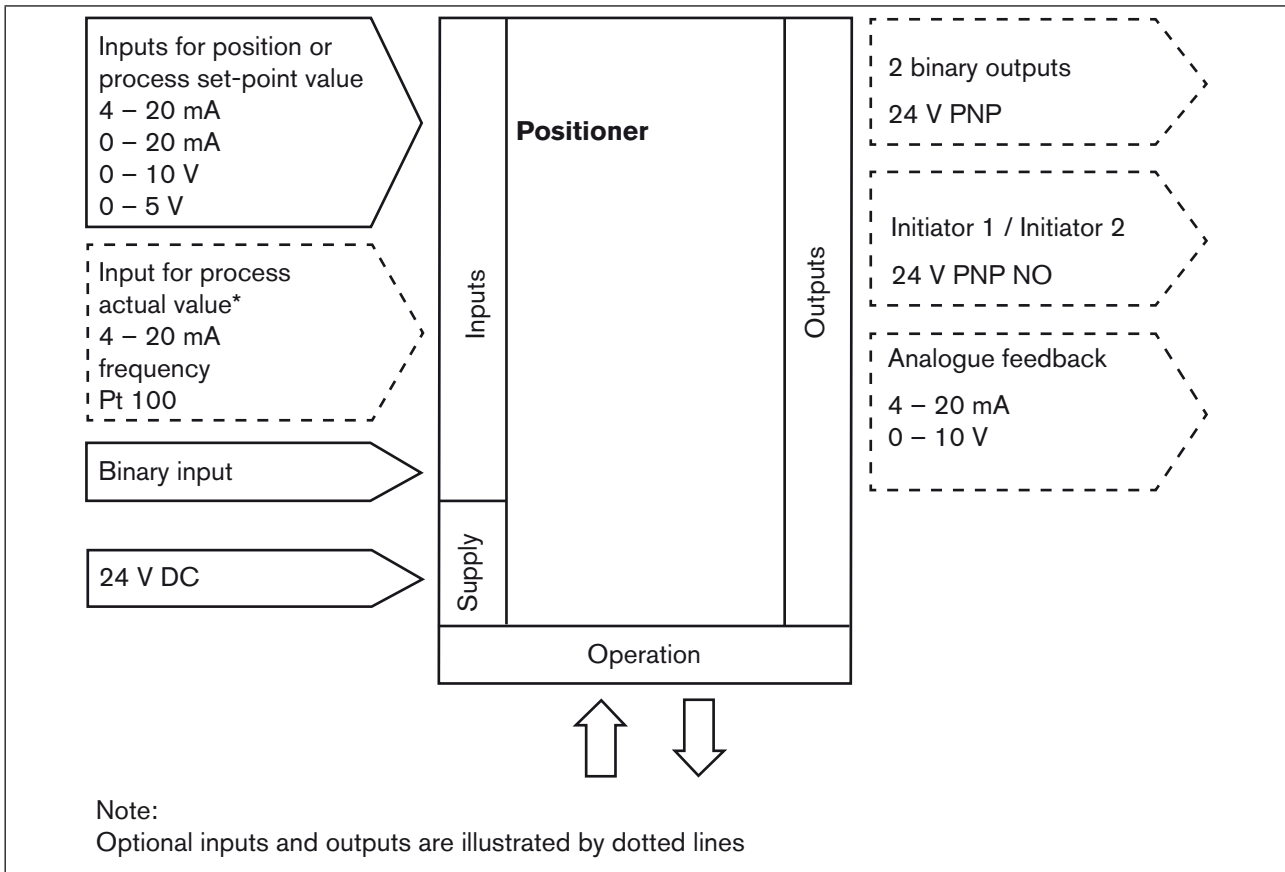
Fig. 7:   Interfaces of the positioner

The positioners Type 8792 and Type 8793 are 3-wire devices, i.e. the power (24 V DC) is supplied separately from the set-point value signal.

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* only for process controller Type 8793

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10. TECHNICAL DATA

10.1. Safety positions after failure of the electrical or pneumatic auxiliary power

In single-acting actuators the safety position depends on the fluid connection of the drive to the working connections A1 or A2 (see *Fig. 8:* and *Fig. 9:*)
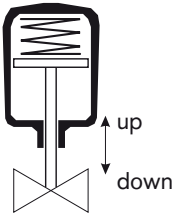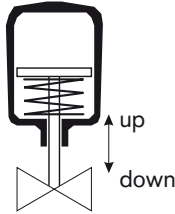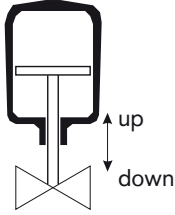
Actuator system	Designation	Safety positions after failure of the auxiliary power	
		electrical	pneumatic
up down	single-acting Control function A	Connection according to *Fig. 8:* down — Connection according to *Fig. 9:* up	down
up down	single-acting control function B	Connection according to *Fig. 8:* up — Connection according to *Fig. 9:* down	up
up down	double-acting Control function I	down / up (depending on the connection of the control cables)	not defined

Table 7:   Safety Positions

Fig. 8:   Connection A1

Sealing working connection 2

Fig. 9:   Connection A2

Sealing working connection 1
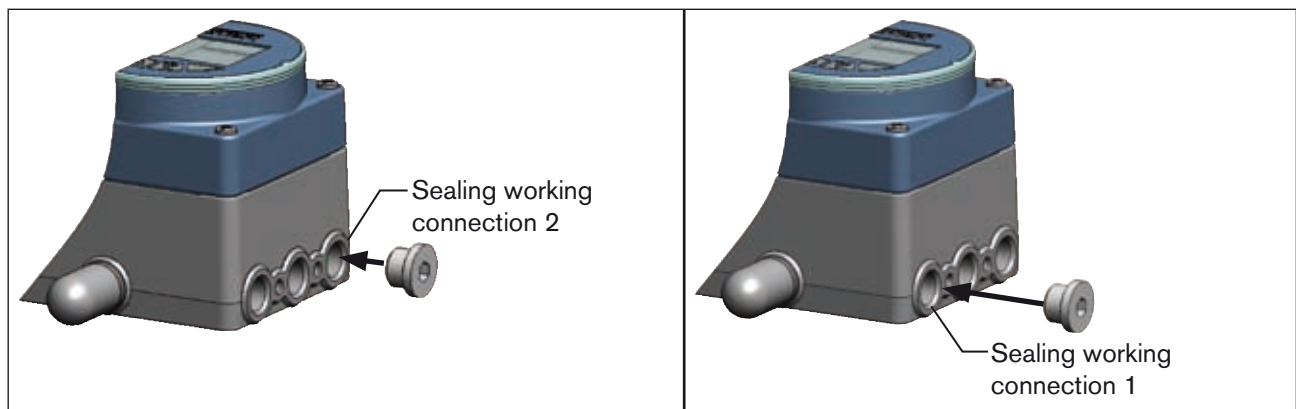
10.2.   Factory settings of the positioner

Function	Factory setting	Function	Factory setting
INPUT	4 – 20 mA	X.CONTROL	
		DBND	1.0%
CHARACT	linear	KXopn	(1) Values of X.TUNE determined
		KXcls	(1) Values of X.TUNE determined
DIR.CMD	Rise	After running SET.FACTORY: 1	
CUTOFF	Min 0% Max 100%	SECURITY Access Code 1	0000
DIR.ACT	Rise	SAFEPOS	0%
SPLTRNG	Min 0% Max 100%	SIG.ERROR SP/CMD Input	Error off
X.LIMIT	Min 0% Max 100%	P.CONTROL	
		PARAMETER	
X.TIME		DBND	1.0%
Open	(1s) Values of X.TUNE determined	KP	1.00
Close	(1s) Values of X.TUNE determined	TN	999.9
After running SET.FACTORY: 1s		TV	0.0
		X0	0.0%
OUTPUT		FILTER	0
OUT ANALOG	Out POS	SETUP	
	OUT type 4 – 20 mA	SP-INPUT	internal
OUT BIN1	Out DEV.X	PV-INPUT	4 – 20 mA
	Lim. DEV.X 1.0%	PV SCALE	PVmin 0.0
	OUT.BIN1 type normally open	PV SCALE	PVmax 100.0
OUT BIN2	Out DEV.X Lim. DEV.X 1.0%	P.CO-INIT	bunpless
	OUT.BIN1 type normally open		
BINARY. IN	SafePos		
BIN. IN type	normally open		

Table 8:   Factory settings

10.3. Specifications of the Positioner

10.3.1. Operating Conditions

NOTE!

If used outside, the device may be exposed to direct sunlight and temperature fluctuations which may cause malfunctions or leaks!

- If the device is used outdoors, do not expose it unprotected to the weather conditions.

- Ensure that the permitted ambient temperature does not exceed the maximum value or drop below the minimum value.

Environmental temperature	0 − +60 **°C**
Protection class	IP 65 / IP 67* according to EN 60529 (only if cables, plugs and sockets have been connected correctly) * If the positioner is used under IP 67 conditions, the ventilation filter (see *Fig. 1:Structure, positioner type 8792 / 8793*) must be removed and the exhaust air conducted into the dry area.

10.3.2. Conformity

CE mark conforms to EMC Directive 2004/108/EC (until now: 89/336/EMC)
(only if cables, plugs and sockets have been connected correctly)

10.3.3. Mechanical data

Dimensions	See data sheet
Material	
Housing material	Plastic-coated aluminium
Other external parts	Stainless steel (V4A), PC, PE, POM, PTFE
Sealing material	EPDM, NBR, FKM
Mass	approx. 1.0 kg

10.3.4. Electrical data

Connections	2 cable bushings (M20 x 1.5) with screw-type terminals 0.14 − 1.5 mm^2 or multi-pole plug
Power supply	24 V DC ± 10% max. residual ripple 10%
Power consumption	< 5 W

Input data for actual value signal

4 − 20 mA:	Input resistance	180 Ω
	Resolution	12 bit

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Frequency:	Measuring range	0 – 1000 Hz
	Input resistance	17 kΩ
	Resolution	1‰ of the measured value,
	Input signal	> 300 mV_{ss}
	Signal form Sine, rectangle, triangle	

Pt 100	Measuring range	-20 – +220 °C,
	Resolution	< 0.1 °C,
	Measurement current	< 1 mA

Input data for set-point value signal

| 0/4 – 20 mA: | Input resistance | 180 Ω |
| | Resolution | 12 bit |

| 0 – 5/10 V: | Input resistance | 19 kΩ |
| | Resolution | 12 bit |

| Protection class | 3 in accordance with VDE 0580 |

Analogue feedback

| max. current | 10 mA (for voltage output 0 – 5/10 V) |

| Burden (load) | 0 – 560 Ω (for current output 0/4 – 20 mA) |

| Inductive proximity switches | 100 mA current limit |

| Binary outputs | galvanically isolated |

| Current limiting | 100 mA, output is clocked if overload occurs |

Binary input	Galvanically isolated
	0 – 5 V = log "0", 10 – 30 V = log "1"
	inverted input in reverse order
	(input current < 6 mA)

10.3.5. Pneumatic data

| Control medium | Quality classes in accordance with DIN ISO 8573-1 |

| Dust content | Class 5, max. particle size 40 µm, max. particle density 10 mg/m³ |

| Water content | Class 3, max. pressure dew point - 20 °C or min. 10 degrees below the lowest operating temperature |

| Oil content | Class 5, max. 25 mg/m³ |

| Temperature range of compressed air | 0 – +60 °C |

| Pressure range | 1.4 – 7 bar |

Air flow rate	95 l_N / min (at 1.4 bar*) for aeration and deaeration
	150 l_N / min (at 6 bar*) for aeration and deaeration
	(Q_{Nn} = 100 l_N / min (according to definition for pressure drop from 7 to 6 bar absolute)).

| Connections | Internal thread G1/4" |

* *Pressure specifications: Overpressure with respect to atmospheric pressure*

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Control and display elements, operating modes

CONTENTS

11.   CONTROL AND DISPLAY ELEMENTS

The following chapter describes the control and display elements of the positioner.

Further information on the control of the positioner can be found in the chapters entitled "*Installation*", "*Start-up and operation of the position controller Type 8792*" and *"Start-up and operation of the position controller Type 8793"*.

11.1.   Control and display elements of the positioner
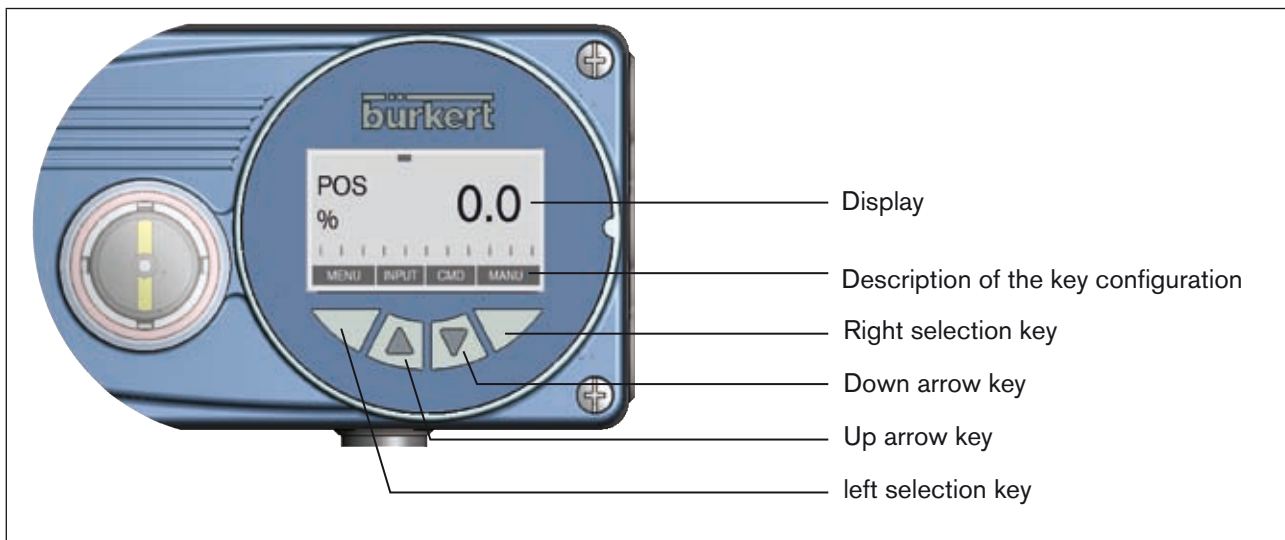

Fig. 10:   Description of the control module

The positioner features a 4-key control panel and a 128x64 dot matrix graphics display as a display element.

11.2. Configuration of the keys

The assignment of the 4 keys on the control panel differs depending on the operating status (AUTOMATIC / MANUAL) or operating level (Operate process / Parameterization and Configuration) of the positioner.

The configuration of the keys is represented in the lower grey bar on the display panel.

> The description of the operating statuses (AUTOMATIC / MANUAL) and the operating levels (Operate process / Parameterization and Configuration) can be found in the chapters entitled "*12.Operating modes*" and "*13.Operating levels*".

Key	Configuration (indicated in the lower bar)	Operating status / Operating level
Up / down arrow key	Change the display (e.g. *POS-CMD-TEMP-...*)	AUTOMATIC / Operate process
	OPN - CLS (OPEN - CLOSE) manual opening and closing of the actuator	MANUAL / Operate process
	Scroll up and down the menus	AUTOMATIC or MANUAL / Parameterization or Configuration
	+ and - increase or reduce numerical values	AUTOMATIC or MANUAL / Parameterization or Configuration
	+ and ← adjust numerical values by individual digits	AUTOMATIC or MANUAL / Parameterization or Configuration
left selection key	Switch to the Parameterization level (MENU) Note: the key must be pressed for approx. 3 s. (countdown: 2 bars converge on the display panel)	AUTOMATIC or MANUAL / Operate process
	EXIT (BACK) Operate process on the operating level	AUTOMATIC or MANUAL / Parameterization
	EXIT (BACK) from a menu option on the operating level Parameterization or Configuration	AUTOMATIC or MANUAL / Parameterization or Configuration
	ESC Leave a menu	AUTOMATIC or MANUAL / Parameterization or Configuration
	STOP End a sequence	AUTOMATIC or MANUAL / Parameterization or Configuration
right selection key	Switch between AUTOMATIC and MANUAL mode	Operate process
	Select, activate or deactivate a menu option (ENTER, SELEC, OK, INPUT)	AUTOMATIC or MANUAL / Parameterization or Configuration
	EXIT (BACK) from a menu option on the operating level Parameterization or Configuration	AUTOMATIC or MANUAL / Parameterization or Configuration
	RUN Start a sequence	AUTOMATIC or MANUAL / Parameterization or Configuration
	STOP End a sequence	AUTOMATIC or MANUAL / Parameterization or Configuration

Table 9: Button configuration

11.3. Information on the display

The following representation describes the information on the display:

Display for AUTOMATIC mode:
bar runs from left to right

Description of the value

Unit or percentage of the value

POS
%
0.0

Value

Bar graph display of the value

MENU | INPUT | CMD | MANU

Configuration of the keys
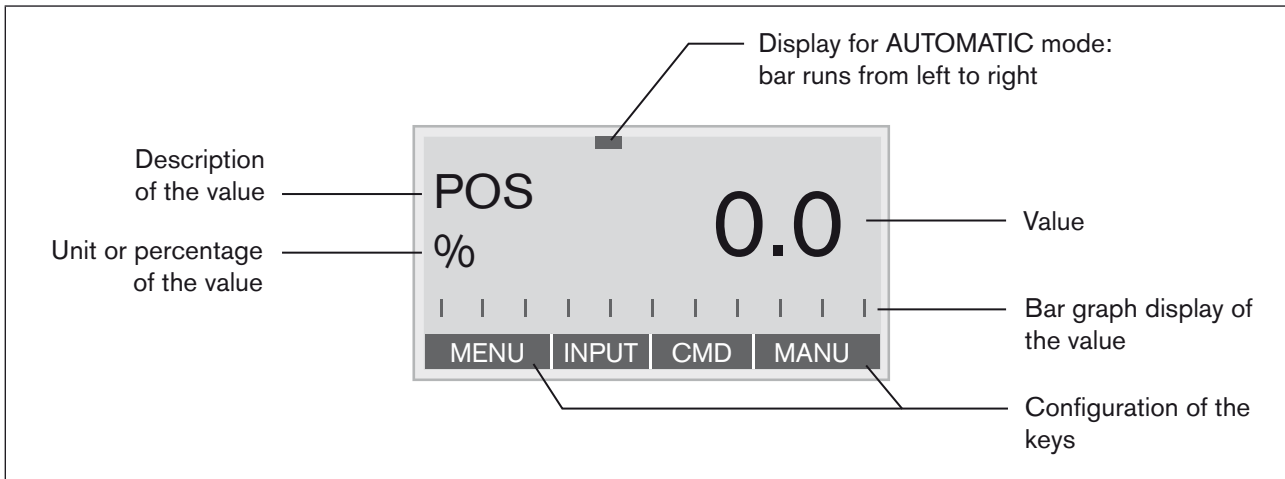
Fig. 11:   Description of display

List of values which can be displayed in AUTOMATIC mode:

Representation of value	Unit, Value range	Description
POS	%	Display of actual position of the valve actuator
CMD	%	Display of nominal position of the valve actuator
TEMP	°C	Internal temperature in the housing of the positioner
INPUT	mA, V	Input signal for nominal position
PV (PROCESS VALUE)	bar, mbar, psi, %, mm, litre l/s, l/min, l/h, m³/min, m³/h, UG/s, UG/min, UG/h, IG/s, IG/min, IG/h °C, °F	Process actual value, 4 – 20 mA input Process actual value, frequency input Process actual value, PT100 input
SP (SETPOINT)	bar, mbar, psi, %, mm, litre l/s, l/min, l/h, m³/min, m³/h, UG/s, UG/min, UG/h, IG/s, IG/min, IG/h °C, °F *	Process set-point value
SP / PV graphic	–	Graphic display: Course of set-point and actual value is displayed graphically.

Table 10:   Representable values in AUTOMATIC mode

*   *Unit depending on process actual value.*

12.   OPERATING MODES

12.1.   Operating state

The positioner has 2 operating states: AUTOMATIC and MANUAL mode.

| | | | | | | | | | |
MENU   MANU

AUTOMATIC   Normal control mode is implemented and monitored in AUTOMATIC operating state.

(A bar runs along the upper edge of the display).

| | | | | | | | | | |
MENU | OPN | CLS | AUTO
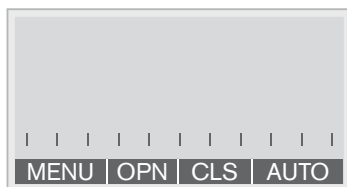
MANUAL   In MANUAL operating state the valve can be opened and closed manually via the arrow key (OPN/CLS).

(No bar running along the upper edge of the display).

The right selection key can be used to switch between the two operating states AUTOMATIC (AUTO) and MANUAL (MANU).

> It is possible to switch from AUTOMATIC to MANUAL mode only on the *POS* and *CMD* displays and also on the *PV* display for Type 8793. On the *SP* display only for external process set-point value (see also chapter "*11.2.Configuration of the keys*").

12.2. AUTOMATIC Operating State for Type 8792

(Bar runs along the upper edge of the display from left to right)

Normal control mode is implemented and monitored in AUTOMATIC operating state.

The arrow keys can be used to switch between the following displays in AUTOMATIC operating state:
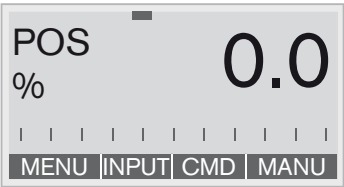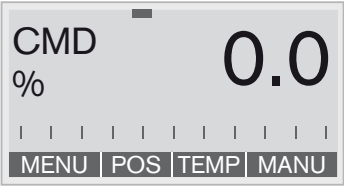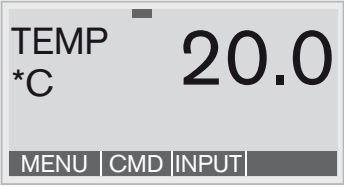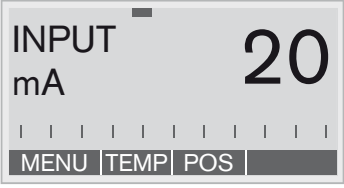
	POS % **0.0** MENU INPUT CMD MANU	Display of actual position of the valve actuator (0 – 100%)
▽	CMD % **0.0** MENU POS TEMP MANU	▪ Display of nominal position of the valve actuator or ▪ Display of nominal position of the valve actuator after rescaling by possibly activated split range function or correction characteristic (0 – 100%)
▽	TEMP *C **20.0** MENU CMD INPUT	Internal temperature in the housing of the positioner (°C)
▽	INPUT mA **20** MENU TEMP POS	Input signal for nominal position (0 – 5/10 V or 0/4 – 20 mA)

Table 11: Automatic Operating State for Type 8792

12.3.   AUTOMATIC Operating State for Type 8793

(Bar runs along the upper edge of the display from left to right)

Normal control mode is implemented and monitored in AUTOMATIC operating state.

If the *P.CONTROL* additional function is activated for Type 8793, it is possible to switch between the following states in AUTOMATIC operating state:

	POS % 0.0 MENU | SP | CMD | MANU	Display of actual position of the valve actuator (0 – 100%)
▽	CMD % 0.0 MENU | POS | TEMP | MANU	▪ Display of nominal position of the valve actuator or ▪ Display of nominal position of the valve actuator after rescaling by possibly activated split range function or correction characteristic (0 – 100%)
▽	TEMP *C 20.0 MENU | CMD | PV	Internal temperature in the housing of the positioner (°C)
▽	PV l/s 0.0 MENU | TEMP | SP | MANU	Process actual value
▽	SP l/s 0.0 MENU | PV | POS | INPUT*	Process set-point value
▽	MENU | SP / PU (t) | HOLD	Display of process actual value and set-point value

Table 12:   Automatic Operating State for Type 8793

> ⚠ If the *P.CONTROL* additional function is not active, the displays are represented as under Type 8792.

*   Here is indicated: - INPUT if the internal set-point value default is selected (*P.CONTROL - SP-INPUT - internal*).
                          - MANU if the external set-point value default is selected (*P.CONTROL - SP-INPUT - external*).

12.4. MANUAL operating state

(no bar running along upper edge of display)

In MANUAL operating state the valve can be opened and closed manually via the arrow keys.

Meaning of the arrow keys in MANUAL operating state:

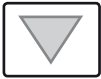|	
	Press the up arrow key: Aerate the actuator Control function A (SFA): Valve opens Control function B (SFB): Valve closes Control function I (SFI): Connection 2.1 aerated
	Press the down arrow key: Deaerate the actuator Control function A (SFA): Valve closes Control function B (SFB): Valve opens Control function I (SFI): Connection 2.2 aerated

Table 13: Meaning of the arrow keys in MANUAL operating state

SFA: Actuator spring force closing

SFB: Actuator spring force opening

SFI: Actuator double-acting

13. OPERATING LEVELS

The menu structure in the control module of the positioner contains 2 operating levels:

Level 1: **Operate process**

Operating mode   AUTOMATIC   →   Process / Input data displayed

MANUAL   →   Actuator opened and closed manually

Level 2: **Parameterization and Configuration**

Input operating parameters

Supplement the menu with optional menu options

13.1. Switching between the operating levels

> If AUTOMATIC operating mode has been set when switching from level 1 (Operate process) to level 2 (Parameterization and Configuration), the process continues running while positioner settings are implemented on level 2.

→ To switch from level 1 (Operate process) to level 2 (Parameterise), press the left selection key (MENU) for approx. 3 seconds. During these 3 seconds (Countdown) 2 bars converge (see *Fig. 12:*).

→ To switch back from level 2 (Parameterise and Configure) to level 1 (Operate process), press the left selection key (EXIT).

Switch to level 2: Parameterization   Switch back to level 1: Operate process

Selection key
on left press for
approx. 3 seconds

2 bars
which converge
Countdown

Press selection key
on left
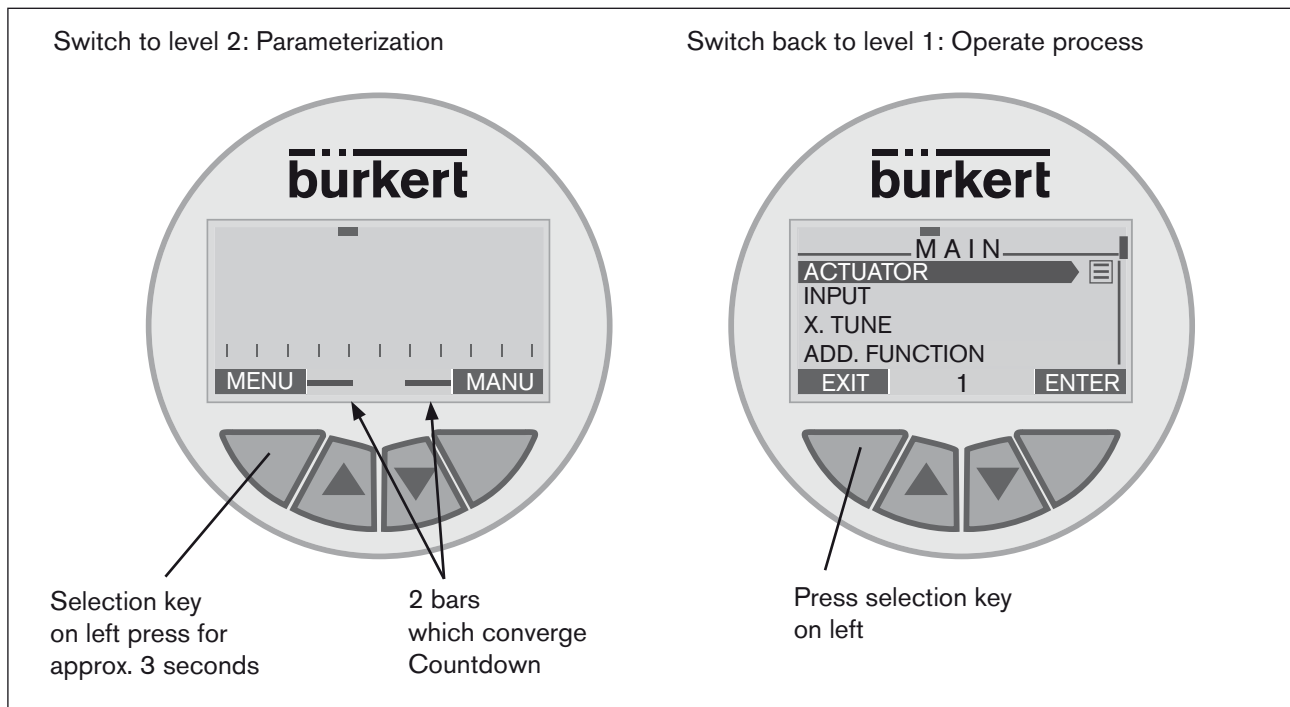
Fig. 12:   witch operating level

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Installation

CONTENTS

14. ATTACHMENT AND ASSEMBLY

> The dimensions of the positioner and the different device versions can be found on the data sheet.

14.1. Safety Instructions:

⚠ WARNING!

Risk of injury from improper installation!

▪ Installation may be carried out by authorised technicians only and with the appropriate tools!

Risk of injury from unintentional activation of the system and an uncontrolled restart!

▪ Secure system from unintentional activation.

▪ Following assembly, ensure a controlled restart.

14.2.   Attachment to a proportional valve with push drives according to NAMUR

The valve position is transferred to the position measuring system installed in the positioner via a lever (according to NAMUR).

14.2.1. Attachment kit for push drives (serial no. 787 215)

(Can be purchased as an accessory from Bürkert).

Part no.	Quantity	Name
1	1	NAMUR mounting bracket IEC 534
2	1	Pick-up bracket
3	2	Clamping piece
4	1	Driver pin
5	1	Conical roller
6a	1	NAMUR lever for stroke range 3 – 35 mm
6b	1	NAMUR lever for stroke range 35 – 130 mm
7	2	U-bolt
8	4	Hexagon bolt DIN 933 M8 x 20
9	2	Hexagon bolt DIN 933 M8 x 16
10	6	Circlip DIN 127 A8
11	6	Washer DIN 125 B8.4
12	2	Washer DIN 125 B6.4
13	1	Spring VD-115E 0.70 x 11.3 x 32.7 x 3.5
14	1	Spring washer DIN 137 A6
15	1	Locking washer DIN 6799 - 3.2
16	3	Circlip DIN 127 A6
17	3	Hexagon bolt DIN 933 M6 x 25
18	1	Hexagon nut DIN 934 M6
19	1	Square nut DIN 557 M6
21	4	Hexagon nut DIN 934 M8
22	1	Guide washer 6.2 x 9.9 x 15 x 3.5

Table 14:   Attachment kit for push drives"

14.2.2. Installation

⚠ **WARNING!**

Risk of injury from improper installation!

- Installation may be carried out by authorised technicians only and with the appropriate tools!

Risk of injury from unintentional activation of the system and an uncontrolled restart!

- Secure system from unintentional activation.

- Following assembly, ensure a controlled restart.

Procedure:

→ Using ② the clamping pieces ③, hexagon bolts ⑰ and circlips ⑯ attach the hoop to the actuator spindle.
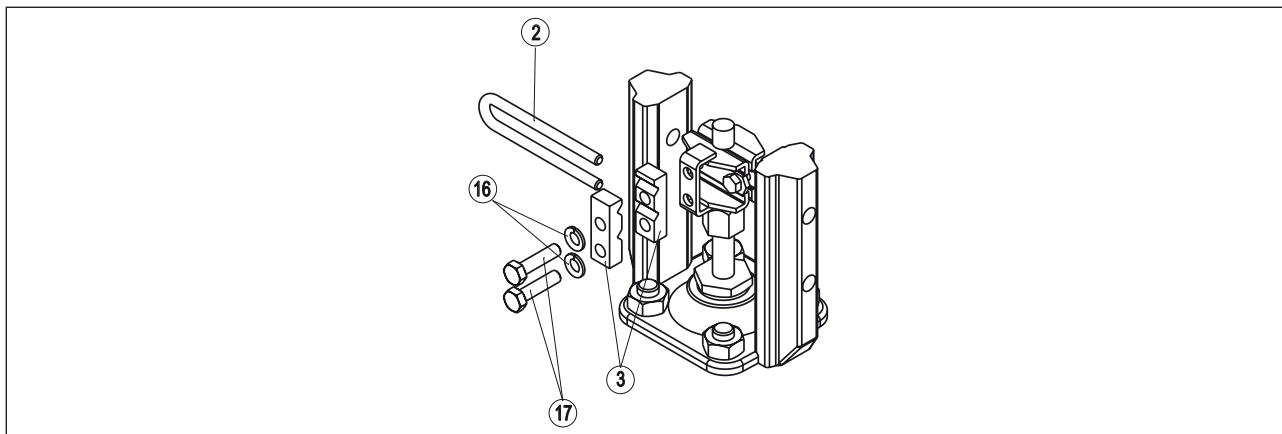
Fig. 13:   Attaching the hoop

→ Select short or long lever according to the stroke of the actuator. (see *Table 14:Attachment kit for push drives"* part no. 6a/6b).).

→ Assemble lever (if not pre-assembled) (*Fig. 14:*).
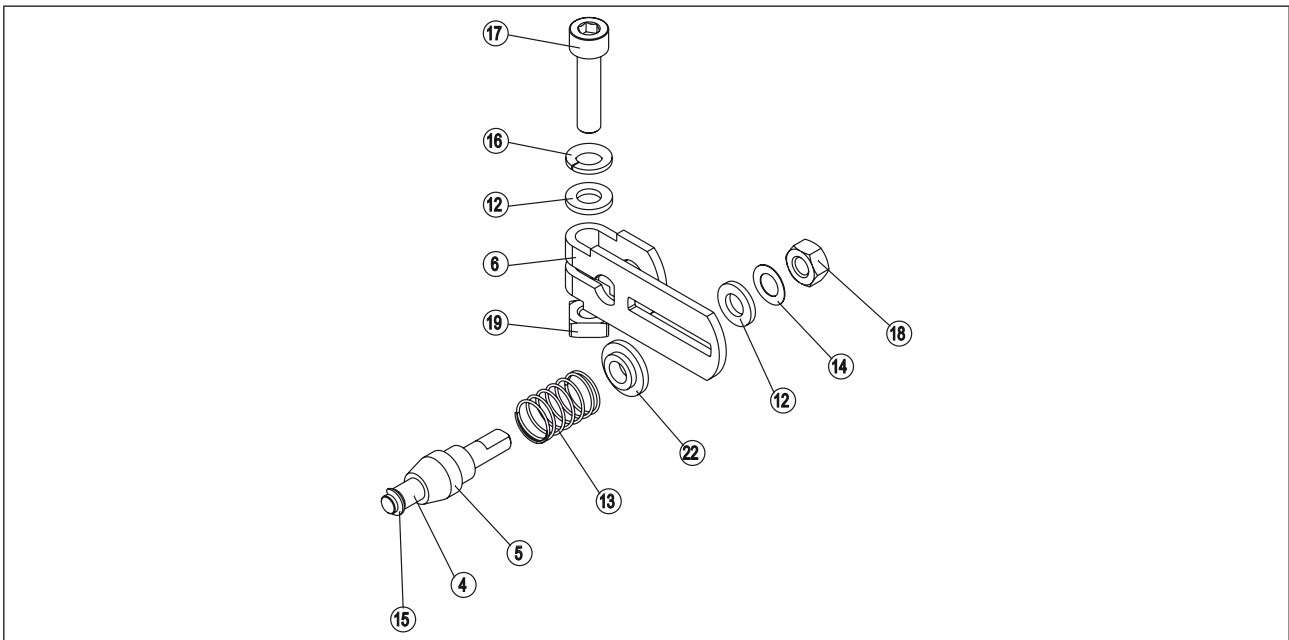
Fig. 14:   Assembling the lever

The gap between the driver pin and the axle should be the same as the drive stroke. As a result, the lever has a swivel range of 60° (see *Fig. 15:*).

Slewing range of the position measuring system:
The maximum slewing range of the position measuring system is 120°.

Swivel range of the lever:
To ensure that the position measuring system operates at a good resolution, the swivel range of the lever must be at least 60°.

The swivel movement of the lever must be within the position measuring system slewing range of 120°.

The scale printed on the lever is not relevant.

The swivel movement of the lever must be within the position measuring system slewing range of 120 °.
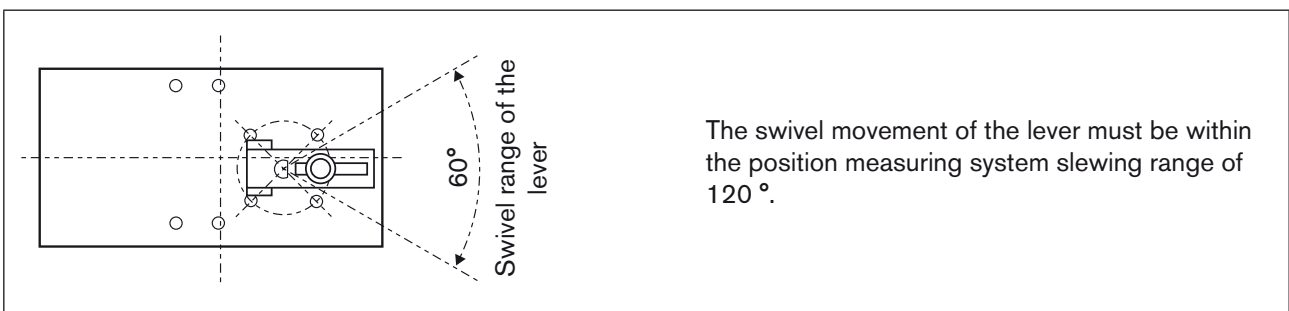
Fig. 15:   Slewing range of the lever

→ Attach lever to the axle of the positioner and screw tight.

14.2.3. Attaching mounting bracket

→ Attach mounting bracket ① to the back of the positioner with hexagon bolts ⑨, circlip ⑩ and washers ⑪ (see *Fig. 16:*).

🛇 The selection of the M8 thread used on the positioner depends on the size of the actuator.

→ To determine the correct position, hold the positioner with mounting bracket on the actuator.

The conical roller on the lever of the position measuring system in the hoop must be able to run freely on the drive over the entire stroke range.
At 50% stroke the lever position should be approximately horizontal (see chapter *14.2.4.Aligning lever mechanism*).
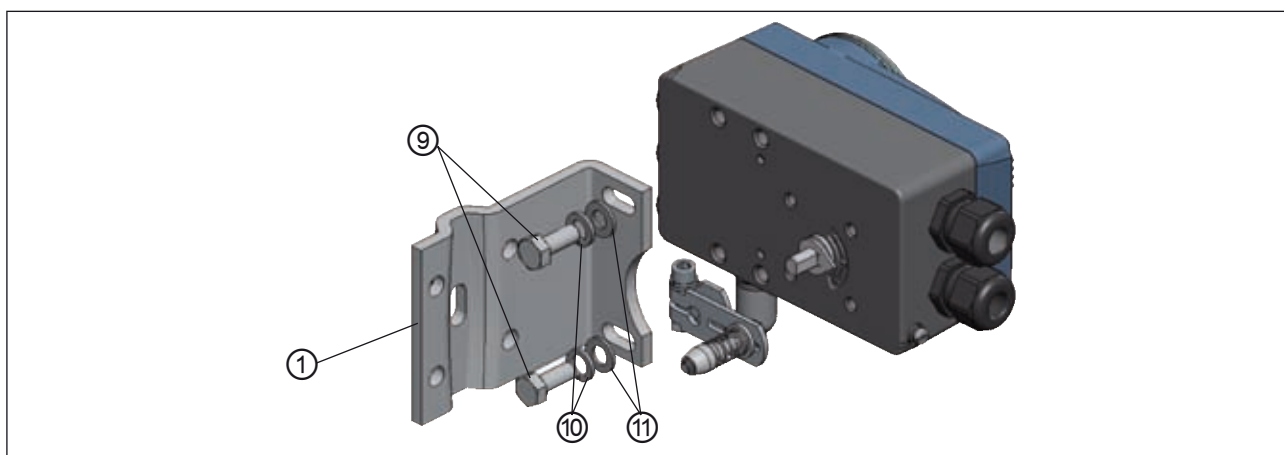
Fig. 16:   Attaching mounting bracket

Attaching the positioner with mounting bracket for actuators with cast frame:

→ Attach mounting bracket to the cast frame with one or more hexagon bolts ⑧, washers ⑪ and circlips ⑩ (see *Fig. 17:*).
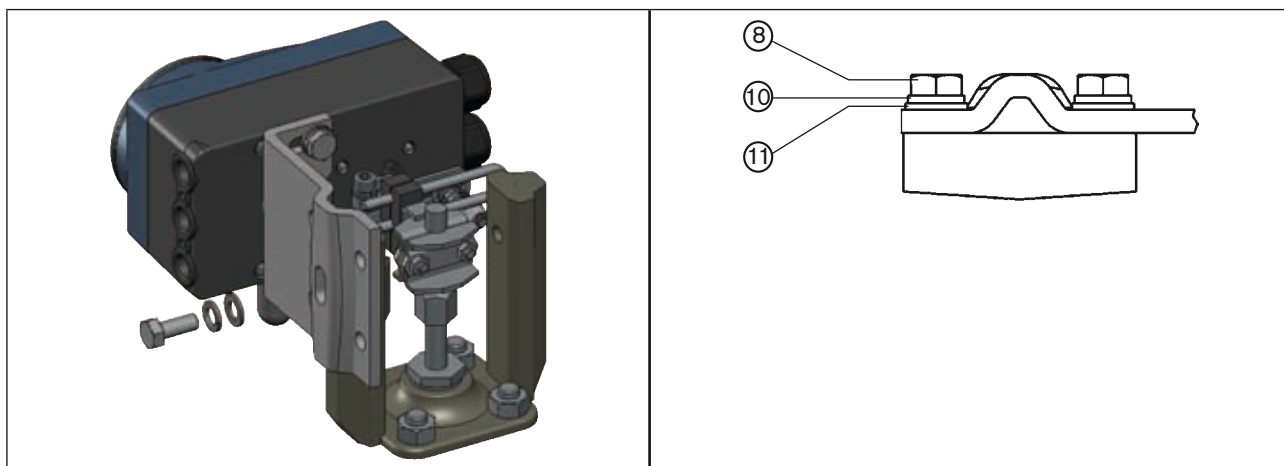
Fig. 17:   Attach positioner with mounting bracket; for actuators with cast frame

Attaching the positioner with mounting bracket for actuators with columnar yoke:

→ Attach mounting bracket to the columnar yoke with the U-bolt ⑦, washers ⑪, circlips ⑩ and hexagon nuts ㉑ (see *Fig. 18:*).
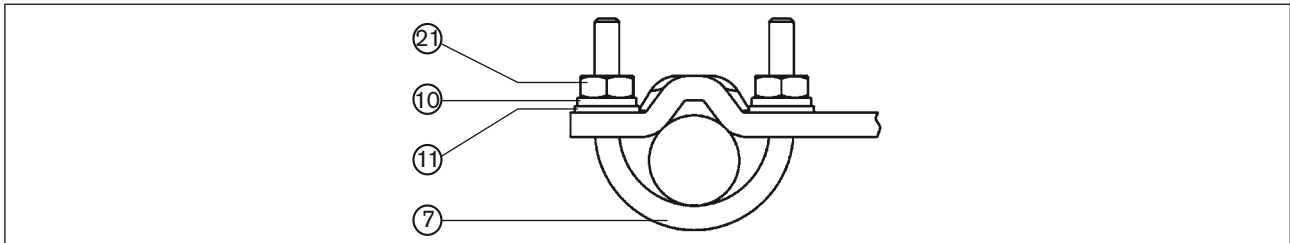
Fig. 18:   Attach positioner with mounting bracket; for actuators with cast frame

14.2.4. Aligning lever mechanism

⚠ The lever mechanism cannot be correctly aligned until the device has been connected electrically and pneumatically.

→ Move the actuator in manual mode to half stroke (according to the scale on the actuator).

→ Adjust the height of the positioner until the lever is horizontal.

→ Fix the positioner in this position on the actuator.

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14.3. Attachment to a proportional valve with swivel actuator

The axle of the position measuring system integrated in the positioner is connected directly to the axle of the swivel actuator.

14.3.1. Mounting kit on swivel actuator (part no. 787338)

(Can be purchased as an accessory from Bürkert).

Part no.	Quantity	Name
1	1	Adapter
2	2	Setscrew DIN 913 M4 x 4
3	4	Cheese-head screw DIN 933 M6 x 12
4	4	Circlip B6

Table 15: Mounting kit on swivel actuator

Other accessories:

The mounting bracket with fastening screws (in accordance with VDI/VDE 3845) must be purchased from the manufacturer of the swivel actuator.

14.3.2. Installation

⚠ **WARNING!**

Risk of injury from improper installation!

▪ Installation may be carried out by authorised technicians only and with the appropriate tools!

Risk of injury from unintentional activation of the system and an uncontrolled restart!

▪ Secure system from unintentional activation.

▪ Following assembly, ensure a controlled restart.

Procedure:

→ Specify the attachment position of the positioner:
  - parallel to the actuator or
  - rotated by 90° to the actuator.

→ Determine home position and direction of rotation of the actuator.

→ Connect adapter to the axle of the positioner and secure with 2 setscrews.

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Anti-twist safeguard:

Note the flat side of the axle!
One of the setscrews must be situated on the flat side of the axle as an anti-twist safeguard
(see *Fig. 19:*).

Slewing range of the position measuring system:

The maximum slewing range of the position measuring system is 120**°**.
The axle of the positioner may be moved within this range only.

90°

Swivel range of the positioner

The swivel movement of the positioner must be within the position measuring system slewing range of 120**°**.

Flattened axle
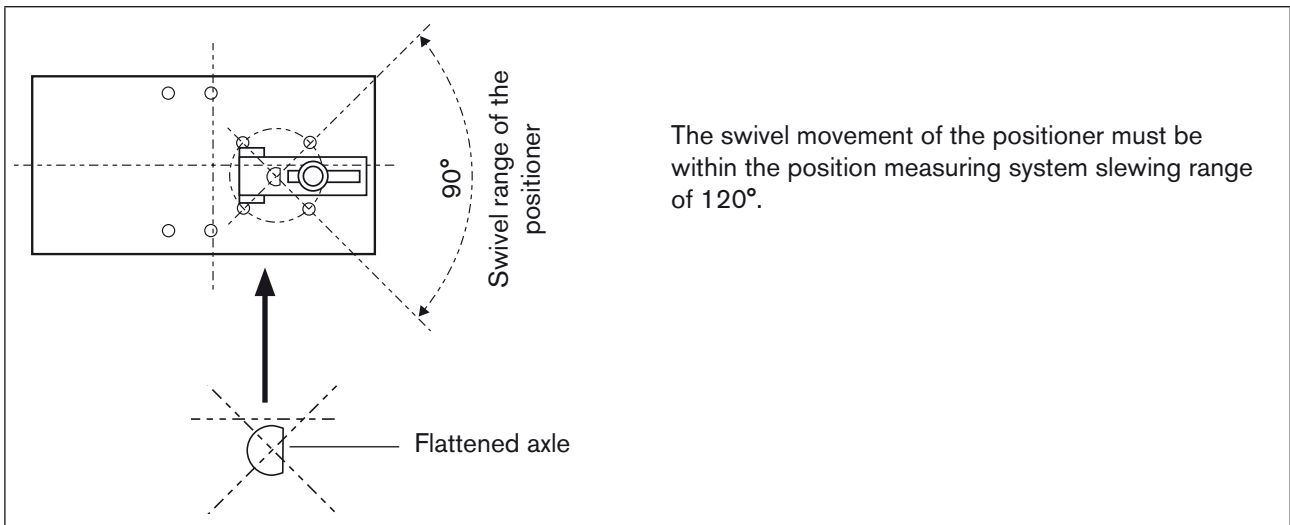
Fig. 19:   lewing range / anti-twist safeguard

→ Place positioner on mounting bracket and attach with 4 cheese-head screws ③ and circlips ④
   (see *Fig. 20:*).

④

③
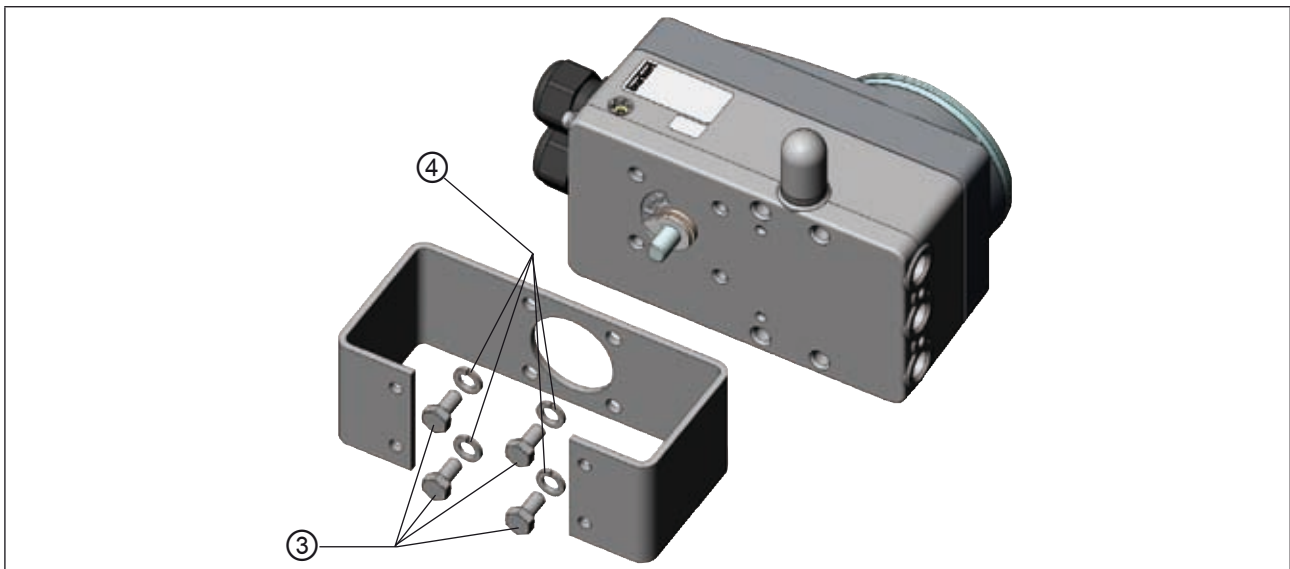
Fig. 20:   Attaching mounting bracket

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→ Place positioner with mounting bracket on the swivel actuator and attach (see *Fig. 21:*
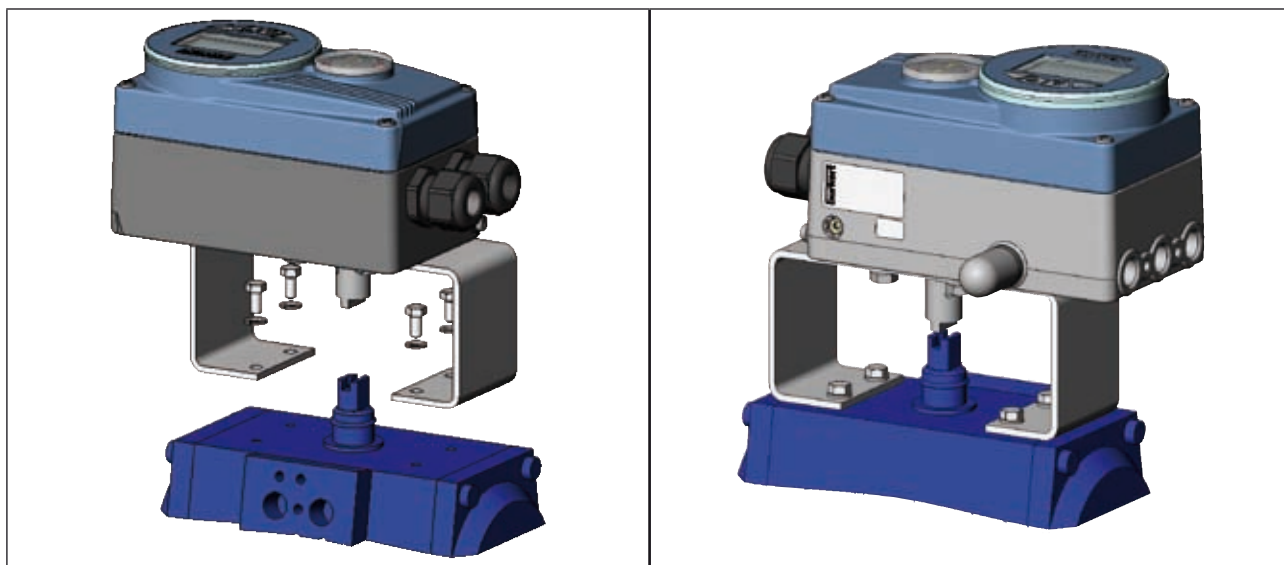
Fig. 21:   Swivel actuator attachment

> ⚠ If the X.TUNE ERROR 5 message is indicated on the graphics display after the *X.TUNE* function starts, the axle of the positioner is not correctly aligned with the axle of the actuator
> (see in chapter *Error and warning messages while the X.TUNE function is running*).
>
> ▪ Check alignment (as described previously in this chapter).
>
> ▪ Then repeat the *X.TUNE* function.

14.4. Remote operation with external position measuring system

In the case of this model the positioner has no position measuring system in the form of a rotary position sensor, but an external remote sensor.

Either the remote sensor type 8798 can be connected via a serial, digital interface or any high-resolution path sensor can be connected via a 4 – 20 mA interface.

14.4.1. Mounting accessories

There are two options of attaching the positioner in remote operation (see *Fig. 22:*).

Installation on a DIN rail with accessory kit, part no. 675702	Installation on a wall with accessory kit, part no. 675715
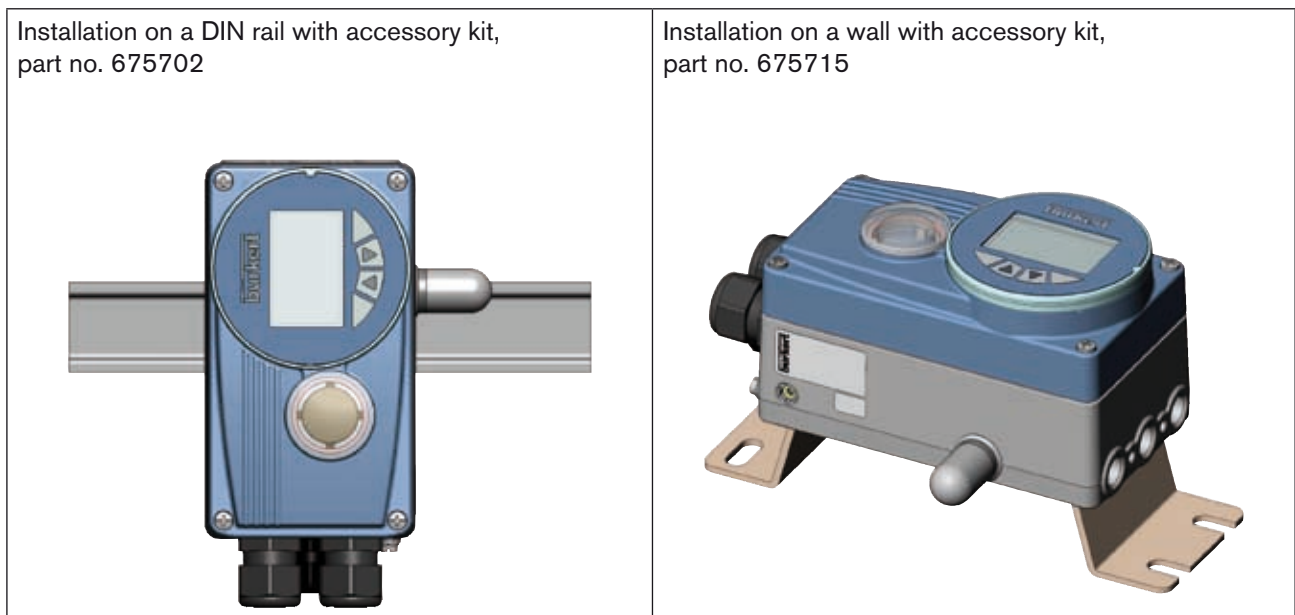
Fig. 22:   Attachment types in remote operation

14.4.2. Connection and start-up of the Remote Sensor Type 8798

⚠ **WARNING!**

Risk of injury from improper start-up!

▪ Start-up may be carried out by authorised technicians only and with the appropriate tools!

Risk of injury from unintentional activation of the system and an uncontrolled restart!

▪ Secure system from unintentional activation.

▪ Following assembly, ensure a controlled restart.

→ Connect the 4 wires of the sensor cable to the designated screw-type terminals of the positioner (see chapter *17.2.4.Connecting the external position measuring system (for remote model only)*).

→ Attach remote sensor on the actuator.
  The correct procedure is described in the brief instructions for the remote sensor.

→ Connect compressed air to positioner.

→ Connect positioner pneumatically to the actuator.

→ Switch on power supply to the positioner.

→ Run the *X.TUNE* function.

14.4.3. Connection and start-up via a 4 – 20 mA path sensor (for type 8793 remote model only)

> When a 4 – 20 mA path sensor is connected, the process controller type 8793 can be used as a position controller only, as the process actual value input is used as input for the path sensor.

In principle, any path sensor with a 4 – 20 mA output can be connected which has an adequate resolution of the path signal.

Good control properties are obtained if the resolution of the path sensor allows at least 1000 measuring steps over the path to be measured.

Example: Path sensor with 150 mm measurement range
             Of which used measurement range (= stroke) 100 mm

Required minimum resolution of the sensor:

$$\frac{100 \text{ mm}}{1000 \text{ Steps}} = 0.1 \text{ mm}$$

⚠ WARNING!

Risk of injury from improper start-up!

▪ Start-up may be carried out by authorised technicians only and with the appropriate tools!

Risk of injury from unintentional activation of the system and an uncontrolled restart!

▪ Secure system from unintentional activation.

▪ Following assembly, ensure a controlled restart.

Connect 4 – 20 mA path sensor to the terminals 1 - 4 of the process controller type 8793 remote model.
(see chapter *17.3.1.*, *Table 25:Terminal assignments of the process actual value input* / row 1 or 3).

→ Attach path sensor to the drive.
   The correct procedure is described in the instructions for the path sensor.

→ Connect compressed air to the process controller type 8793.

→ Connect process controller type 8793 pneumatically to the drive

→ Switch on positioner power supply.

→ To obtain the best possible control precision, adjust the path sensor so that path to be measured corresponds to the signal range 4 – 20 mA (only if the path sensor includes this function).

→ In the menu activate the *POS.SENSOR* function via *ADDFUNCTION* and set to *ANALOG*.
   (see chapter *POS.SENSOR*).

→ Run the *X.TUNE* function.

15.   FLUID CONNECTION

15.1.   Safety instructions

⚠ **DANGER!**

Risk of injury from high pressure in the equipment!

▪ Before loosening the lines and valves, turn off the pressure and vent the lines.

⚠ **WARNING!**

Risk of injury from improper installation!

▪ Installation may be carried out by authorized technicians only and with the appropriate tools!

Risk of injury from unintentional activation of the system and an uncontrolled restart!

▪ Secure system from unintentional activation.

▪ Following installation, ensure a controlled restart.
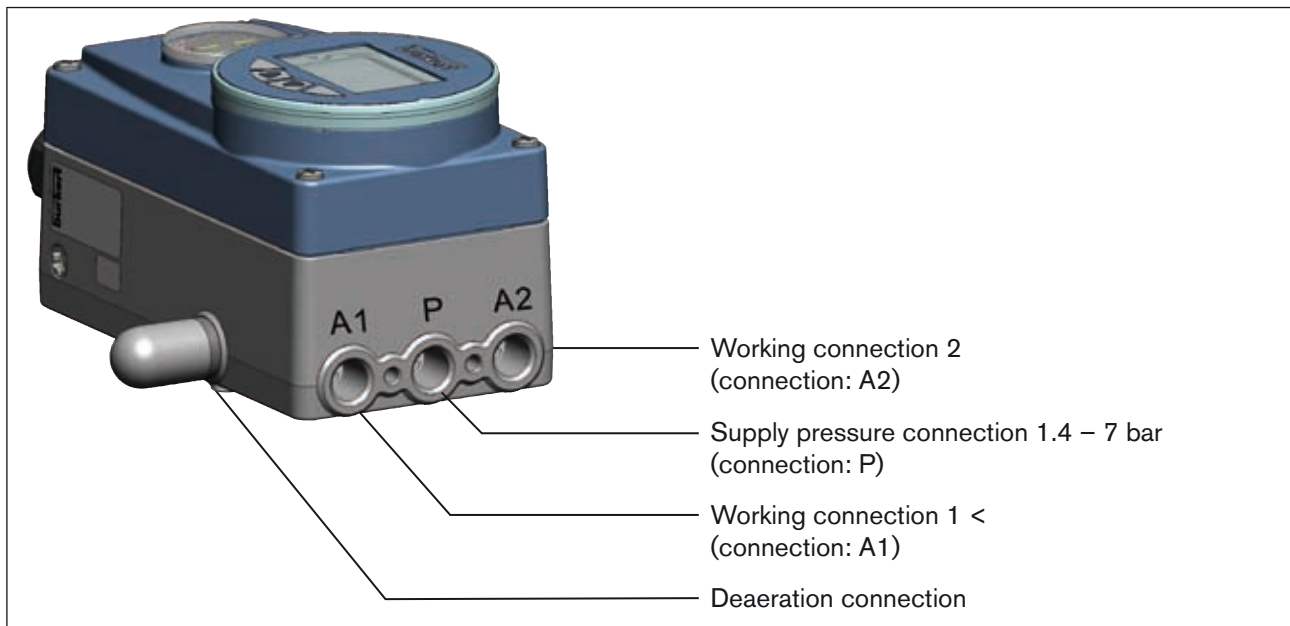
Fig. 23:   Fluid installation / Location of the connections

Procedure:

→ Apply supply pressure (1.4 – 7 bar) to the supply pressure connection P.

For single-acting actuators:

→ Connect one working connection (A1 or A2, depending on required safety position) to the chamber of the single-acting actuator.
  Safety positions see chapter *10.1.Safety positions after failure of the electrical or pneumatic auxiliary power*).

→ Seal a working connection which is not required with a plug.

For double-acting actuators:

→ Connect working connections A1 and A2 to the respective chambers of the double-acting actuator.

> **Important information for perfect control behaviour!**
>
> This ensures that the control behaviour is not extremely negatively affected in the upper stroke range on account of too little pressure difference.
>
> ▪ keep the applied supply pressure at least 0.5 – 1 bar above the pressure which is required to move the pneumatic actuator to its end position.
>
> If fluctuations are greater, the control parameters measured with the *X.TUNE* function are not optimum.
>
> ▪ during operation keep the fluctuations of the supply pressure as low as possible (max. ±10%).

16.2.   Connection of the position controller Type 8792

16.2.1. Input signals of the control centre (e.g. PLC) - M12, 8-pole plug

Pin	Wire colour*	Configuration	External circuit / Signal level
1	white	Set-point value + (0/4 – 20 mA or 0 – 5/10 V	1 ○———— + (0/4 – 20 mA or 0 – 5 / 10 V) completely galvanically isolated
2	brown	Set-point value GND	2 ○———— GND
5	grey	Binary input	5 ○———— + < 0 – 5 V (log. 0) / 10 – 30 V (log. 1)
6	pink	Binary input GND	6 ○———— GND
* The indicated wire colours refer to the connection cable, part no. 919061, available as an accessory.				

Table 16:   Pin assignment; input signals of the control centre - M12, 8-pole plug

16.2.2. Output signals to the control centre (e.g. PLC) - M 12, 8-pole plug (required for analogue output option only)

→ Connect pins according to the model (options) of the positioner.

Pin	Wire colour*	Configuration	External circuit / signal level
8	red	Analogue feedback +	8 ○———— + (0/4 – 20 mA or 0 – 5 / 10 V) completely galvanically isolated
7	blue	Analogue feedback GND	7 ○———— GND
* The indicated wire colours refer to the connection cable, part no. 919061, available as an accessory.				

Table 17:   Pin assignment; output signals to the control centre - M12, 8-pole plug

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16.2.3. Output signals to the control centre (e.g. PLC) - M8, 4-pole socket (for binary outputs option only)

Pin	Configuration	External circuit / Signal level
1	Binary output 1	1 ○————► 0 – 24 V
2	Binary output 2	2 ○————► 0 – 24 V
3	Binary output GND	3 ○————► GND

Table 18:   Pin assignment; output signals to the control centre - M8, 4-pole plug

16.2.4. Operating voltage - M12, 8-pole circular connector

Pin	Wire colour*	Configuration	External circuit / Signal level
3	green	GND	3 ○———┐ 24 V DC ± 10%
4	yellow	+24 V	4 ○———┘ max. residual ripple 10%
* The indicated wire colours refer to the connection cable, part no. 919061, available as an accessory.			

Table 19:   Pin assignment; operating voltage - M12, 8-pole circular connector

When the power supply voltage is applied, the positioner is operating.

→ Now make the required basic settings and actuate the automatic adjustment of the positioner. The procedure is described in chapter *Initial start-up* and chapter *Starting up and adjusting the process controller*.

16.3. Type 8793 - designation of the circular connectors and contacts

Operating voltage
and diverse signals

Process actual value

Binary outputs

M12, 8-pole plug

M8, 4-pole plug

M8, 4-pole socket

Function earth FE
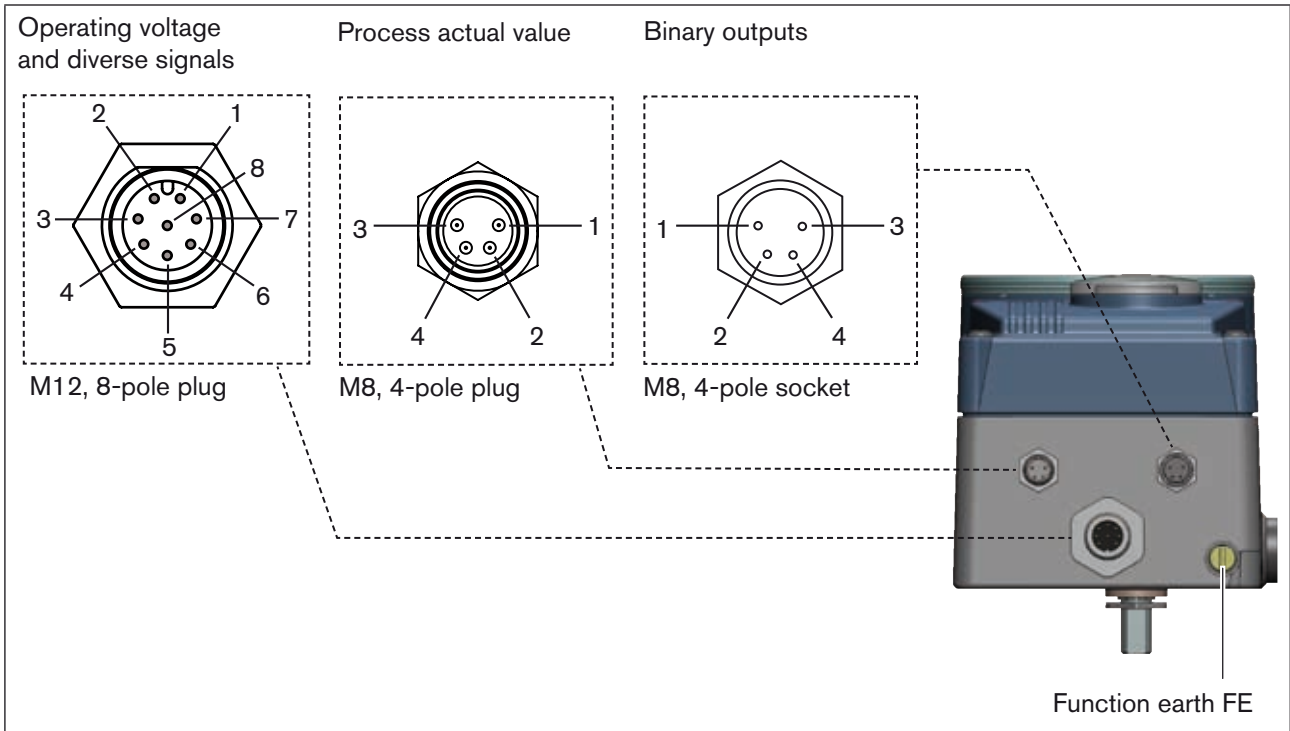
Fig. 25:   Type 8793; designation of the multi-pole connectors and contacts

Location of the DIP switch:

Symbols for
switch position

Location of the
DIP switch

Switch on right

Switch on left
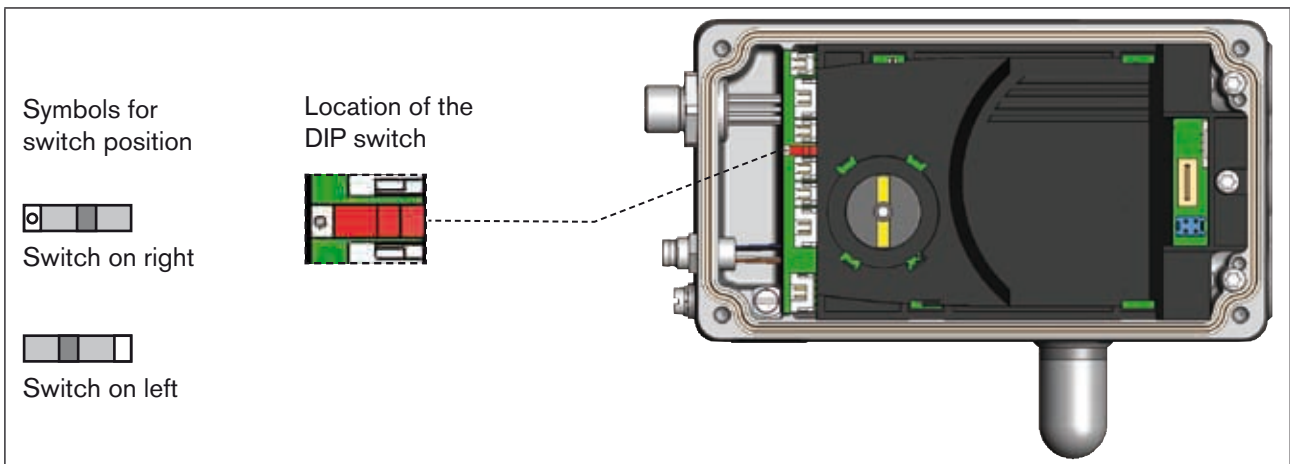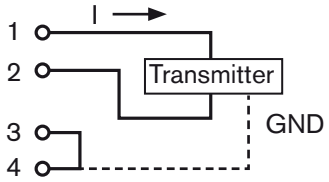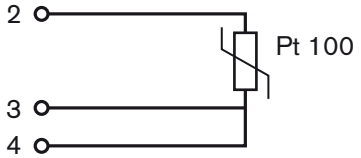
Fig. 26:   Location of the DIP switch; symbols for switch position

16.4. Connecting the process controller 8793

→ First connect the process controller as described in chapter *16.2.Connection of the position controller Type 8792.*

16.4.1. Plug assignments of the process actual value input (M8 circular plug)

| Input type*	Pin	Configuration	DIP Switches	External circuit
4 – 20 mA-internally supplied	1 2 3 4	+24 V transmitter supply Output from transmitter GND Bridge after GND (GND from 3-conductor transmitter)	Switch on left	1 2 Transmitter 3 GND 4
4 – 20 mA-externally supplied	1 2 3 4	not used Process actual + not used Process actual –	Switch on right	2 4 - 20 mA 4 GND
Frequency-internally supplied	1 2 3 4	+24 V sensor supply Clock input + Clock input – (GND) not used	Switch on left	1 +24 V 2 Clock + 3 Clock –
Frequency- externally supplied	1 2 3 4	not used Clock input + Clock input – not used	Switch on right	2 Clock + 3 Clock –
Pt 100 (see information below)	1 2 3 4	not used Process actual 1 (power supply) Process actual 3 (GND) Process actual 2 (compensation)	Switch on right	2 Pt 100 3 4
* Can be adjusted via software (see chapter Specifying the standard settings).				

Table 20:   Plug assignments of the process actual value input (M8 circular plug)

⚠ Connect the Pt 100 sensor via 3 cables for cable compensation reasons.It is essential to bridge Pin 3 and Pin 4 on the sensor.

When the power supply voltage is applied, the positioner is operating.

→ Now make the required basic settings and actuate the automatic adjustment of the positioner. The procedure is described in chapter *Initial start-up* and chapter *Starting up and adjusting the position controller.*

17. ELECTRICAL CONNECTION - TERMINAL MODEL FOR CABLE GLAND

⚠ **DANGER!**

Risk of injury due to electrical shock!

▪ Before reaching into the device or the equipment, switch off the power supply and secure to prevent reactivation!

▪ Observe applicable accident prevention and safety regulations for electrical equipment!

⚠ **WARNING!**

Risk of injury from improper installation!

▪ Installation may be carried out by authorized technicians only and with the appropriate tools!

Risk of injury from unintentional activation of the system and an uncontrolled restart!

▪ Secure system from unintentional activation.

▪ Following installation, ensure a controlled restart.

❗ **Using the 4 – 20 mA nominal value input**

If the operating voltage of one positioner device fails in a series connection of several devices, the input of the failed positioner device becomes highly resistive.
As a result, the 4 – 20 mA standard signal fails.
In this case please contact Bürkert Service directly.

17.1. Connection board of the positioner with screw-type terminals

Fig. 27: Designation of the screw-type terminals

english
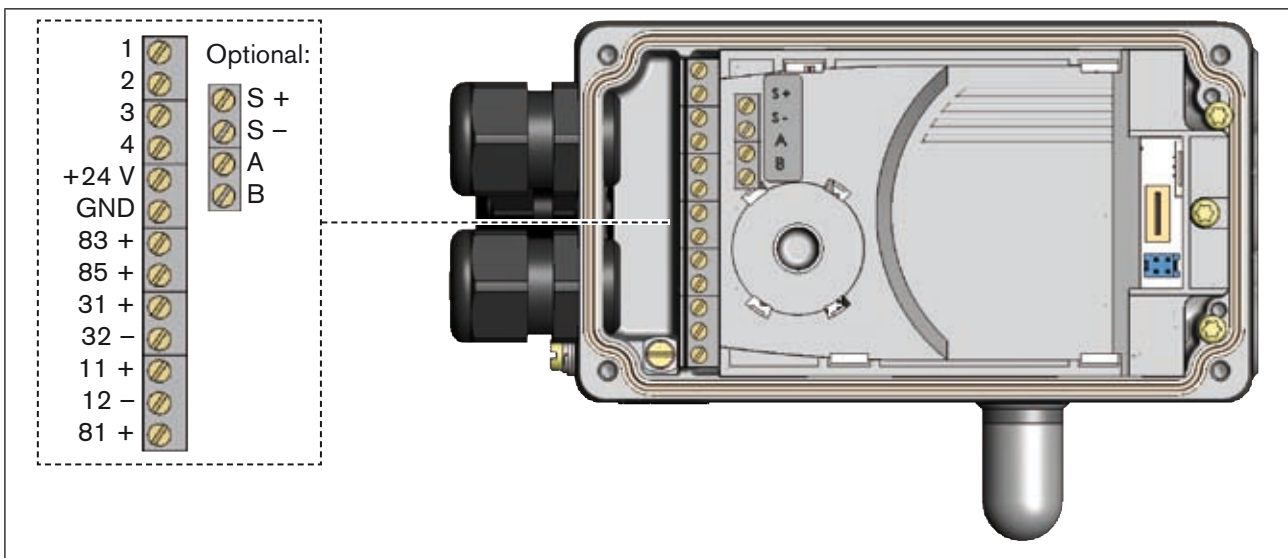
Procedure:

→ Unscrew the 4 screws on the housing cover and remove the cover.
The screw-type terminals are now accessible.

→ Connect positioner.
The procedure is described in the following chapters.
for Type 8792: see chapter entitled *17.2.Terminal Assignment for Cable Gland - Position Controller Type 8792*.
for Type 8793: chapter *17.3.Terminal Assignment for Cable Gland - Position Controller Type 8793*.

17.2. Terminal Assignment for Cable Gland - Position Controller Type 8792

17.2.1. Input signals from the control centre (e.g. PLC)

Terminal	Configuration	External circuit / Signal level
11 +	Set-point value +	11 + ○———— + (0/4 − 20 mA or 0 − 5 / 10 V) completely galvanically isolated
12 −	Set-point value GND	12 − ○———— GND
81 +	Binary input +	81 + ○———— + 0 − 5 V (log. 0) / 10 − 30 V (log. 1) specific to operating voltage GND (terminal GND)

Table 21: Terminal assignment; input signals of the control centre

17.2.2. Output signals to the control centre (e.g. PLC) (required for Analogue output and/or Binary output option only)

→ Connect terminals according to the model (options) of the positioner.

Terminal	Configuration	External circuit / Signal level
83 +	Binary output 1	83 + ○———— 24 V / 0 V, NC / NOspecific to operating voltage GND (terminal GND)
85 +	Binary output 2	85 + ○———— 24 V / 0 V, NC / NOspecific to operating voltage GND (terminal GND)
31 +	Analogue feedback +	31 + ○———→ + (0/4 − 20 mA or 0 − 5 / 10 V) completely galvanically isolated
32 −	Analogue feedback GND	32 − ○———→ GND

Table 22: Terminal assignment; output signals to the control centre

17.2.3. Operating voltage

Terminal	Configuration	External circuit / Signal level
+24 V	Operating voltage +	+24 V 24 V DC ± 10%
GND	Operating voltage GND	GND max. residual ripple 10%

Table 23: Pin assignment; operating voltage - M12, 8-pole circular connector

17.2.4. Connecting the external position measuring system (for remote model only)

Terminal	Configuration	External circuit / Signal level	
S +	Supply sensor +	S + +	Remote
S -	Supply sensor –	S – –	Sensor
A	Serial interface, A cable	A A line	Typ 8798
B	Serial interface, B-cable	B B line	

Table 24: Terminal assignment; external position measuring system

When the power supply voltage is applied, the positioner is operating.

→ Now make the required basic settings and actuate the automatic adjustment of the positioner. The procedure is described in chapter *Initial start-up* and chapter *Starting up and adjusting the position controller*.

17.3. Terminal Assignment for Cable Gland - Position Controller Type 8793

→ First connect the process controller as described in chapter *17.2.Terminal Assignment for Cable Gland - Position Controller Type 8792*.

17.3.1. Terminal assignments of the process actual value input

Input type*	Terminal		Configuration	External circuit
4 – 20 mA - internally supplied	actual value	1	+24 V transmitter input	
		2	Output from transmitter	
		3	Bridge after GND (GND from 3-conductor transmitter)	
		4	not used	
	GND		GND	
Frequency - internally supplied	actual value	1	+24 V sensor supply	
		2	Clock input +	
		3	not used	
		4	Clock input –	
	GND		GND	
4 – 20 mA	actual value	1	not used	
		2	Process actual +	
		3	Process actual –	
		4	not used	
Frequency - externally supplied	actual value	1	not used	
		2	Clock input +	
		3	not used	
		4	Clock input –	
Pt 100 (see information below)	actual value	1	not used	
		2	Process actual 1 (Power supply)	
		3	Process actual 3 (GND)	
		4	Process actual 2 (Compensation)	
* Can be adjusted via software (see chapter Specifying the standard settings).				

Table 25: Terminal assignments of the process actual value input

Connect the Pt 100 sensor via 3 cables for cable compensation reasons.
It is essential to bridge Pin 3 and Pin 4 on the sensor.

When the power supply voltage is applied, the positioner is operating.

→ Now make the required basic settings and actuate the automatic adjustment of the positioner. The procedure is described in chapter *Initial start-up* and chapter *Starting up and adjusting the position controller*.

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Initial start-up

CONTENTS

18. INITIAL START-UP

This section enables you to start up the positioner quickly in order to perform a function check. Additional functions which are not required are not dealt with in this chapter.

18.1. Safety instructions

DANGER!

Risk of injury from high pressure in the equipment!

▪ Before loosening the lines and valves, turn off the pressure and vent the lines.

WARNING!

Risk of injury from improper start-up!

▪ Start-up may be carried out by authorised technicians only and with the appropriate tools!

Risk of injury from unintentional activation of the system and an uncontrolled restart!

▪ Secure system from unintentional activation.

▪ Following start-up, ensure a controlled restart.

18.2. Installation

→ Before start-up, carry out fluid and electrical installation of the positioner and valve.

When the operating voltage is applied, the positioner is operating and is in the AUTOMATIC operating state.

18.3. Specifying the standard settings

The basic settings of the positioner are implemented at the factory.

Before the positioner can undergo a function check, the unit input signal (standard signal) must still be set following installation of the device and the *X.TUNE* function run to adjust the device to local conditions.

To specify the basic settings, switch from the process operating level to the configuration level.

Hold down the left selection key (MENU) for approx. 3 seconds (countdown: two bars converge on the display). Then the main menu (MAIN) is indicated on the display together with the menu options which can be individually marked via the arrow keys and then selected via the right selection key (ENTER). (see *Fig. 28:Operating module; Specifying the Basic Settings*).

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Display

Description of the key configuration

Right selection key

Down arrow key

Up arrow key

left selection key
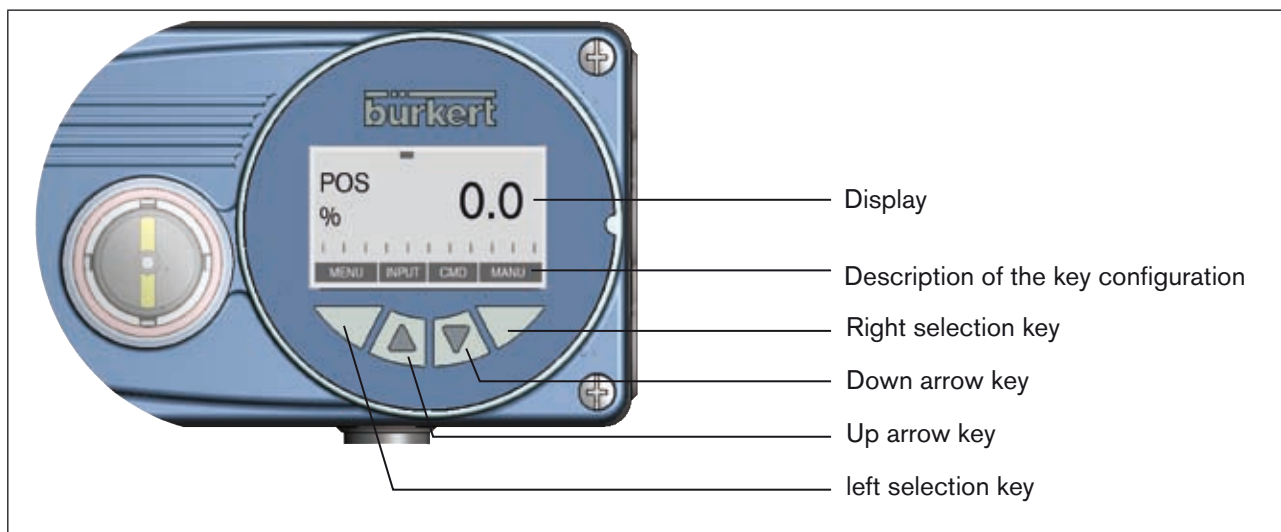
Fig. 28:   Operating module; Specifying the Basic Settings

> The overview of the operating structure for the basic settings is illustrated in the following subchapter *18.3.3.* in *Fig. 29:Operating structure; Basic settings for intial start-up*

18.3.1. Setting the Input Signal (Standard Signal)

→ Using the arrow keys, mark the *INPUT* menu option in the main menu and then press the right selection key (ENTER) to enter the *INPUT* submenu.

→ Using the arrow keys, select the input signal (4 – 20 mA, 0 – 20 mA, ...).

→ Press the right selection key (SELEC) to select the input signal (dot is marked).

→ To leave the submenu, press the left selection key (EXIT).

→ To leave the main menu, press the left selection key (EXIT).

> You have to leave the main menu by pressing the left selection button (EXIT) before the modified data is saved in the memory (EEPROM). During the save process the message "*SAVE EEPROM*" is indicated on the display.

18.3.2. Running the Automatic Adjustment *X.TUNE*

> ⓘ An exact description of the *X.TUNE* function can be found in the chapter entitled *Start-up and operation of the position controller Type 8792*.

⚠ **WARNING!**

Uncontrolled valve movements while the *X:TUNE* function is running!

While this function is running, the valve automatically moves from its current position!

▪ Never run *X.TUNE* while a process is running!

▪ Take appropriate measures to prevent the equipment from being unintentionally actuated!

NOTE!

An incorrect supply pressure or incorrectly connected operating medium pressure may cause the controller to be wrongly adjusted!

▪ *X.TUNE* **at the supply** pressure available during subsequent operation (= pneumatic auxiliary energy).

▪ Run the *X.TUNE* function preferably **without** operating medium pressure to exclude interference caused by flow forces.

→ To enter the main menu, hold down the left selection key (MENU) for approx. 3 s (countdown on the display).

→ Using the arrow keys, select the *X.TUNE* menu option.

→ To start the automatic adjustment *X.TUNE*, hold down the right selection key (RUN) for approx. 3 s (countdown on the display).

While the automatic adjustment is running, messages on the progress of the *X.TUNE* (e.g. *"TUNE #1...."*) are indicated on the display.

When the automatic adjustment completes, the message *"X.TUNE READY"* is indicated.

→ To return to the main menu, press any key.

→ To leave the main menu, press the left selection key (EXIT).

> ⓘ You have to leave the main menu by pressing the left selection button (EXIT) before the modified data is saved in the memory (EEPROM). During the save process the message "*SAVE EEPROM*" is indicated on the display.

18.3.3. Overview of the operating structure for initial start-up
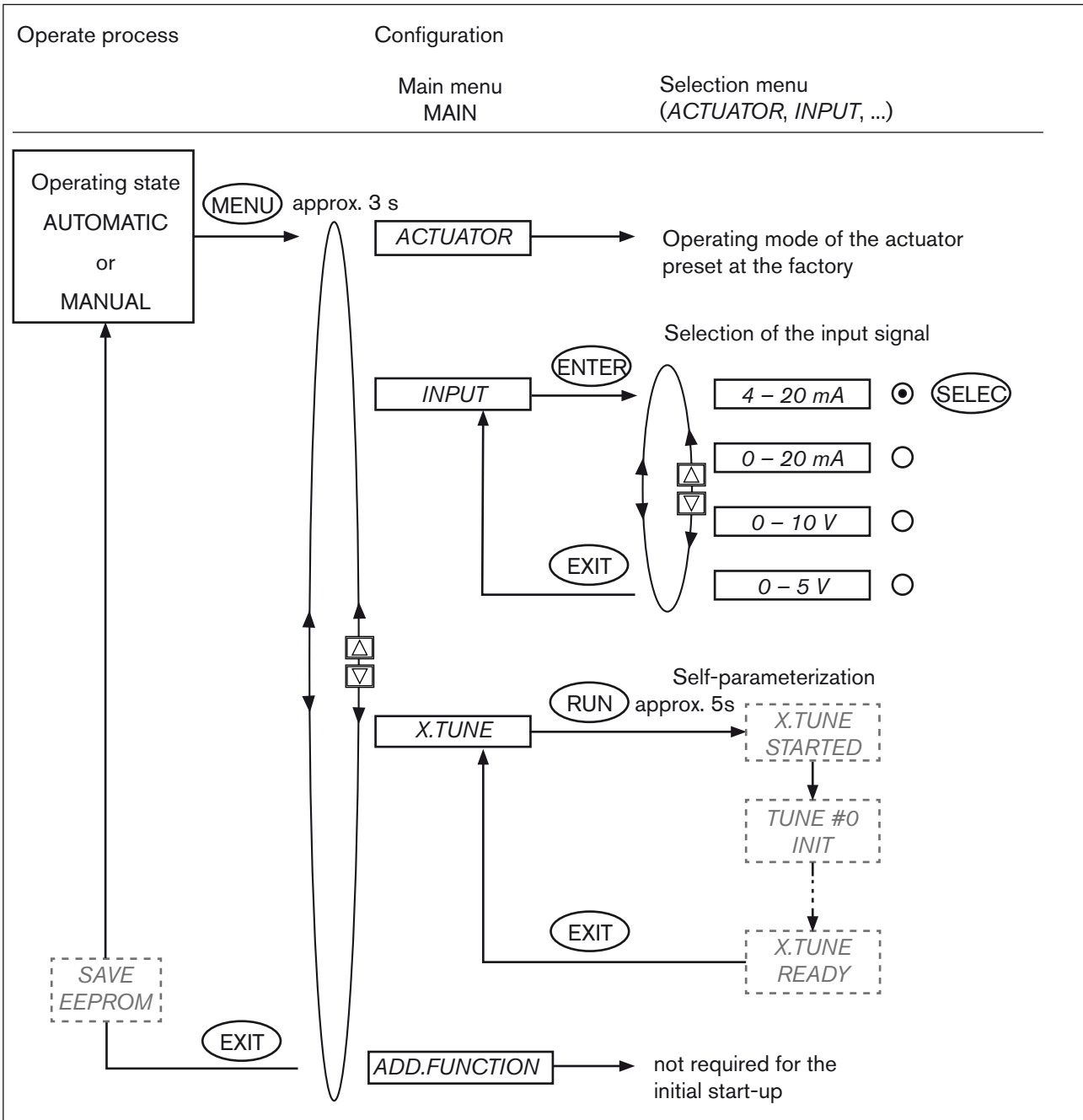
Operate process   Configuration

Main menu
MAIN

Selection menu
(*ACTUATOR*, *INPUT*, ...)

Operating state
AUTOMATIC
or
MANUAL

(MENU) approx. 3 s

ACTUATOR → Operating mode of the actuator preset at the factory

Selection of the input signal

(ENTER)

INPUT →

(EXIT)

4 – 20 mA ⊙ (SELEC

0 – 20 mA ○

0 – 10 V ○

0 – 5 V ○

Self-parameterization
(RUN) approx. 5s

X.TUNE →

X.TUNE STARTED

TUNE #0 INIT

(EXIT)

X.TUNE READY

SAVE EEPROM

(EXIT)

ADD.FUNCTION → not required for the initial start-up

Fig. 29:   *Operating structure; Basic settings for intial start-up*

Start-up and operation of the position controller Type 8792

CONTENTS

19. STARTING UP AND ADJUSTING THE POSITION CONTROLLER

19.1. Safety instructions

⚠ **DANGER!**

Risk of injury from high pressure in the equipment!

▪ Before loosening the lines and valves, turn off the pressure and vent the lines.

⚠ **WARNING!**

Risk of injury from improper start-up!

▪ Start-up may be carried out by authorised technicians only and with the appropriate tools!

Risk of injury from unintentional activation of the system and an uncontrolled restart!

▪ Secure system from unintentional activation.

▪ Following start-up, ensure a controlled restart.

19.2. Installation

→ Before start-up, carry out fluid and electrical installation of the positioner and valve.

19.3. Procedure for specifying the settings

When the operating voltage has been switched on, the positioner is at the process operating level in the AUTOMATIC operating state.

To specify the standard settings, switch to the configuration level.

→ Hold down the left selection key (MENU) for approx. 3 seconds (wait for countdown on display).

Then the main menu is indicated on the display (MAIN).

→ Use the arrow keys to switch between the main menu options and select a menu.

→ Press the right selection key (ENTER/RUN) to confirm the selection.

Depending on the function, a menu sub-option or a selection screen is indicated on the display.

Use the arrow keys to switch between the submenu options and select the required settings.

→ Press the right selection key (SELEC/ENTER) to confirm the selection (the dot after the selected parameter is now marked).

→ To return to the main menu, press the left selection key (EXIT).

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position controller Type 8792

→ To save the changed settings, leave the configuration level by pressing the left selection key (EXIT).

The positioner is now back on the process operating level.

> ⚠ Only when you leave the configuration level by pressing the right selection key, are the changed parameters and settings saved (*"save EEPROM"*).

19.4. Factory settings of the position controller

Function	Factory setting	Function	Factory setting
INPUT	4 – 20 mA	X.CONTROL	
		DBND	1.0%
CHARACT	linear	KXopn	(1) Values of X.TUNE determined
		KXcls	(1) Values of X.TUNE determined
DIR.CMD	Rise	After running SET.FACTORY: 1	
CUTOFF	Min 0%		
	Max 100%	SECURITY	
		Access Code 1	0000
DIR.ACT	Rise	SAFEPOS	0%
SPLTRNG	Min 0%	SIG.ERROR	
	Max 100%	SP/CMD Input	Error off
X.LIMIT	Min 0%		
	Max 100%	OUTPUT*	
X.TIME		OUT ANALOG	Out POS
Open	(1s) Values of X.TUNE determined		OUT type 4 – 20 mA
Close	(1s) Values of X.TUNE determined	OUT BIN1	Out DEV.X
After running SET.FACTORY: 1 s			Lim. DEV.X 1.0%
			OUT.BIN1 type normally open
BINARY. IN	SafePos	OUT BIN2	Out DEV.X
BIN. IN type	normally open		Lim. DEV.X 1.0%
			OUT.BIN1 type normally open
* only optional			

Table 26: Factory settings of the position controller

19.5.   Specifying the standard settings

When starting up the positioner for the first time, implement the following standard settings:

→ Specify the selected unit signal input for the set-point value default (*INPUT*)
(4 – 20 mA; 0 – 20 mA; 0 – 10 V or 0 – 5 V).

→ Start automatic adjustment of the position controller to the particular operating conditions (*X.TUNE*)

The exact description of the *INPUT* and *X.TUNE* functions can be found in the chapter entitled *19.6.Description of the basic functions in the main menu.*

The basic settings for the positioner are implemented at the factory. During start-up, however, it is essential to input the unit signal (*INPUT*) and run *X.TUNE*. Using the *X.TUNE* function, the positioner **automatically** determines the optimum settings for the current operating conditions.

If the auxiliary function *X.CONTROL* is in the main menu while *X.TUNE* is running, the position controller dead band *DBND* is also determined automatically depending on the friction behaviour of the actuator drive (see chapter entitled *21.3.10.X.CONTROL   Parameterization of the position controller*).

19.6. Description of the basic functions in the main menu

19.6.1. Main menu of the positioner
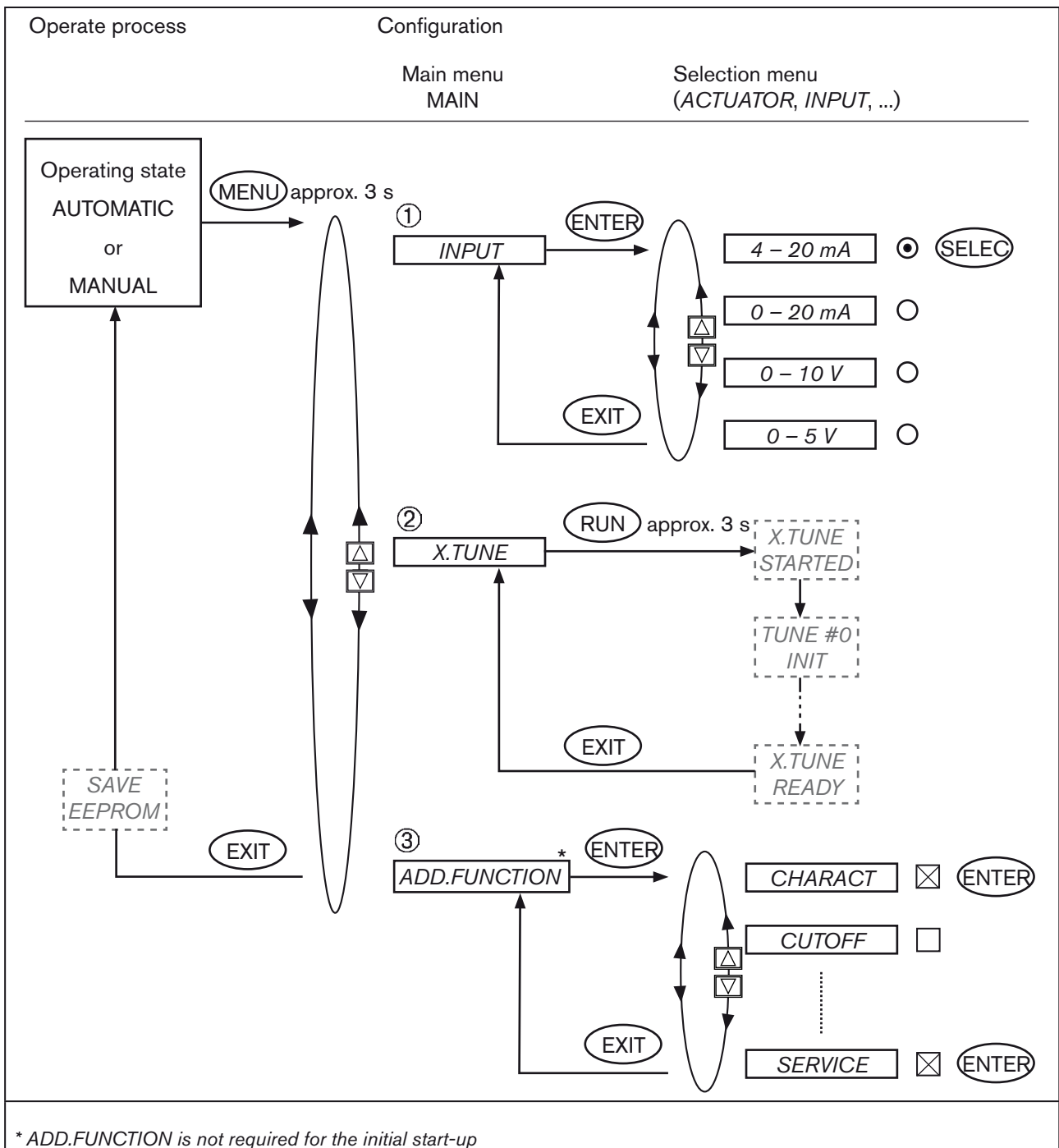
Fig. 30: Operating structure; Basic settings

19.6.2. Inputting the input signal

INPUT - Selected unit input signal

→ Under this menu option input the unit signal used for the set-point value.
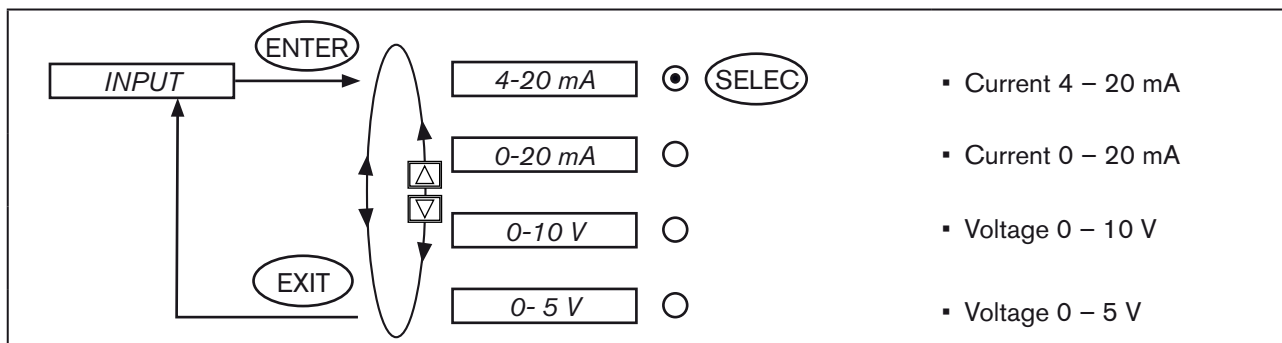
Fig. 31:   Operating structure INPUT

19.6.3. Automatic adjustment (autotune) of the position controller

X.TUNE - Autotune for position controller

⚠ **WARNING!**

Uncontrolled valve movements while the *X:TUNE* function is running!

While this function is running, the valve automatically moves from its current position!

▪ Never run *X.TUNE* while a process is running!

▪ Take appropriate measures to prevent the equipment from being unintentionally actuated!

NOTE!

An incorrect supply pressure or incorrectly connected operating medium pressure may cause the controller to be wrongly adjusted!

▪ *X.TUNE* **at the supply** pressure available during subsequent operation (= pneumatic auxiliary energy).

▪ Run the *X.TUNE* function preferably **without** operating medium pressure to exclude interference caused by flow forces.

The following functions are actuated automatically:

▪ Adjustment of the sensor signal to the (physical) stroke of the actuator used.

▪ Determination of parameters for the PWM signals to control the solenoid valves integrated in the positioner.

▪ Adjustment of the controller parameters for the position controller. Optimization occurs according to the criteria of a shortest possible correction time with a simultaneous freedom from overshoot.

→ Start Autotune by selecting *X.TUNE* in the main menu (MAIN) using the arrow keys.

→ Then hold down the right selection key (RUN) for approx. 3 seconds (countdown on display).

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When the automatic adjustment completes, the message *"X.TUNE READY"* is indicated.

If an error occurs, the *"TUNE err/break"* message is indicated.

→ To return to the main menu, press any key.

🛑 To stop *X.TUNE*, press the left or right selection key (STOP).

Sequence for automatic adjustment of the position controller to the particular operating conditions

Display	Description
X.TUNE started	Start of *X.TUNE*
TUNE #0 Init *TUNE #1 Max-Pos* *TUNE #2 Min-Pos* :	Display of the *X.TUNE* phase which is currently running (progress is indicated by a progress bar along the upper edge of the display).
X.TUNE ready	Display at the end of the *X.TUNE*
TUNE err/break	Display when a fault occurs

Table 27:   Automatic adjustment of the position controller

19.6.4.   Adding auxiliary functions

ADD.FUNCTION

With *ADD.FUNCTION* auxiliary functions can be included in the main menu.

See chapter *21.Configuring the auxiliary functions*.

🛑 Jump this menu option during the initial start-up.

19.6.5.   Leaving the main menu

→ To leave the main menu, press the left selection key (EXIT).

🛑 You have to leave the main menu by pressing the left selection button (EXIT) before the modified data is saved in the memory (EEPROM). During the save process the message *"SAVE EEPROM"* is indicated on the display.

When the main menu is left, the device is back in the same operating state in which it was before the switchover to the main menu (MANUAL or AUTOMATIC).

20. OPERATING THE POSITION CONTROLLER

> 🛈 A precise description of the control and display elements, as well as the configuration of the keys, can be found in chapter *11.Control and display elements*.

When the operating voltage has been switched on, the positioner is at the process operating level in the AUTO-MATIC operating state.

At the process operating level the normal control mode is implemented and monitored (AUTOMATIC) and the valve is manually opened or closed (MANUAL).
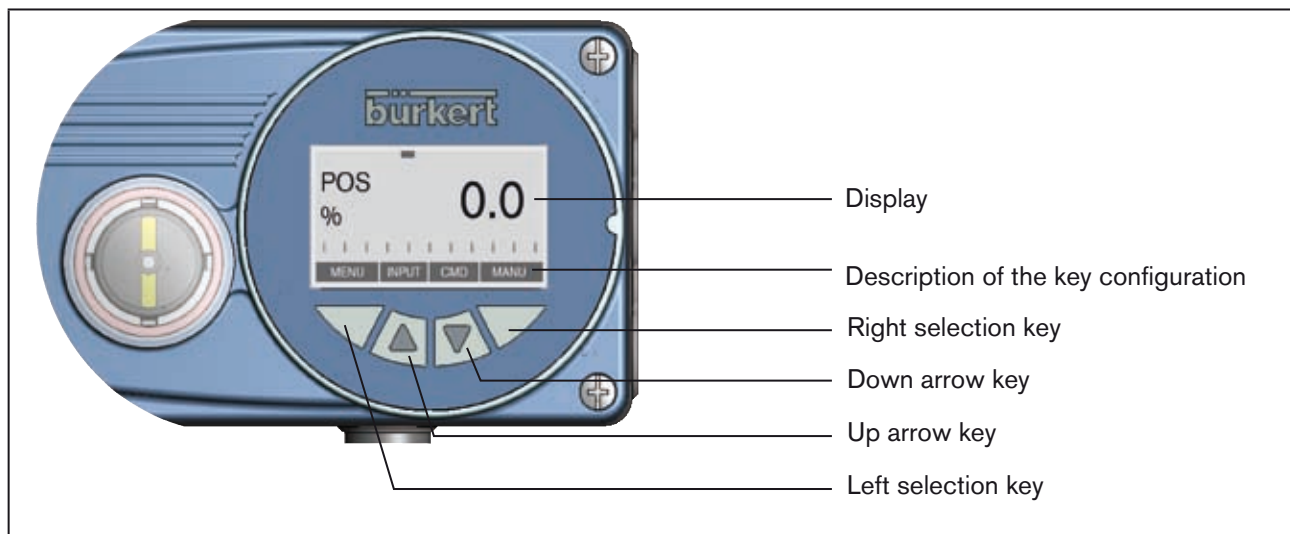
Fig. 32:   Operating module; Specifying the Basic Settings

20.1.   Switching between the operating states

The right Selection key can be used to switch between the two operating states AUTOMATIC (AUTO) and MANUAL (MANU).

In the AUTOMATIC operating state a bar runs along the upper edge of the display from left to right.

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20.2. Switching between the operating levels

Process operating level -> Configuration level

To switch to the configuration level in the MANUAL or AUTOMATIC operating state

→ hold down the left selection key (MENU) for approx. 3 seconds (Countdown: two bars converge on the display).

At the Configuration level the operating parameters can be input or changed, auxiliary functions supplemented or the automatic adjustment (*X.TUNE*) of the controller started.

> A precise description of the individual functions can be found in chapter *21.Configuring the auxiliary functions.*

Configuration level -> Process operating level

Press the left selection key (EXIT) to switch from the Configuration level to the Process operating level. In doing so, the operating state which was selected before the switchover (AUTOMATIC or MANUAL) is set.

20.3. AUTOMATIC operating state

Bar running from left to right along the upper edge of the display.

Normal control mode is implemented and monitored in AUTOMATIC operating state.

20.3.1. Meaning of the keys

key	Configu-ration	Description
Left selection key	MENU	Switch to the Configuration level (press for approx. 3 s)
Right selection key	MANU	Switch between the AUTOMATIC (AUTO) or MANUAL (MANU) operating modes
Up arrow key	INPUT POS CMD TEMP	Switch between the individual displays
Down arrow key	CMD TEMP INPUT POS	

Table 28: AUTOMATIC operating state; Meaning of the keys; Position controller type Type 8792

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20.3.2. Information on the display

The following variables are indicated on the display for the position controller and it is possible to switch between them with the arrow keys:

Representation of value	Value range / Unit	Description
POS XXX	0 – 100 %	Display of actual position of the valve actuator
CMD XXX	0 – 100 %	Display of nominal position of the valve actuator
TEMP XXX	-100 – 150 °C	Internal temperature in the housing of the positioner
INPUT XXX	0/4 – 20 mA, 0 – 5/10 V	Input signal for nominal position

Table 29: Display; Position controller type Type 8792

20.3.3. Operating structure
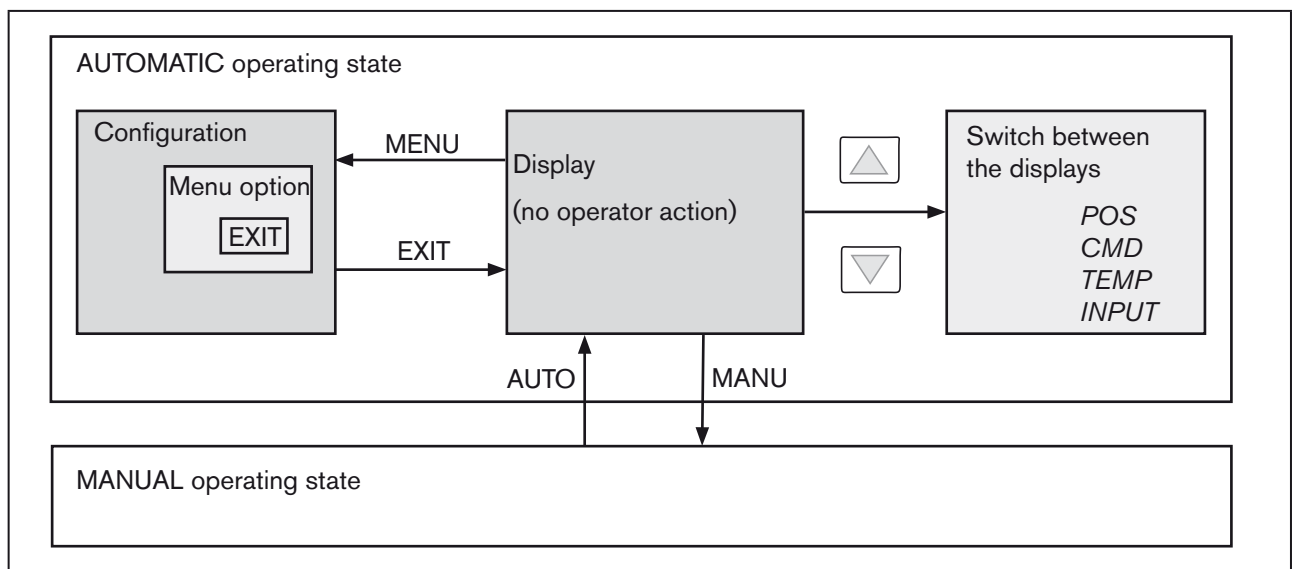
Fig. 33: Operating structure AUTOMATIC; position controller type Type 8792

20.4. MANUAL operating state

Without bar running from left to right along the upper edge of the display.

In MANUAL operating state the valve can be opened or closed manually.

20.4.1. Meaning of the keys

key	Configu-ration	Description
Left selection key	MENU	Switch to the Configuration level (press for approx. 3 s)
Right selection key	MANU	Switch between the AUTOMATIC (AUTO) or MANUAL (MANU) operating modes
Up arrow key	OPN	Aerate the actuator
	CLS*	Control function A (SFA): Valve opens Control function B (SFB): Valve closes Control function I (SFI): Connection A1 aerated
Down arrow key	CLS	Deaerate the actuator
	OPN*	Control function A (SFA): Valve closes Control function B (SFB): Valve opens Control function I (SFI): Connection A2 aerated
* only if "Fall" is set in the DIR.ACT auxiliary function		

Table 30:   AUTOMATIC operating state; meaning of the keys

> SFA: Actuator closes by spring force
>
> SFB: Actuator opens by spring force
>
> SFI: Actuator double-acting

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20.4.2. Information on the display

After switching to the MANUAL operating state, the display automatically jumps to the actual position (*POS*) of the valve actuator.

20.4.3. Operating structure

Fig. 34:   Operating structure MANUAL

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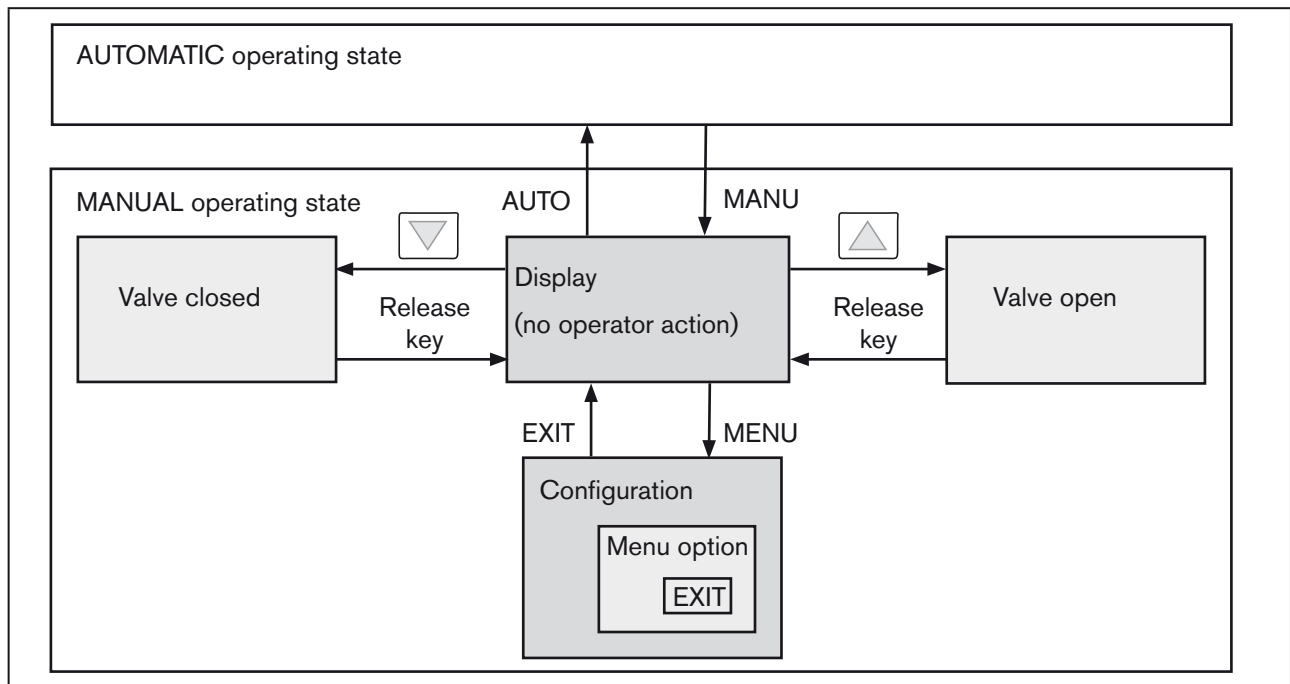
21.   CONFIGURING THE AUXILIARY FUNCTIONS

The operating concept for the positioner is based on a strict division between basic and auxiliary functions.

When the device is delivered, only the basic functions are activated. They are used during the initial start-up to implement basic settings specific to the device. They are adequate for normal operation.
For more demanding control tasks select and specify auxiliary functions at the Configuration level.

21.1.   Keys at the Configuration level

Press the key	in the menu	in a selected and confirmed menu option
▲ ▼	Scroll up (select) / Scroll down (select)	Increment (increase) numerical values / Decrement (reduce) numerical values

Press the key	in the menu	in the ADD.FUNCTION menu
Selection key on right ENTER	Retrieve the selected menu option to input parameters or start the *X.TUNE*	Select a menu option in the auxiliary menu for inclusion in or removal from the main menu. The menu option is indicated in the auxiliary menu by a cross (x) in the box

Press the key	in the menu	in a selected and confirmed menu option
Selection key on right ENTER SELEC	Retrieve the selected menu option to input parameters or start the *X.TUNE*	Confirm the parameter selection marked with arrow keys.

Press the key	in the menu	in a selected and confirmed menu option
Selection key on left EXIT	The Configuration level is left and the data is saved in the memory (EEPROM).	Leave a sub-menu option.

Table 31:   Configuration level; Key functions

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21.2. Configuration menu

The Configuration menu consists of the main menu and auxiliary menu.

▪ The main menu includes firstly the basic functions which you specify during the initial start-up.

▪ The auxiliary menu includes additional functions and is accessible via the *ADD.FUNCTION* menu option of the main menu.

Device functions and parameters can be specified within the main menu. If required, extend the main menu with auxiliary menu functions which you can then specify.

21.2.1. Switching between process operating level and configuration level
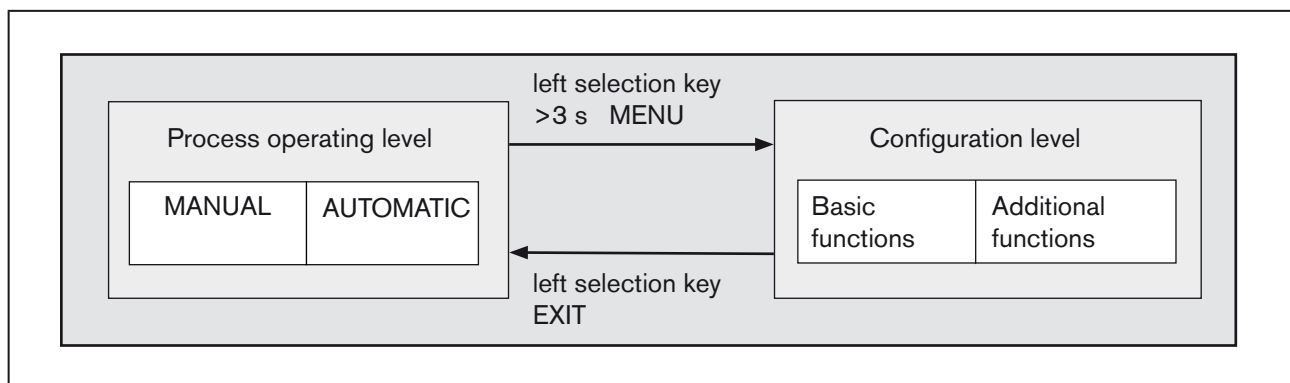
Fig. 35:   Operating levels

To activate the Configuration menu on the Process operating level

→ hold down the left selection key (MENU) for approx. 3 seconds (Countdown: two bars converge on the display).

21.2.2. Including auxiliary functions in the main menu

→ In the main menu press the arrow keys to select the *ADD.FUNCTION* menu option and press the selection key on the right (ENTER) to enter the submenu.

→ Press the arrow keys to select the required auxiliary function.

→ Press the selection key on the right (ENTER) to mark the auxiliary function with a cross (x).

→ Press the selection key on the left (EXIT) to transfer the marked functions into the main menu.

→ In the main menu now input the parameters for the auxiliary functions.

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21.2.3. Removing auxiliary functions from the main menu

> ⓘ If a function is removed from the main menu, the settings implemented previously under this function become invalid again.

→ In the main menu press the arrow keys to select the *ADD.FUNCTION* menu option and press the selection key on the right (ENTER) to enter the submenu.

→ Using the arrow keys, select an auxiliary function indicated with a cross (x).

→ Press the selection key on the right (ENTER) to remove the cross (x).

→ After pressing the selection key on the left (EXIT), the auxiliary function is deactivated and removed from the main menu.

21.2.4. Setting numerical values

Numerical values can be set in the designated menu options by pressing the keys once or repeatedly:
    - up arrow key (increase the numerical value)
    - down arrow key (reduce the numerical value)

In the case of four-digit numbers only the saved digit can be set with the up arrow key. Press the down arrow key to switch to the next digit (see *Fig. 36:Setting numerical values*).
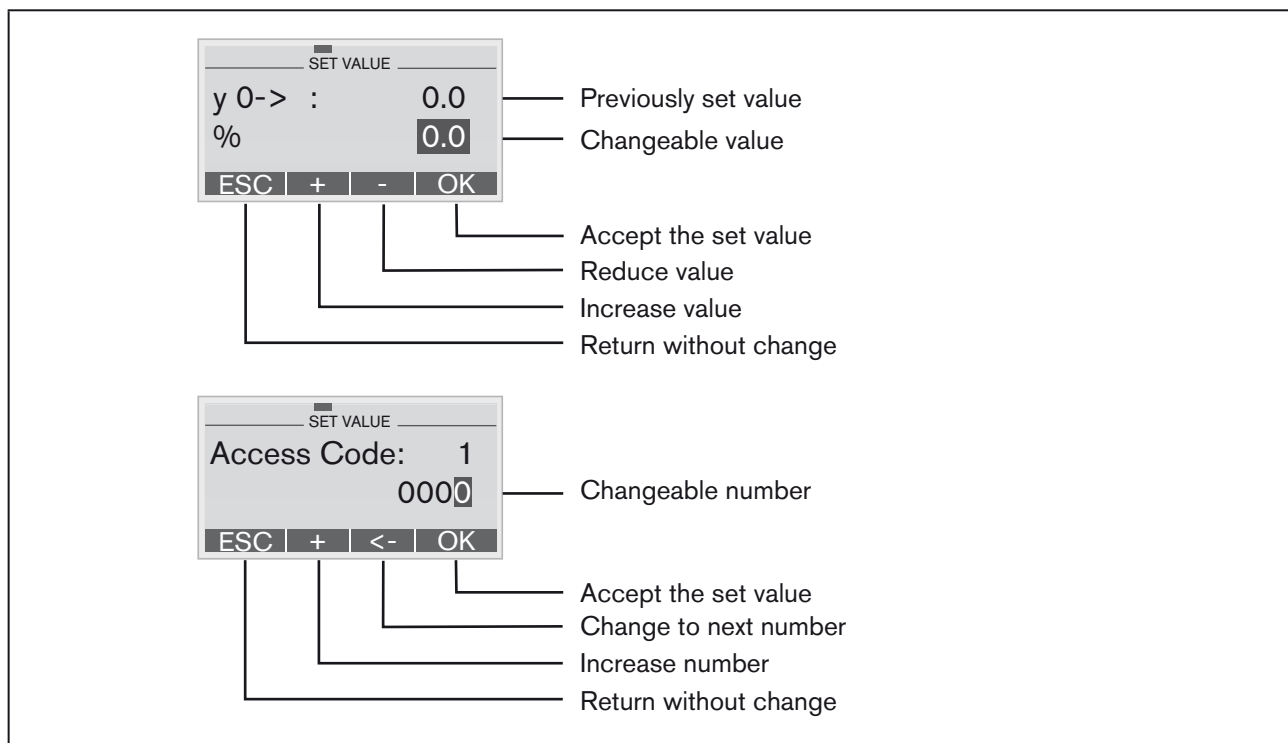
Fig. 36:   Setting numerical values

21.2.5. Principle of including auxiliary functions in the main menu
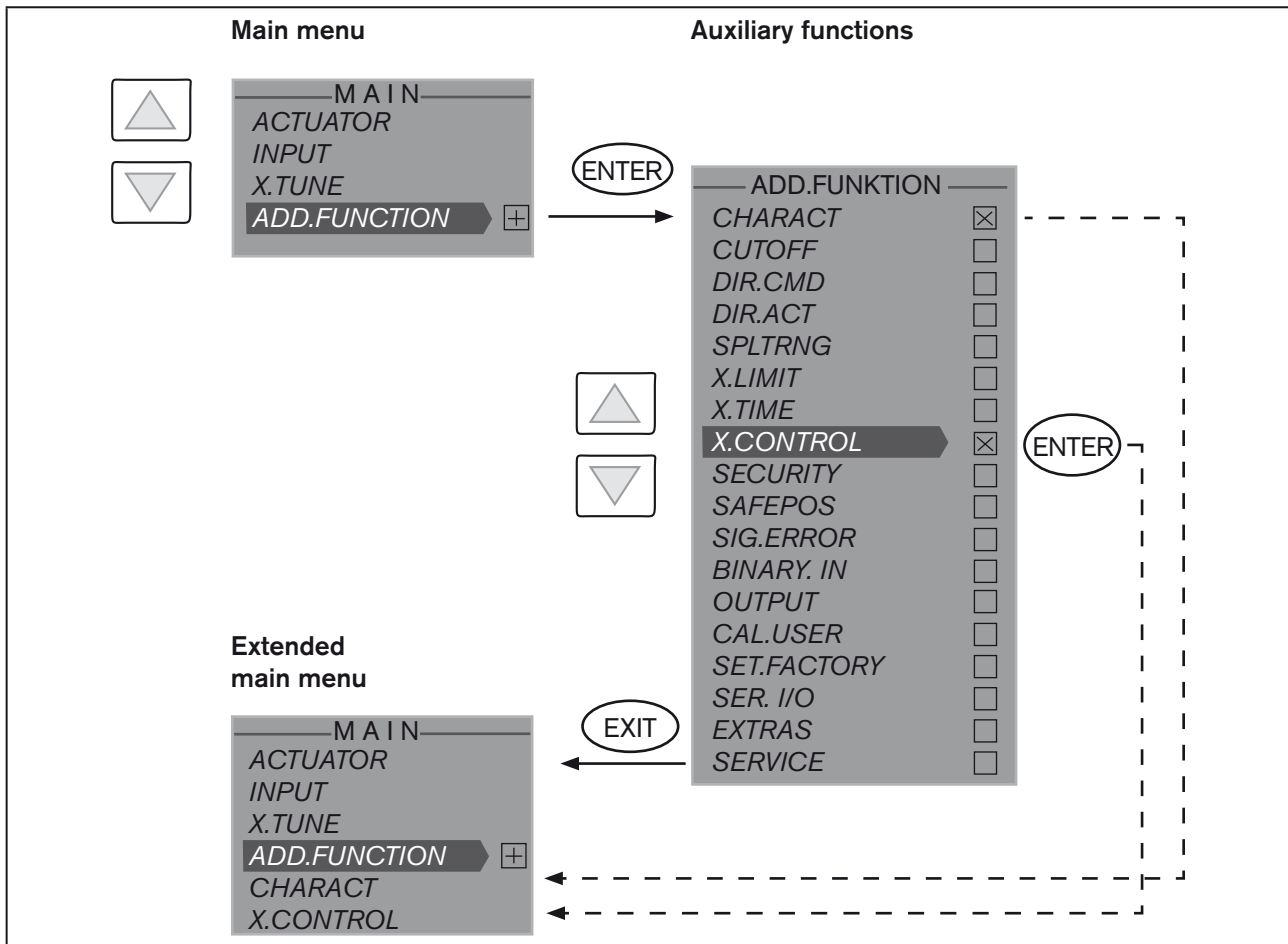
Fig. 37:   Including auxiliary functions

21.3. Auxiliary functions

21.3.1. Overview of auxiliary functions for the position controller Type 8792

CHARACT	Selection of the transfer characteristic between input signal and stroke (correction characteristic)
CUTOFF	Sealing function for position controller
DIR.CMD	Effective sense of direction between input signal and set-point position
DIR.ACT	Assignment of the aeration state of the actuator chamber to the actual position
SPLTRNG	Signal split range; input signal as % for which the valve runs through the entire stroke range.
X.LIMIT	Limit of the mechanical stroke range
X.TIME	Limiting the control speed
X.CONTROL	Parameterization of the position controller
SECURITY	Code protection for settings
SAFEPOS	Input the safety position
SIG.ERROR	Configuration of signal level fault detection
BINARY. IN	Activation of the binary input
OUTPUT	Configuration of the outputs (only with auxiliary board for analogue feedback signal or binary outputs)
CAL.USER	Calibration
SET.FACTORY	Reset to factory settings
SER. I / O	Configuration of serial interface
EXTRAS	Set colours on display
SERVICE	For internal use only
POS.SENSOR	For type 8793 remote version only: Setting of interface for remote path sensor

Fig. 38:   Overview - auxiliary functions, position controller Type 8792

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21.3.2. *CHARACT*
Select the transfer characteristic between input signal
(position set-point value) and stroke

Characteristic (customer-specific characteristic)

Use this auxiliary function to select a transfer characteristic with reference to set-point value (nominal position, *CMD*) and valve stroke (*POS*) for correction of the flow-rate or operating characteristic.

Factory setting: *linear*
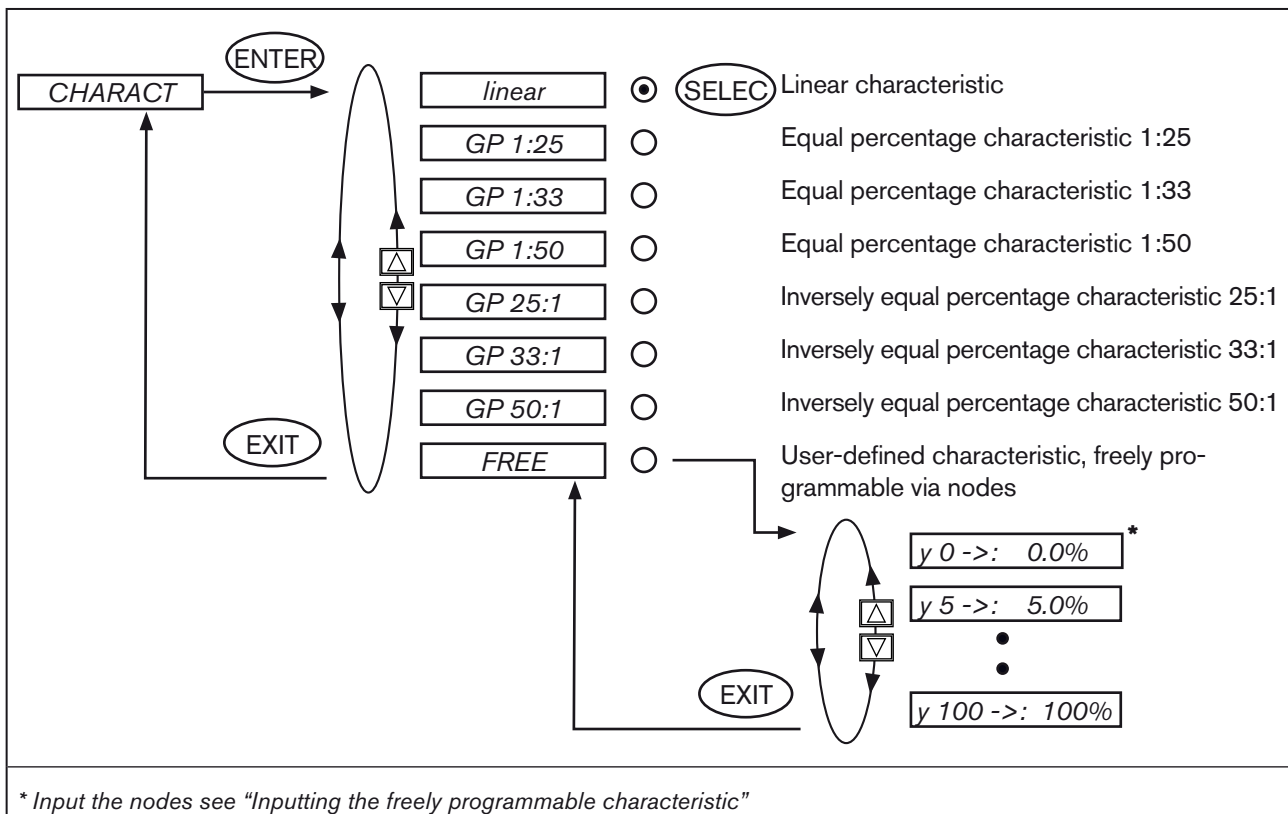
* Input the nodes see "Inputting the freely programmable characteristic"

Fig. 39:   Operating structure CHARACT

The flow characteristic k_V = f(s) indicates the flow-rate of a valve, expressed by the k_V value depending on the stroke s of the actuator spindle. It is specified by the design of the valve seat and the seat seal. In general two types of flow characteristics are implemented, the linear and the equal percentage.

In the case of linear characteristics identical k_V value changes k_V are assigned to identical stroke changes ds.

$$(dk_V = n_{lin} \cdot ds).$$

In the case of an equal percentage characteristic an equal percentage change of the k_V value corresponds to a stroke change ds.

$$(dk_V/k_V = n_{equalper} \cdot ds).$$

The operating characteristic Q = f(s) specifies the correlation between the volumetric flow Q in the installed valve and the stroke s. This characteristic has the properties of the pipelines, pumps and consumers. It therefore exhibits a form which differs from the flow characteristic.
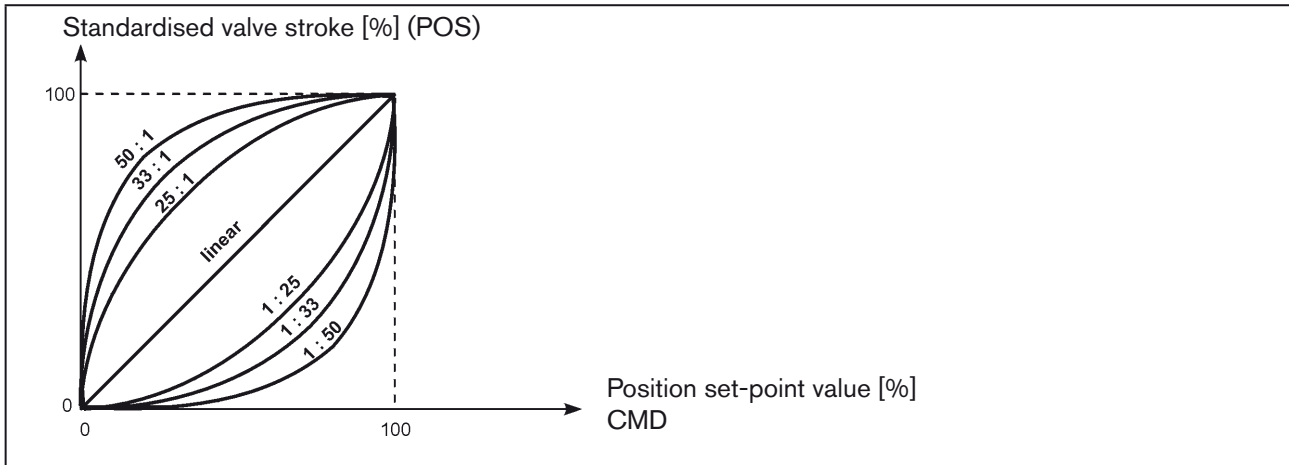
Fig. 40:   Characteristics

In the case of control tasks for closed-loop control systems it is usually particular demands which are placed on the course of the operating characteristic, e.g. linearity. For this reason it is occasionally necessary to correct the course of the operating characteristic in a suitable way. For this purpose the positioner features a transfer element which implements different characteristics. These are used to correct the operating characteristic.

Equal percentage characteristics 1:25, 1:33, 1:50, 25:1, 33:1 and 50:1 and a linear characteristic can be set. Furthermore, a characteristic can be freely programmed via nodes or automatically calibrated.

21.3.3.   Inputting the freely programmable characteristic

The characteristic is defined via 21 nodes which are distributed uniformly via the position set-point values ranging from 0 – 100%. Their distance is 5%. A freely selectable stroke (adjustment range 0 – 100%) is assigned to each node. The difference between the stroke values of two adjacent nodes must not be larger than 20%.
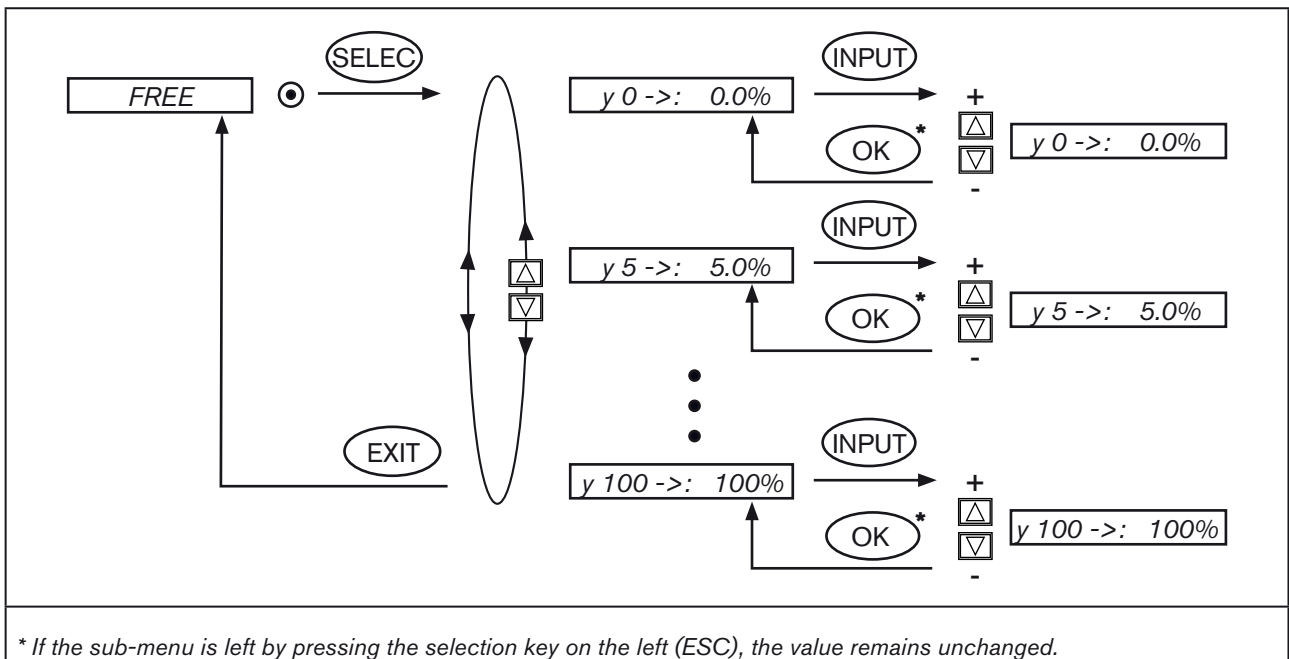
Fig. 12: Operating structure CHARACT FREE

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Procedure:

→ To input the characteristic points (function values), select the *FREE* sub-menu option using the arrow keys and confirm by pressing the selection key on the right (SELEC).

Another sub-menu (*FREE*) opens in which the individual nodes are listed (as %).

→ Select the individual nodes using the arrow keys and confirm by pressing the selection key on the right (INPUT) in order to change the value in the *SET VALUE* sub-menu.
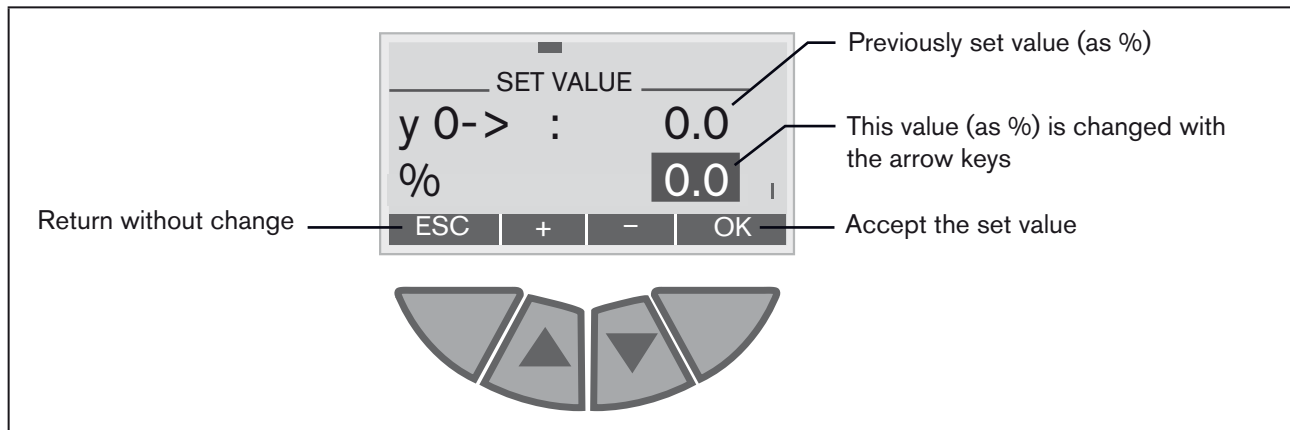
Fig. 41:   Display CHARACT FREE

→ Using the arrow keys (+/-), set the function value from 0 to 100% and confirm by pressing the selection key on the right (OK).

→ When all changes have been made, leave the sub-menu by pressing the selection key on the left (EXIT).

→ Press the selection key on the left again (EXIT) to return to the *CHARACT* menu option.

⚠ Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.

Example of a programmed characteristic
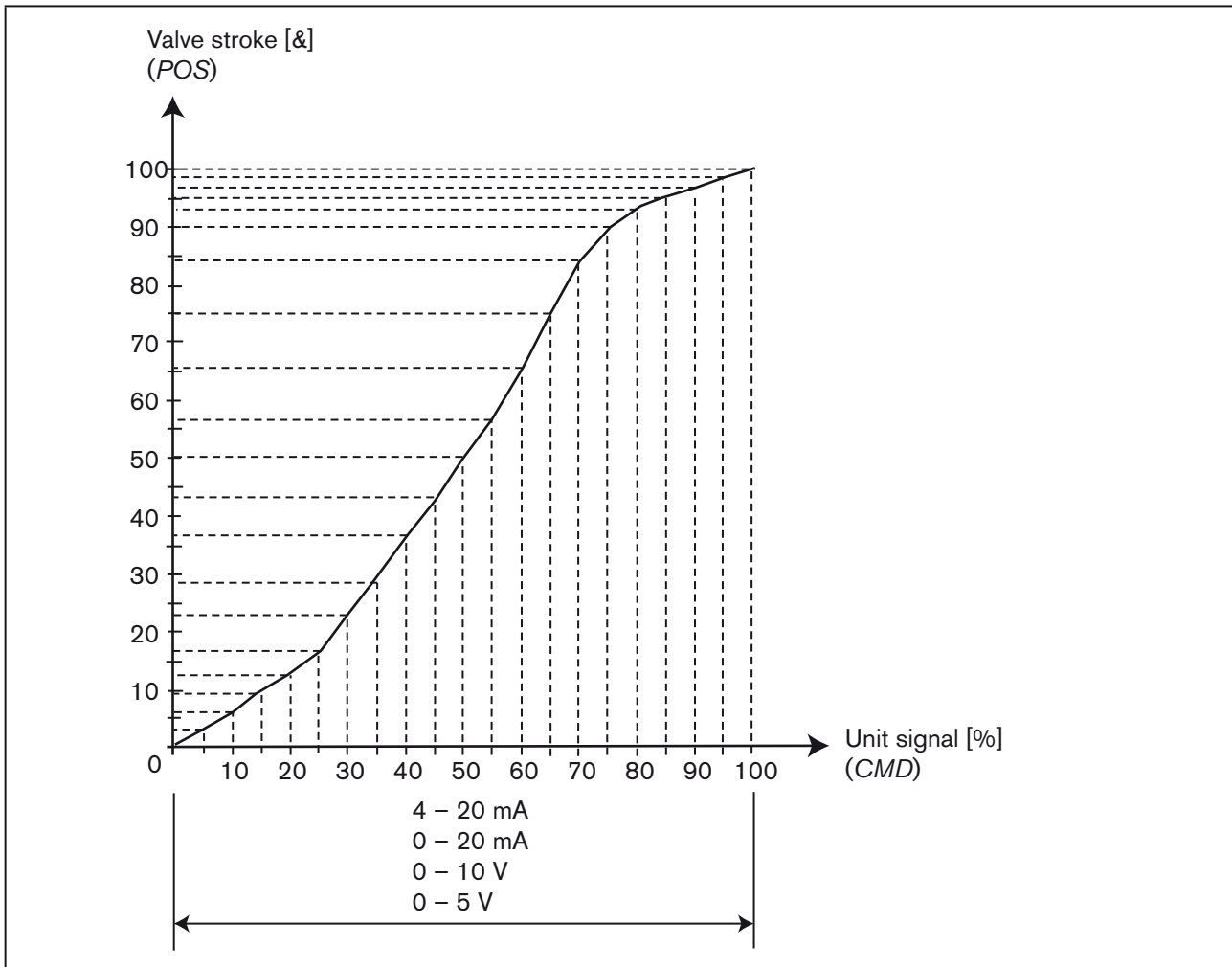
Fig. 42:   Example of a programmed characteristic

> In the section *"Tables for customer-specific settings"* in chapter *"Settings of the Freely Program-mable Characteristic"* there is a table in which you can enter your settings for the freely programmable characteristic.

21.3.4. *CUTOFF*
Sealing function for the position controller type Type 8792

> The sealing function for the process controller type Type 8793 can be found in chapter *Auxiliary functions for the process controller.*

This function causes the valve to be sealed outside the control area.

This is where you input the limits for the position set-point value (*CMD*) as a percentage, from which the actuator is fully deaerated or aerated.
Control mode opens or resumes at a hysteresis of 1%.
If the process valve is in the sealing area, the message *"CUTOFF ACTIVE"* is indicated on the display.

Factory setting: *Min = 0%;*   *Max = 100%*
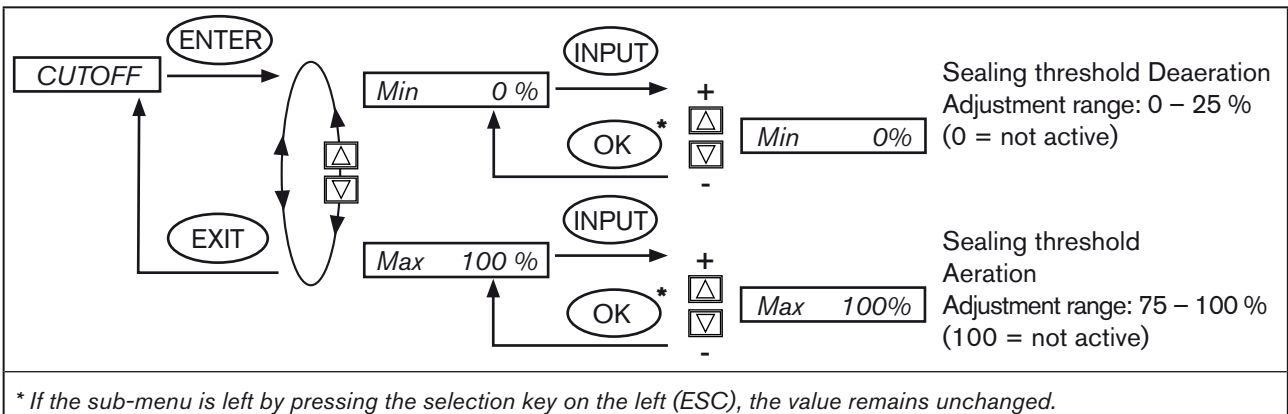
Fig. 43:   Operating structure CUTOFF

> Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.
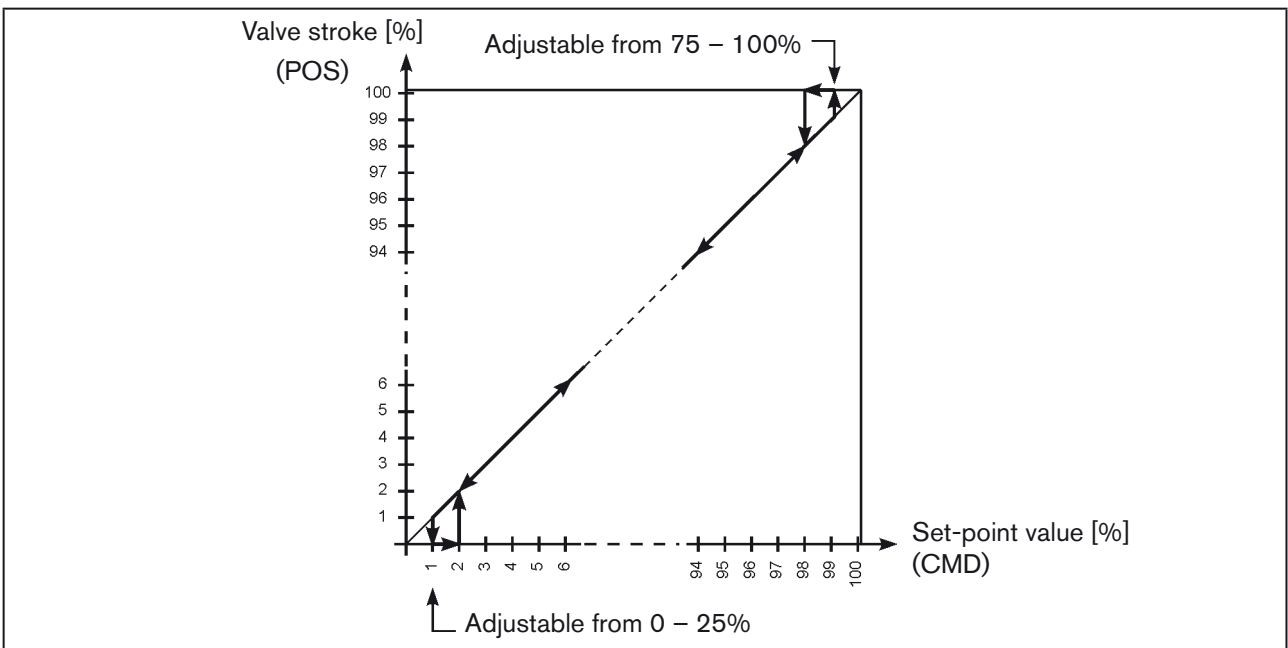
Fig. 44:   Graph - CUTOFF; Position controller type Type 8792

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21.3.5. DIR.CMD
Effective sense (direction) of the position controller set-point value

Use this auxiliary function to set the effective sense of direction between the input signal (*INPUT*) and the nominal position (*CMD*) of the actuator.

Factory setting: *Rise*
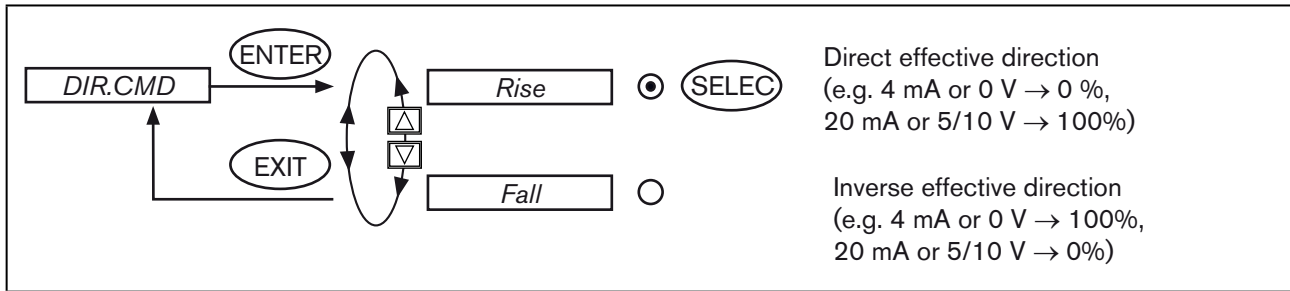
Fig. 45:   Operating structure DIR.CMD

⚠ Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.

Fig. 46:   DIR.CMD graph

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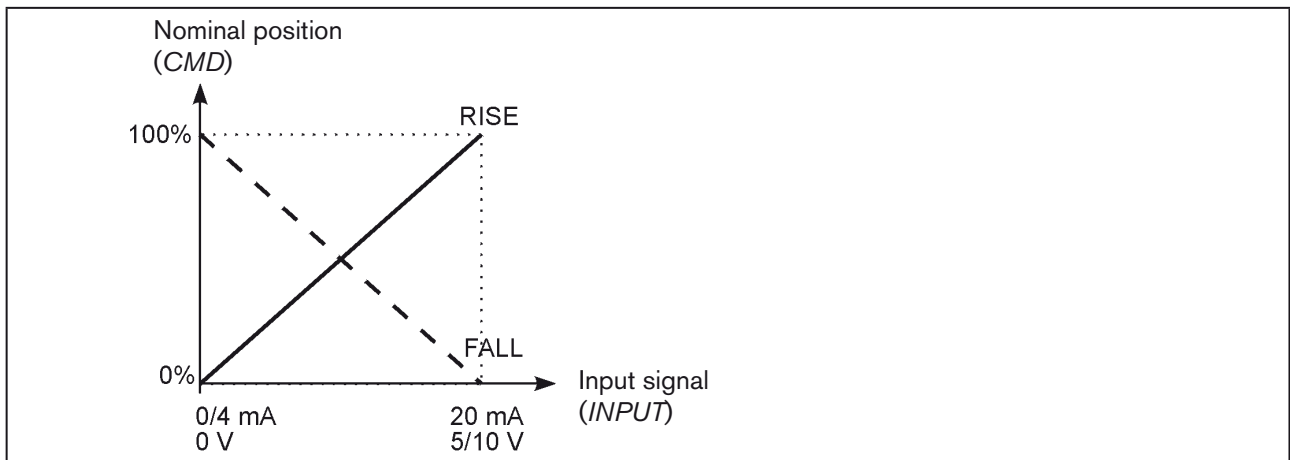
21.3.6. *DIR.ACT*
Effective sense (direction) of the actuator driv

Use this auxiliary function to set the effective sense of direction between the aeration state of the actuator and the actual position (*POS*).

Factory setting: *Rise*

Fig. 47:   Operating structure DIR.ACT

If the *Fall* function is selected, the description of the arrow keys (on the display) changes in the MANUAL operating state
(OPN → CLS and CLS → OPN).

Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.
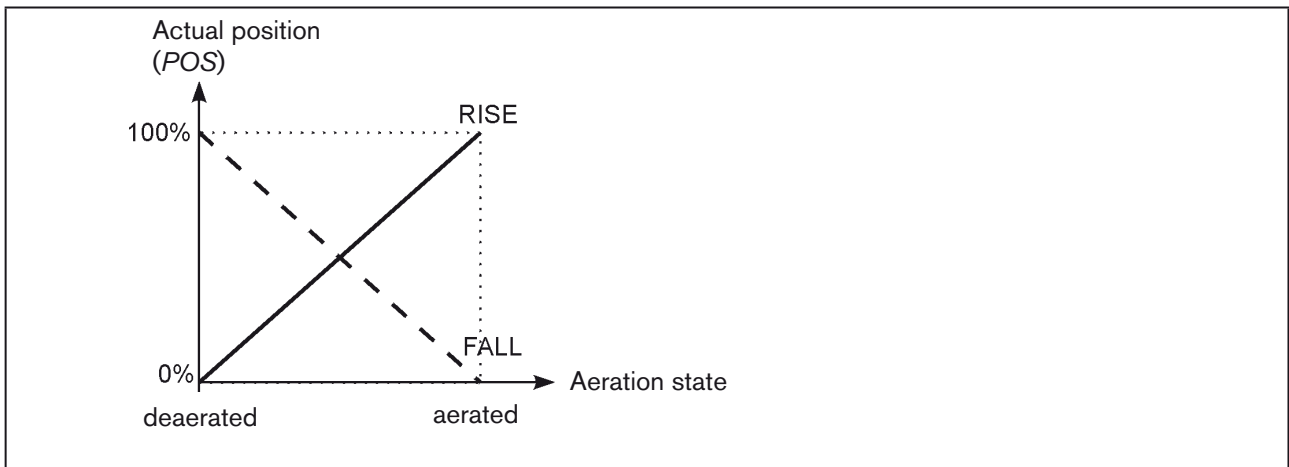
Fig. 48:   DIR.ACT graph

21.3.7. *SPLTRNG*
Signal split range

Min. and max. values of the input signal as % for which the valve runs through the entire stroke range.

Factory setting: *Min = 0%;   Max = 100%*

> ⊘ This function is effective only im Betrieb as a position controller.

Use this auxiliary function to limit the position set-point value range of the positioner by specifying a minimum and a maximum value.

As a result, it is possible to divide a utilised unit signal range (4 − 20 mA; 0 − 20 mA; 0 − 10 V or 0 − 5 V) into several positioners (without or with overlapping).

This allows several valves to be used **alternately** or in the case of overlapping set-point value ranges **simultaneously** as actuators.

Fig. 49:   Operating structure SPLTRNG

> ⊘ Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.

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Splitting a unit signal range into two set-point value ranges

Fig. 50:   SPLTRNG graph

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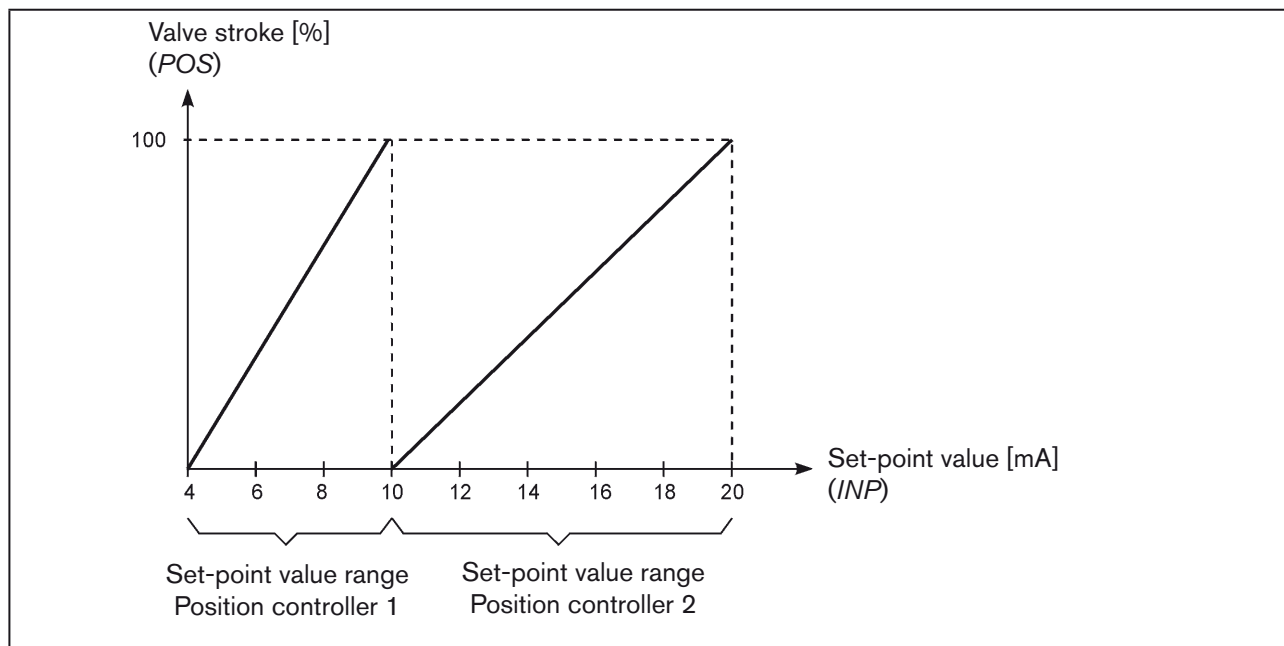
21.3.8. *X.LIMIT*
Limits the mechanical stroke range

This auxiliary function limits the (physical) stroke to specified % values (minimum and maximum). In doing so, the stroke range of the limited stroke is set equal to 100%.

If the limited stroke range is left during operation, negative *POS* values or *POS* values greater than 100% are indicated.

Factory setting: *Min = 0%,*   *Max = 100%*

* If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.

Fig. 51:   Operating structure X.LIMIT

Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.

Fig. 52:   X.LIMIT graph

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21.3.9. *X.LIMIT*
Limiting the control speed

Use this auxiliary function to specify the opening and closing times for the entire stroke and limit the control speeds.

> **!** When the *X.TUNE* function is running, the minimum opening and closing time for the entire stroke is automatically entered for *Open* and *Close*. Therefore, movement can be at maximum speed.

Factory setting: values determined at the factory by the *X.TUNE*

If the control speed is limited, values can be input for *Open* and *Close* which are between the minimum values determined by the *X.TUNE* and 60 s.

* If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.
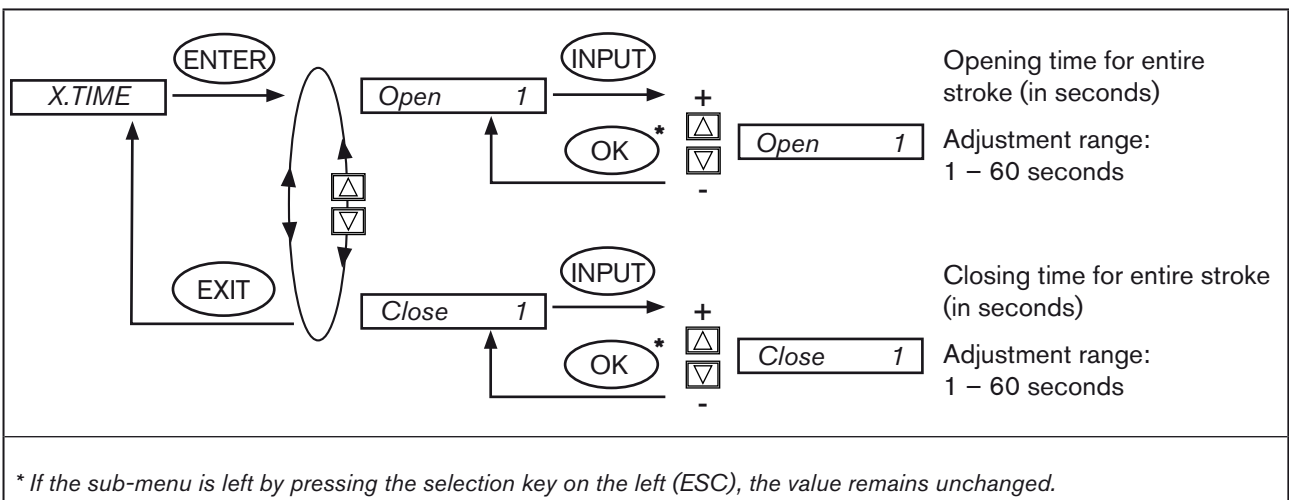
Fig. 53:   Operating structure X.TIME

> **!** Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.

Effect of limiting the opening speed when there is a jump in the set-point value
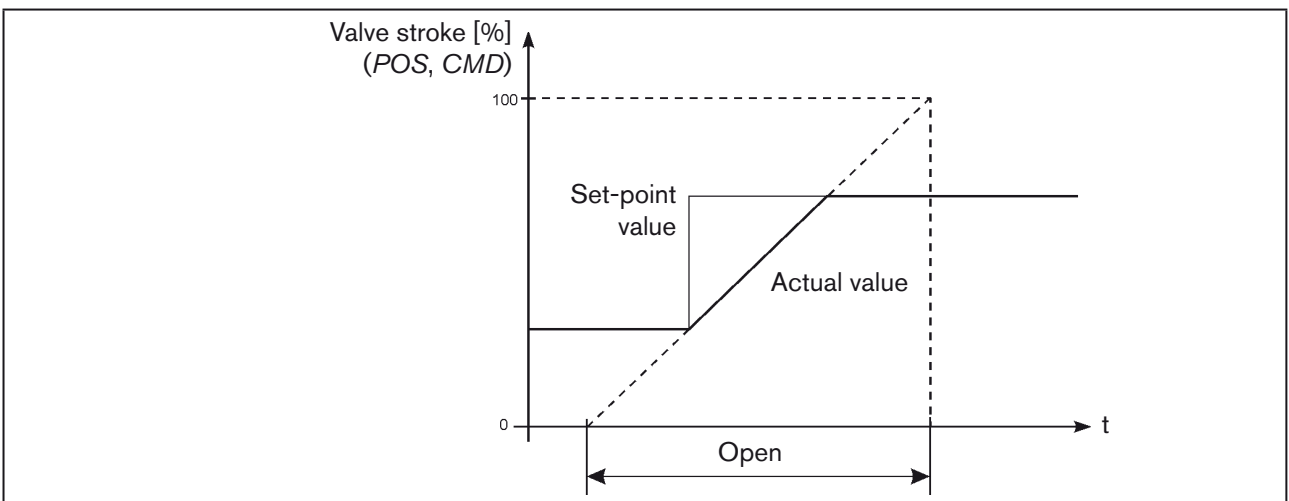
Fig. 54:   X.TIME graph

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21.3.10. *X.CONTROL*
Parameterization of the position controller

Use this function to set the parameters for the position controller (dead band and amplification factors).

* If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.
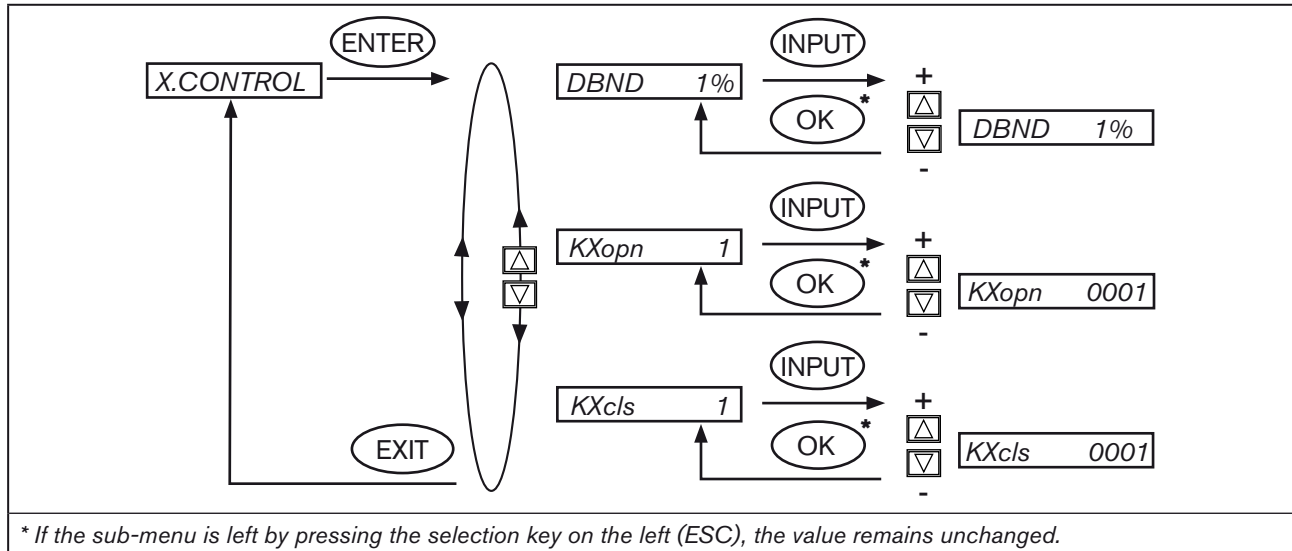
Fig. 55: Operating structure X.CONTROL

DBND **Insensitivity range (dead band) of the position controller**

Input the dead band as %, relating to the scaled stroke range;
i.e. *X.LIMIT Max - X.LIMIT Min* (see Auxiliary function *21.3.8.X.LIMIT Limits the mechanical stroke range*).

This function causes the controller to respond only from a specific control difference; as a result the solenoid valves in the positioner and the pneumatic actuator are protected.

> ! If the auxiliary function *X.CONTROL* is in the main menu while *X.TUNE* (Autotune of the position controller) is running, the dead band *DBND* is determined automatically depending on the friction behaviour of the actuator drive. The guide value determined in this way can be re-adjusted manually.
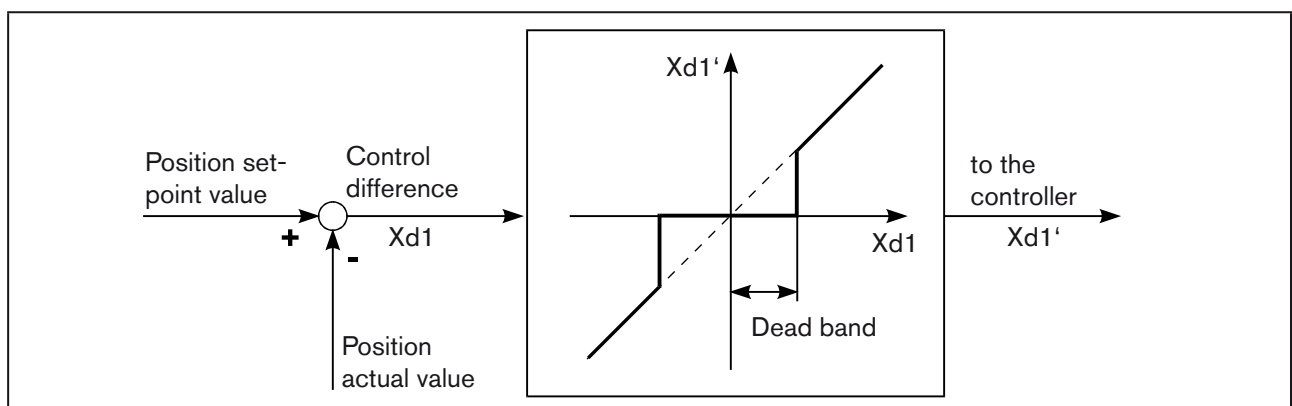
Fig. 56: X.CONTROL graph

KX XXX *Parameter of the position controller*
   KXopn Amplification factor of the position controller (for closing the valve)
   KXcls Amplification factor of the position controller (for opening the valve)

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21.3.11. *SECURITY*
Code protection for the settings

Use the *SECURITY* function to prevent the positioner or individual functions from being accessed unintentionally.

Factory setting: *Access Code: 0000*

If the code protection is activated, the code (set access code or master code) must be input whenever operator action is disabled.

> All operator actions can be implemented with the non-changeable master code. This 4-digit master code can be found in the appendix of these operating instructions in the chapter entitled *"Master code"*.
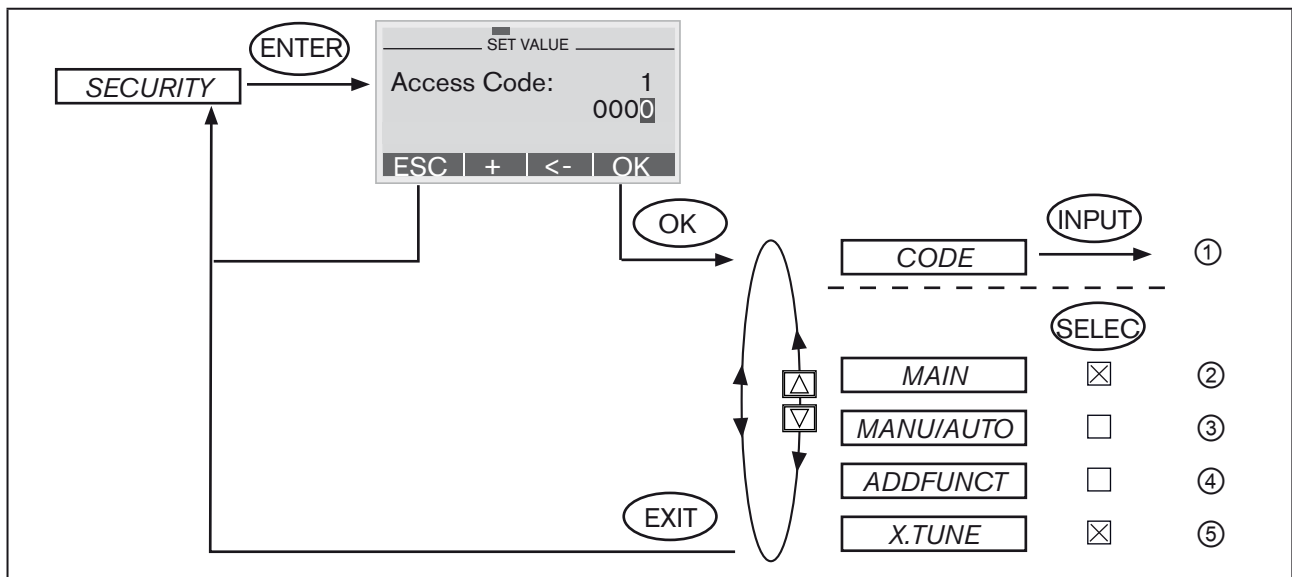
Fig. 57:   Operating structure SECURITY, position controller type Type 8792

① Input screen for inputting or changing the *access code* (for description of input see below)

② Blocking access to the configuration level

③ Blocking switchover between the MANUAL / AUTOMATIC (MANU/AUTO) operating states

④ Blocking the input of auxiliary function

⑤ Blocking the activation of self-parameterization (Autotune)

Inputting the access code:

→ To access the input screen with marked selection menu CODE, press the selection key on the right (INPUT).
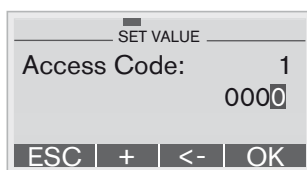
The four-digit code can be changed via the arrow keys.

Down arrow key (←)	Select the individual digits.
Up arrow key (+)	Change the selected digit.
Left selection button (ESC)	Leave the input screen without making a change.
Right selection button (OK)	Leave the input screen saving the input or making a change.

21.3.12. *SAFEPOS*
Input the safety position

This function specifies the actuator safety position which is started at defined signals.

> The set safety position is only started
>
> ▪ if there is a corresponding signal on the binary input
>   (Configuration see *chapter 21.3.14.BINARY-IN   Activation of the binary input*) or
>
> ▪ if a signal fault occurs
>   (Configuration see *chapter 21.3.13.SIG-ERROR   Configuration of signal level fault detection*).
>
> In the case of the bus version (Profibus / DeviceNet) the safety position is also started with
>
> ▪ corresponding parameter telegram
>
> ▪ *BUS ERROR* (adjustable)
>
> If the mechanical stroke range is limited with the *X.LIMIT* function, only safety positions within these limits can be started.
>
> This function is executed in AUTOMATIC mode only.

Factory setting: 0%

* If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.

** If the safety position is 0 % or 100 %, the actuator is completely deaerated or aerated as soon as the safety position is active in the SIG-ERROR or BINARY-IN auxiliary functions.
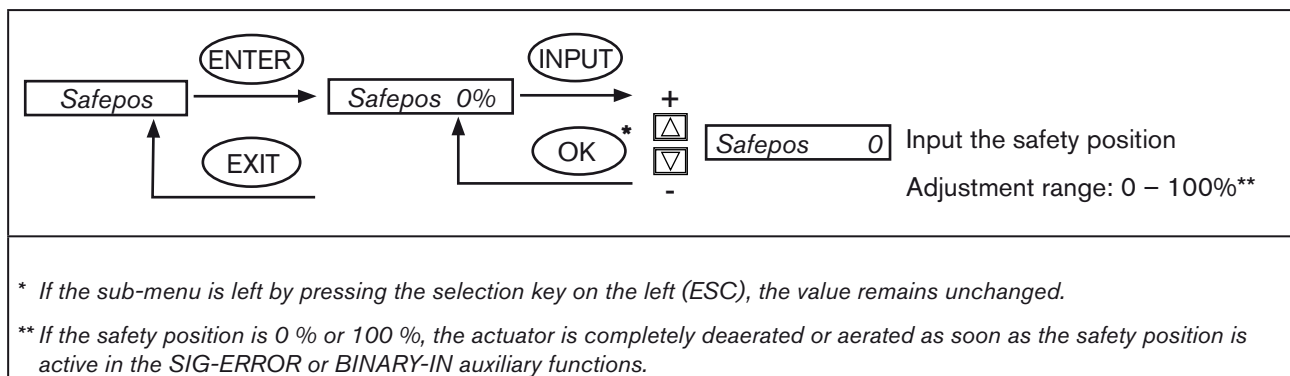
Fig. 58:   Operating structure SAFEPOS

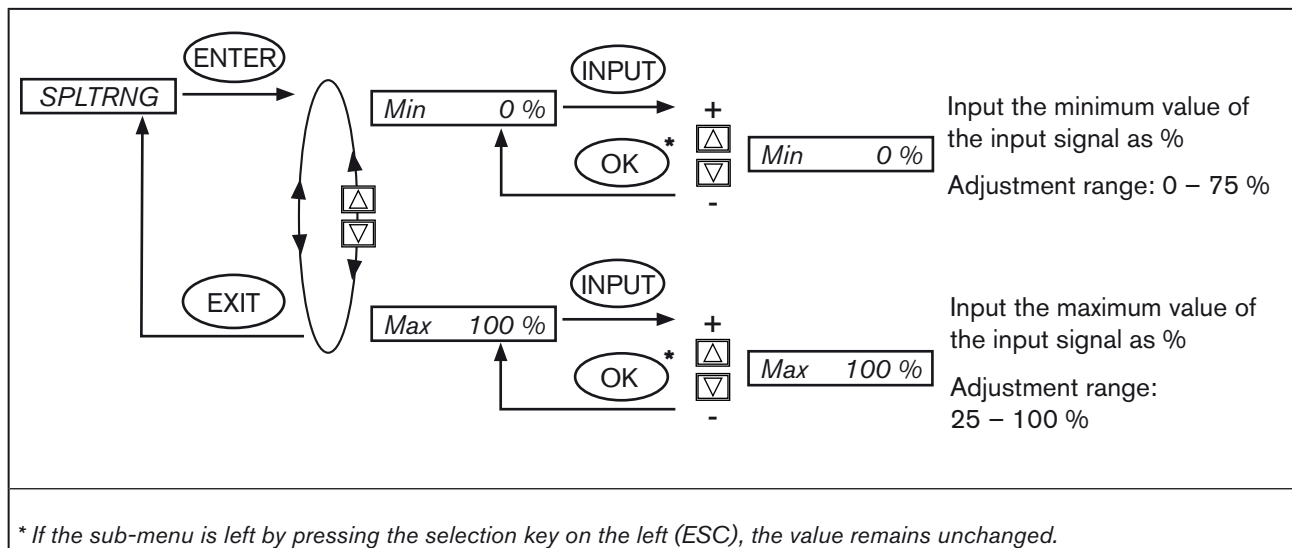> Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.

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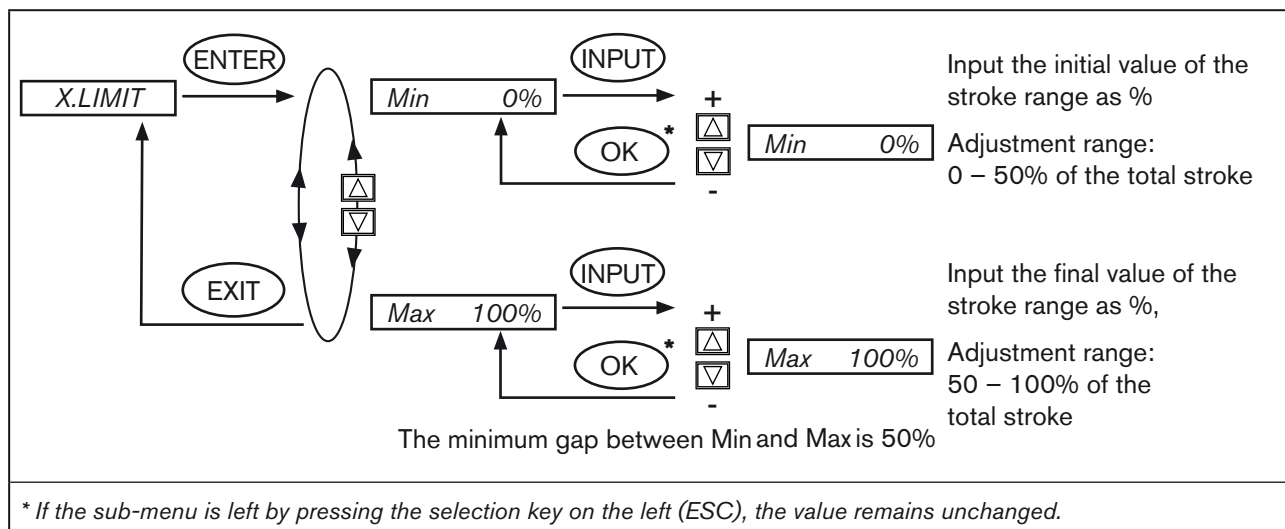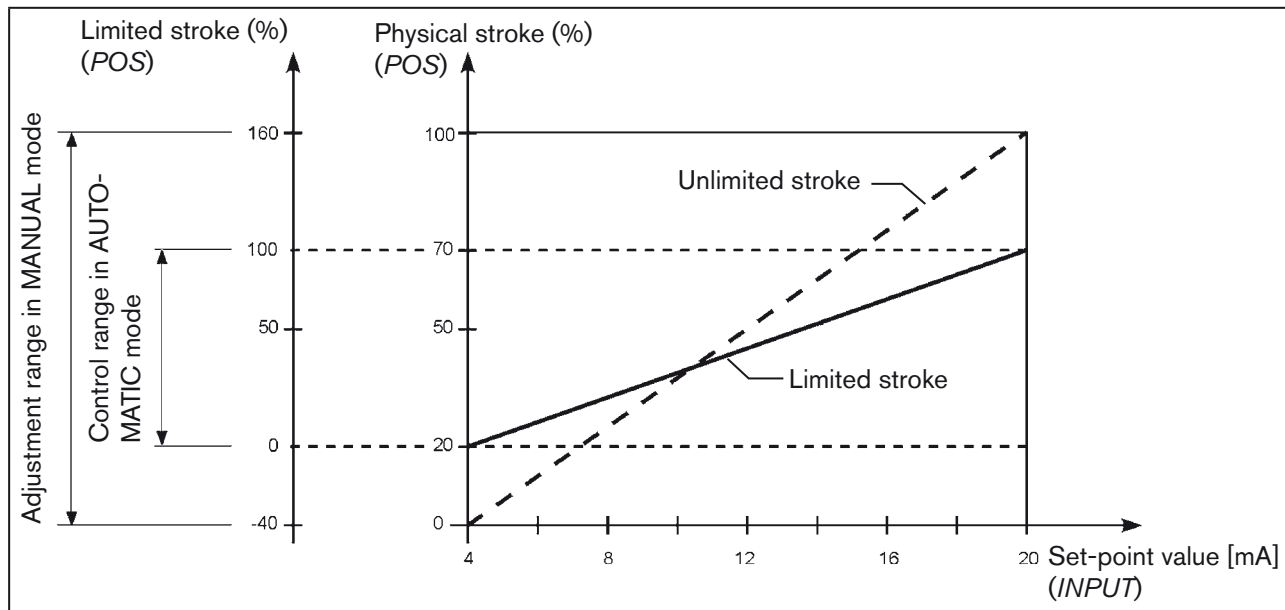
21.3.13. *SIG-ERROR*
Configuration of signal level fault detection

The *SIG-ERROR* function is used to detect a fault on the input signal.

> **Fault detection**
> Fault detection can be selected at 4 – 20 mA signal only:
> Fault with input signal ≤ 3.5 mA (± 0.5% of final value, hysteresis 0.5% of final value)
>
> If other signal types are selected, the respective menu branch is hidden. If this configuration does not allow fault detection, *not available* is indicated in the selection menu.

Fig. 59:   Operating structure SIG-ERROR

If signal fault detection is activated, the respective fault is indicated on the display.
(see chapter *Error Messages on the Display*).

Safety position SAFEPOS on

When *SAFEPOS on* is set, the following configurations may occur:

Active menu option *SAFEPOS*   If a fault is detected, the actuator moves to the lower *SAFEPOS* set position.

Inactive menu option *SAFEPOS*   If a fault is detected, the actuator moves to the end position which the actuator would specify in the isolated state.

21.3.14. *BINARY-IN*
Activation of the binary input

This function activates the binary input.

The following settings can be implemented for this:

▪ Approaching the safety position or

▪ Switching over the MANUAL/AUTOMATIC operating mode
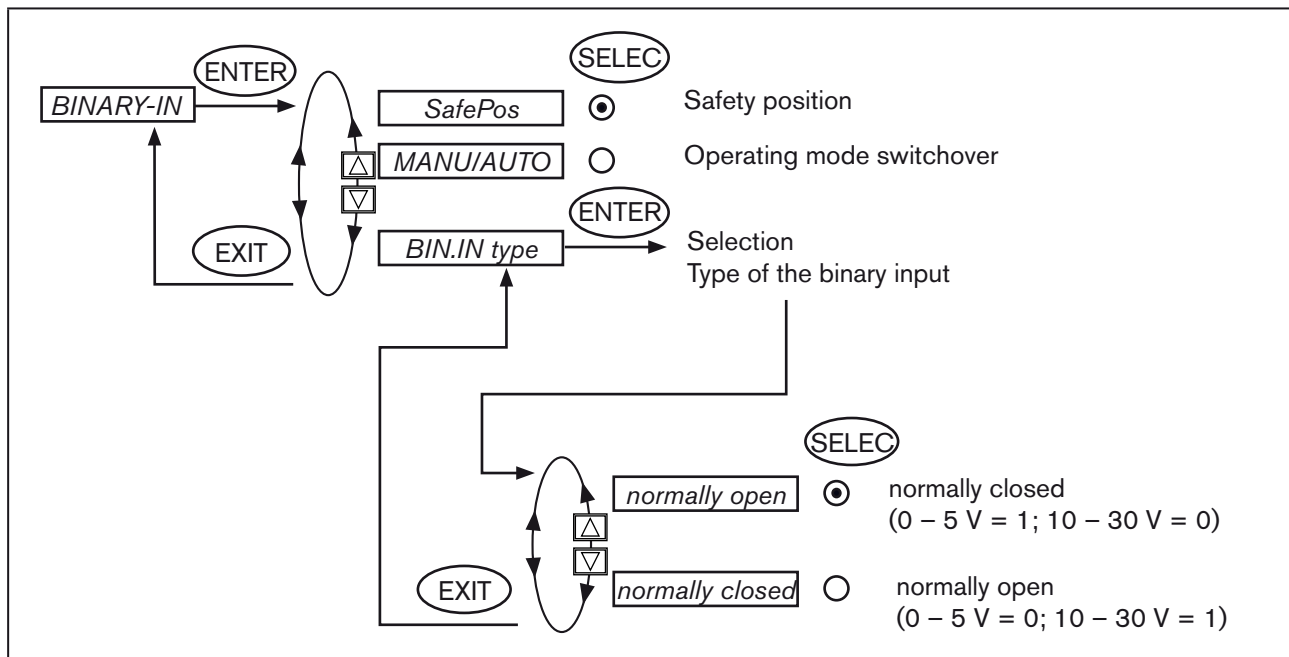
Fig. 60:   Operating structure BINARY-IN

SAFEPOS safety position

Approaching a safety position:

Active menu option *SAFEPOS*   The actuator moves to the lower *SAFEPOS* set position.

Inactive *SAFEPOS* menu option   The actuator moves to the end position which it would specify in the isolated state.

Operating mode switchover MANU/AUTO

Switch over the operating state to MANUAL or AUTOMATIC:

Binary input = 0   → AUTOMATIC operating mode

Binary input = 1   → MANUAL operating mode

> ⊘ If operating mode switchover is selected, you can no longer switch over the operating mode via the selection key on the right (MANU/AUTO).

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21.3.15. *OUTPUT* (option) Configuring the outputs

> ⓘ The *OUTPUT* menu option is only indicated in the selection menu of *ADD.FUNCTION* if the positioner has outputs (option).

The outputs can be used for the following feedback signals:

Analogue output: Feedback signal of the current position (*POS*) or of the set-point value (*CMD*) to the control centre.

Binary outputs: ▪ Alarm output for excessively large control deviations of the position controller

▪ for the output of the current position with respect to a specified limit position (> or <)

▪ for output: actuator in safety position

▪ for the output: sensor break

▪ for the output: operating state (AUTOMATIC / MANUAL).

The positioner which has the outputs option is available in the following versions:

▪ one analogue output

▪ one analogue and two binary outputs

▪ two binary outputs

> ⓘ According to the version of the positioner only the possible adjustable outputs (*ANALOGUE, ANALOGUE + BIN 1 + BIN 2 or BIN 1 + BIN 2*) are indicated in the OUTPUT menu option.

Fig. 61:   *Operating structure OUTPUT; position controller type Type 8792*

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① *OUT ANALOG* - Configuring the analogue output

> **!** Only for the versions:
> ▪ one analogue output
> ▪ one analogue and two binary outputs

The feedback signal of the current position (*POS*) or of the set-point value (*CMD*) can be transmitted to the control centre via the analogue output.
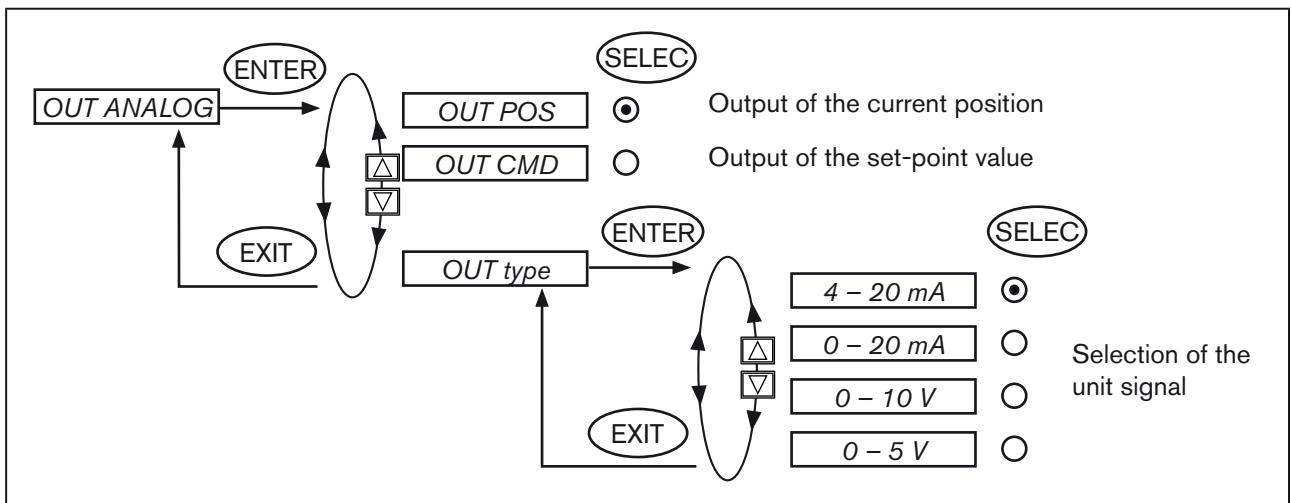
Fig. 62: Operating structure OUTPUT-ANALOG; position controller type Type 8792

> **!** Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.

② *OUT BIN1* - Configuring the binary output 1

③ *OUT BIN2* - Configuring the binary output 2

The following description is valid for both binary outputs *OUT BIN 1* and *OUT BIN 2*, as the operation in the menu is identical.

The binary outputs 1 and 2 can be used for one of the following outputs:

▪ Alarm output for excessively large control deviations of the position controller

▪ for the output of the current position with respect to a specified limit position (> or <)

▪ for the output: actuator in safety position

▪ for the output: sensor break

▪ for the output: operating state (AUTOMATIC / MANUAL)
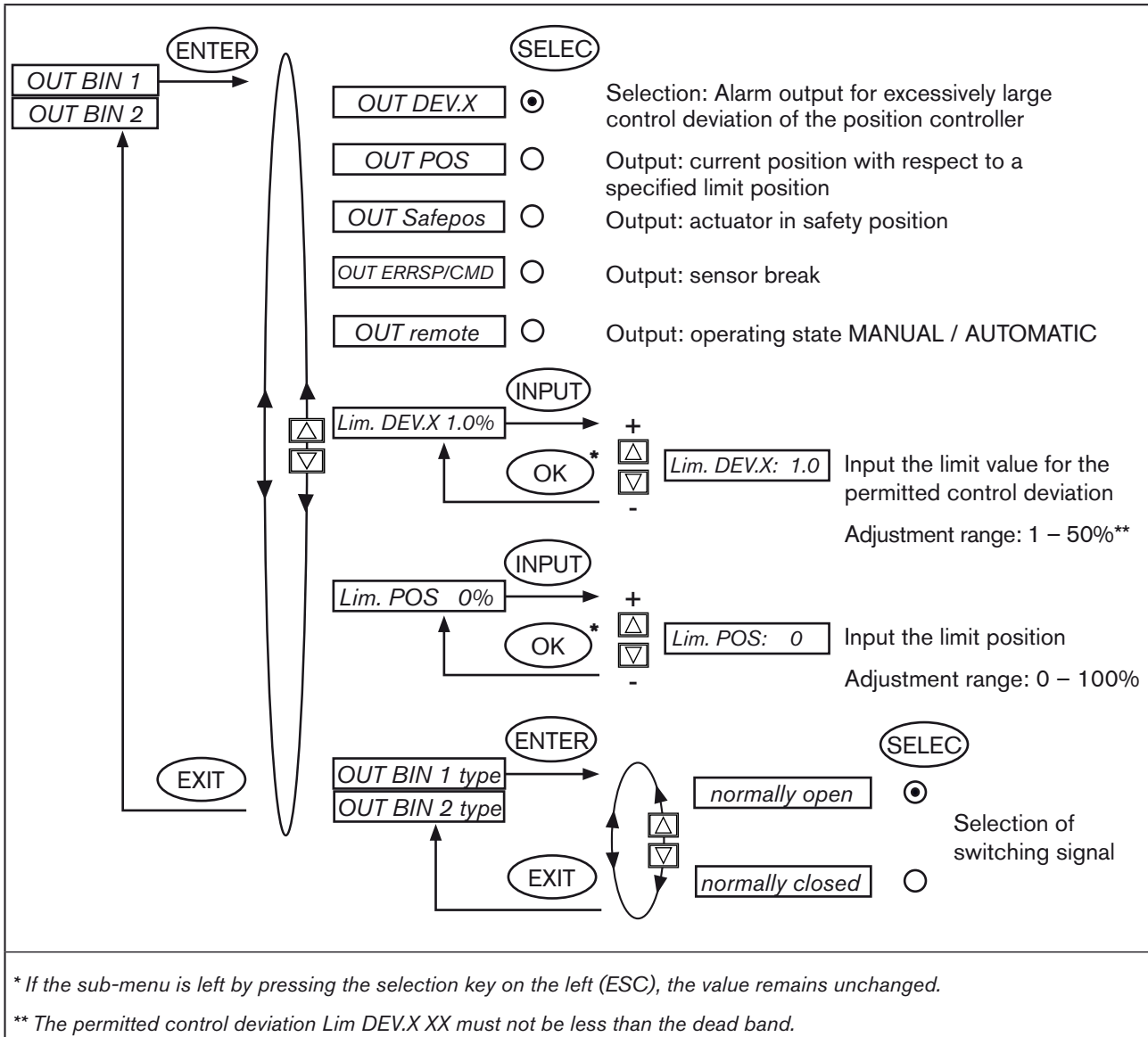
Fig. 63:   Operating structure OUTPUT-BIN1/BIN2; position controller type Type 8792

> ⚠ *Normally closed* output, in switched state *low* ($\cong$ 0 V)
>
> *Normally opened* output, in switched state *high* ($\cong$ 24 V)

> ⚠ Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.

OUT DEV.X **Alarm output for excessively large control deviation of the position controller:**

→ Press the arrow keys to mark the *OUT DEV.X* menu option and confirm with the selection key on the right (SELEC).

→ Press the arrow keys to input the the limit value for the permitted control deviation in the Lim. DEV.X menu option and accept with the selection key on the right (OK).

> ⓘ The permitted control deviation *Lim. DEV.X XX* must not be less than the dead band.

→ In the *OUT BIN1/2 type* menu option input the required switching status (*normally open / normally closed*) (see *Table 32:*).

OUT POS **Output of the current position with respect to a specified limit position:**

→ Press the arrow keys to mark the *OUT POS* menu option and confirm with the selection key on the right (SELEC).

→ Press the arrow keys to input the value of the limit position in the Lim. POS 0% menu option and accept with the selection key on the right (OK).

→ In the *OUT BIN1/2 type* menu option input the required switching status (*normally open / normally closed*) (see *Table 32:*).

OUT BIN1/2	normally open*	normally closed**
POS > LIM	0 V ─o⟋o─	24 V ─o⟋ᴵ─
POS < LIM	24 V ─o⟋ᴵ─	0 V ─o⟋o─
* Normally open- output, in switched state *high* ($\cong$ 24 V) **** Normally closed- output, in switched state *low* ($\cong$ 0 V)		

Table 32: Switching status OUT BIN - POS > LIM; position controller type Type 8792

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OUT Safepos   **Output of message: Actuator in safety position:**

→ Press the arrow keys to mark the *OUT Safepos* menu option and confirm with the selection key on the right (SELEC).

→ In the *OUT BIN type* menu option input the required switching status (*normally open / normally closed*) (see *Table 33:*).

OUT ERR SP/CMD   **Output broken sensor:**

→ Press the arrow keys to mark the *OUT ERR SP/CMD* menu option and confirm with the selection key on the right (SELEC).

→ In the *OUT BIN1/2 type* menu option input the required switching status (*normally open / normally closed*) (see *Table 33:*).

OUT remote   **Output operating state AUTOMATIC / MANUAL:**

→ Press the arrow keys to mark the *OUT remote* menu option and confirm with the selection key on the right (SELEC).

→ In the *OUT BIN1/2 type* menu option input the required switching status (*normally open / normally closed*) (see *Table 33:*).

OUT BIN1/2	*normally open*	*normally closed*
AUTOMATIC operating state	0 V	24 V
MANUAL operating state	24 V	0 V
* Normally open- output, in switched state *high* ($\cong$ 24 V)		
** Normally closed- output, in switched state *low* ($\cong$ 0 V)		

Table 33:   Switching status OUT BIN - MANUAL / AUTOMATIC; position controller type Type 8792

21.3.16. *CAL.USER*
Calibrating the actual value display and the inputs for the position set-point value

The following points can be manually calibrated with this function:

▪ Position display (*POS*) 0 – 100%

▪ Position set-point value display (*INPUT*)
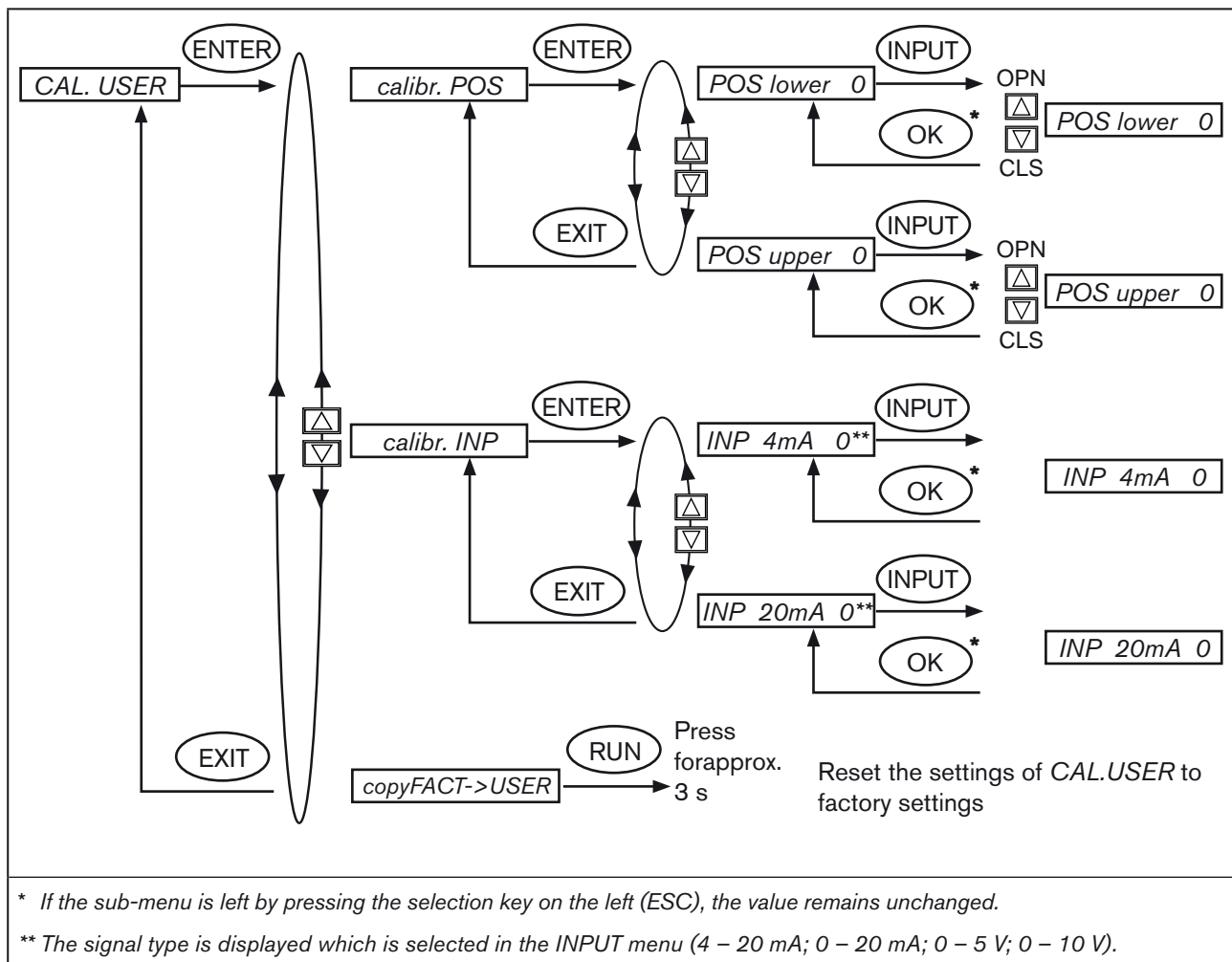
Fig. 64:   Operating structure CAL.USER; position controller type Type 8792

⚠ Remove the *CAL.USER* auxiliary function to re-activate the factory calibration.

Procedure:

calibr. POS **Calibrating the actual value display POS (0 – 100%):**

→ In the *CAL. USER* menu press the arrow keys to select the *calibr. POS* and confirm with the selection key on the right (ENTER).

Accept the minimum position:

→ Press the arrow keys to mark the *POS lower X* menu option and confirm with the selection key on the right (SELEC).

→ Approach the minimum position of the valve using the arrow keys (OPN/CLS) and confirm this value by pressing the selection key on the right (OK).

Accept the maximum position:

→ Press the arrow keys to mark the *POS upper X* menu option and confirm with the selection key on the right (SELEC).

→ Approach the maximum position of the valve using the arrow keys (OPN/CLS) and confirm this value by pressing the selection key on the right (OK).

calibr. INP   **Calibrating the position set-point value (4 – 20 mA; 0 – 20 mA; 0 – 5 V; 0 – 10 V):**

→ In the *CAL. USER* menu press the arrow keys to select the *calibr. INP* and confirm with the selection key on the right (ENTER).

Accept the minimum input signal (0 mA; 4 mA; 0 V):

→ Using the arrow keys, select the *INP (0 mA; 4 mA; 0 V)* menu option and confirm with the selection key on the right (INPUT).

→ Specify the minimum value of the unit signal at the input and confirm this value with the selection key on the right (OK).

Accept the maximum input signal (20 mA; 5 V; 10 V):

→ Using the arrow keys, select the *INP (20 mA; 5 V; 10 V)* menu option and confirm with the selection key on the right (INPUT).

→ Specify the maximum value of the unit signal at the input and confirm this value with the selection key on the right (OK).

copy FACT→USER   **Resetting the settings under CAL.USER to the factory settings:**

→ In the *CAL.USER* menu select the *copy FACT→USER* menu option using the arrow keys and confirm with the selection key on the right (ENTER).

→ Hold down the selection key on the right (RUN) (for approx. 3 seconds) until the countdown has elapsed.

21.3.17. *SET.FACTORY*
Resetting to the factory settings

This function allows all settings implemented by the user to be reset to the delivery status.

All EEPROM parameters with the exception of the calibration values are reset to default values. Then a hardware reset is implemented.
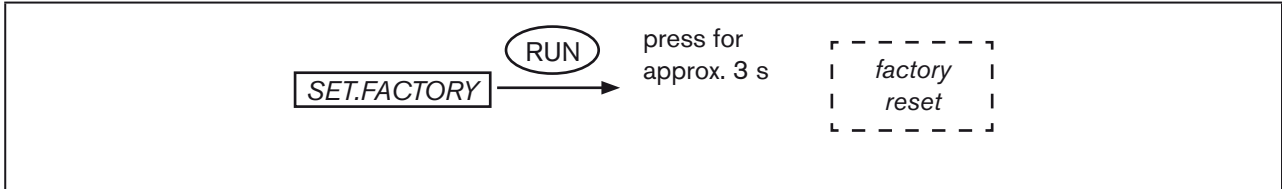
Fig. 65:   Operating structure SET.FACTORY

→ To activate the *SET.FACTORY* function, hold down the selection key on the right (RUN) for approx. 3 s until the countdown has elapsed.

To adjust the positioner to the operating parameters, re-implement self-parameterization of the position controller (*X.TUNE*).

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21.3.18. *SER. I\O*
Settings of the serial interface

This function can be used to set the type of the serial interface and the baud rate.
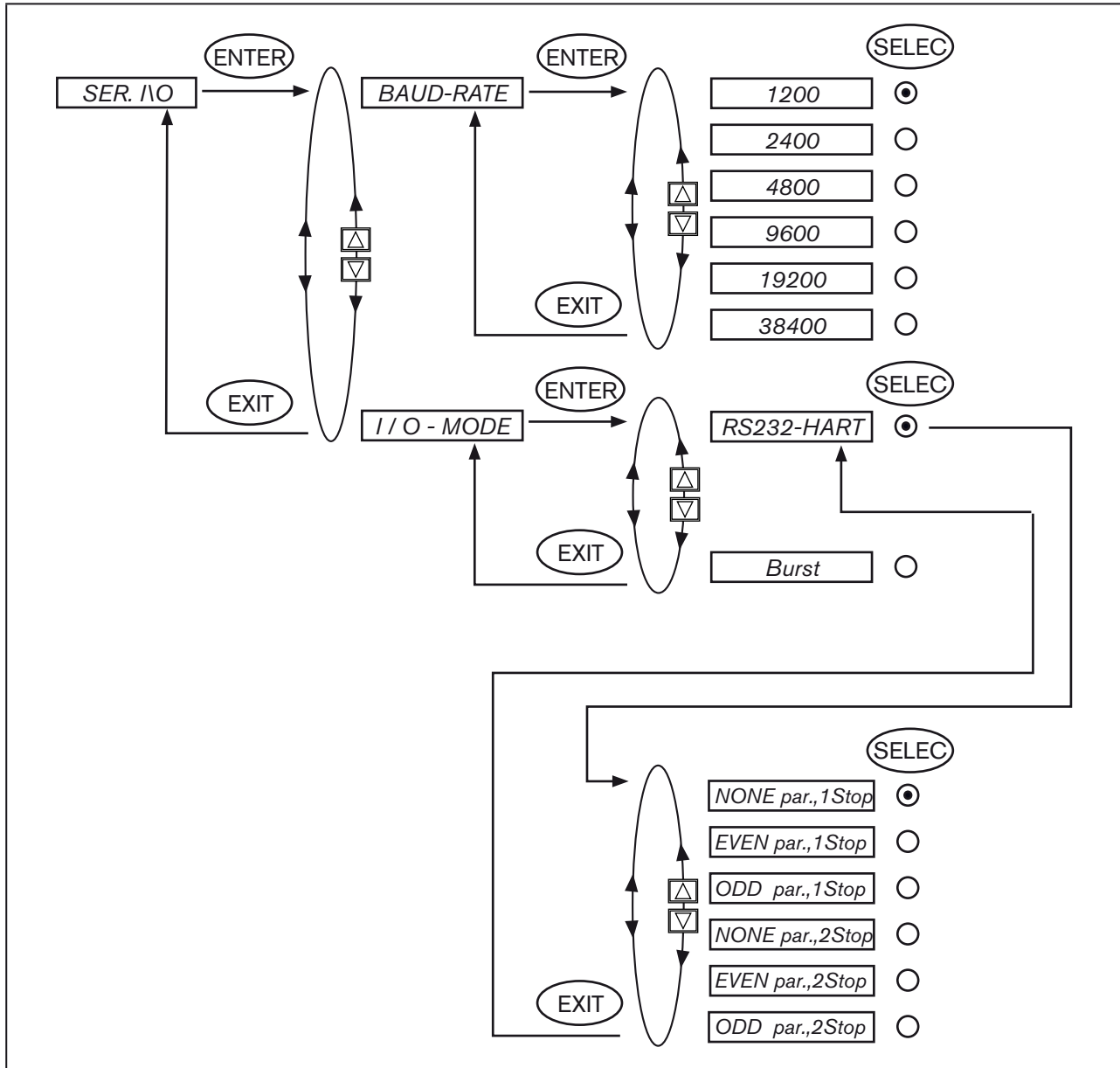
Fig. 66:   Operating structure SER. I\O

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21.3.19. *EXTRAS*

This function can be used to set the representation on the display.
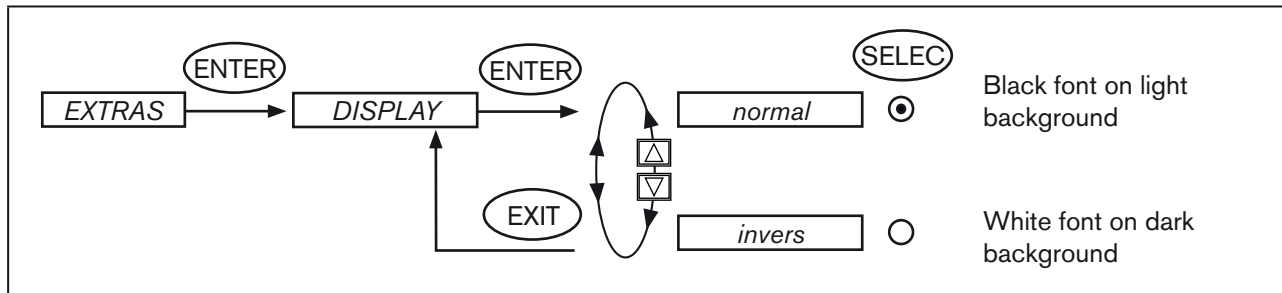
Fig. 67: *Operating structure EXTRAS*

21.3.20. *POS.SENSOR*

The remote model of the process controller type 8793 can be connected to the path sensor by means of different interfaces (the position controller type 8792 remote model with digital interface only).

> The *POS.SENSOR* menu option does not appear in the *ADD.FUNCTION* selection menu unless a process controller type 8793 is a remote model.
>
> If the *ANALOG* interface setting is selected, the positioner can be operated as a position controller only and no longer as a process controller.
>
> The *P:CONTROL* menu option is removed automatically.
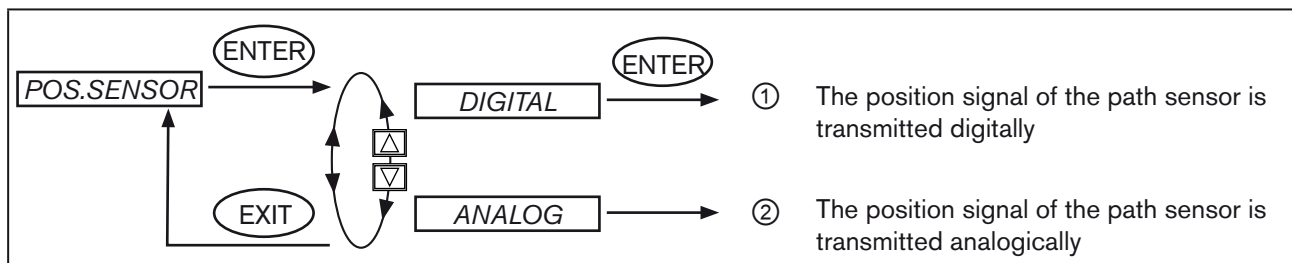
Bild 1: *Operating structure POS.SENSOR*

① Digital interface (menu option *POS.SENSOR → DIGITAL*):
  The positioner is connected to the path sensor type 8791 via a digital interface (see chapter *17.2.4.*).

② Analog interface (menu point *POS.SENSOR → ANALOG*):
  The positioner is connected via a 4 – 20 mA interface to any path sensor with a 4 – 20 mA output signal.

  If the path sensor requires an additional power supply voltage of 24 V DC, this can be supplied via the positioner (see chapter *17.3.1.*.

21.3.21. *SERVICE*

This function is of no importance to the operator of the positioner. It is for internal use only.

Start-up and operation of the position controller Type 8793

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english

22. STARTING UP AND ADJUSTING THE PROCESS CONTROLLER

22.1. Safety instructions

⚠ **DANGER!**

Risk of injury from high pressure in the equipment!

▪ Before loosening the lines and valves, turn off the pressure and vent the lines.

⚠ **WARNING!**

Risk of injury from improper start-up!

▪ Start-up may be carried out by authorised technicians only and with the appropriate tools!

Risk of injury from unintentional activation of the system and an uncontrolled restart!

▪ Secure system from unintentional activation.

▪ Following start-up, ensure a controlled restart.

22.2. Installation

→ Before start-up, carry out fluid and electrical installation of the positioner and valve.

❗ To set up the positioner as a process controller, it is first necessary to specify the basic functions of the position controller and then supplement the auxiliary functions for the process control.

22.3. Procedure for specifying the settings

When the operating voltage has been switched on, the positioner is at the process operating level in the AUTOMATIC operating state.

To specify the standard settings, switch to the configuration level.

→ Hold down the left selection key (MENU) for approx. 3 seconds (wait for countdown on display).

Then the main menu is indicated on the display (MAIN).

→ Use the arrow keys to switch between the main menu options and select a menu.

→ Press the right selection key (ENTER/RUN) to confirm the selection.

Depending on the function, a menu sub-option or a selection screen is indicated on the display.

Use the arrow keys to switch between the submenu options and select the required settings.

→ Press the right selection key (SELEC/ENTER) to confirm the selection (the dot after the selected parameter is now marked).

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→ To return to the main menu, press the left selection key (EXIT).

→ To save the changed settings, leave the configuration level by pressing the left selection key (EXIT).

The positioner is now back on the process operating level.

> Only when you leave the configuration level by pressing the right selection key, are the changed parameters and settings saved (*"save EEPROM"*).

22.4. Factory settings of the process controller

Function	Factory setting	Function	Factory setting
P.CONTROL		*SETUP*	
PARAMETER		*PV-INPUT*	*4 – 20 mA*
DBND	*1.0%*	*PV SCALE*	*PVmin 0.0*
KP	*1.00*		*PVmax 100.0*
TN	*999.9*	*SP-INPUT*	*internal*
TV	*0.0*	*P.CO-INIT*	*bumpless*
X0	*0.0%*		
FILTER	*0*		

Table 34:   Factory settings; process controller Type 8793

> The factory settings of the position controller can be found in chapter *Factory settings of the position controller*.

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22.5. Procedure for setting up a process control

> ⚠ **The process control cannot be implemented until the position controller has been automatically adjusted *(X.TUNE)*!**

To operate the positioner as a process controller, implement the following steps in the indicated sequence:

Setting up the position controller:

A → Specify the basic settings of the positioner and implement automatic adjustment of the position controller *(X.TUNE)*.

Setting up the process controller:

B → Start the *P.CONTROL* auxiliary function via the configuration menu in the main menu.
The *P.CONTROL* function also inserts the *P.Q'LIN* and *P.TUNE* function into the main menu.

C → Implement the basic settings for the process controller under *P.CONTROL*.

D Linearization of the process characteristic

→ Implement the P.Q'LIN function.

E Self-optimization of the process controller

→ Activate the *P.TUNE* function.

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22.6.   Setting up the position controller Ⓐ

Specification of the basic settings is described in the chapter entitled *Start-up and operation of the position controller Type 8792 / Specifying the standard settings.*

When starting up the positioner for the first time, implement the following basic settings:

→ Specify the selected unit signal input for the set-point value default (*INPUT*)
(4 – 20 mA; 0 – 20 mA; 0 – 10 V or 0 – 5 V).

→ Start automatic adjustment of the position controller to the particular operating conditions (*X.TUNE*).

The exact description of the *INPUT* and *X.TUNE* functions can be found in the chapter entitled *Start-up and operation of the position controller Type 8792 / Description of the basic functions in the main menu.*

The basic settings for the positioner are implemented at the factory.

Essential inputs for start-up:

▪ Input the input signal (*INPUT*) and

▪ Run *X.TUNE*

▪ *X.TUNE function*, the positioner automatically determines the optimum settings for the current operating conditions.

22.7.   Setting up the process controller

22.7.1.   *P.CONTROL*   Starting the auxiliary function Ⓑ

How to start the auxiliary functions is described in the chapter entitled *Start-up and operation of the position controller Type 8792 / Configuring the auxiliary functions.*

→ Press the left selection key (MENU) to switch to the configuration level in the main menu (MAIN).

→ Using the arrow keys, select the *ADD.FUNCTION* menu option and confirm by pressing the right selection key (ENTER).

→ Using the arrow keys, select the *P.CONTROL* menu option and confirm by pressing the right selection key (ENTER).

→ Press the left selection key (EXIT) to return to the main menu.

The main menu now contains the *P.CONTROL*, *P.Q'LIN* and *P.TUNE* auxiliary functions.

22.7.2. *P.CONTROL* Basic settings for the function Ⓒ

*   *The SP SCALE function is indicated only if the external set-point value default (external) menu option is activated under SP INPUT.*
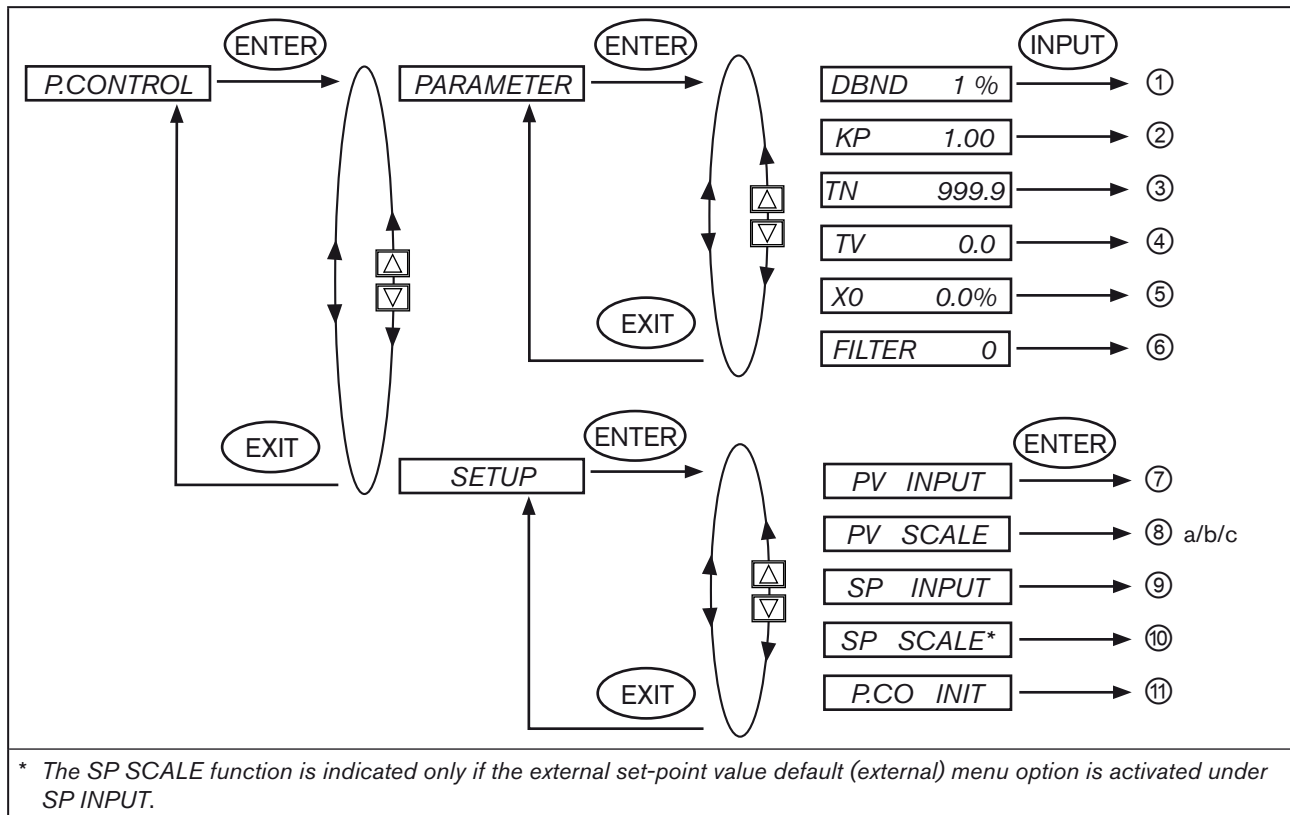
Fig. 68: Operating structure P.CONTROL

Legend:

① Insensitivity range (dead band) of the PID process controller
② Amplification factor of the process controller
③ Reset time
④ Hold-back time
⑤ Working point
⑥ Filtering of the process actual value input
⑦ Specification of the signal type for process actual value
⑧a Scaling the process controller for signal type 4 – 20 mA
⑧b Scaling the process controller for frequency input signal type
⑧c Scaling the process controller for selection of the Pt 100 input
⑨ Type of set-point value default (internal or external)
⑩ Scaling of the position controller (for external set-point default value only)
⑪ Enables a smooth switchover between AUTOMATIC and MANUAL mode

22.7.2.1. *Parameters* Setting parameters for the process controller

These positioner functions are used to manually set the control parameters of the process controller.

The setting can be implemented automatically by means of the *P.TUNE* function (see chapter *22.7.4.*).

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> The basic principles of setting a controller can be found under *Additional technical information* in chapter *Properties of PID Controllers.*

① *DBND* - **Insensitivity area (dead band) of the process controller**

This function causes the process controller to respond from a specific control difference only. This protects both the solenoid valves in the positioner and the pneumatic actuator.

Factory setting: 1.0% (with reference to the range of the process actual value scaled by *PV SCALE - PVmin* and *PVmax*)

* If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.
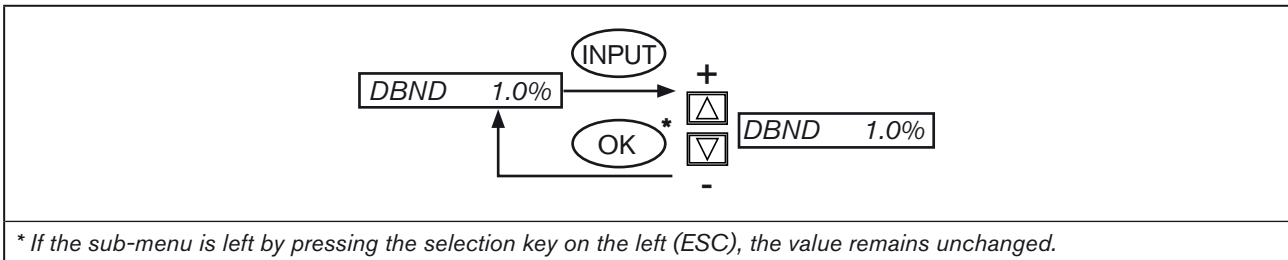
Fig. 69:   Operating structure P.CONTROL - DBND

Insensitivity area for process control
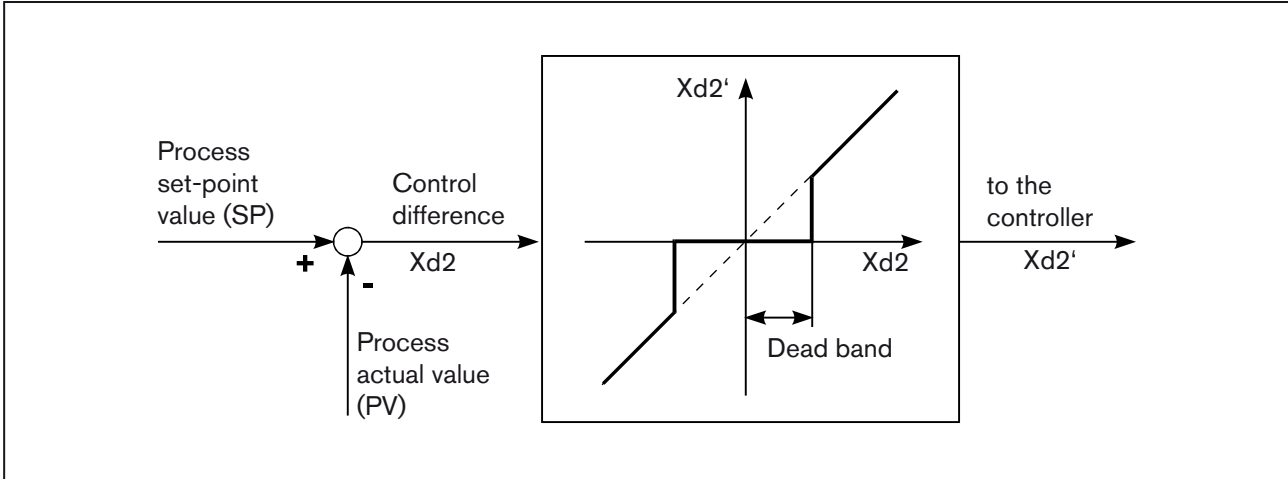
Fig. 70:   P.CONTROL - DBND graph

② *KP* - Amplification factor of the process controller

The amplification factor specifies the P-contribution of the PID controller.

Factory setting: 1.00

| KP 1.00 | INPUT → | + △ ▽ * | KP 1.00 | Adjustment range: 0 – 99.99 (% / set unit) |
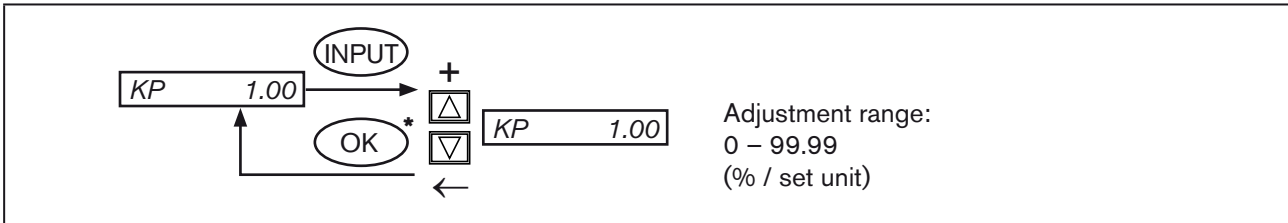
Fig. 71:   Operating structure P.CONTROL - KP

> The *KP* amplification of the process controller refers to the scaled unit.

③ *TN* - Reset time of the process controller

Specifies the I-contribution of the PID controller.

Factory setting: 999.9 s

| TN 0.5 | INPUT | + △ ▽ * | TN 999.9 | Adjustment range: 0.5 – 999.9 s |
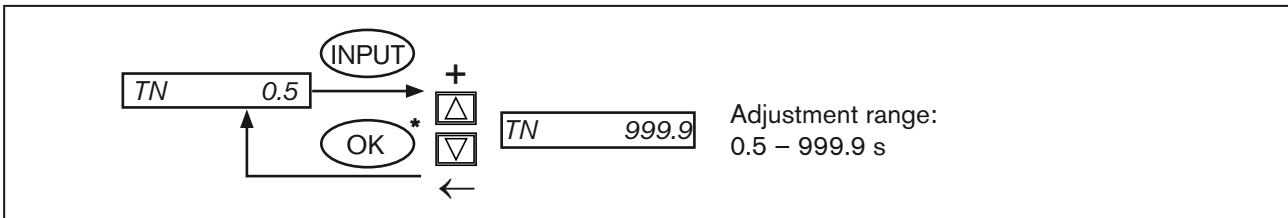
Fig. 72:   Operating structure P.CONTROL - TN

④ *TV* - Hold-back time of the process controller

Specifies the D-contribution of the PID controller.

Factory setting: 0.0 s

| TV 0.0 | INPUT | + △ ▽ * | TV 0.0 | Adjustment range: 0 – 999.9 s |
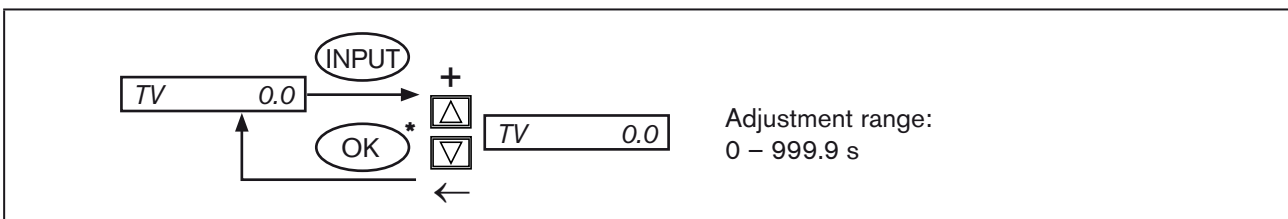
Fig. 73:   Operating structure P.CONTROL - TV

* If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.

⑤ *X0* - **Working point of the process controller**

Operating point of the proportional part when control difference = 0.

Factory setting: 0.0 %
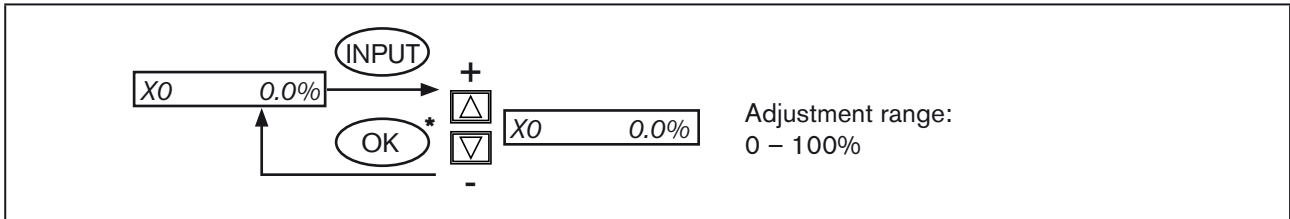
Fig. 74:   Operating structure P.CONTROL - X0

> In the section "*Tables for customer-specific settings*" in chapter "*Table for Your Settings on the Process Controller 8793*" there is a table in which you can enter your parameters.

⑥ *Filter* - **Filtering of the process actual value input**

The filter is valid for all process actual value types and has a low pass behaviour (PT1).

Factory setting: 0
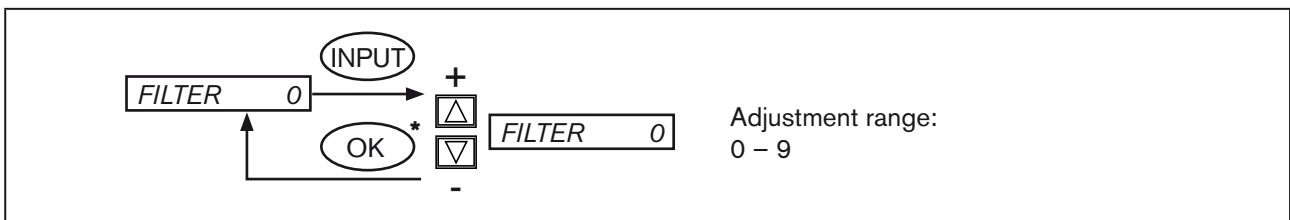
Fig. 75:   Operating structure P.CONTROL - FILTER

Setting the filter effect in 10 stages

Setting	Corresponds to limit frequency (Hz)	Effect
0	10	Lowest filter effect
1	5	
2	2	
3	1	
4	0.5	
5	0.2	
6	0.1	
7	0.07	
8	0.05	
9	0.03	Largest filter effect

Table 35:   Setting the filter effect

* If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.

22.7.2.2. *SETUP* Setting up the process controller

These functions specify the type of control.

⑦ *PV-INPUT* - **Indication of the signal type for the process actual value**

The *PV INPUT* function specifies the signal type of the process actual value:

- Unit signal   4 – 20 mA   Flow-rate, pressure, level

- Frequency signal   0 – 1000 Hz   Flow

- Circuit with PT 100   -20 °C – +220 °C   temperature

Factory setting: 4 – 20 mA

When the operating voltage is switched on, the device searches for excluded sensor types (automatic sensor detection).

When a sensor type is detected (Pt100 or 4 – 20 mA), the signal type is automatically implemented in the *PV-INPUT* operating menu.

🛈 The frequency signal of the signal type cannot be detected automatically, but must be set manually in the *PV-INPUT* operating menu.
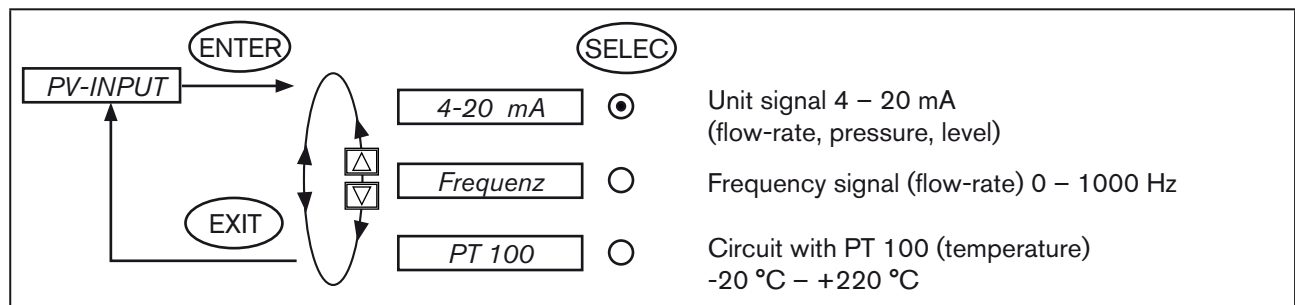
Fig. 76:   Operating structure P.CONTROL - PV-INPUT

⑦ *PV-Scale* - **Scaling of the process actual value**

The *PV-SCALE* function specifies the following settings:

- The unit of the process actual value.

- The position of the decimal point.

- The values for the lower and upper process actual value.

🛈 If the settings for the unit of the process actual value or the position of the decimal point are input or changed, this setting applies to all scaling values (*SPmin, SPmax, PVmin, PVmax*).

Procedure for setting the scaling values:

Inputting the unit and the position of the decimal point for the scaling values (possible in PVmin only):

→ Using the arrow keys, select the *PV SCALE* menu option and confirm by pressing the right selection key (ENTER).

→ Press the right selection key (INPUT) to switch to the input screen for *PVmin*.

On the display the field for the unit has a dark background and is therefore marked.

→ Press the up arrow key (+) to select the unit (bar, mbar, ... °F) for the scaling values. The units indicated here depend on the signal type (PV INPUT).

→ Press the down arrow key (←) to change the dark highlighted background to the decimal point of the value.

→ Press the up arrow key (+) to specify the position of the decimal point.

Inputting the scaling value:

→ Press the down arrow key (←) to change the dark highlighted background to the last digit of the value.

→ Press the up arrow key (+) to specify the value of the individual digit.

→ Press the down arrow key (←) to switch to the next digit.

→ When all input values have been specified, confirm the values by pressing the right selection key (OK).
The menu then jumps back to the selection screen.

⑧a *PV-SCALE* - **Scaling the process actual value for signal type 4 – 20 mA** *(PV-INPUT 4 – 20 mA)*

With the *PV-SCALE* function for signal type 4 – 20 mA the following settings are specified:

▪ The unit of the process actual value.

▪ The position of the decimal point.

▪ The values for the lower and upper process actual value are assigned to the respective current value of the unit signal.

> ⊗ If the settings for the unit of the process actual value or the position of the decimal point are input or changed, this setting applies to all scaling values (*PVmin, PVmax, SPmin, SPmax*).
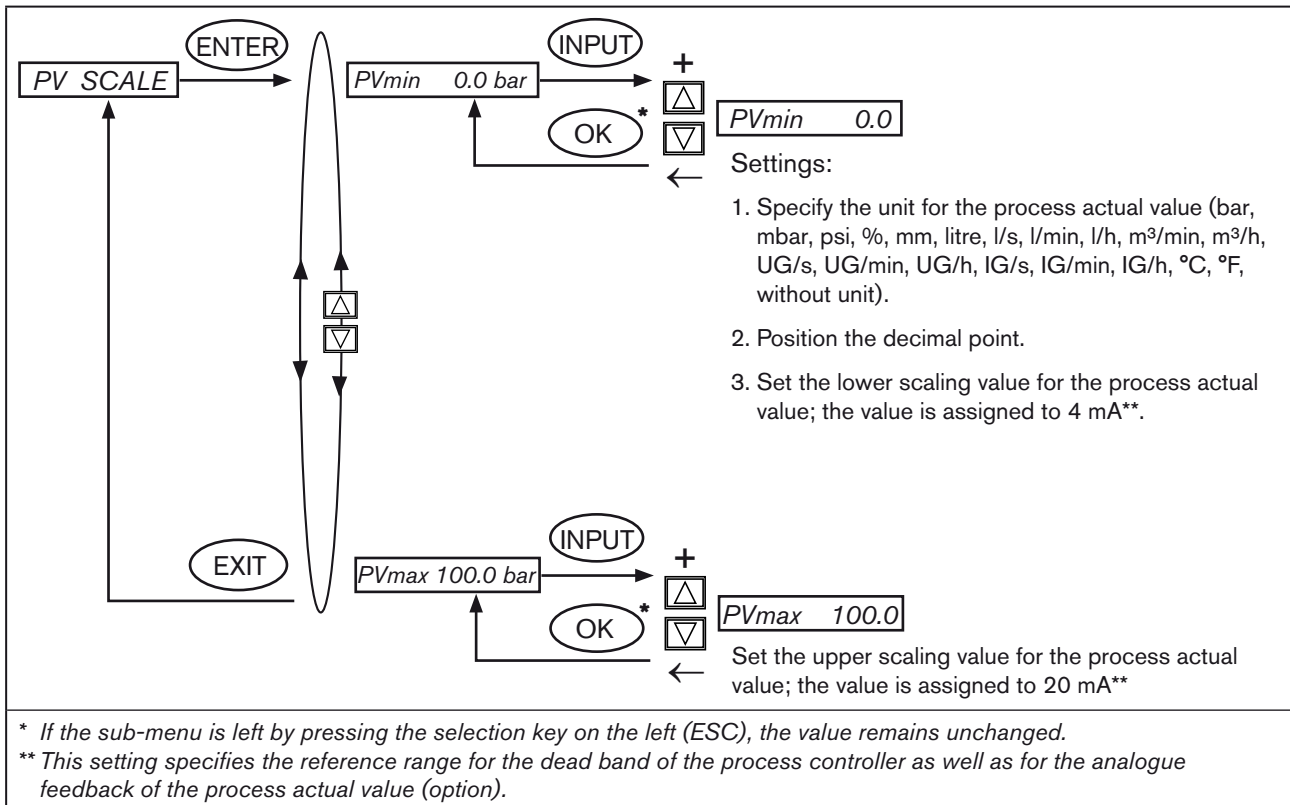
Fig. 77:   Operating structure P.CONTROL - PV-SCALE - 4 – 20 mA

Scaling example of the 4 – 20 mA input

Process actual value from the transmitter: 4 – 20 mA corresponds to 0 – 10 l/min

Process set-point value from PLC: 4 – 20 mA corresponds to 0 – 8 l/min

Example of inputting scaling values			
	Variant 1	Variant 2	Variant 3
PVmin	0	0	0
PVmax	1.0	10.0	100.0
SPmin	0	0	0
SPmax	0.8	8.0	80.0
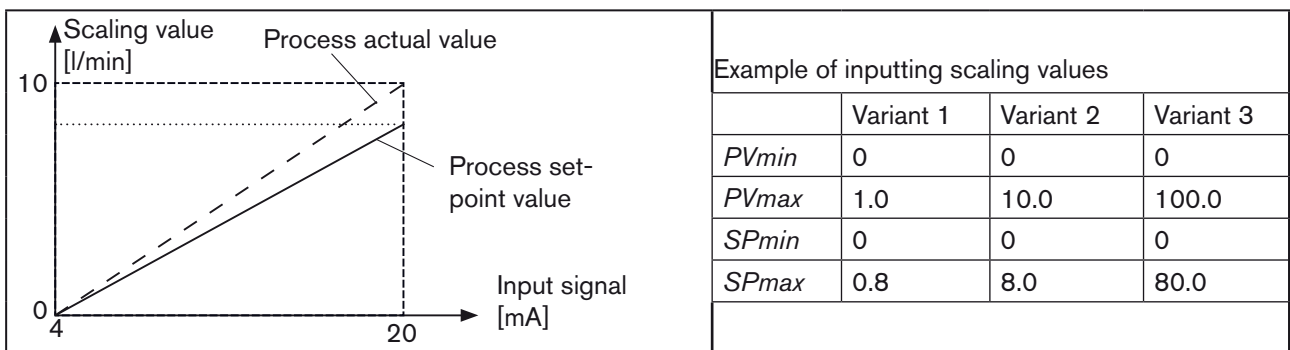
Fig. 78:   Scaling example

> For SP INPUT internal (set-point value default via the arrow keys) the scaling of the set-point value via SPmin and SPmax is not possible. The set-point value can be input directly according to the scaled process variable (PVmin, PVmax).

⑧b *PV-SCALE* - PV-SCALE - 2 - Scaling of the process actual value for frequency input signal type (PV INPUT frequency)

The *PV-SCALE* function specifies the following settings for frequency input signal type:

▪ The unit of the process actual value.

▪ The position of the decimal point.

▪ The values for the lower and upper process actual value.

▪ The K-factor.

> ❗ If the settings for the unit of the process actual value or the position of the decimal point are input or changed, this setting applies to all scaling values (*PVmin, PVmax, SPmin, SPmax*).

* If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.
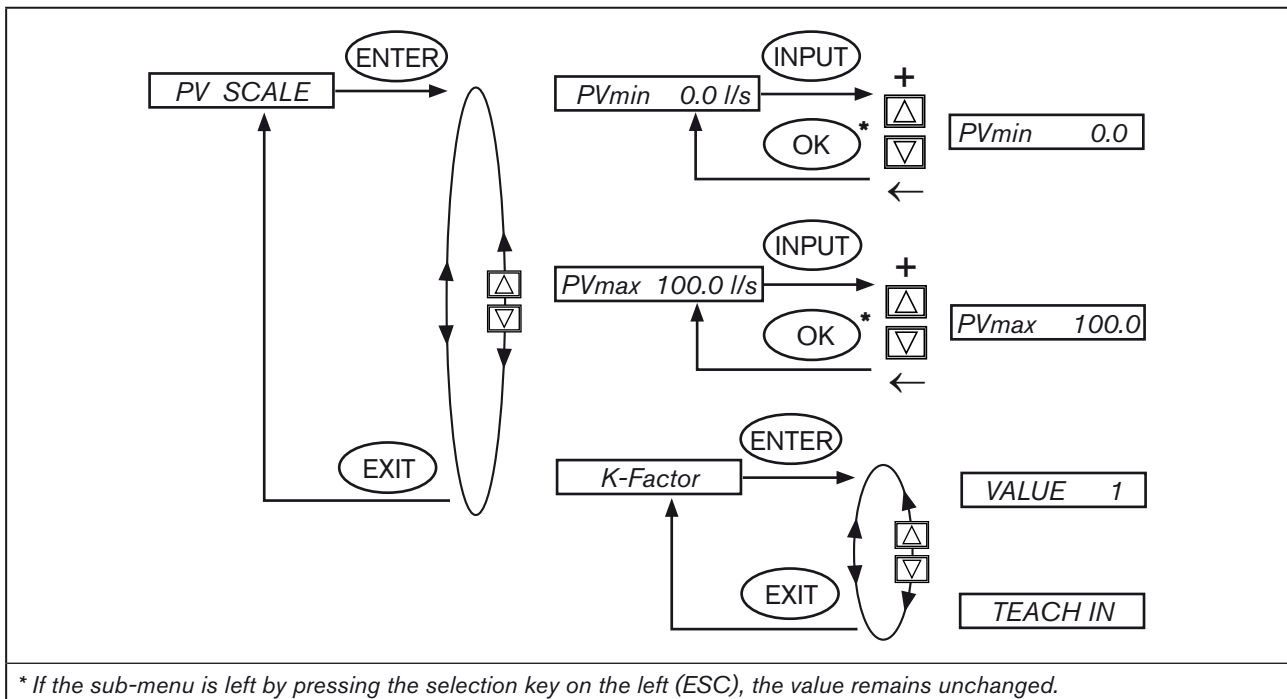
Fig. 79:   Operating structure P.CONTROL - PV-SCALE - Frequency

Specifying the settings:

| PVmin   X x/x | **Lower scaling value for the process actual value**

1. Select the unit for the flow-rate
The unit on the display has a dark background.
Press the up arrow key (+) to select from the following units:

l/s, l/min, l/h, m³/min, m³/h, UG/s (gal(US)/s), UG/min (gal(US)/min), UG/h (gal(US)/h), IG/s (gal(Imperial)/s), IG/min (gal(Imperial)/min), IG/h (gal(Imperial)/h).

2. Input the position of the decimal point
Press the down arrow key (←) to highlight the decimal point with a dark background.
Press the up arrow key (+) to specify the position.

3. Input the lower scaling value for the process actual value
Press the down arrow key (←) to highlight the individual digits with a dark background.
Press the up arrow key (+) to set the value.

Adjustment range: 0 – 9999

This setting specifies the reference range for the dead band of the process controller as well as for the analogue feedback of the process actual value (option).

| PVmax   X x/x | **Upper scaling value for the process actual value**

The unit for flow-rate and the position for the decimal point is transferred from the inputs of the lower scaling value.

1. Input the upper scaling value for the process actual value
Press the down arrow key (←) to highlight the individual digits with a dark background.
Press the up arrow key (+) to set the value.

Adjustment range: 0 – 9999

This setting specifies the reference range for the dead band of the process controller as well as for the analogue feedback of the process actual value (option).

| K-Factor | → | VALUE   X | **Manual input of the K factor for the flow sensor**
(e.g. from the data sheet of the flow sensor)

1. Input the position of the decimal point
The decimal point on the display is highlighted with a dark background.
Press the up arrow key (+) to set the position.

Adjustment range: 1 or 2

2. Input the K factor
Press the down arrow key (←) to highlight the individual digits with a dark background.
Press the up arrow key (+) to set the value.

Adjustment range: 0 – 9999

| K-Factor | → | TEACH IN | **Teach-in function:**

Calculating the K-factor by measuring a specific flow rate.

Hold down the selection key on the right (ENTER) for approx. 3 s
(countdown on display).

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When this menu is entered, the valve is closed in order to have a defined initial state for implementation of the Teach-in function.

Starting the measurement
Press the selection key on the right (START) to start the measurement (the message "*Teach-in at work" is dis-played briefly)*.
The valve is opened and the container is filled
("→ *fill .."* is indicated on the display).

Ending the measurement
Press the selection key on the right (STOP) to end the measurement and to display the input screen for the volume.

Input the position of the decimal point
The decimal point on the display is highlighted with a dark background.
Press the up arrow key (+) to specify the position.

Input the measured volume
Press the down arrow key (←) to highlight the individual digits with a dark background.
Press the up arrow key (+) to set the value.

Adjustment range: 0 – 9999

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⑧c *PV-SCALE - Scaling of the* process actual value *for selection of the PT 100 input (PV INPUT PT 100)*

The *PV-SCALE* function specifies the following settings for the PT 100 signal type:

▪ The unit of the process actual value.

▪ Position of the decimal point.

▪ The values for the lower and upper process actual value.

> ❗ If the settings for the unit of the process actual value or the position of the decimal point are input or changed, this setting applies to all scaling values (*PVmin, PVmax, SPmin, SPmax*).

** If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.*
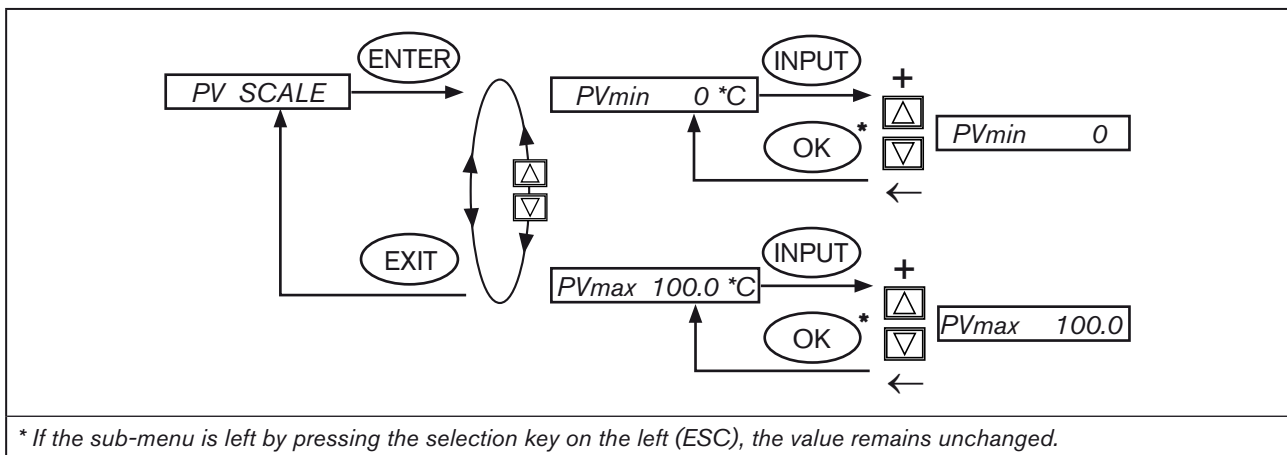
Fig. 80:   Operating structure P-CONTROL-PV-SCALE - PT100

Specifying the settings:

| PVmin   X *X | **Lower scaling value for the process actual value**

1. Select the unit for the temperature
The unit on the display is highlighted with a dark background. Press the up arrow key (**+**) to select from the following units:

°C or **°F**.

2. Input the position of the decimal point
Press the down arrow key (**←**) to highlight the decimal point with a dark background. Press the up arrow key (**+**) to specify the position.

Adjustment range: 1 or 2

3. Input the lower scaling value for the process actual value
Press the down arrow key (**←**) to highlight the individual digits with a dark background. Press the up arrow key (**+**) to set the value.

Adjustment range: -200 – 800

Measurement range of the PT 100: -20 **°C** – 220 **°C** or -4 **°F** – 428 **°F**

This setting specifies the reference range for the dead band of the process controller as well as for the analogue feedback of the process actual value (option)

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PVmax   X *X   **Upper scaling value for the process actual value**

The unit for the temperature and the position for the decimal point is transferred from the inputs of the lower scaling value.

1. Input the upper scaling value for the process actual value

Press the down arrow key (←) to highlight the individual digits with a dark background. Press the up arrow key (+) to set the value.

Adjustment range: -200 – 800

Measurement range of the PT 100: -20 **°C** – 220 **°C** or -4 **°F** – 428 **°F**

This setting specifies the reference range for the dead band of the process controller as well as for the analogue feedback of the process actual value (option).

⑨ *SP-INPUT* **- Type of set-point value default (internal / external)**

This function specifies whether the set-point value default

▪ internal: is implemented by pressing the keys on the positioner or

▪ external: is implemented via the unit signal input.

Factory setting internal:
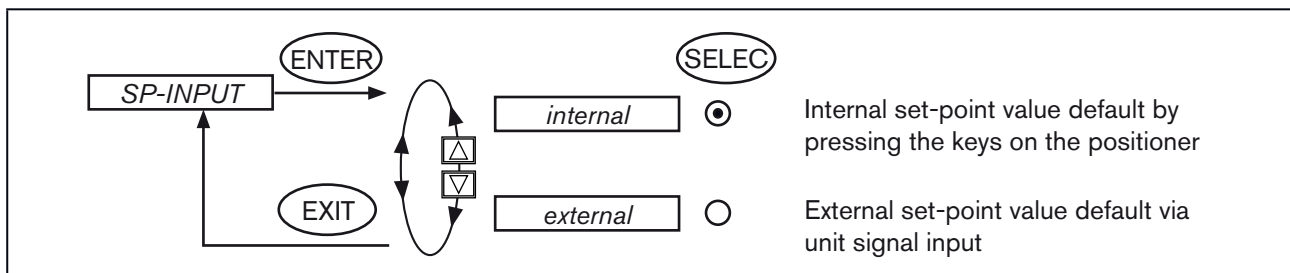
Fig. 81:   Operating structure P.CONTROL - SP-INPUT

⑩ *SP-SCALE* - Scaling of the process set-point value

> ❗ This function is indicated in the selection menu only if the external set-point value default *(external)* has been selected in the SP INPUT menu option.

The *SP-SCALE* function assigns the values for the lower and upper process set-point value to the particular current or voltage value of the unit signal.

* If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.
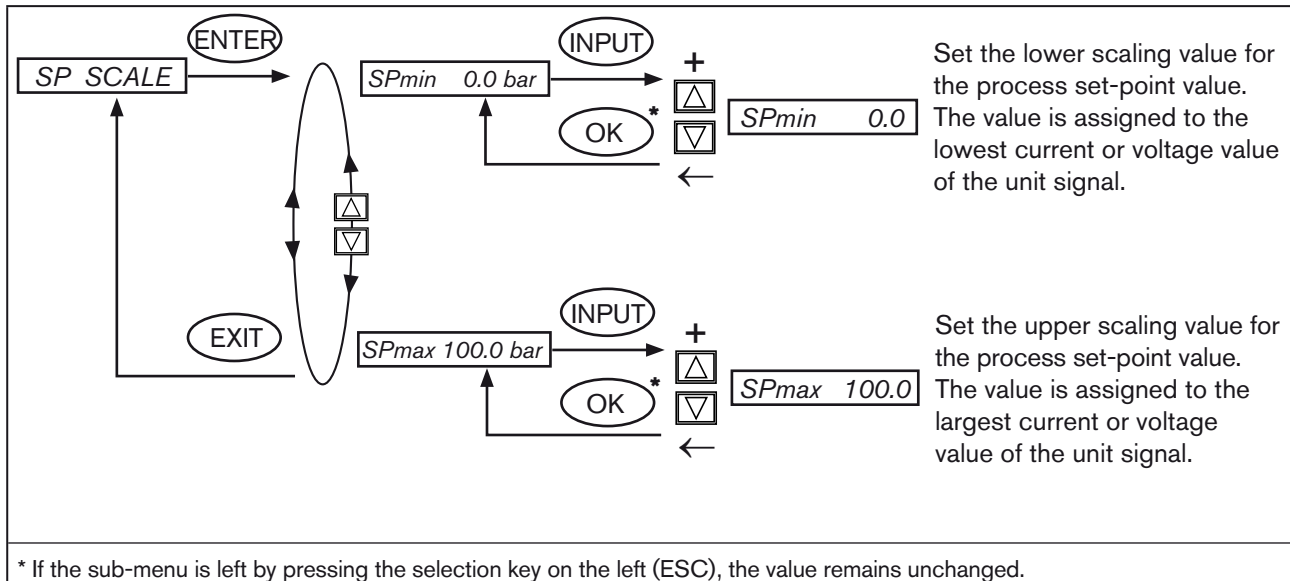
Fig. 82: Operating structure P.CONTROL - SP-SCALE

Procedure for setting the scaling values (in the example of the lower scaling value SPmin):

→ Press the right selection key (INPUT) to select the input screen for *SPmin*.

On the display the last digit of the value is highlighted with a dark background.

→ Press the up arrow key (+) to specify the value of the individual digit.

→ Press the down arrow key (←) to switch to the next digit.

→ When all input values have been specified, confirm the values by pressing the right selection key (OK). The menu then jumps back to the selection screen.

⑪ *P.CO INIT* - **Setting the smooth switchover between MANUAL and AUTOMATIC**

The *P.CO INIT* function enables a smooth switchover between the MANUAL and AUTOMATIC operating states.

Factory setting: *bumpless*

Fig. 83:   Operating structure P.CO INIT

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22.7.3. *P.Q'LIN* Linearization of the process characteristic Ⓓ

This function automatically linearises the process characteristic.

When the *P.CONTROL* function is activated, the *P.Q'LIN* functions required for process control are copied into the main menu. This function starts the program which automatically determines the nodes for a correction characteristic.

→ Start the routine to linearise the process characteristic by selecting the *P.Q'LIN* menu option in the main menu and press the selection key on the right (RUN) for approx. 3 seconds (countdown).

The program goes through the valve stroke in 20 steps from 0 to 100 % and measures the associated process variable. The value pairs of the correction characteristic are placed as a freely programmable characteristic under the *CHARACT / FREE* menu option and can be viewed under this menu option.

If the *CHARACT* menu option under the *ADDFUNCTION* menu option was not transferred into the main menu, the transfer occurs automatically when the *P.Q'LIN* function is implemented.
At the same time the *CHARACT / FREE* menu option is activated.

Displays on the panel during selection and implementation of the routine

Display	Description
Q.LIN #0 *CMD=0%* *Q.LIN #1* *CMD=10%* *:* *Q.LIN #10* *CMD=100%*	Display of the node which is just being started (progress is indicated by a bar running along the upper edge of the display)
Q.LIN *ready* or *Q.LIN* *err/break*	Display at the end of the routine Display if an error occurs

Table 36:   Display for P,Q'LIN - Linearization of the process characteristic

22.7.4. *P.TUNE*   Self-optimization of the process controller (process tune) Ⓔ

The control system of the type 8793 has an integrated PID process controller. When an appropriate sensor is connected, any process variable such as flow rate, temperature, pressure, etc. can be controlled.

To obtain a good control performance, the structure and parameterization of the controller must be adjusted to the properties of the process (controlled system).
This task requires experience in control technology as well as in measurement aids and is time-consuming. Therefore, the control system of type 8793 features the *P.TUNE* self-optimization function which determines the structure and parameters of the process controller at the press of a button.
The determined PID parameters can be seen via the operating menu and modified at will.

22.7.4.1.   Operating mode

When the *P.TUNE* function runs, the process is automatically identified. To do this, the process is initiated with a defined disturbance variable. Characteristic process parameters are derived from the response signal and are the basis for determining the structure and parameters of the process controller.

If the *P.TUNE* self-optimization is used, optimum results are obtained based on the following requirements:

▪ Stable or stationary conditions with reference to the process actual value PV when *P.TUNE* starts.

▪ Implementation of the *P.TUNE* in the operating point or in the operating range of the process control.

22.7.4.2.   Operation

The *P.TUNE* function can be run when the process controller is either in automatic or manual mode.

When *P.TUNE* ends, the control system is in the operating mode which was set previously.

> ⊘ The procedures described in the following sections a) and b) are not mandatory requirements for running the *P.TUNE* function.
> However, they increase the quality of the result.

a) *P.TUNE* in manual mode

The operator is on the process operating level.

→ Press the arrow keys to display the process value PV.

→ Switch the control system to manual mode by pressing the right key HAND.

The requirements mentioned in the previous chapter to obtain optimum results are set in the following Way:

→ Manually open or close the control valve by pressing the OPEN / CLOSE arrow keys and move the process value up to the required operating point or operating range.

→ As soon as the obtained setting is temporally constant, start the P.TUNE function (see chapter 22.7.4.3. Start the *P.TUNE* function).

b) *P.TUNE* in automatic mode

The operator is on the process operating level.

→ Specify a process set-point value SP via the keyboard or via the analog set-point value input.
In doing so, observe the setting for the internal or external set-point value default!
The selected set-point value SP should be near the future operating point.

According to the set-point value default the process variable *PV* changes on the basis of the PID parameters preset at the factory.

→ To satisfy the requirements mentioned in the chapter for obtaining optimum results, wait until the *PV* reaches a stable state.

When *PV* is oscillating permanently, the preset value *KP* of the process controller should be reduced in the *P.CONTROL* → *PARAMETER* menu.

→

> **!** To observe *PV*, you can select the graphical display *SP/PV*(t) by pressing the arrow keys.

→ As soon as the *PV* is temporally constant, start the *P.TUNE* function (see the following chapter).

22.7.4.3. Start the *P.TUNE fundtion*

⚠ **WARNING!**

Risk of injury due to uncontrolled process!

While the *P.TUNE* function is running, the control valve automatically changes the momentary degree of opening and engages in the current process.

▪ Using suitable measures, prevent the permitted process limits from being exceeded.
For example by:
- an automatic emergency shutdown
- stopping the P.TUNE function by pressing the STOP key (press left or right key).

The operator is on the configuration and parameterization level.

→ In the main menu select the *P.TUNE* function by pressing the arrow keys.

→ Hold down the right *RUN* key for approx. 3 s (countdown on display). The *P.TUNE* self-optimization function runs according to the diagram indicated in the following *Table 37:*. At the end the *TUNE ready* message is indicated.

→ Press any key to return to the main menu.

> **!** To stop the *P.TUNE* self-optimization function, press the left or right key STOP key.

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22.7.4.4. Self-optimization sequence of the process controller

Display	Description
starting process tune	Start of the self-optimization function.
identifying control process	Automatic process identification. Characteristic process parameters are deter-mined from the response signal to a defined prompt.
calculating PID parameters	Determination of the structure and parameters of the PID controller.
TUNE ready	Successful end to the self-optimization function.
TUNE err/break	Display if the self-optimization function is stopped or if a fault occurs.

Table 37: Sequence of the self-optimization function

23. OPERATION OF THE PROCESS CONTROLLER

A precise description of the control and display elements, as well as the configuration of the keys, can be found in chapter *11.Control and display elements*.

When the operating voltage has been switched on, the positioner is at the process operating level in the AUTO-MATIC operating state.

At the process operating level the normal control mode is implemented and monitored (AUTOMATIC) and the valve is manually opened or closed (MANUAL).

Display

Description of the key configuration

Right selection key

Down arrow key

Up arrow key
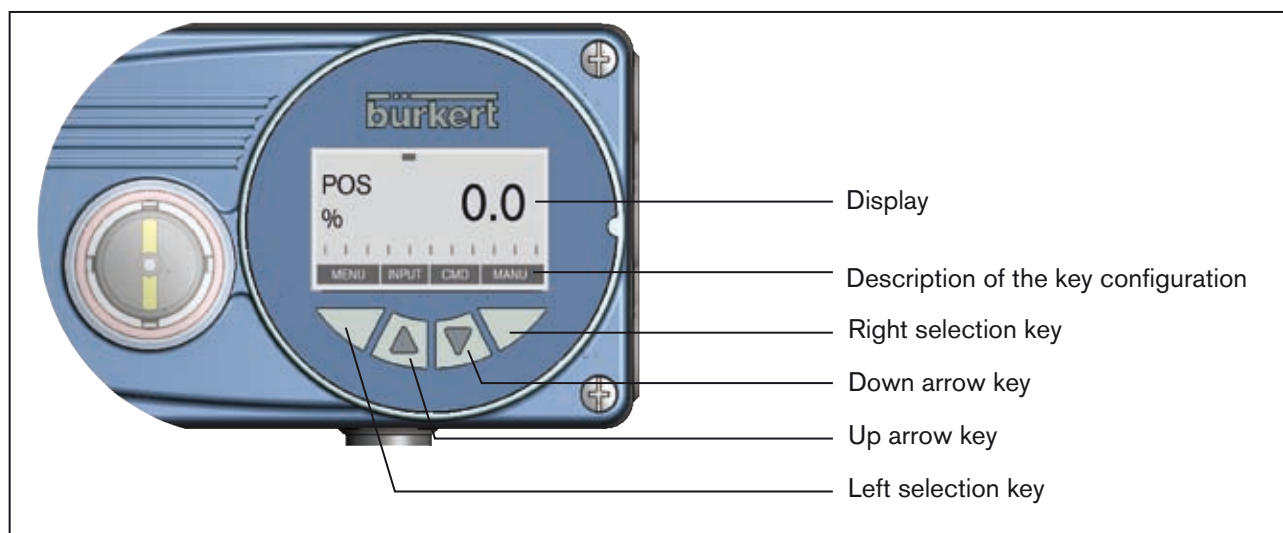
Left selection key

Fig. 84:   Operating module; Specifying the Basic Settings

23.1. Switching between the operating states

The right Selection key can be used to switch between the two operating states AUTOMATIC (AUTO) and MANUAL (MANU).

In the AUTOMATIC operating state a bar runs along the upper edge of the display from left to right.

23.2. Switching between the operating levels

Process operating level -> Configuration level

To switch to the configuration level in the MANUAL or AUTOMATIC operating state

→ hold down the left selection key (MENU) for approx. 3 seconds (countdown: two bars converge on the display).

At the Configuration level the operating parameters can be input or changed, auxiliary functions supplemented or the automatic adjustment (*X.TUNE*) of the controller started.

> A precise description of the individual functions can be found in chapter *Configuring the auxiliary functions.*

Configuration level -> Process operating level

Press the left selection key (EXIT) to switch from the Configuration level to the Process operating level. In doing so, the operating state which was selected before the switchover (AUTOMATIC or MANUAL) is set.

23.3. AUTOMATIC operating state

Bar running from left to right along the upper edge of the display.

Normal control mode is implemented and monitored in AUTOMATIC operating state.

23.3.1. Meaning of the keys

key	Configuration*	Description
Left selection key	MENU	Switch to the Configuration level (press for approx. 3 s)
Right selection key	MANU	Switch between the AUTOMATIC (AUTO) or MANUAL (MANU) operating modes
Up arrow key	SP SP/PV graphic POS CMD TEMP PV	Switch between the individual displays
Down arrow key	CMD TEMP PV SP SP/PV graphic POS	
* Displayed only when P.CONTROL auxiliary function activated		

Table 38: AUTOMATIC operating state; Meaning of the keys; Process controller Type 8793

english

23.3.2. Information on the display

The following variables are indicated on the display for the process controller and it is possible to switch between them with the arrow keys:

Representation of value	Value range / Unit	Description
POS XXX	0 – 100 %	Display of actual position of the valve actuator
CMD XXX	0 – 100 %	Display of nominal position of the valve actuator
TEMP XXX	-100 – 150 °C	Internal temperature in the housing of the positioner
PV XXX	Depending on the signal type	Process actual value
SP XXX	Depending on the signal type	Process set-point value

Table 39: Display; process controller Type 8793

23.3.3. Operating structure

* Displayed only when P.CONTROL auxiliary function activated.

** only active if the internal set-point value default (P.CONTROL / SETUP / SP INPUT / internal) has been selected.
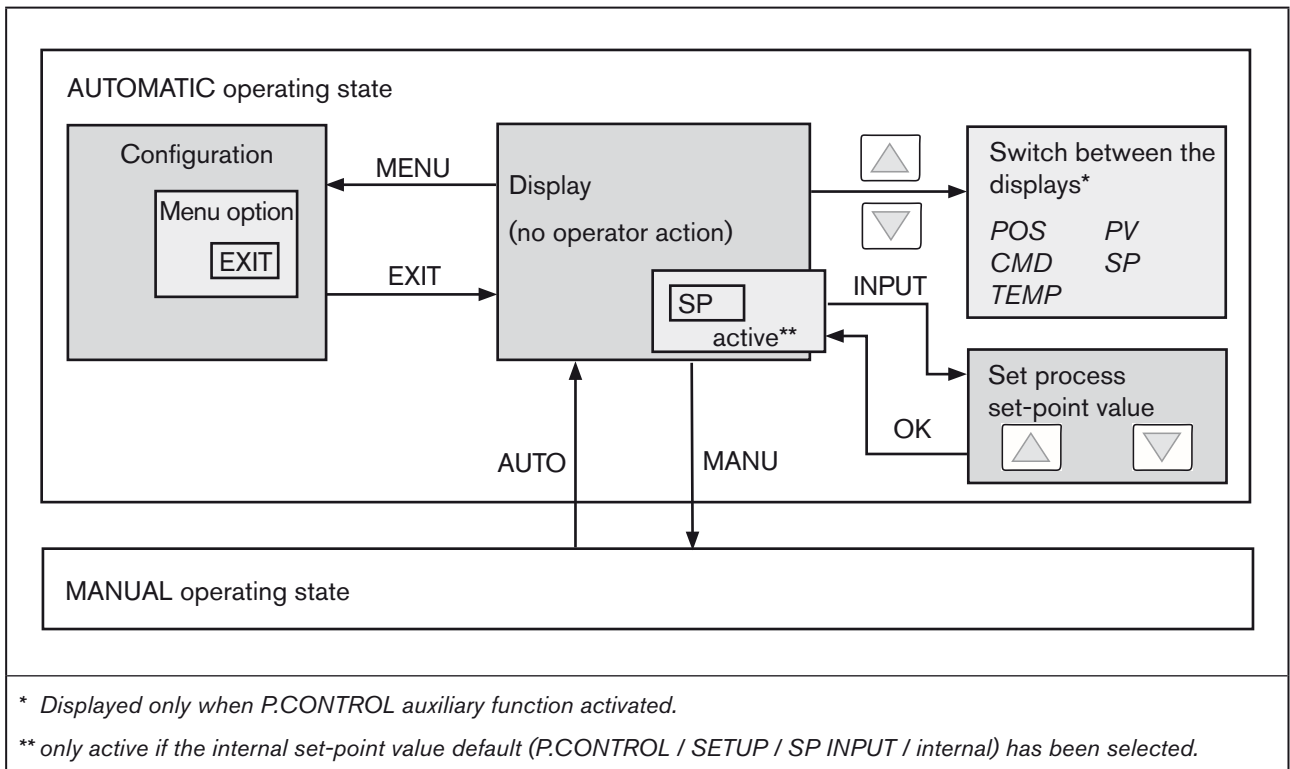
Fig. 85: Operating structure AUTOMATIC; process controller Type 8793

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23.3.4. Manually Changing the Process Set-Point Value

→ When configuring the auxiliary function, specify
P.CONTROL / SETUP / SP INPUT / internal (set the set-point value by pressing keys).

→ When the *SP* (Setpoint) display is set by pressing the right selection key (INPUT), activate the menu for changing the process set-point value.

→ Set the individual digits by pressing the arrow keys

→ Press the right selection key (OK) to accept the set value (see *Fig. 86:Setting numerical values SP*).
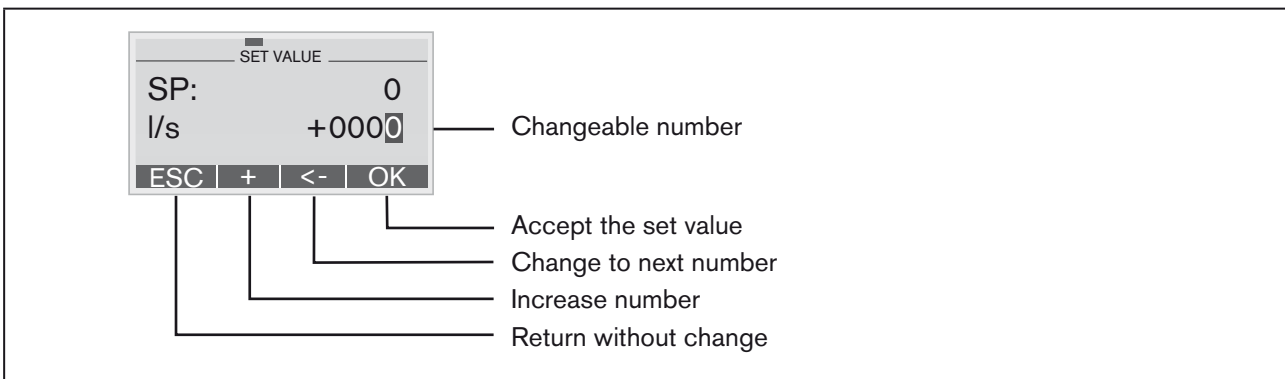
Fig. 86:   Setting numerical values SP

23.4.   MANUAL operating state

Without bar running from left to right along the upper edge of the display.

In MANUAL operating state the valve can be opened or closed manually.

23.4.1. Meaning of the keys

Key	Configuration	Description
Left selection key	MENU	Switch to the Configuration level (press for approx. 3 s)
Right selection key	MANU	Switch between the AUTOMATIC (AUTO) or MANUAL (MANU) operating modes
Up arrow key	OPN	Aerate the actuator
	CLS*	Control function A (SFA): Valve opens Control function B (SFB): Valve closes Control function I (SFI): Connection A1 aerated
Down arrow key	CLS	Deaerate the actuator
	OPN*	Control function A (SFA): Valve closes Control function B (SFB): Valve opens Control function I (SFI): Connection A2 aerated
* only if "Fall" is set in the DIR.ACT auxiliary function		

Table 40:   AUTOMATIC operating state; meaning of the keys

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> SFA: Actuator closes by spring force
>
> SFB: Actuator opens by spring force
>
> SFI: Actuator double-acting

23.4.2. Information on the display

After switching to the MANUAL operating state, the display automatically jumps to the actual position (*POS*) of the valve actuator.

23.4.3. Operating structure
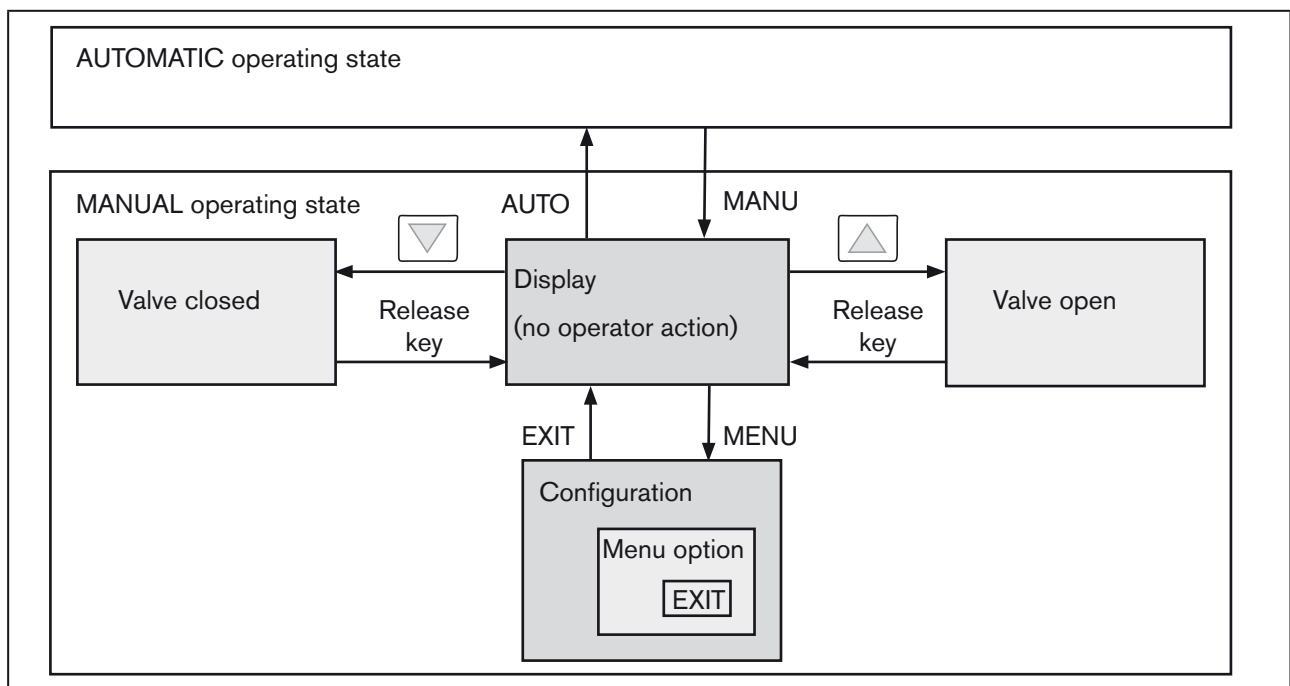
Fig. 87:   Operating structure MANUAL

24. AUXILIARY FUNCTIONS FOR THE PROCESS CONTROLLER

In this chapter only those auxiliary functions are described which differ from the position controller Type 8792. All other auxiliary functions and their settings can be found in the chapters entitled *Start-up and operation of the position controller Type 8792 / 21.Configuring the auxiliary functions*.

24.1. Overview of the auxiliary functions

ADD.FUNCTION — ENTER →	CHARACT	Selection of the transfer characteristic between input signal and stroke (correction characteristic)
	CUTOFF	**Sealing function for position controller**
	DIR.CMD	Effective sense of direction between input signal and set-point position
	DIR.ACT	Assignment of the aeration state of the actuator chamber to the actual position
	SPLTRNG *	Signal split range; input signal as % for which the valve runs through the entire stroke range.
	X.LIMIT	Limit of the mechanical stroke range
	X.TIME	Limiting the control speed
	X.CONTROL	Parameterization of the position controller
	P.CONTROL	**Parameterization of the PID process controller**
	SECURITY	**Code protection for settings**
	SAFEPOS	Input the safety position
	SIG.ERROR	**Configuration of signal level fault detection**
	BINARY. IN	Activation of the binary input
	OUTPUT	**Configuration of the outputs (option only)**
	CAL.USER	**Caiibration**
	SET.FACTORY	Reset to factory settings
	SER. I / O	Configuration of serial interface
	EXTRAS	Set colours on display
EXIT	SERVICE	For internal use only

* *SPLTRNG auxiliary function can only be selected if P.CONTROL auxiliary function is inactive.*

150 *Fig. 88:   Overview - auxiliary functions*

If the *P.CONTROL* auxiliary function is active for the process controller Type 8793, the following auxiliary func-
tions differ from those described for the position controller Type 8792 (highlighted in *Fig. 88:*):

▪ *CUTOFF*

▪ *P.CONTROL*

▪ *SECURITY*

▪ *SIG.ERROR*

▪ *OUTPUT*

▪ *CAL. USER*

24.1.1.   Including auxiliary functions in the main menu

→ In the main menu press the arrow keys to select the *ADD.FUNCTION* menu option and press the selection
key on the right (ENTER) to enter the submenu.

→ Press the arrow keys to select the required auxiliary function.

→ Press the selection key on the right (ENTER) to mark the auxiliary function with a cross (x).

→ Press the selection key on the left (EXIT) to transfer the marked functions into the main menu.

→ In the main menu now input the parameters for the auxiliary functions.

24.1.2.   Removing auxiliary functions from the main menu

If a function is removed from the main menu, the settings implemented previously under this function
become invalid again.

→ In the main menu press the arrow keys to select the *ADD.FUNCTION* menu option and press the selection
key on the right (ENTER) to enter the submenu.

→ Using the arrow keys, select an auxiliary function indicated with a cross (x).

→ Press the selection key on the right (ENTER) to remove the cross (x).

→ After pressing the selection key on the left (EXIT), the auxiliary function is deactivated and removed from the
main menu.

How to operate the auxiliary functions is described exactly in the chapter entitled *Start-up and operation of
the position controller Type 8792 / 21.Configuring the auxiliary functions.*

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24.2. *CUTOFF*
Sealing function for the position controller Type 8793

This function causes the valve to be sealed outside the control area.

This is where you input the limits for the position set-point value (*CMD*) as a percentage or for the process set-point value (*SP*) as a percentage of the scaling range, from which the actuator is fully deaerated or aerated.

Control mode opens or resumes at a hysteresis of 1%.

If the process valve is in the sealing area, the message *"CUTOFF ACTIVE"* is indicated on the display.

Factory setting: *Min= 0%*;   *Max = 100%;   CUT type = Type PCO*
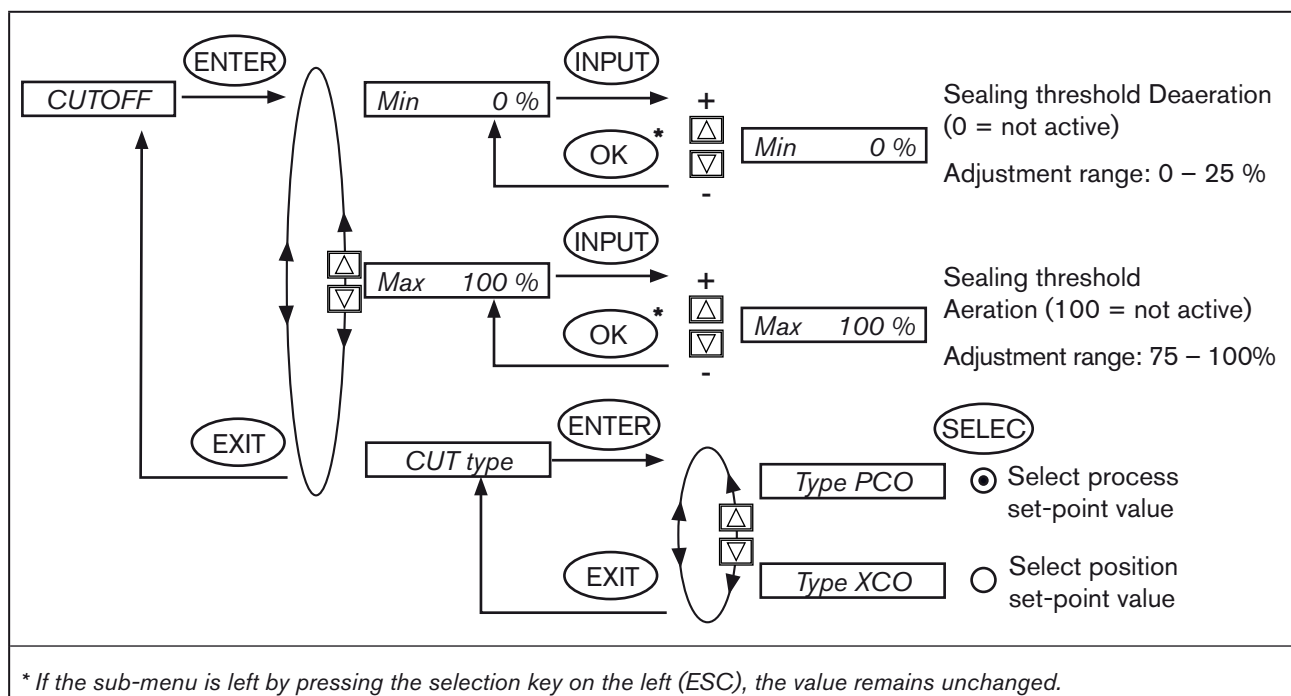

Fig. 89:   Operating structure CUTOFF, process controller type Type 8793

(!) Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.

MAN 1000118577 EN Version: A Status: RL (released I freigegeben) printed: 01.09.2009
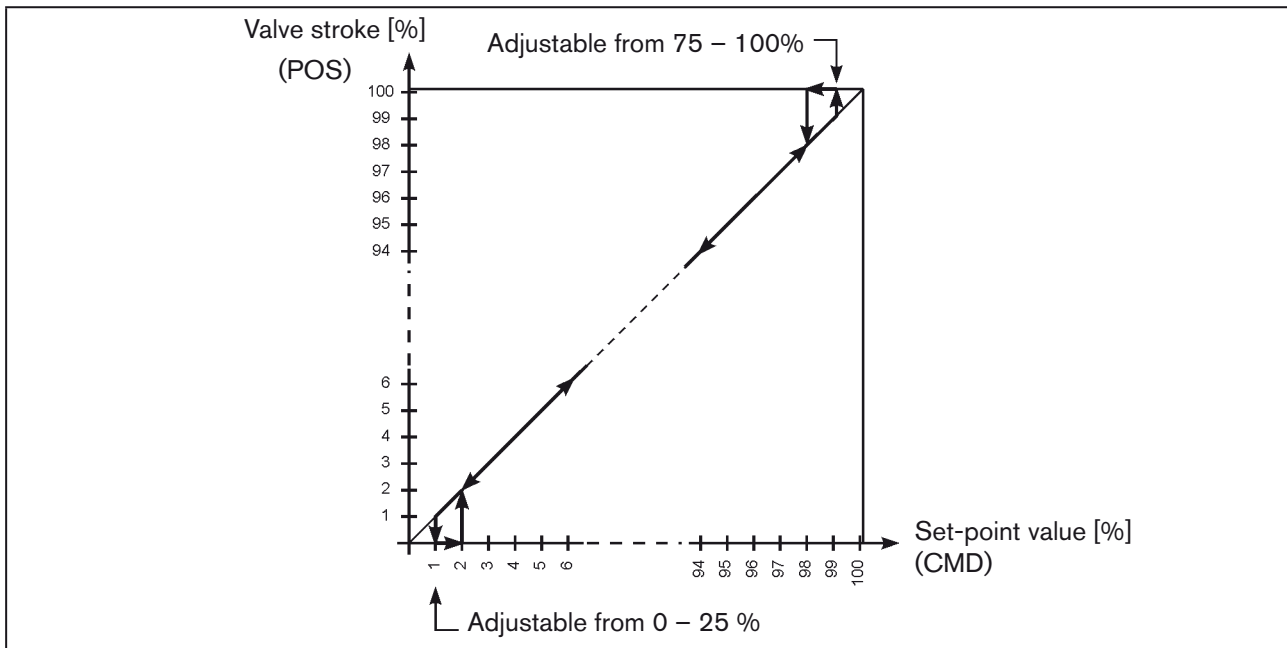
Fig. 90: *Graph - CUTOFF; process controller*

24.3. *SECURITY*
Code protection for the settings

Use the *SECURITY* function to prevent the positioner or individual functions from being accessed unintentionally.

Factory setting: *Access Code: 0000*

If the code protection is activated, the code (set access code or master code) must be input whenever operator action is disabled.

> All operator actions can be implemented with the non-changeable master code. This 4-digit master code can be found in the appendix of these operating instructions in the chapter entitled "*Master code*".
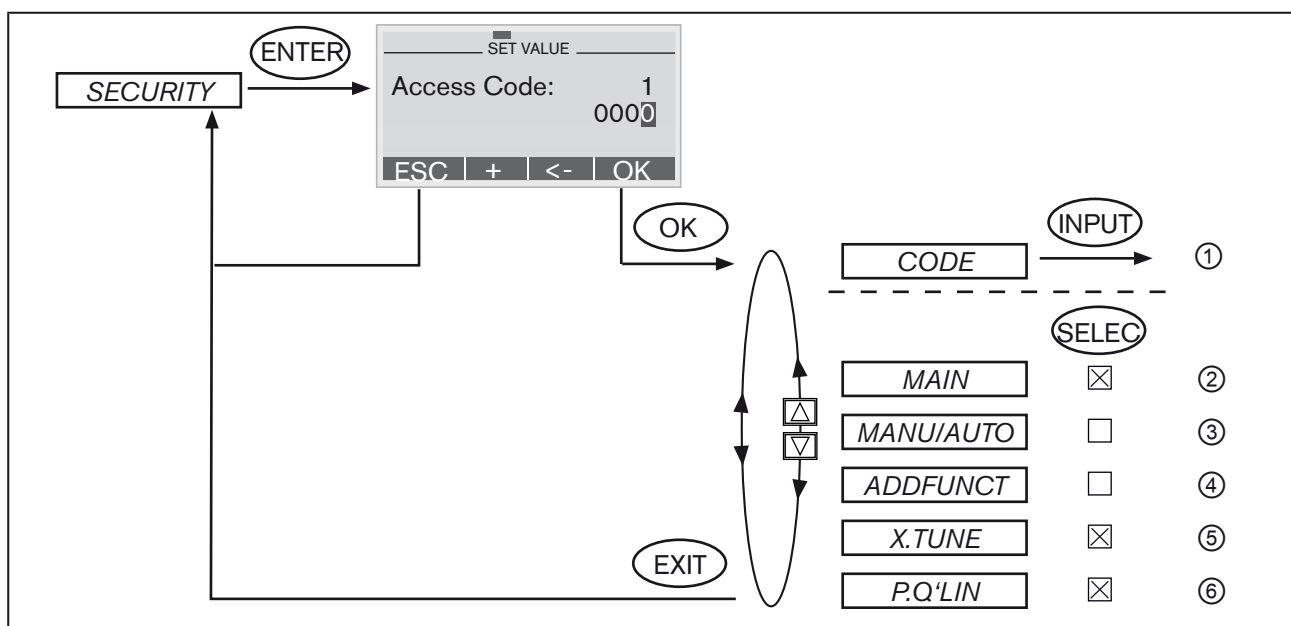
Fig. 91:   Operating structure SECURITY; process controller

① Input screen for inputting or changing the *access code* (for description of input see below)

② Blocking access to the configuration level

③ Blocking switchover between the MANUAL / AUTOMATIC (MANU/AUTO) operating states

④ Blocking the input of auxiliary function

⑤ Blocking the activation of self-parameterization (Autotune)

⑥ Blocking the activation of the linearization of the process characteristic

Inputting the access code:

→ To access the input screen with marked selection menu CODE, press the selection key on the right (INPUT).

```
┌─────── SET VALUE ───────┐
│                          │
│ Access Code:          1  │
│                   0000   │
│                          │
│  ESC │  +  │ <- │  OK    │
└─────────────────────────┘
```
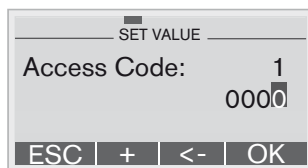
The four-digit code can be changed via the arrow keys.

Down arrow key (←)	Select the individual digits.
Up arrow key (+)	Change the selected digit.
Left selection button (ESC)	Leave the input screen without making a change.
Right selection button (OK)	Leave the input screen saving the input or making a change.

24.4. *SIG-ERROR*
Configuration of signal level fault detection

The *SIG-ERROR* function is used to detect a fault on the input signal.

> **Fault detection**
> Fault detection can be selected at 4 – 20 mA and Pt 100 signal can be selected:
>
> ▪ 4 – 20 mA
>   Fault if input signal ≤ 3.5 mA (± 0.5% of final value, hysteresis 0.5% of final value)
>
> ▪ PT100
>   Fault if input signal 225 °C (± 0.5% of final value, hysteresis 0.5% of final value)
>
> If other signal types are selected or if process controllers are not activated, the respective menu branch is hidden. If this configuration does not allow either of the two fault detections, *not available* is indicated in the selection menu.
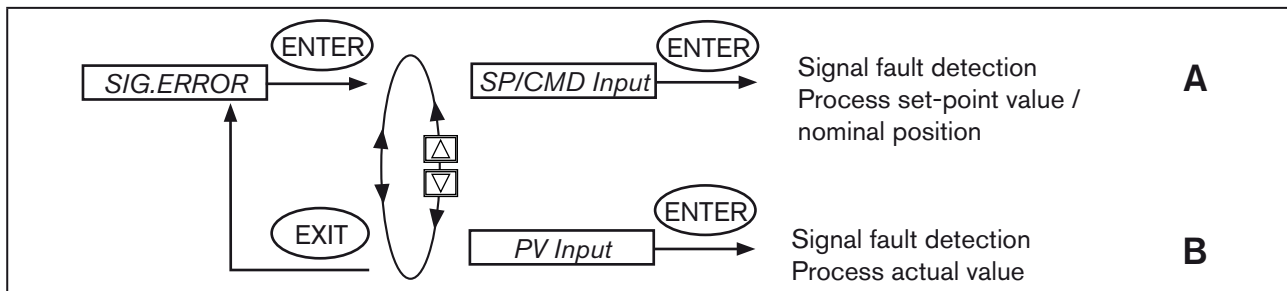

Fig. 92:   Operating structure SIG-ERROR-8793

The operating structure of the menu options *SP/CMD Input* and *PV Input* is identical and is described in the diagram below:
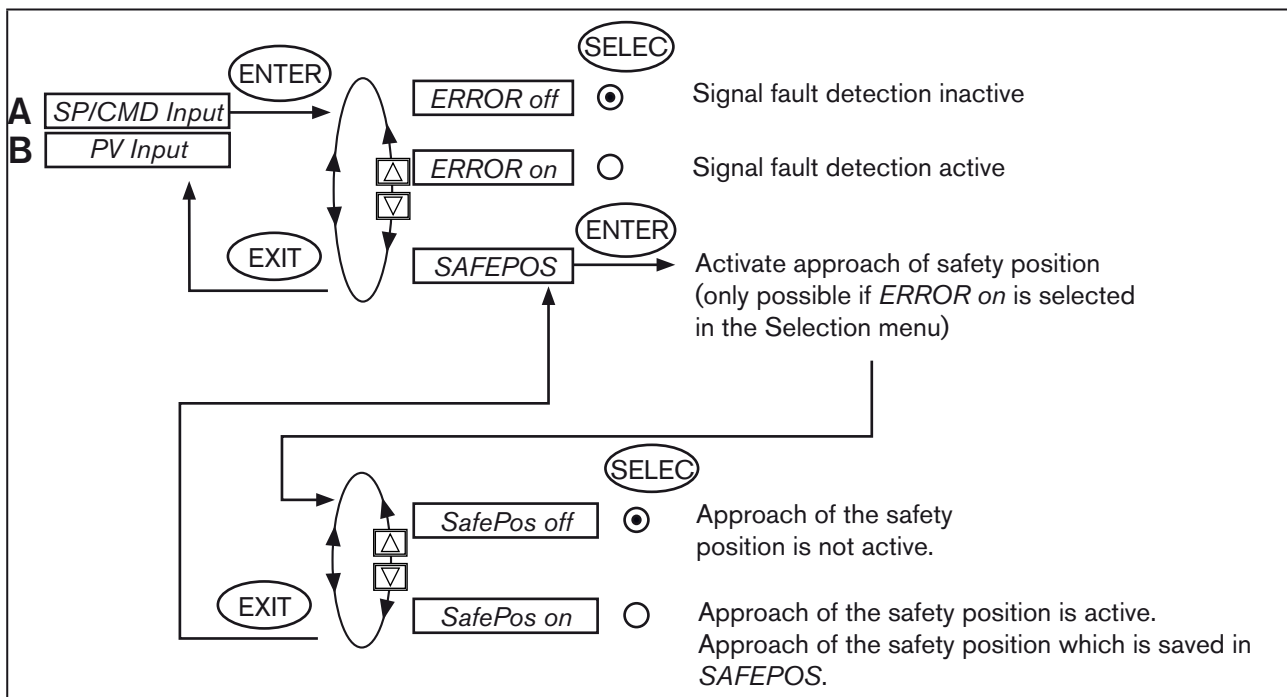

Fig. 93:   Operating structure SIG-ERROR

If signal fault detection is activated, the respective fault is indicated on the display.
(see chapter *Error Messages on the Display*).

Safety position SAFEPOS on

When *SAFEPOS on* is set, the following configurations may occur:

Active menu option *SAFEPOS*   If a fault is detected, the actuator moves to the lower *SAFEPOS* set position.

Inactive menu option *SAFEPOS*   If a fault is detected, the actuator moves to the end position which the actuator
would specify in the isolated state.

24.5. *OUTPUT* (option) Configuring the outputs

The *OUTPUT* menu option is only indicated in the selection menu of *ADD.FUNCTION* if the positioner has outputs (option).

The outputs can be used for the following feedback signals:

Analogue output: Feedback signal of the current position (*POS*) or of the set-point value (*CMD*) to the
control centre.

Binary outputs: ▪ Alarm output for excessively large control deviations of the position controller

▪ for the output of the current position with respect to a specified limit position (> or <)

▪ for output: actuator in safety position

▪ for the output: sensor break

▪ for the output: operating state (AUTOMATIC / MANUAL).

The positioner which has the outputs option is available in the following versions:

▪ one analogue output

▪ one analogue and two binary outputs

▪ two binary outputs

According to the version of the positioner only the possible adjustable outputs (*ANALOGUE, ANA-LOGUE + BIN 1 + BIN 2 or BIN 1 + BIN 2*) are indicated in the OUTPUT menu option.

Fig. 94:   *Operating structure OUTPUT, process controller type Type 8793*

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① *OUT ANALOG* - **Configuring the analogue output**

> Only for the versions:
> - one analogue output
> - one analogue and two binary outputs

The feedback of the current position (*POS*) or of the set-point value (*CMD*), of the process actual value *(PV)* or of the process set-point value *(SP)* can be transmitted to the control centre via the analogue output.
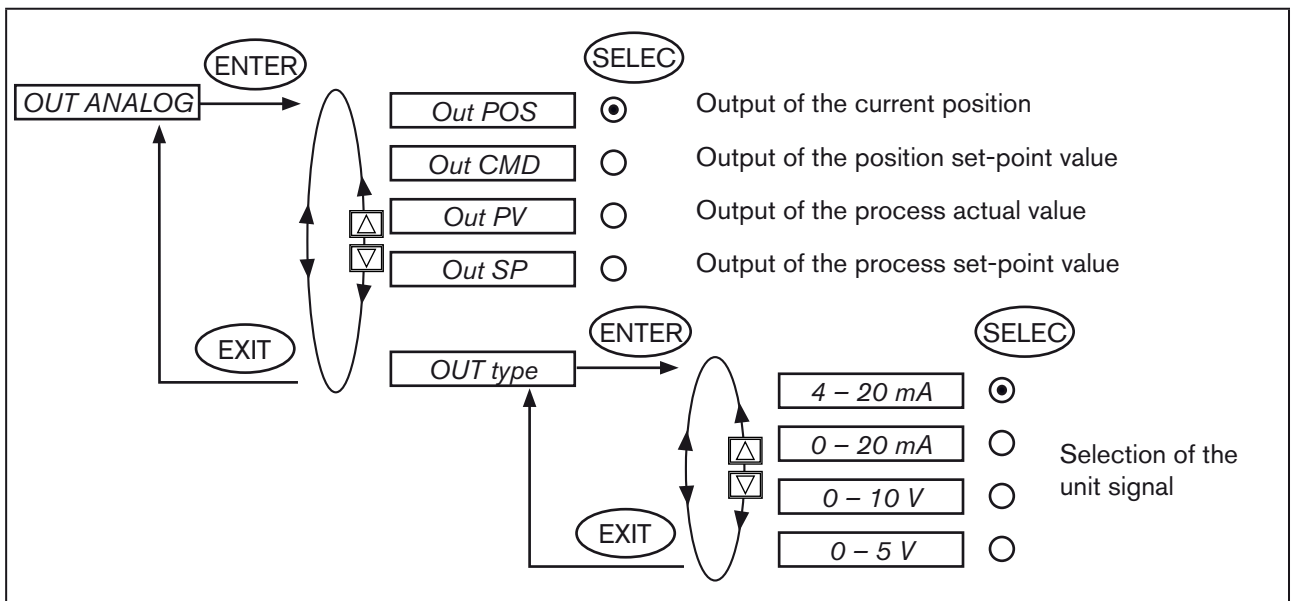
Fig. 95:   Operating structure OUTPUT-ANALOG, process controller type Type 8793

> Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.

② *OUT BIN1* - **Configuring the binary output 1**

③ *OUT BIN2* - **Configuring the binary output 2**

> Only for the versions:
> - one analogue output and two binary outputs
> - two binary outputs

The following description is valid for both binary outputs *OUT BIN 1* and *OUT BIN 2*, as the operation in the menu is identical.

The binary outputs 1 and 2 can be used for one of the following outputs:

- Alarm output for excessively large control deviations of the position controller
- for the output of the current position with respect to a specified limit position (> or <)

- for the output: actuator in safety position

- for the output: sensor break process set-point value ***

- for the output: sensor break process actual value ***

- for the output: operating state (AUTOMATIC / MANUAL)
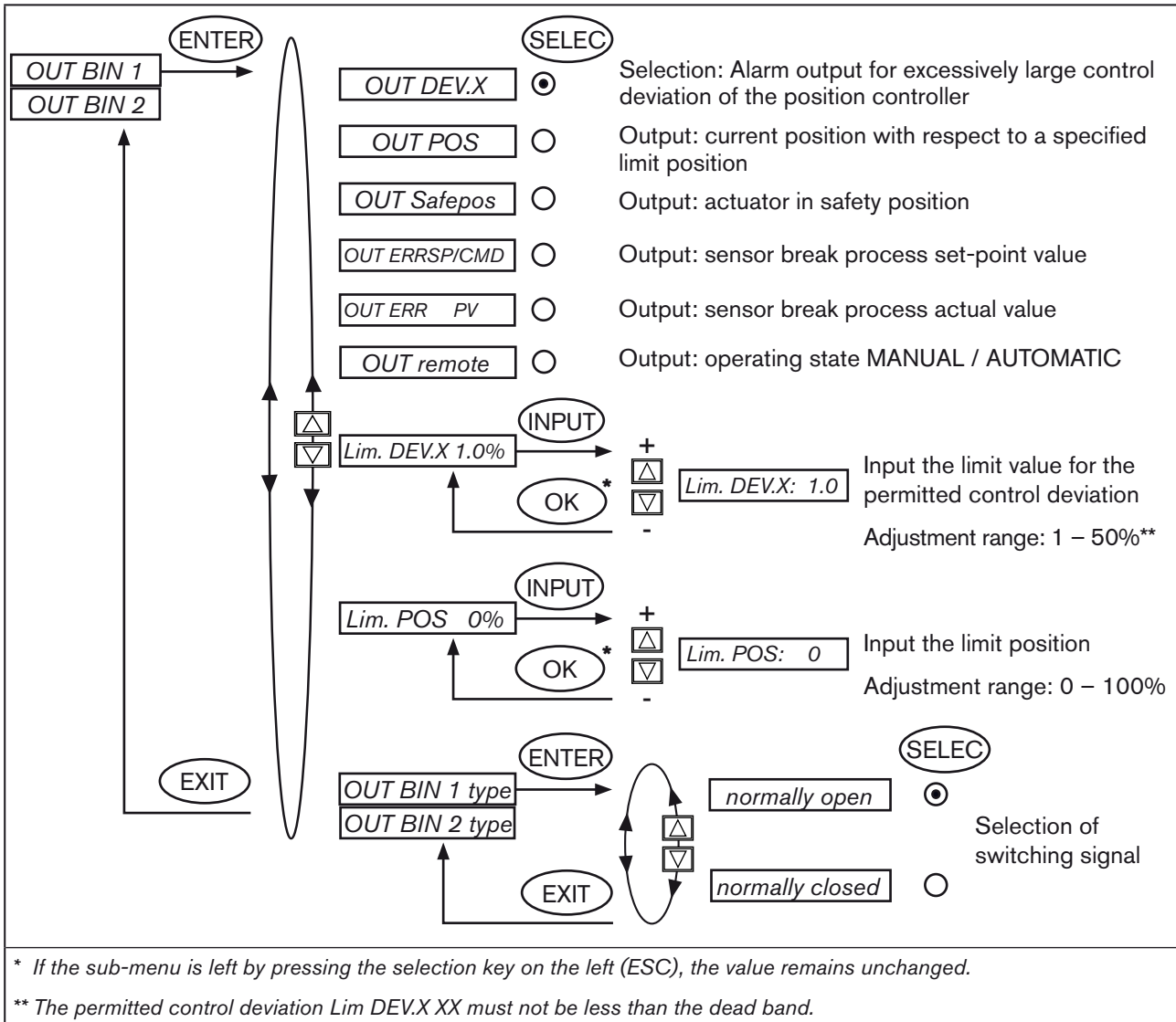
Fig. 96: Operating structure OUTPUT-BIN1/BIN2; process controller type Type 8793

Normally closed output, in switched state *low* ($\cong$ 0 V)

Normally opened output, in switched state *high* ($\cong$ 24 V)

Changed values are not transferred into the memory (EEPROM) until the main menu (MAIN) is left.

*** only possible if signal level fault detection activated (see chapter *24.4.SIG-ERROR Configuration of signal level fault detection*)

OUT DEV.X **Alarm output for excessively large control deviation of the position controller:**

→ Press the arrow keys to mark the *OUT DEV.X* menu option and confirm with the selection key on the right (SELEC).

→ Press the arrow keys to input the the limit value for the permitted control deviation in the Lim. DEV.X menu option and accept with the selection key on the right (OK).

> The permitted control deviation *Lim. DEV.X XX* must not be less than the dead band.

→ In the *OUT BIN1/2 type* menu option input the required switching status (*normally open / normally closed*) (see *Table 41:*).

OUT POS   **Output of the current position with respect to a specified limit position:**

→ Press the arrow keys to mark the *OUT POS* menu option and confirm with the selection key on the right (SELEC).

→ Press the arrow keys to input the value of the limit position in the Lim. POS 0% menu option and accept with the selection key on the right (OK).

→ In the *OUT BIN1/2 type* menu option input the required switching status (*normally open / normally closed*) (see *Table 41:*).

OUT BIN1/2	normally open*	normally closed**
POS > LIM	0 V	24 V
POS < LIM	24 V	0 V
* Normally open- output, in switched state *high* ($\cong$ 24 V) ** Normally closed- output, in switched state *low* ($\cong$ 0 V)		

Table 41:   witching status OUT BIN - POS > LIM; process controller type Type 8793

OUT Safepos   **Output of message: Actuator in safety position:**

→ Press the arrow keys to mark the *OUT Safepos* menu option and confirm with the selection key on the right (SELEC).

→ In the *OUT BIN1/2 type* menu option input the required switching status (*normally open / normally closed*) (see *Table 42:*).

OUT ERR SP/CMD*   **Output broken sensor, process set-point value:**

→ Press the arrow keys to mark the *OUT ERR SP/CMD* menu option and confirm with the selection key on the right (SELEC).

→ In the *OUT BIN type* menu option input the required switching status (*normally open / normally closed*) (see *Table 42:*).

OUT ERR PV*   **Output broken sensor, process actual value:**

→ Press the arrow keys to mark the *OUT ERR PV* menu option and confirm with the selection key on the right (SELEC).

→ In the *OUT BIN1/2 type* menu option input the required switching status (*normally open / normally closed*) (see *Table 42:*).

OUT remote   **Output operating state AUTOMATIC / MANUAL:**

→ Press the arrow keys to mark the *OUT remote* menu option and confirm with the selection key on the right (SELEC).

→ In the *OUT BIN type* menu option input the required switching status (*normally open / normally closed*) (see *Table 42:*).

OUT BIN1/2	*normally open*	*normally closed*
AUTOMATIC operating state	0 V	24 V
MANUAL operating state	24 V	0 V
* *Normally open-* output, in switched state *high* ($\cong$ 24 V)		
** *Normally closed-* output, in switched state *low* ($\cong$ 0 V)		

Table 42:   witching status OUT BIN - MANUAL / AUTOMATIC; process controller Type 8793

* *only possible if signal level fault detection activated (see chapter 24.4.SIG-ERROR   Configuration of signal level fault detection).*

24.6. *CAL.USER*
Calibrating the actual value display and the inputs for the process values

The following points can be manually calibrated with this function:

▪ Position display (*POS*) 0 – 100%

▪ Process set-point value display (*SP*)***

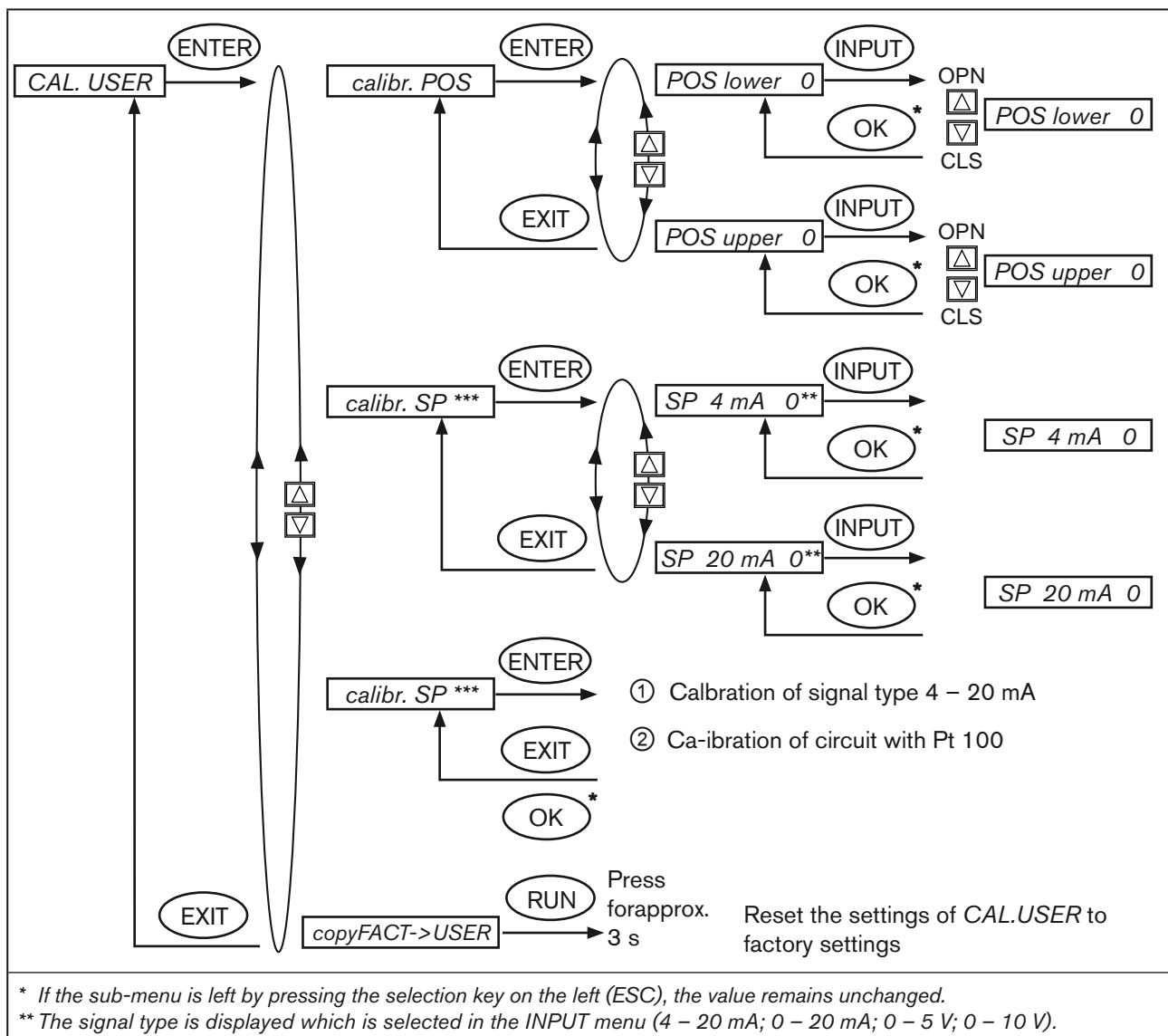▪ Process actual value display (PV)

Fig. 97:   Operating structure CAL.USER; process controller Type 8793

Remove the *CAL.USER* auxiliary function to re-activate the factory calibration.

Procedure:

calibr. POS **Calibrating the actual value display POS (0 – 100%):**

→ In the *CAL. USER* menu press the arrow keys to select the *calibr. POS* and confirm with the selection key on the right (ENTER).

Accept the minimum position:

→ Press the arrow keys to mark the *POS lower X* menu option and confirm with the selection key on the right (SELEC).

→ Approach the minimum position of the valve using the arrow keys (OPN/CLS) and confirm this value by pressing the selection key on the right (OK).

Accept the maximum position:

→ Press the arrow keys to mark the *POS upper X* menu option and confirm with the selection key on the right (SELEC).

→ Approach the maximum position of the valve using the arrow keys (OPN/CLS) and confirm this value by pressing the selection key on the right (OK).

*calibr. SP **** **Calibrating the process set-point value (4 – 20 mA; 0 – 20 mA; 0 – 5 V; 0 – 10 V):**

→ In the *CAL. USER* menu press the arrow keys to select the *calibr. INP* and confirm with the selection key on the right (ENTER).

Accept the minimum input signal (0 mA; 4 mA; 0 V)**:

→ Using the arrow keys, select the *INP (0 mA; 4 mA; 0 V)*** menu option and confirm with the selection key on the right (INPUT).

→ Specify the minimum value of the unit signal at the input and confirm this value with the selection key on the right (OK).

Accept the maximum input signal (20 mA; 5 V; 10 V)**:

→ Using the arrow keys, select the *INP (20 mA; 5 V; 10 V)*** menu option and confirm with the selection key on the right (INPUT).

→ Specify the maximum value of the unit signal at the input and confirm this value with the selection key on the right (OK).

** *The signal type is displayed which is selected in the INPUT menu (4 – 20 mA; 0 – 20 mA; 0 – 5 V; 0 – 10 V).*

*** *Only if external set-point value default is set in the P.CONTROL / SETUP / SP-INPUT menu*

calibr. PV **Calibrating the process actual value (4 – 20 mA or Pt 100):**

① **4 – 20 mA**

* If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.
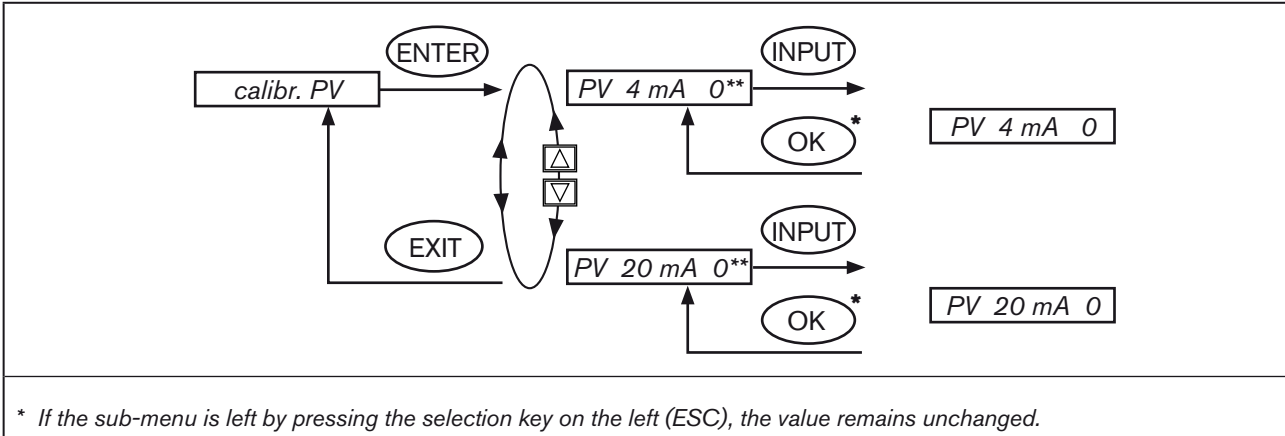
Fig. 98:   Operating structure CAL.USER - PV-4-20; process controller Type 8793

→ In the *CAL. USER* menu press the arrow keys to select the *calibr. PV* and confirm with the selection key on the right (ENTER).

Accept the minimum input signal (4 mA):

→ Press the arrow keys to mark the *PV 4 mA* menu option and confirm with the selection key on the right (INPUT).

→ Specify the minimum value of the unit signal at the input and confirm this value with the selection key on the right (OK).

Accept the maximum input signal (20 mA):

→ Press the arrow keys to mark the *PV 20 mA* menu option and confirm with the selection key on the right (INPUT).

→ Specify the maximum value of the unit signal at the input and confirm this value with the selection key on the right (OK).

② **Pt 100**
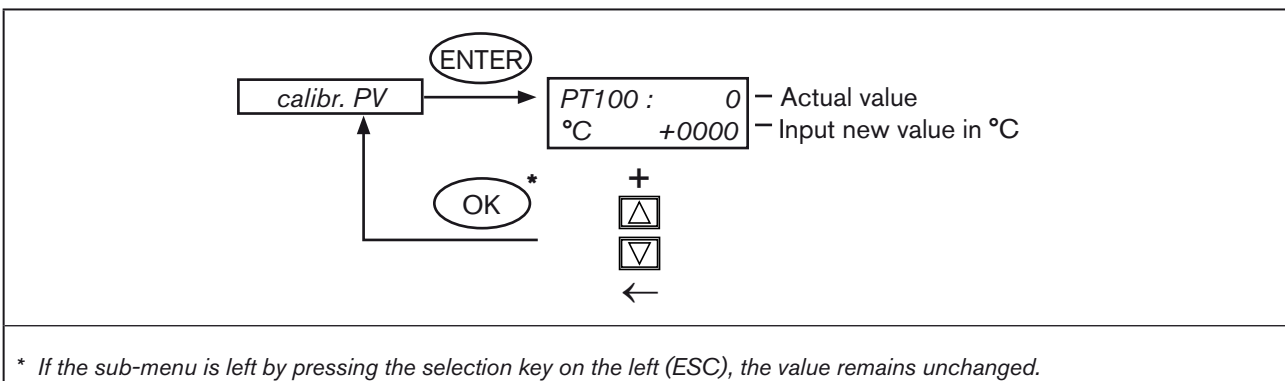
* If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.

164   *Fig. 99:   Operating structure CAL.USER - PV-Pt 100; process controller Type 8793*

→ Press the right selection key (ENTER) to select the input screen for *Pt 100*.

On the display the last digit of the value is highlighted with a dark background.

→ Press the up arrow key (+) to specify the value of the individual digit.

→ Press the down arrow key (←) to switch to the next digit.

→ When all input values have been specified, confirm the values by pressing the right selection key (OK).
The menu then jumps back to the selection screen.

copy FACT→USER   **Resetting the settings under CAL.USER to the factory settings:**

→ In the *CAL.USER* menu select the *copy FACT→USER* menu option using the arrow keys and confirm with the selection key on the right (ENTER).

→ Hold down the selection key on the right (RUN) (for approx. 3 seconds) until the countdown has elapsed.

Operating structure of the positioner

CONTENTS

25. OPERATING STRUCTURE POSITIONER
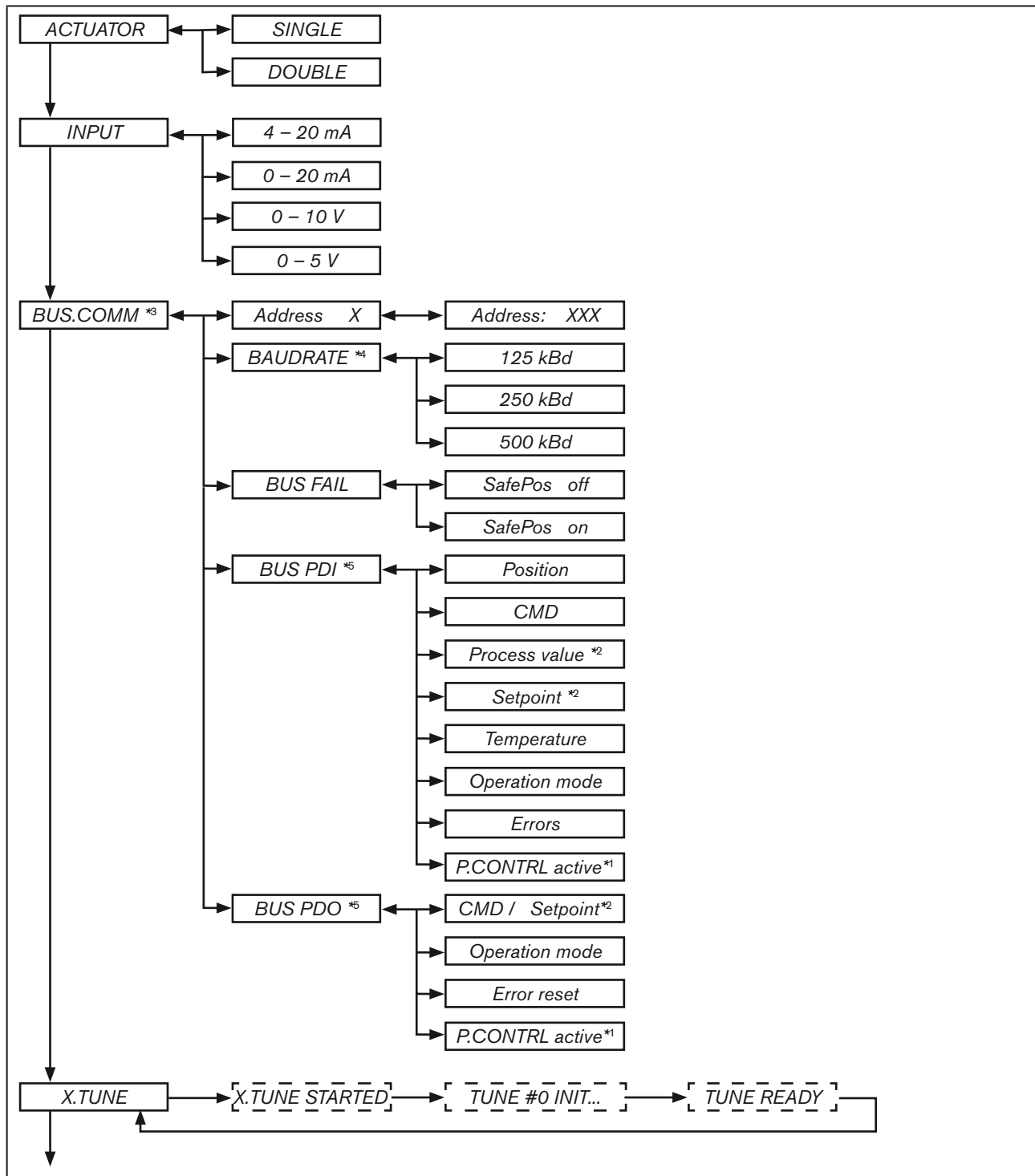
Fig. 100:   Operating structure - 1

MAN 1000118577 EN Version: A Status: RL (released I freigegeben) printed: 01.09.2009

*1 only process controller 8793
*2 only process controller 8793 and activated process controller
*3 only field bus
*4 only DeviceNet
*5 only Profibus DP

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MAN 1000118577 EN Version: A Status: RL (released I freigegeben) printed: 01.09.2009
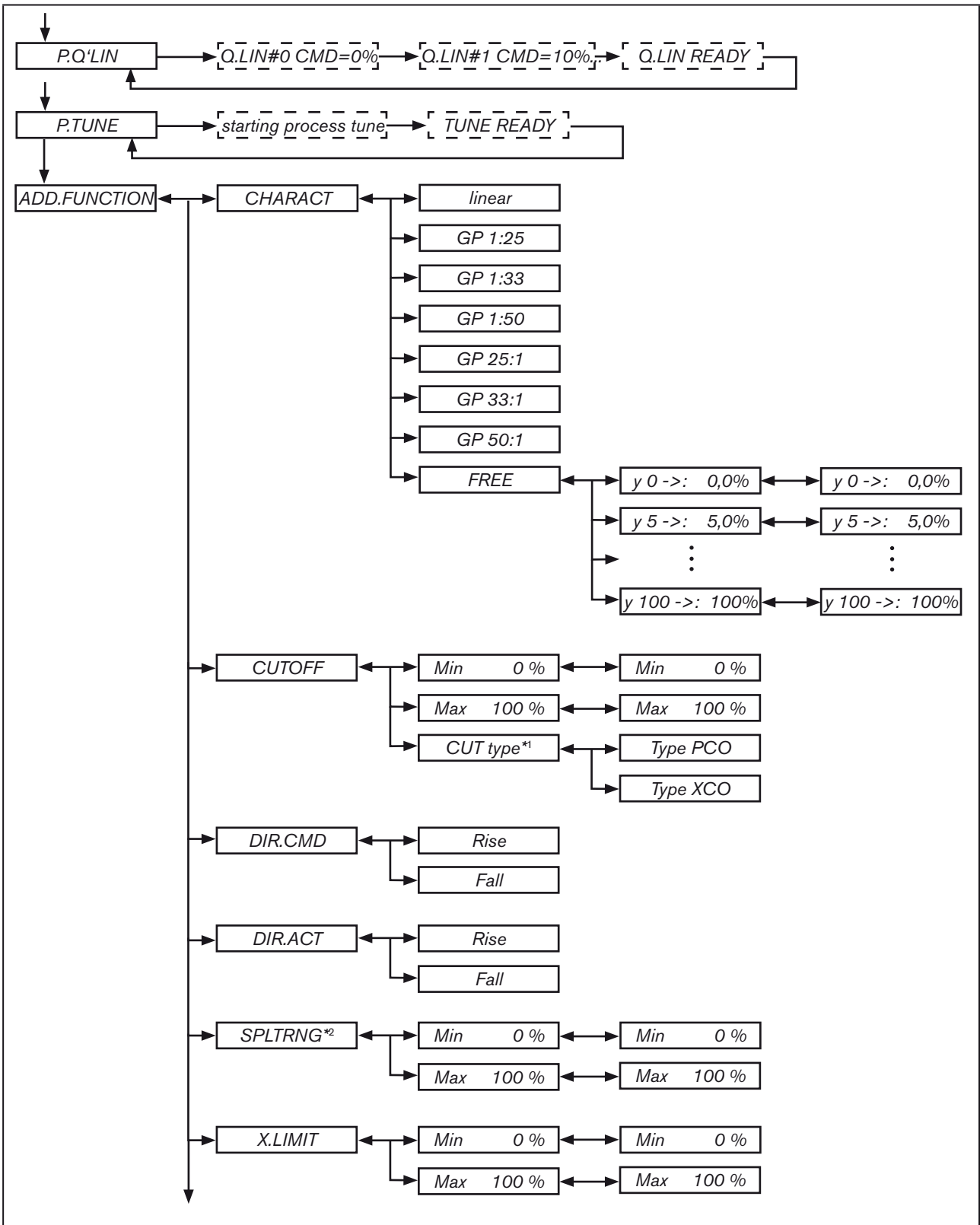
Fig. 101: Operating structure - 2

*1 only process controller 8793
*2 only position controller 8792

MAN 1000118577 EN Version: A Status: RL (released I freigegeben) printed: 01.09.2009

| X.TIME | Open 1 | Open 1 |
| | Close 1 | Close 1 |

X.CONTROL	DBND 1%	DBND 1%
	KXopn 1	KXopn 0001
	KXcls 1	KXcls 0001

P.CONTROL *1	PARAMETER	DBND 1%	DBND 1%
		KP 1.00	KP 1.00
		TN 999.9	TN 999.9
		TV 0.0	TV 0.0
		X0 0.0%	X0 0.0%
		FILTER 0	FILTER 0

	SETUP	PV INPUT	4 – 20 mA
			Frequenz
			PT 100

		PV SCALE	PVmin 0.0 bar
			PVmin 0.0
			PVmax 100.0 bar
			PVmax 100.0
			K-Factor *2
			VALUE / TEACH IN

| | | SP INPUT | internal |
| | | | external |

Fig. 102: Operating structure - 3

*1 only process controller 8793
*2 only for frequency signal type (PV INPUT / frequency)

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MAN 1000118577 EN Version: A Status: RL (released I freigegeben) printed: 01.09.2009

			SP SCALE*²		SPmin 0.0 bar
					SPmin 0.0
					SPmax 100.0 bar
					SPmax 100.0
			P.CO INIT		bumpless
					standard
	SECURITY	Access Code	CODE		CODE
			MAIN		
			MANU/AUTO		
			ADDFUNCT		
			X.TUNE		
			P.Q'LIN *¹		
	Safepos	Safepos 0%	Safepos 0		
	SIG.ERROR	SP/CMD Input	ERROR off		
			ERROR on		
			SAFEPOS		SafePos off
					SafePos on
		PV Input *¹	ERROR off		
			ERROR on		
			SAFEPOS		SafePos off
					SafePos on

Fig. 103: Operating structure - 4

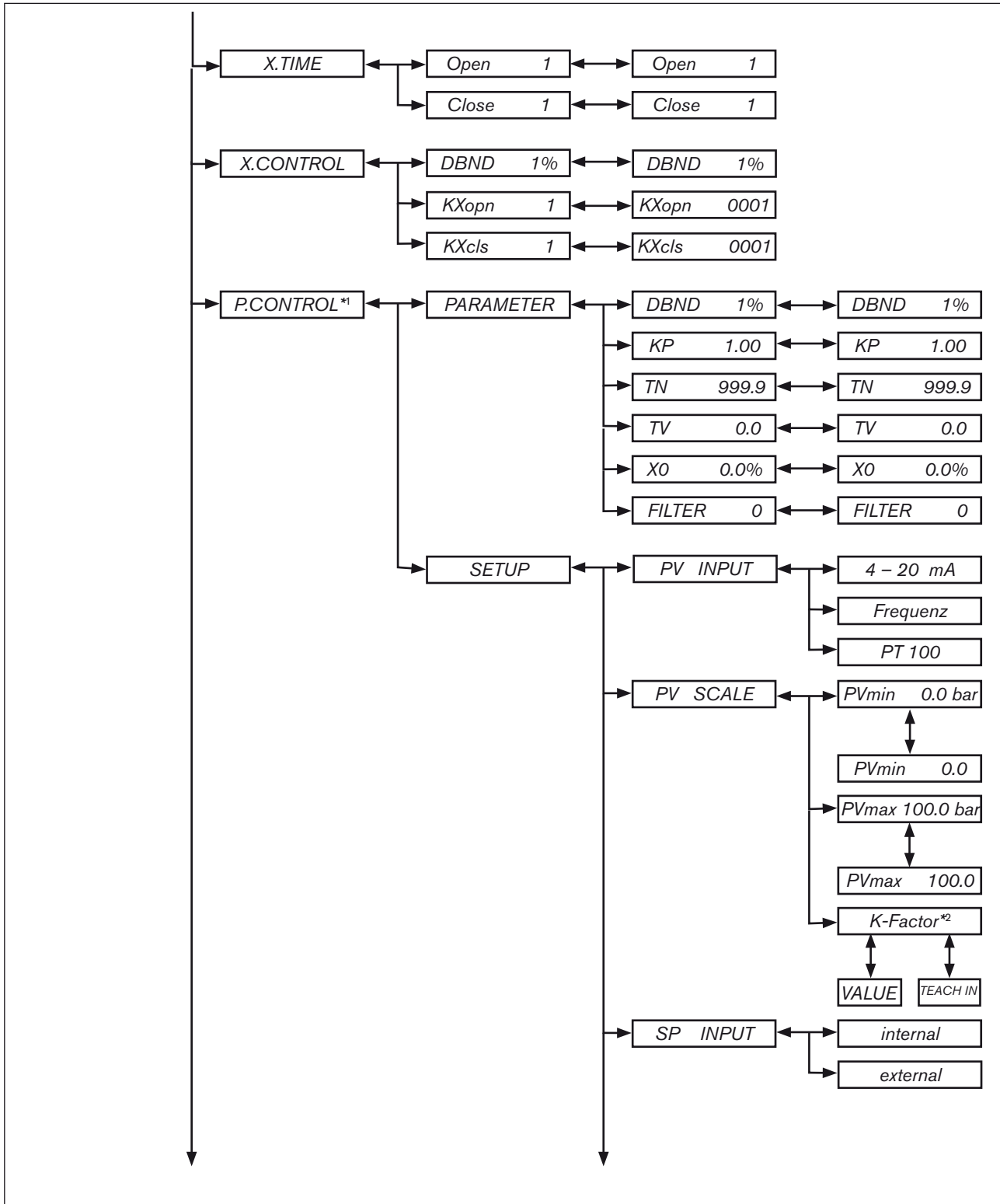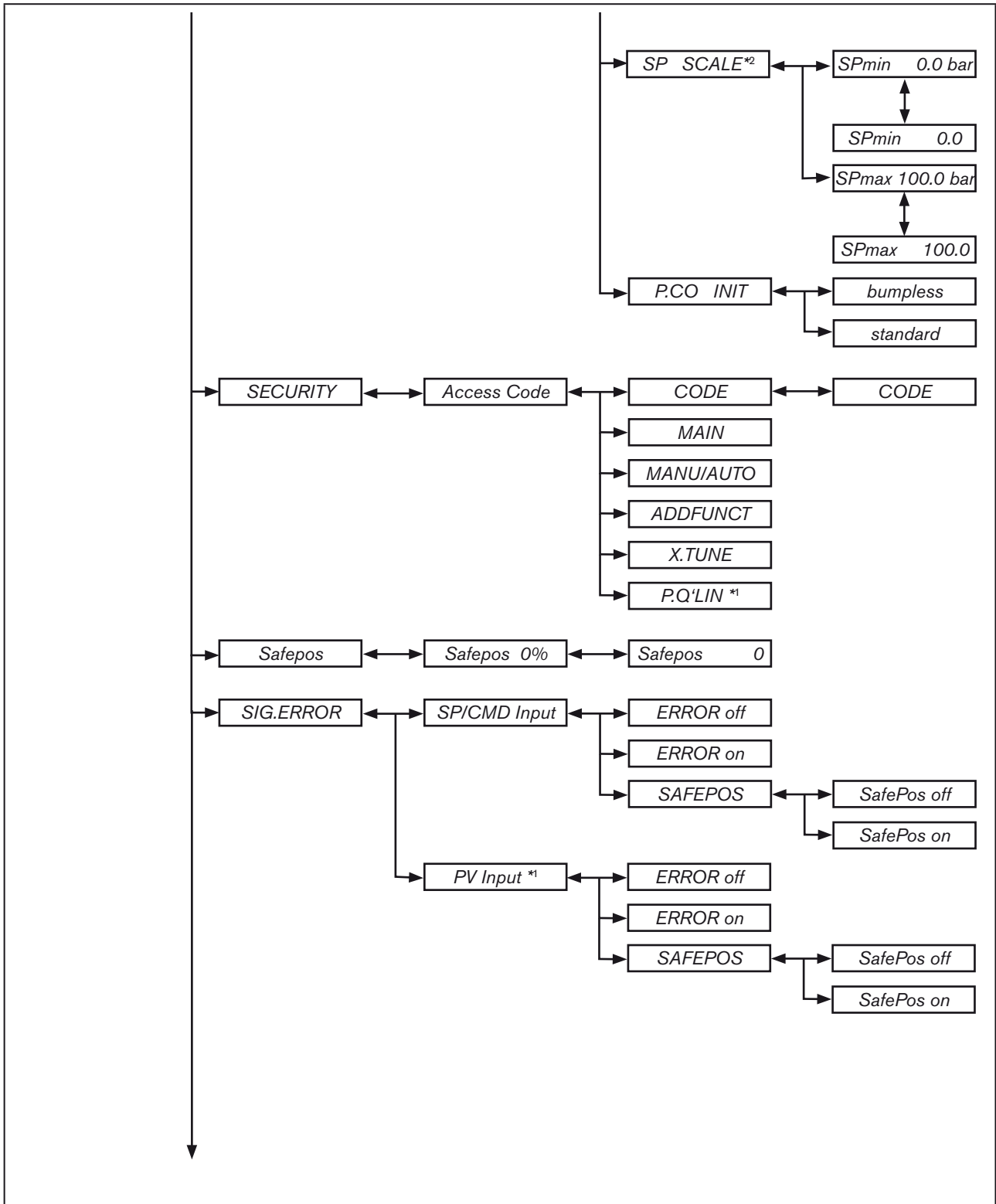*¹ only process controller 8793
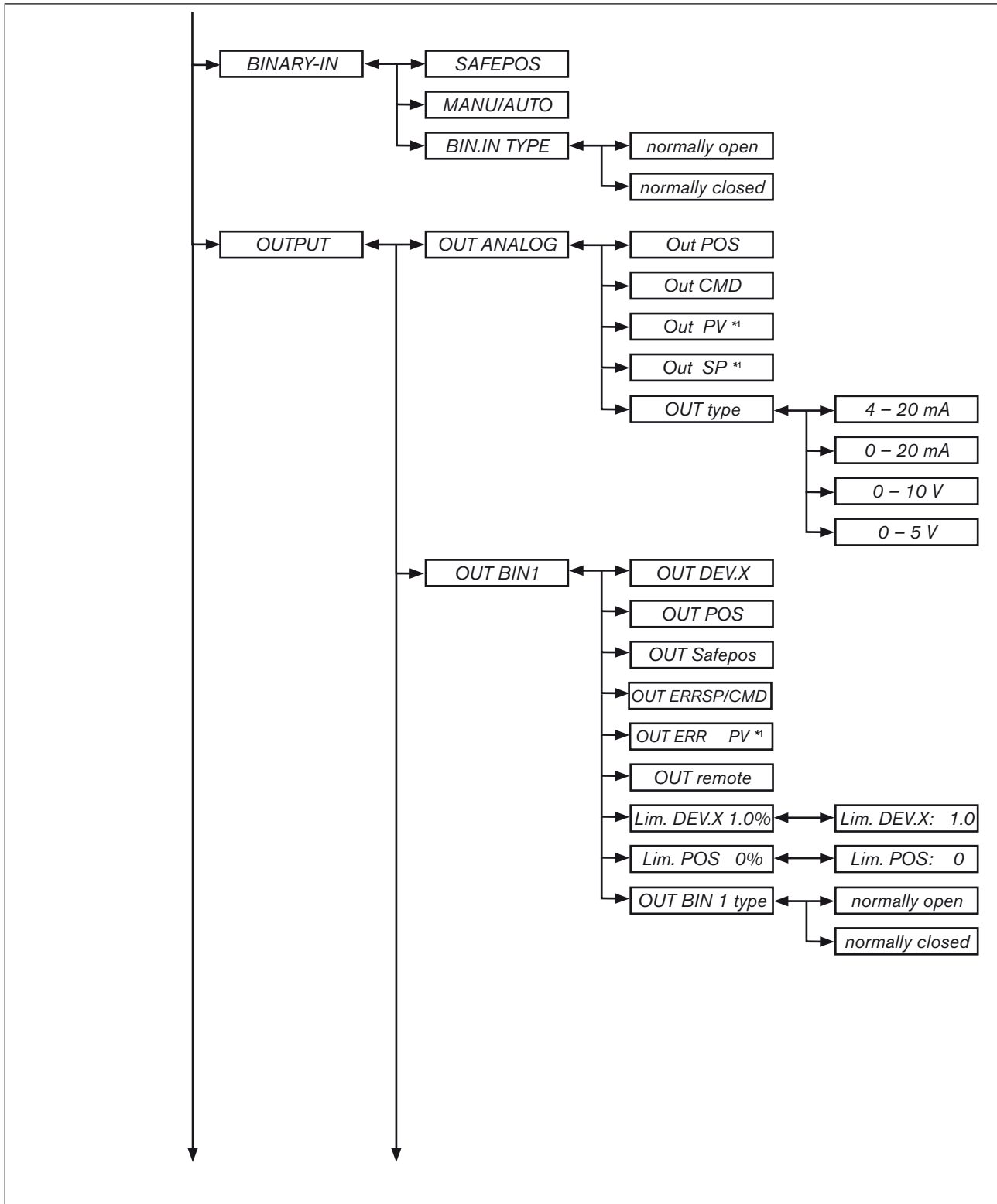*² only for external set-point value default (SP INPUT / external)

Fig. 104:   Operating structure - 5

172   *1 only process controller

MAN 1000118577 EN Version: A Status: RL (released I freigegeben) printed: 01.09.2009

OUT BIN2 → OUT DEV.X

OUT POS

OUT Safepos

OUT ERRSP/CMD

OUT ERR   PV *1

OUT remote

Lim. DEV.X 1.0% ↔ Lim. DEV.X: 1.0

Lim. POS   0% ↔ Lim. POS: 0

OUT BIN 2 type ↔ normally open

normally closed

CAL. USER → calibr. POS ↔ POS lower   0 ↔ POS lower   0

POS upper   0 ↔ POS upper   0

calibr. INP*2 ↔ INP 4 mA 0*3 ↔ INP 4 mA   0

INP 20 mA 0*3 ↔ INP 20 mA 0

calibr. SP*4 ↔ SP 4 mA   0*3 ↔ SP 4 mA   0

SP 20 mA 0*3 ↔ SP 20 mA 0

calibr. PV *5 ↔ PV   4 mA   0 ↔ PV 4 mA   0

PV   20 mA 0 ↔ PV 20 mA 0

calibr. PV *6 ↔ PT100   0
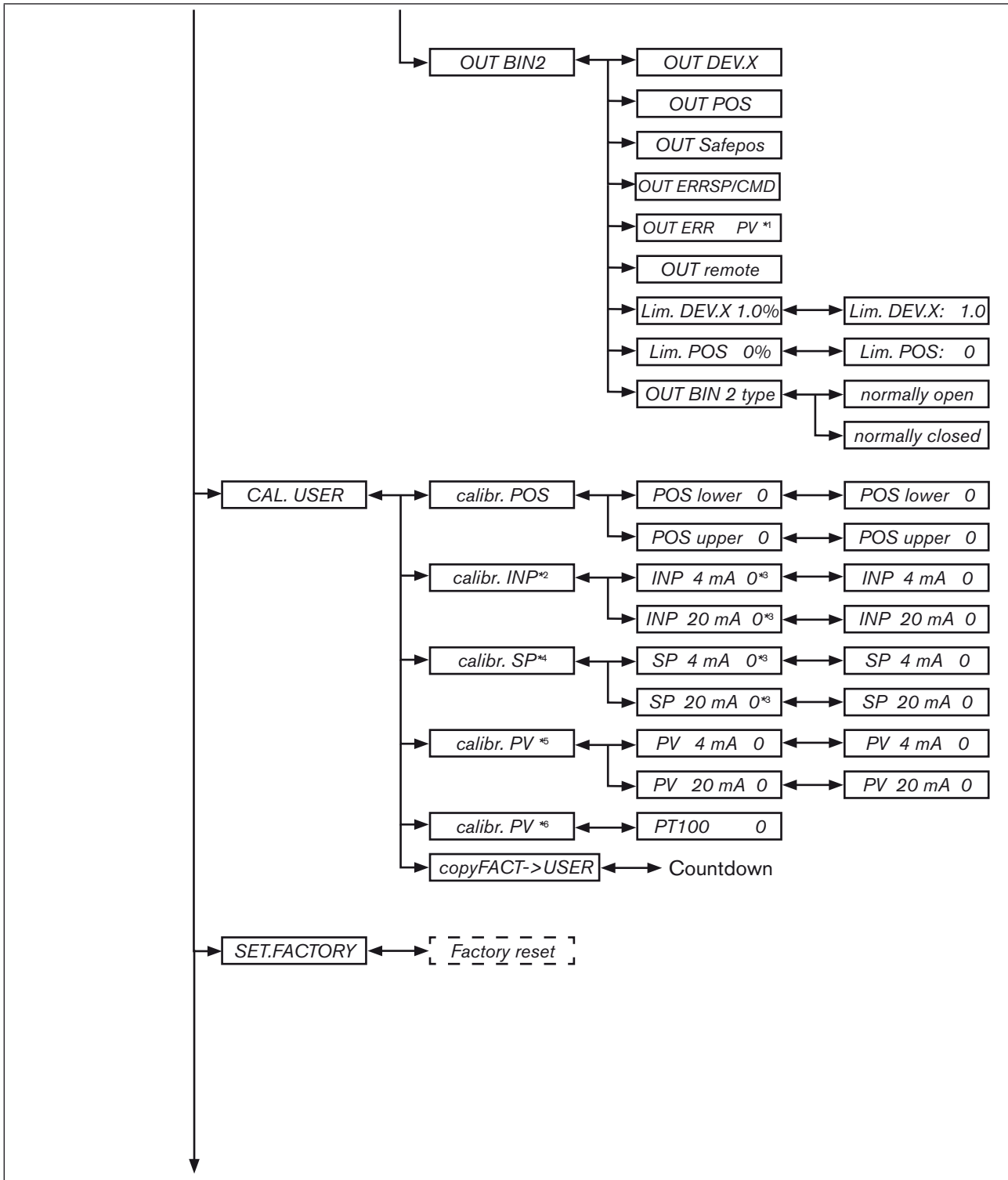
copyFACT->USER ↔ Countdown

SET.FACTORY ↔ Factory reset

Fig. 105:   Operating structure - 6

1 only process controller 8793
2 only position controller 8792
3 The signal type is displayed which is selected in the INPUT menu
4 only 8793, only for external set-point value default (P.CONTROL / SETUP / SP-INPUT / external)
5 only 8793, only for signal type 4 − 20 mA
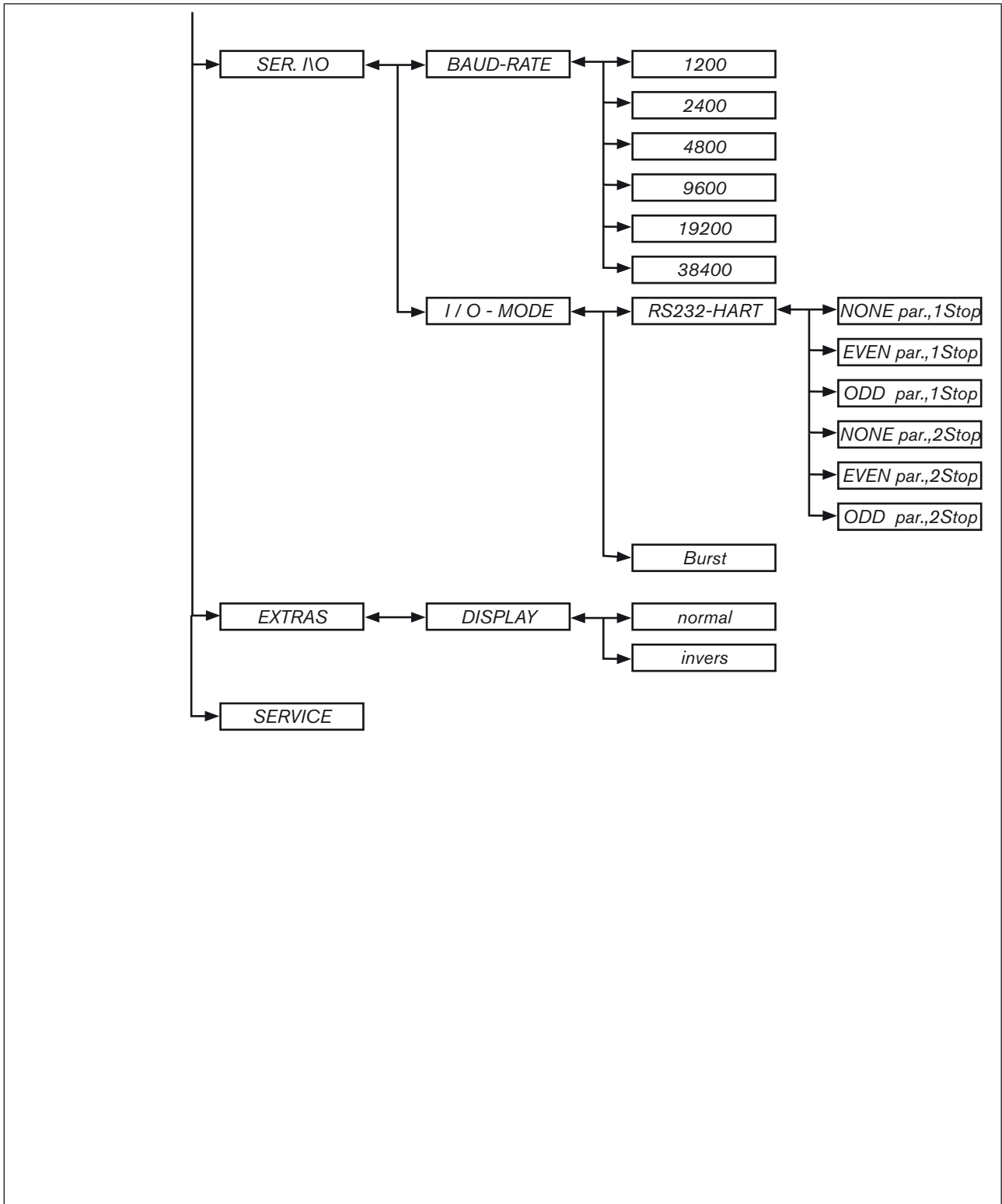*6 only 8793, only for circuit with PT 100*

Fig. 106: Operating structure - 7

MAN 1000118577 EN Version: A Status: RL (released I freigegeben) printed: 01.09.2009

burkert
FLUID CONTROL SYSTEMS

PROFIBUS-DP

CONTENTS

26. GENERAL INFORMATION

The following sections of the general operating instructions do not apply to the positioner with PROFIBUS-DP:

- ▪ Variants of the positioner

- ▪ Initial start-up

- ▪ Electrical connection

- ▪ Specifying the standard settings

> Function *INPUT*
>
> Function *SPLTRNG*
>
> Function *BINARY-IN*
>
> Function *OUTPUT*
>
> Function *CAL.USER / calibr. INP*
>
> Function *CAL.USER / calibr. SP*

27. TECHNICAL DATA

The protocol sequence complies with the standard DIN 19245 Part 3.

GSD file	BUER0C1E.gsd
Bitmap files	BUER0C1E.bmp
PNO-ID	0C1E Hex
Baud rate	Max. 12 mbaud (is automatically set by the positioner)
Sync and Freeze mode	Are not supported
Diagnosis telegram	No device-specific diagnosis
Parameter telegram	No user parameters

The process data is configured in the positioner and in the PROFIBUS master.

Maximum 10 process values (total *INPUT* and *OUTPUT*) can be transferred.

28.   SAFETY SETTINGS IF THE BUS FAILS

The position is approached which corresponds to the set-point value last transferred (default setting).

Other setting options (see chapter *31.Settings on the positioner*).

29.   INTERFACES

Bus

Input for process
actual value*
4 – 20 mA
frequency
Pt 100

Binary input

24 V DC

Inputs

Positioner

PROFIBUS-DP

Supply

Outputs

Operation

Bus

2 binary outputs
24 V PNP

Initiator 1 / Initiator 2
24 V PNP NO

Note:
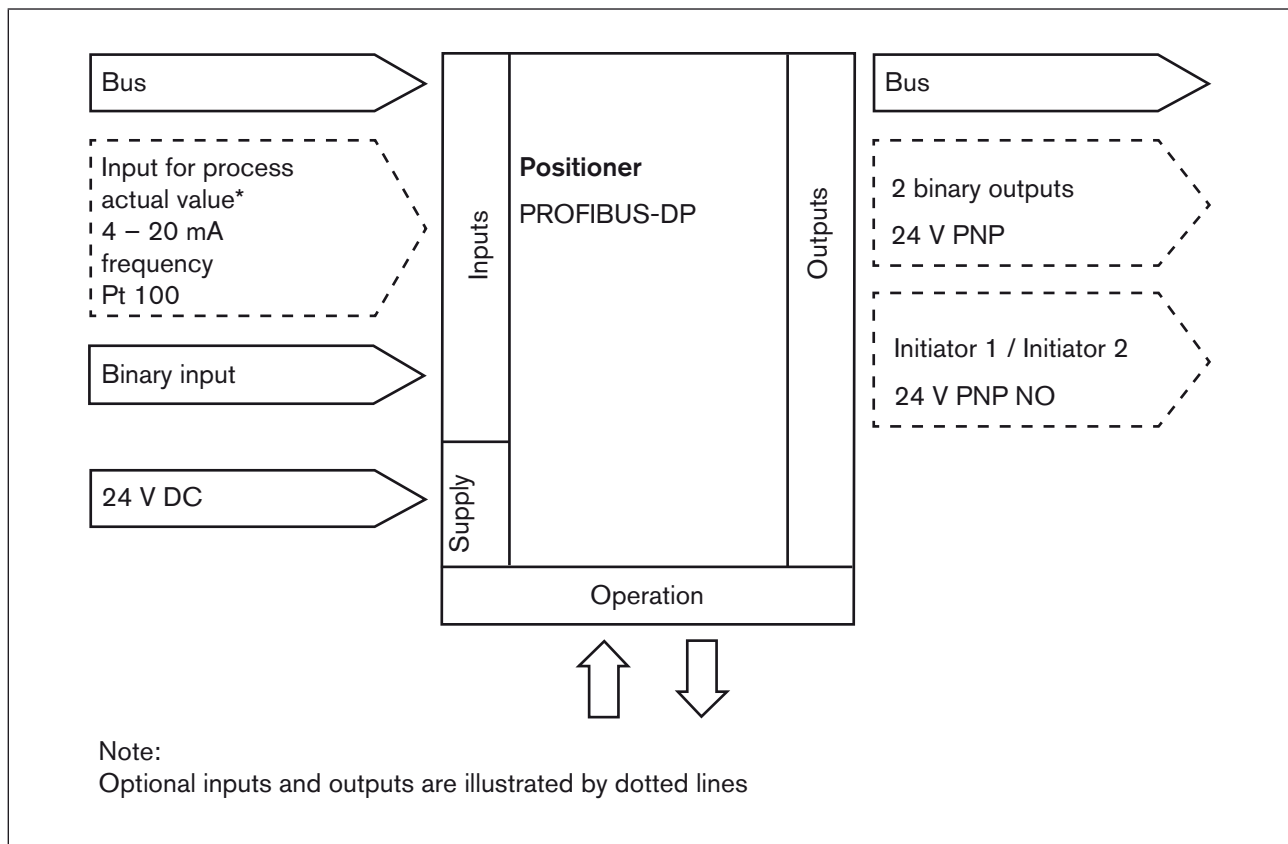Optional inputs and outputs are illustrated by dotted lines

Fig. 107:   Interfaces PROFIBUS-DP

* only for process controller Type 8793

30.   ELECTRICAL CONNECTIONS

⚠ **DANGER!**

Risk of injury due to electrical shock!

▪ Before reaching into the device or the equipment, switch off the power supply and secure to prevent reactivation!

▪ Observe applicable accident prevention and safety regulations for electrical equipment!

⚠ **WARNING!**

Risk of injury from improper installation!

▪ Installation may be carried out by authorized technicians only and with the appropriate tools!

Risk of injury from unintentional activation of the system and an uncontrolled restart!

▪ Secure system from unintentional activation.

▪ Following installation, ensure a controlled restart.

→ For operation of the device always connect the 5-pole, inversely coded M12 socket and the 8-pole M12 plug (power supply).

NOTE!

Electromagnetic compatibility (EMC) is only ensured if the appliance is connected correctly to an earthing point.

On the outside of the housing is a TE terminal for connection of the technical earth (TE).

▪ Connect the TE terminal to the earthing point via a shortest possible cable (maximum length 30 cm).

30.1.   Connection diagram Type 8792

M12, 8-pole plug

M12, 5-pole socket
(inversely coded,
PROFIBUS-DP)

Function earth FE

M12, 5-pole plug
(inversely coded,
PROFIBUS-DP)
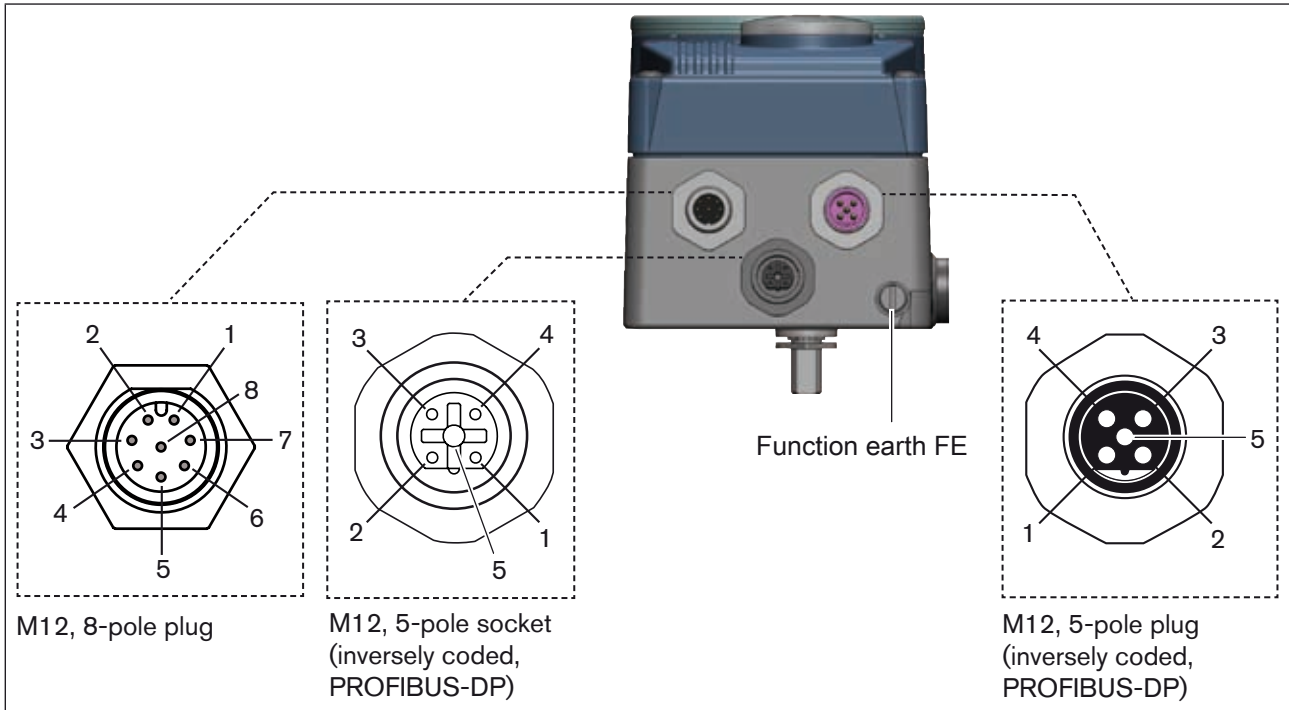
Fig. 108:   Connection PROFIBUS-DP, position controller Typ 8792

30.2.   Connection diagram Type 8793
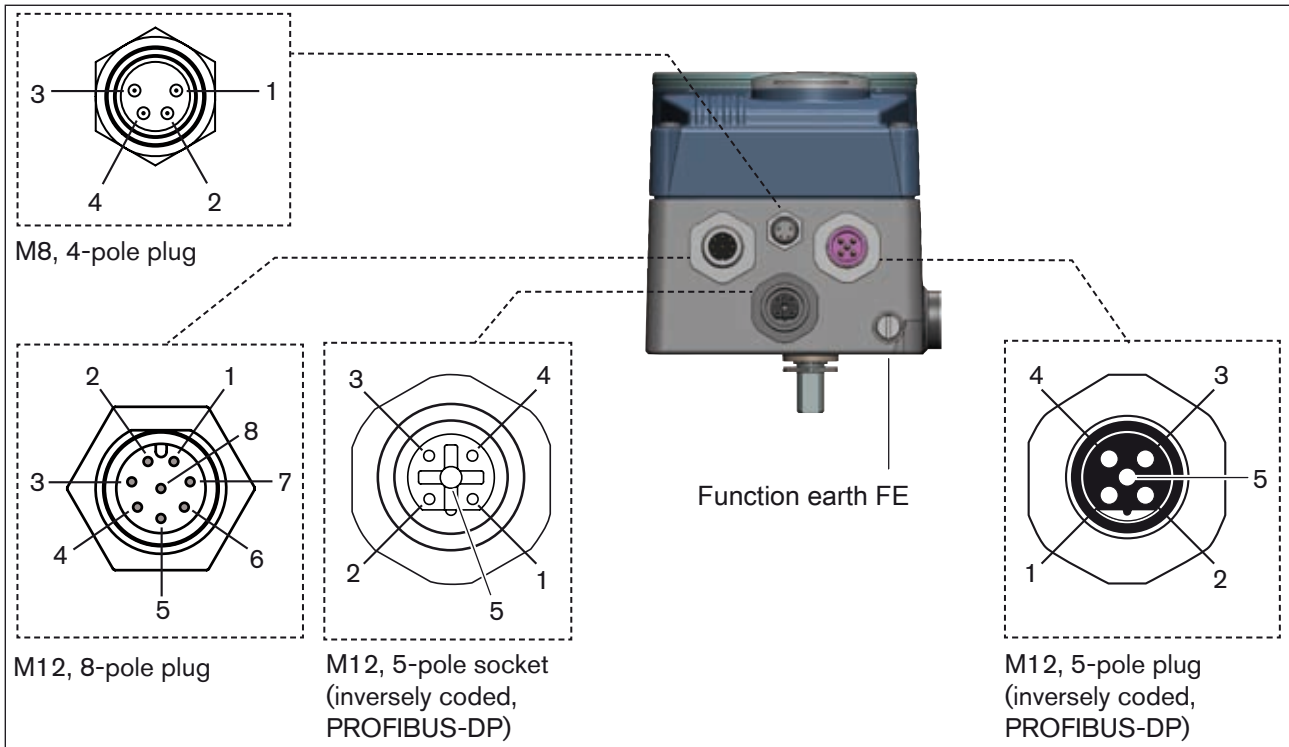
M8, 4-pole plug

M12, 8-pole plug

M12, 5-pole socket
(inversely coded,
PROFIBUS-DP)

Function earth FE

M12, 5-pole plug
(inversely coded,
PROFIBUS-DP)

Fig. 109:   Connection PROFIBUS-DP, process controller Typ 8793

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30.3.   Operating voltage - M12, 8-pole connector
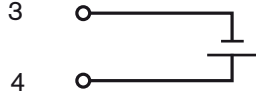
Pin	Configuration	External circuit / Signal level
1	not used	
2	not used	
3	GND	3 ⊶ ⊥ 24 V DC ± 10%
4	+24 V	4 ⊶ max. residual ripple 10%
5	Binary input +	
6	Binary input –	
7	Binary output 1 (referring to Pin 3)	
8	Binary output 2 (referring to Pin 3)	

Table 43:   Pin assignment; operating voltage - M12, 8-pole circular connector; PROFIBUS-DP

30.4.   Bus connection - socket/connector M12, 5-pole

Pin	Configuration	External circuit / Signal level
1	VP+5	Supply the terminating resistors
2	RxD/TxD-N	Received/transmitted data -N, A-line
3	DGND	Data transmission potential (earth to 5 V)
4	RxD/TxD-P	Received/transmitted data -P, B-line
5	Shielding	Shielding / protective earth

Table 44:   Pin assignment; bus connection - M12, 5-pole circular socket/connector; PROFIBUS-DP

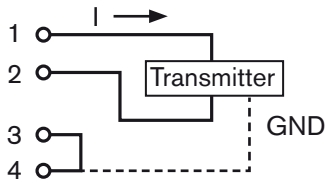## 30.5. Process actual value (M8 circular connector) - Type 8793 only

Input type*	Pin	Configuration	DIP switches**	External circuit
4 – 20 mA - internally supplied	1 2 3 4	+24 V transmitter supply Output from transmitter GND Bridge after GND (GND from 3-conductor transmitter)	Switch on left	1 I → 2 Transmitter 3 GND 4
4 – 20 mA - externally supplied	1 2 3 4	not used Process actual + not used Process actual −	Switch on right	2 4 – 20 mA 4 GND
Frequency - internally supplied	1 2 3 4	+24 V sensor supply Clock input + Clock input − (GND) not used	Switch on left	1 +24 V 2 Clock + 3 Clock −
Frequency - externally supplied	1 2 3 4	not used Clock input + Clock input − not used	Switch on right	2 Clock + 3 Clock −
Pt 100 (see information below)	1 2 3 4	not used Process actual 1 (power supply) Process actual 3 (GND) Process actual 2 (compensation)	Switch on right	2 Pt 100 3 4

* Can be adjusted via software (see chapter 18.3.Specifying the standard settings).

** The switch is located under the screw connection (see Fig. 109:Connection PROFIBUS-DP, process controller Typ 8793)

Table 45:   Plug assignments of the process actual value input (M8 circular plug)

> Connect the Pt 100 sensor via 3 cables for cable compensation reasons.
> It is essential to bridge Pin 3 and Pin 4 on the sensor.

31. SETTINGS ON THE POSITIONER

→ Specify the basic settings on the positioner for *ACTUATOR* and *X.TUNE*.

Specification of the basic settings is described in the chapter entitled *Start-up and operation of the position controller Type 8792 / 19.5.Specifying the standard settings*.

→ Implement the settings in the *BUS.COMM* menu option. The procedure is described in the following chapter *31.1.BUS.COMM   Description of menu* .
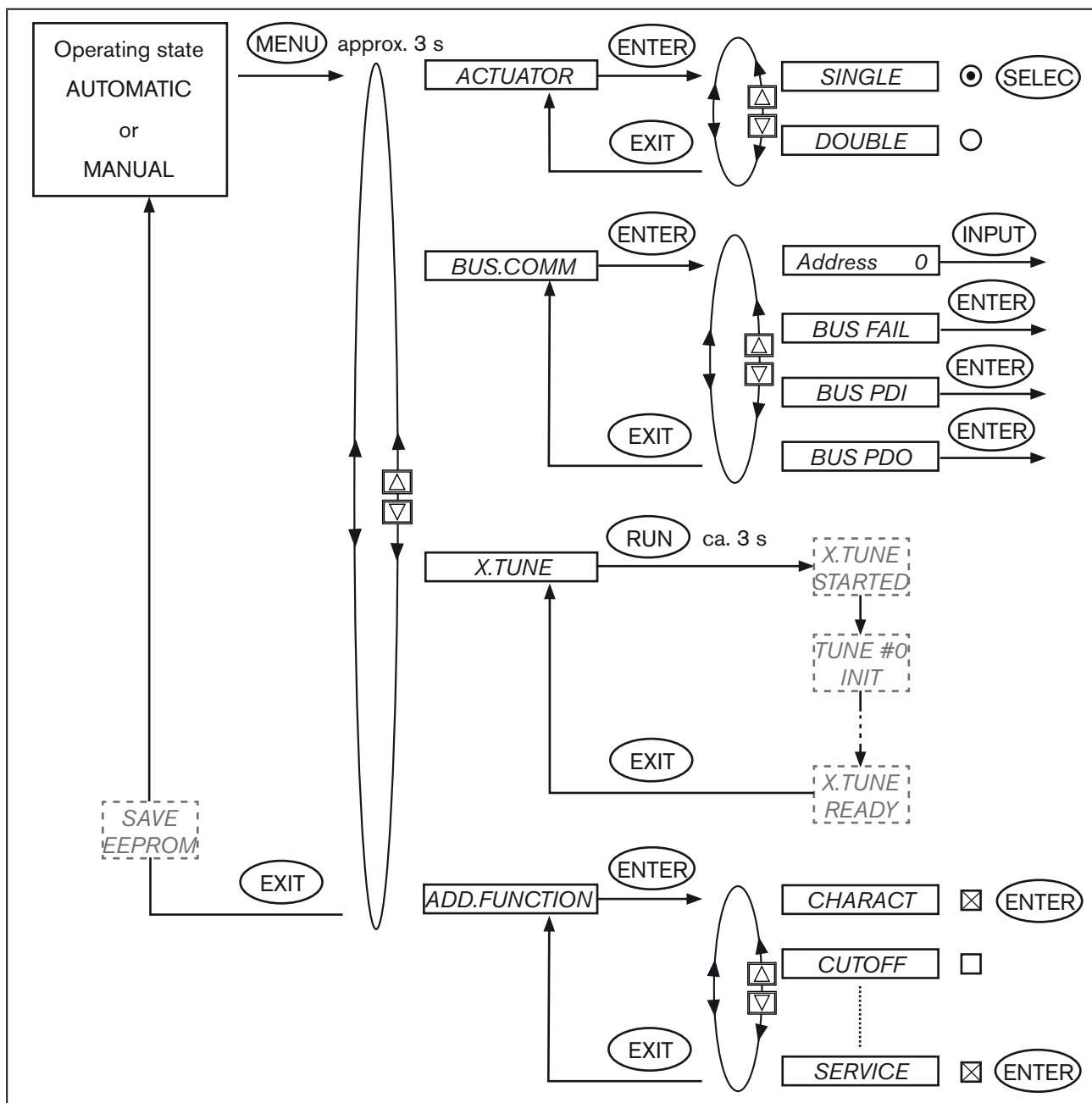
Fig. 110:   Operating structure - basic settings - PROFIBUS-DP

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31.1. *BUS.COMM* Description of menu

31.1.1. *BUS.COMM* Operating structure position controller
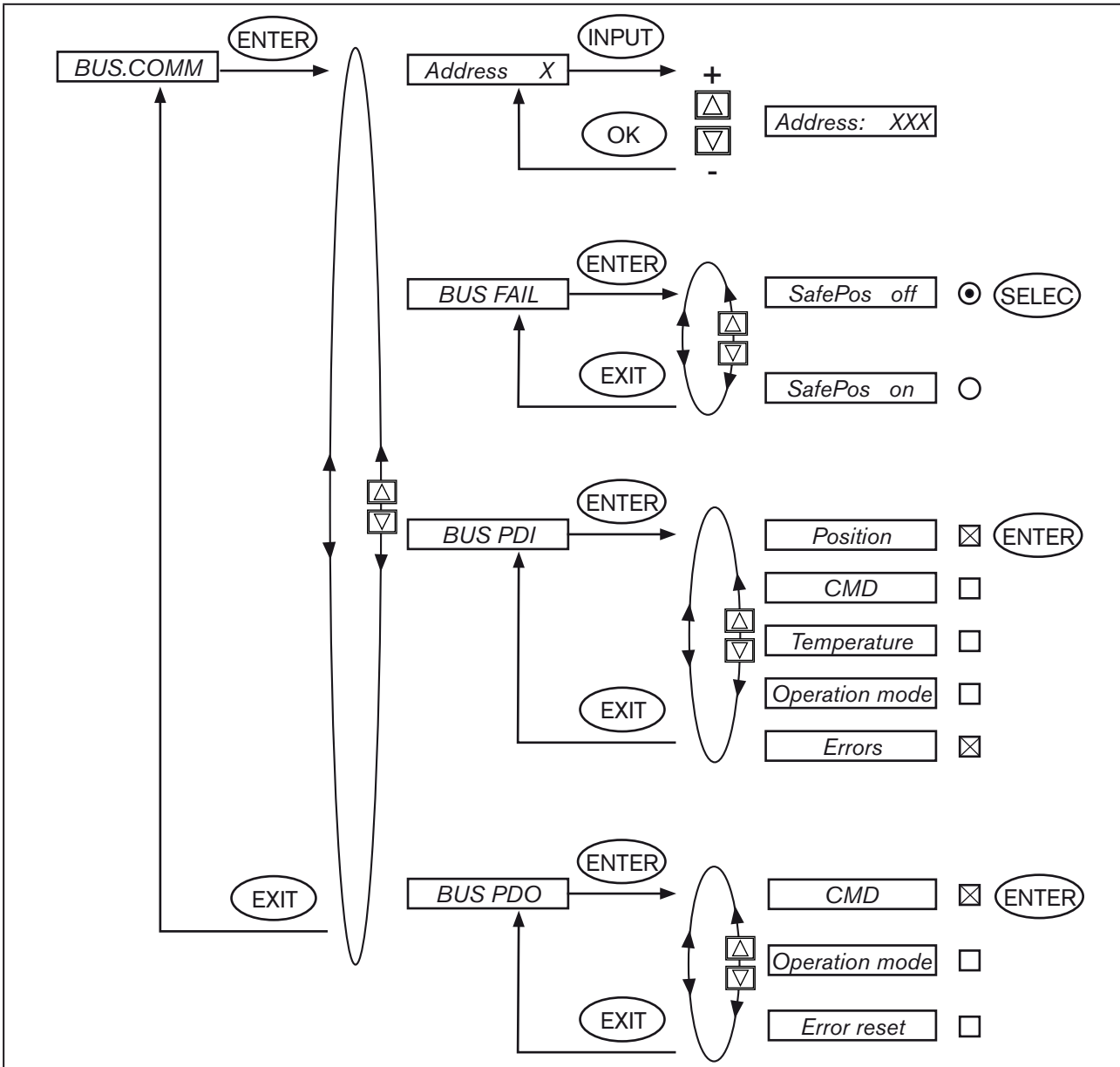
Fig. 111: Operating structure - BUS-COMM; position controller 8792

31.1.2. *BUS.COMM*   Operating structure process controller

* only when process controller activated
** only when process controller activated, otherwise CMD
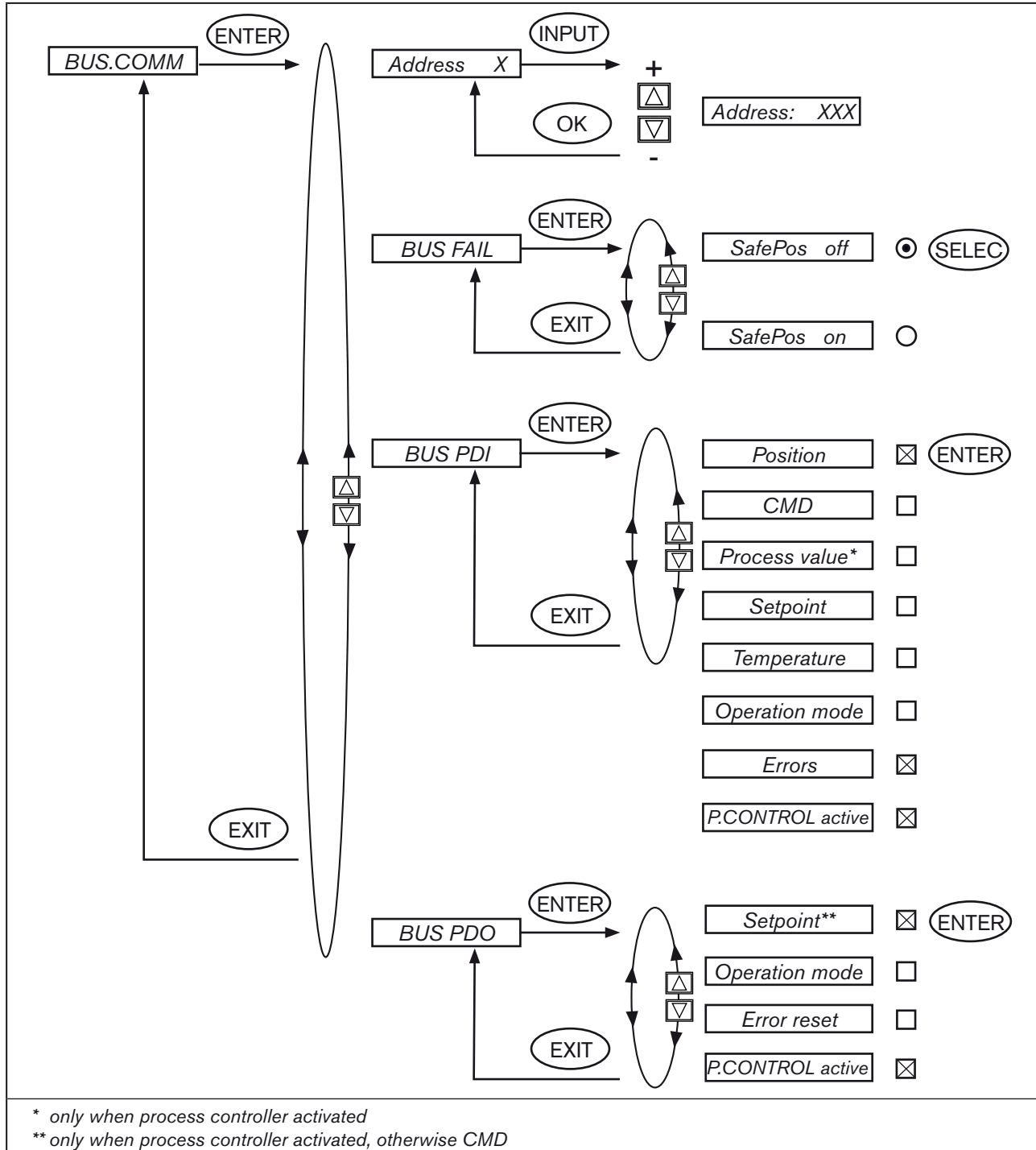
Fig. 112:   Operating structure - BUS-COMM; process controller 8793

31.1.3. *BUS.COMM* Description of the menu options

| Address XXX | **Input the device address**

→ Press the arrow keys (+/-) to set a value from 0 – 126 and confirm with the selection key on the right (OK).

| BUS FAIL | **Activate to approach the safety position if the bus communication fails**

SafePos off

The position is approached which corresponds to the set-point value last transferred.
(default setting)

SafePos on

When *SafePos on* is set, the following configurations may occur:

▪ Active *SAFEPO*
menu option If a fault is detected in the bus communication, the actuator moves to the lower *SAFEPOS* set position.

▪ Inactive *SAFEPOS*
menu option If a fault is detected in the bus communication, the actuator moves to the end position which it would specify in the isolated state.

| BUS PDI | **Selection of the process values which are to be transferred by the positioner to the controller (master).**

Position
CMD
Process value *
Setpoint *
Temperature
Operation mode
Errors
P.CONTRL active **

→ Press the selection button on the right (ENTER) to activate (x) or deactivate ( ) the particular process value. Meaning of the process values see *Table 46:Process Data Input, PROFIBUS-DP.*

| BUS PDO | **Selection of the process values which are to be transferred by the controller (master) to the positioner.**

CMD / Setpoint*
Operation mode
Error reset
P.CONTRL active **

→ Press the selection button on the right (ENTER) to activate (x) or deactivate ( ) the particular process value. Meaning of the process values see *Table 47:Process Data Output, PROFIBUS-DP.*

* only for type 8793 and when process controller activated
** only for type 8793

32. FUNCTIONAL DEVIATIONS FROM THE STANDARD MODEL

It is possible to switch between the MANUAL and AUTOMATIC operating states on the process operating level either via the keyboard on the positioner or via the bus.

It is no longer possible to switch between MANUAL / AUTOMATIC on the keyboard if an operating mode (under *PDO MODE*) is transferred to the positioner via the bus.

33.   CONFIGURATION IN THE PROFIBUS-DP MASTER

User parameters (hexparameters) are not required.

33.1.   Configuration of the Process Values

→ The PDI (Process Data Input) input first.

PDI: **Process Data Input**   (from the positioner to the controller)

Name	Description	Identifier
PDI:POS	Actual position (position) Actual value of position controller as ‰. Value range 0 – 1000. Values < 0 or > 1000 are possible if e.g. Autotune has not run through correctly.	GSD file: *PDI:POS* Identifier (HEX): 41, 40, 00
PDI:CMD	Nominal position (command) Set-point value of position controller as ‰. Value range 0 – 1000.	GSD file: *PDI:CMD* Identifier (HEX): 41, 40, 01
PDI:PV *PDI:SP*	Process actual value (process value) Actual value of process controller in physical unit (as set in the menu *P.CO INP* or *P.CO SCAL*), max. value range -999 – 9999, depending on internal scaling Process set-point value (setpoint) Set-point value of process controller in physical unit (as set in the menu *P.CO INP* or *P.CO SCAL*), max. value range -999 – 9999, depending on internal scaling	GSD file: *PDI:PV* Identifier (HEX): 41, 40, 02 GSD file: *PDI:SP* Identifier (HEX): 41, 40, 03
PDI:TEMP	Device temperature (temperature) Temperature of 0.1 °C is measured on the CPU board by the sensor, Value range -550 (-55 °C) – +1250 (+125 °C)	GSD file: *PDI:TEMP* Identifier (HEX): 41, 40, 04
PDI:MODE	Operating mode (operation mode) Operating mode: 0: *AUTO* 1: *MANUAL* 2: *XTUNE* 9: *P.QLIN* 10: *P.TUNE* 12: *BUSSAFEPOS*	GSD file: *PDI:MODE* Identifier (HEX): 41, 00, 05

Name	Description	Identifier
PDI:ERR	Error Indicates the number of the process value (output) which was not written. The value is retained until it is deleted with *PDO:ERR*. HEX 14 *PDO:CMD / SP* 16 *PDO:MODE*	GSD file: *PDI:ERR* Identifier (HEX): 41, 00, 06
PDI: PCONact	0: Position controller 1: Process controller	GSD file: *PDI:PCONact* Identifier (HEX): 41, 00, 0A

Table 46:   Process Data Input, PROFIBUS-DP

> *PDI:PV* and *PDI:SP* can be selected for Type 8793 (process controller) only and are beneficial only when process controller activated.*PDI:PCONact can be selected* for Type 8793 (process controller) only.

→ Then the process data output input.

PDO: **Process Data Output**   (from the controller to the positioner)

Name	Description	Identifier
PDO:CMD/ SP	for position controller Type 8792: Set-point position (input) Set-point value of position controller as ‰. Value range 0 – 1000 If the value is too small or too large, the last valid value is used and is indicated in *ERR* with HEX 14. for process controller Type 8793: Process set-point value (setpoint) Set-point value of process controller in physical unit (as set in the menu *P.CO INP* or *P.CO SCAL*), max. value range -999 – 9999, depending on internal scaling. If the value is too small or too large, the last valid value is used and is indicated in *ERR* with HEX 14.	GSD file: *PDO:CMD/SP* Identifier (HEX): 81, 40, 14
PDO:MODE	Operating mode (operation mode) Value range 0, 1 or 12: 0: *AUTO* / 1: *HAND* / 12: *BUSSAFEPOS* If the value is too small or too large, the last valid value is used and is indicated in *ERR* with HEX 16.	GSD file: *PDO:MODE* Identifier (HEX): 81, 00, 16
PDO:ERR	Reset error display If the value > 0, *ERR* is reset	GSD file: *PDO:ERR* Identifier (HEX): 81, 00, 17
PDO: CONact	0: Position controller 1: Process controller	GSD file: *PDO:CONact* Identifier (HEX): 81, 00, 19

Table 47:   Process Data Output, PROFIBUS-DP

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34.   BUS STATUS DISPLAY

The bus status is indicated on the display on the device.

Display	Device status	Explanation	Troubleshooting
BUS offline is displayed approx. every 3 seconds	offline	Device is not connected to the bus	▪ Bus connection including plug assignment correct. ▪ Check power supply and bus connection of the other nodes.

Table 48:   Bus status display; PROFIBUS-DP

35. CONFIGURATION WITH SIEMENS STEP7

35.1. Example 1 of a position controller (Type 8792): Transfer of set-point and actual value
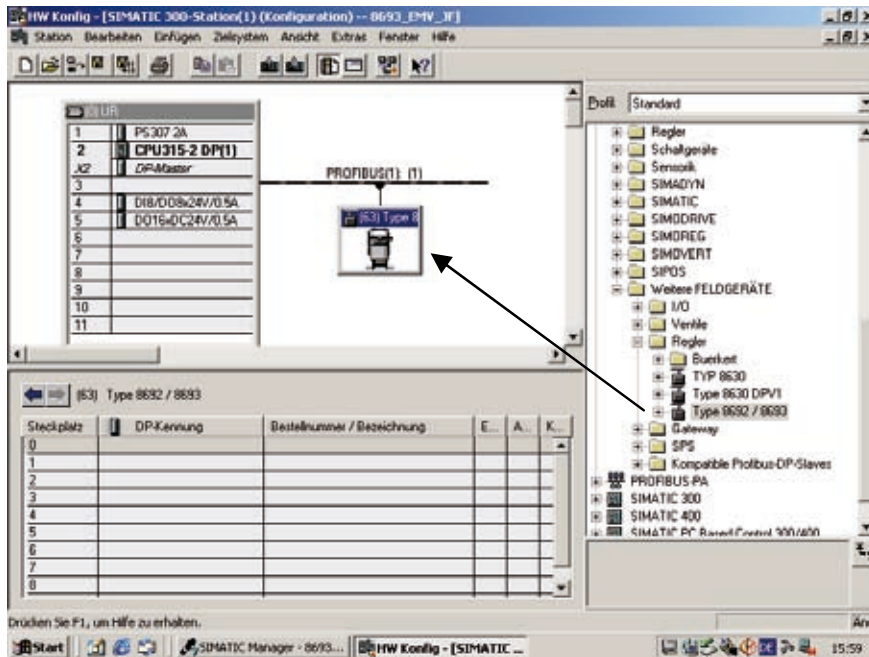

Fig. 113:   ScreenShot PROFIBUS

→ Pull the slave Type 8792 / 8793 onto the bus line with drag-and-drop.

Fig. 114:   ScreenShot position controller

→ Pull the modules PDI:POS and PDO:CMD/SP into the slave Type 8792 / 8793 with drag-and-drop.

35.2. Example 2 of a process controller (Type 8793): Transfer of several process values.

Fig. 115:   ScreenShot PROFIBUS

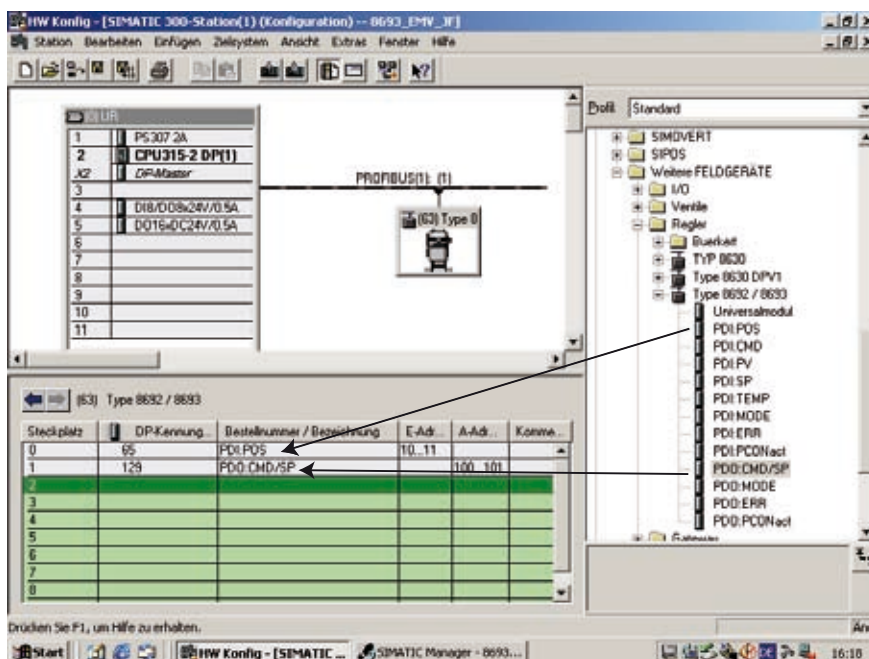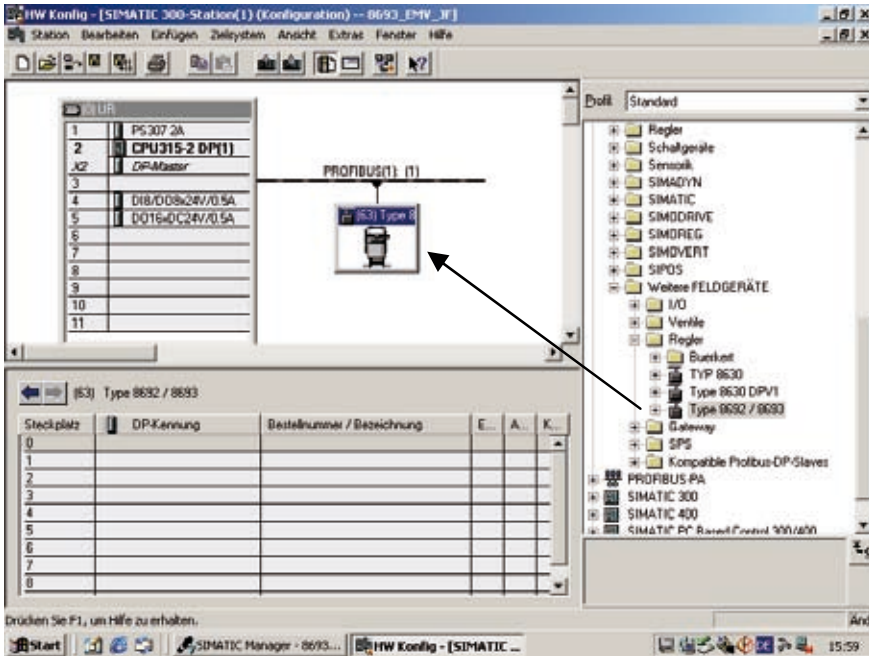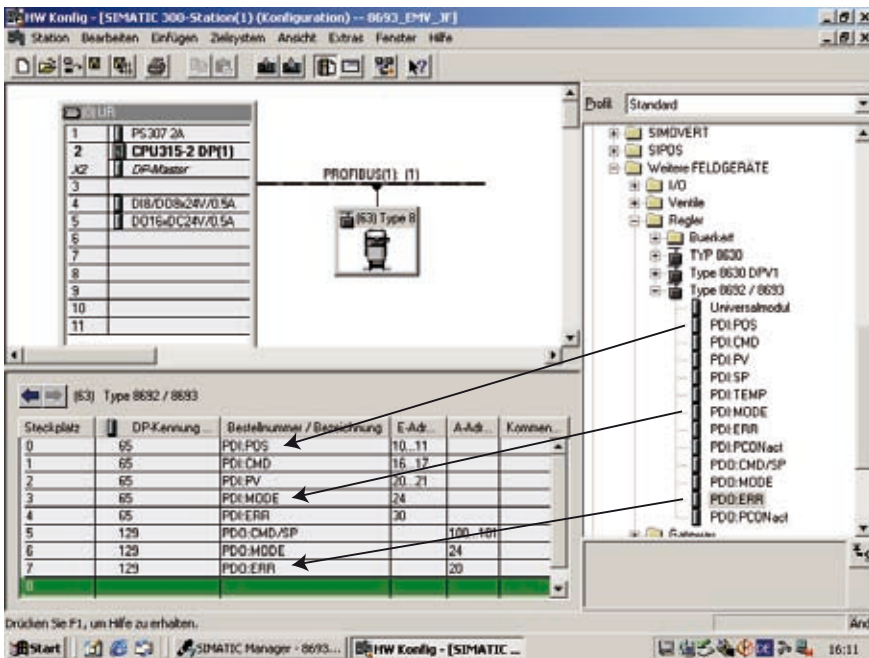→ Pull the slave Type 8792 / 8793 onto the bus line with drag‑and‑drop.

Fig. 116:   ScreenShot process controller

→ Pull the modules into the slave Type 8792 / 8793 with drag‑and‑drop.

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Servicing and Troubleshooting the Position Controller Type 8792

CONTENTS

36.   MAINTENANCE

The positioner Type 8792 is maintenance-free when operated according to the instructions in this manual.

37.   ERROR MESSAGES AND MALFUNCTIONS

37.1.   Error Messages on the Display

37.1.1.   General Error Messages

Display	Causes of error	Remedial action
⚠ min	Minimum input value has been reached	Do not reduce value further
⚠ max	Maximum input value has been reached	Do not increase value further
CMD error	Signal error Set-point value position controller	Check signal
EEPROM fault	EEPROM defective	Not possible, device defective
MFI fault	Field bus board defective	
invalid code	Incorrect access code	Input correct access code

Table 49:   General error message, position controller Type 8792

37.1.2. Error and warning messages while the *X.TUNE* function is running

Display	Causes of error	Remedial action
X.TUNE locked	The *X.TUNE* function is blocked	Input access code
X.TUNE ERROR 1	No compressed air connected	Connect compressed air
X.TUNE ERROR 2	Compressed air failed during Autotune	Check compressed air supply
X.TUNE ERROR 3	Actuator or control system deaeration side leaking	Not possible, device defective
X.TUNE ERROR 4	Control system aeration side leaking	Not possible, device defective
X.TUNE ERROR 5	The slewing range of the position measuring system is exceeded by 120°	Correct attachment of the position measuring system shaft on the actuator (see *chapter 14.2.. and 14.3.. *)
X.TUNE ERROR 6	The end positions for *POS-MIN* and *POS-MAX* are too close together	Check compressed air supply
X.TUNE ERROR 7	Incorrect assignment *POS-MIN* and *POS-MAX*	To determine *POS-MIN* and *POS-MAX*, move the actuator in the direction indicated on the display.
X.TUNE WARNING 1*	Potentiometer is not coupled optimally to the actuator. An optimum connection can provide a more accurate position measurement	Set middle position as described in chapter *14.2.4.Aligning lever mechanism*.
* *Warning information gives tips on optimized operation. The device is operational even if this warning information is not observed. Warning information is automatically hidden after several seconds.*			

Table 50:   *Error and warning message on X.TUNE; position controller 8792*

37.2.   Other faults

Problem	Possible causes	Remedial action
POS = 0 (when *CMD* > 0%) or *POS* = 100%, (when *CMD* < 100%)	Sealing function (*CUTOFF*) has been unintentionally activated	Deactivate sealing function

Table 51:   *Other faults; position controller 8792*

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Servicing and Troubleshooting the Process Controller Type 8793

Contents

38.   MAINTENANCE

The positioner Type 8793 is maintenance-free when operated according to the instructions in this manual.

39.   ERROR MESSAGES AND MALFUNCTIONS

39.1.   Error Messages on the Display

39.1.1. General Error Messages

Display	Causes of error	Remedial action
⚠ min	Minimum input value has been reached	Do not reduce value further
⚠ max	Maximum input value has been reached	Do not increase value further
CMD error	Signal error Set-point value position controller	Check signal
SP error	Signal error Set-point value process controller	Check signal
PV error	Signal error Actual value process controller	Check signal
PT100 error	Signal error Actual value Pt-100	Check signal
invalid code	Incorrect access code	Input correct access code
EEPROM fault	EEPROM defective	Not possible, device defective
MFI fault *	Field bus board defective	
* field bus only		

Table 52:   General error message, process controller Type 8793

39.1.2. Error and warning messages while the *X.TUNE* function is running

Display	Causes of error	Remedial action
X.TUNE locked	The *X.TUNE* function is blocked	Input access code
X.TUNE ERROR 1	No compressed air connected	Connect compressed air
X.TUNE ERROR 2	Compressed air failed during Autotune	Check compressed air supply
X.TUNE ERROR 3	Actuator or control system deaeration side leaking	Not possible, device defective
X.TUNE ERROR 4	Control system aeration side leaking	Not possible, device defective
X.TUNE ERROR 5	The slewing range of the position measuring system is exceeded by 120°	Correct attachment of the position measuring system shaft on the actuator (see *chapter 14.2. and 14.3.*)
X.TUNE ERROR 6	The end positions for *POS-MIN* and *POS-MAX* are too close together	Check compressed air supply
X.TUNE ERROR 7	Incorrect assignment *POS-MIN* and *POS-MAX*	To determine *POS-MIN* and *POS-MAX*, move the actuator in the direction indicated on the display.
X.TUNE WARNING 1*	Potentiometer is not coupled optimally to the actuator. An optimum connection can provide a more accurate position measurement.	Set middle position as described in chapter *14.2.4.Aligning lever mechanism*.
* Warning information gives tips on optimized operation. The device is operational even if this warning information is not observed. Warning information is automatically hidden after several seconds.		

Table 53:   Error and warning message for X.TUNE; process controller 8793

39.1.3. Error Messages while the *P.Q'LIN* Function is Running

Display	Causes of error	Remedial action
P.Q LIN *ERROR 1*	No supply pressure connected	Connect supply pressure.
	No change to process variable	Check process and, if required, switch on pump or open the shut-off valve. Check process sensor.
P.Q LIN *ERROR 2*	Current node of the valve stroke was not reached, as	
	▪ Supply pressure failed during *P.Q'LIN*	Check supply pressure
	▪ Autotune was not run.	Run Autotune.

Table 54:   Error message on P.Q.'LIN; process controller 8793

39.1.4. Error Messages while the *P.TUNE* Function is Running

Display	Causes of error	Remedial action
P.TUNE *ERROR 1*	No supply pressure connected	Connect supply pressure.
	No change to process variable	Check process and, if required, switch on pump or open the shut-off valve. Check process sensor.

Table 55:   Error message on P.TUNE; process controller 8793

39.1.5. Error Messages on Field Bus Devices

On DeviceNet

Display	Device status	Explanation/Troubleshooting
BUS offline is displayed approx. every 3 seconds	offline	Device is not connected to the bus, the network access procedure (duplicate MAC-ID test, duration approx. 2 s) has still not ended or device is only active network node ▪ Baudrate correctly set across network? ▪ Bus connection including plug assignment correct? ▪ Power supply and bus connection of the other nodes correct?
BUS no connection is displayed approx. every 3 seconds	online, no connection to the master	Device is connected correctly to the bus, the network access procedure has ended without errors, however there is no established connection to the master.
BUS timeout is displayed approx. every 3 seconds	I/O connection timeout	An I/O connection is in the *TIME OUT* state. → New connection establishment by master; ensure that I/O data is transferred cyclically or, if *COS* confirmed, that corresponding Acknowledge messages are sent by the master.
BUS critical err is displayed approx. every 3 seconds	Critical bus error	Other device with the same address in the network or *BUS OFF* due to communication problems. → Change address of the device and restart device → Error analysis in the network with a bus monitor.

Table 56:   Error message DeviceNet; process controller 8793

On Profibus:

Display	Device status	Explanation	Troubleshooting
BUS offline is displayed approx. every 3 seconds	offline	Device is not connected to the bus	▪ Bus connection including plug assignment correct. ▪ Check power supply and bus connection of the other nodes.

Table 57:   Error message Profibus; process controller 8793

39.2. Other faults

Problem	Possible causes	Remedial action
POS = 0 (when CMD > 0%) or POS = 100%, (when CMD < 100%) PV = 0 (when SP > 0) or PV = PV (when SP > SP)	Sealing function ($CUTOFF$) has been unintentionally activated	Deactivate sealing function.
Applies only to devices with binary output: Binary output does not switch	Binary output: Current > 100 mA Short-circuit	Check binary output connection.
Applies only to devices with process controller: Device is not operating as a controller, despite correctly implemented settings.	*P.CONTROL* menu option is in the main menu. The device is therefore operating as a process controller and expects a process actual value at the corresponding input.	Remove *P.CONTROL* menu option from the main menu.

Table 58: Other faults; process controller 8793

Packaging, Storage, Disposal

CONTENTS

40. PACKAGING AND TRANSPORT

NOTE!

Transport damages!

Inadequately protected equipment may be damaged during transport.

▪ During transportation protect the device against wet and dirt in shock-resistant packaging.

▪ Avoid exceeding or dropping below the allowable storage temperature.

41. STORAGE

NOTE!

Incorrect storage may damage the device.

▪ Store the device in a dry and dust-free location!

▪ Storage temperature. -20 − +65 °C.

42. DISPOSAL

→ Dispose of the device and packaging in an environmentally friendly manner.

NOTE!

Damage to the environment caused by device components contaminated with media.

▪ Observe applicable disposal regulations and environmental regulations.

Observe national waste disposal regulations.

Additional technical information

CONTENTS

43. SELECTION CRITERIA FOR CONTINUOUS VALVES

The following criteria are crucial for optimum control behaviour and to ensure that the required maximum flow is reached:

▪ the correct selection of the flow coefficient which is defined primarily by the orifice of the valve;

▪ close coordination between the nominal width of the valve and the pressure conditions in consideration of the remaining flow resistance in the equipment.

Design guidelines can be given on the basis of the flow coefficient (k_V value). The k_V value refers to standardised conditions with respect to pressure, temperature and media properties.

The k_V value describes the flow rate of water through a component in m³/h at a pressure difference of $\Delta p = 1$ bar and $T = 20$ °C.

The "k_{VS} value" is also used for continuous valves. This indicates the k_V value when the continuous valve is fully open.

Depending on the specified data, it is necessary to differentiate between the two following cases when selecting the valve:

a) The pressure values p1 and p2, known before and after the valve, represent the required maximum flow-rate Q_{max} which is to be reached:

The required k_{VS} value is calculated as follows:

$$k_{vs} = Q_{max} \cdot \sqrt{\frac{\Delta p_0}{\Delta p}} \cdot \sqrt{\frac{\rho}{\rho_0}} \qquad (1)$$

Meaning of the symbols:

k_{VS} flow coefficient of the continuous valve when fully open [m³/h]
Q_{max} maximum volume flow rate [m³/h]
Δp_0 = 1 bar; pressure loss on the valve according to the definition of the k_V value
ρ_0 = 1000 kg/m³; density of water (according to the definition of the k_V value)
Δp pressure loss on the valve [bar]
ρ density of the medium [kg/m³]

b) The pressure values, known at the input and output of the entire equipment (p_1 and p_2), represent the required maximum flow-rate Q_{max} which is to be reached:

1st   step: Calculate the flow coefficient of the entire equipment k_{Vges} according to equation (1).

2nd   step: Determine the flow-rate through the equipment without the continuous valve (e.g. by "short-circuiting" the line at the installation location of the continuous valve).

3rd   step: Calculate the flow coefficient of the equipment without the continuous valve (k_{Va}) according to equation (1).

4th   step: Calculate the required k_{VS} value of the continuous valve according to equation (2):

$$k_{vs} = \sqrt{\frac{1}{\frac{1}{k_{Vges}^2} - \frac{1}{k_{Va}^2}}} \qquad (2)$$

> The k_{VS} value of the continuous valve should have at least the value which is calculated according to equation (1) or (2) which is appropriate to the application, however it should never be far above the calculated value.
>
> The rule of thumb "slightly higher is never harmful" often used for switching valves may greatly impair the control behaviour of continuous valves!

The upper limit for the k_{VS} value of the continuous valve can be specified in practice via the so-called valve authority Ψ:

$$\psi = \frac{(\Delta p)_{V0}}{(\Delta p)_0} = \frac{k_{Va}^2}{k_{Va}^2 + k_{VS}^2} \qquad (3)$$

$(\Delta p)_{V0}$ Pressure drop over the fully opened valve

$(\Delta p)_0$ Pressure drop over the entire equipment

> **If the valve authority Ψ < 0.3 the continuous valve has been oversized.**
>
> When the continuous valve is fully open, the flow resistance in this case is significantly less than the flow resistance of the remaining fluid components in the equipment. This means that the valve position predominates in the operating characteristic in the lower opening range only. For this reason the operating characteristic is highly deformed.
>
> By selecting a progressive (equal percentage) transfer characteristic between position nominal value and valve stroke, this can be partially compensated and the operating characteristic linearised within certain limits. **However, the valve authority Ψ should be > 0.1 even if a correction characteristic is used.**
>
> The control behaviour (control quality, transient time) depends greatly on the working point if a correction characteristic is used.

44. PROPERTIES OF PID CONTROLLERS

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

44.1. P-portion

Function:

$$Y = K_p \cdot X_d \quad (4)$$

Kp is the proportional coefficient (amplification factor). It is the ratio of the adjusting range ΔY to the proportional range ΔXd.

Characteristic and step response of the P portion of a PID controller
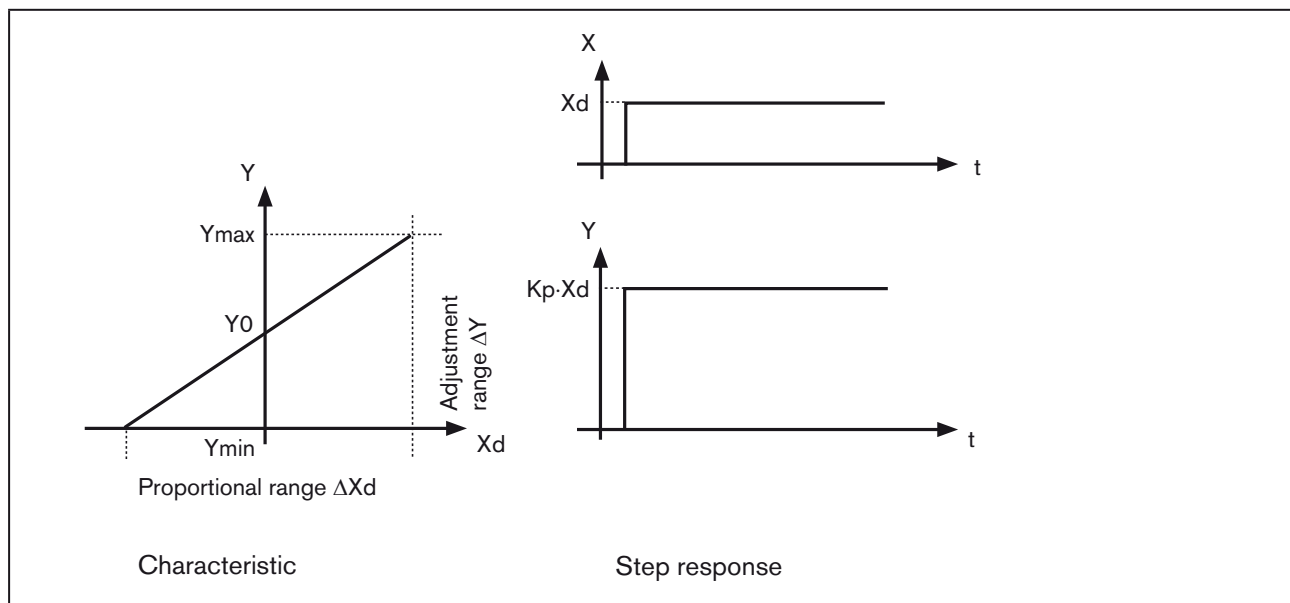

Fig. 117:   Characteristic and step response of the P portion of a PID controller

Properties

In theory a pure P-controller functions instantaneously, i.e. it is quick and therefore dynamically favourable. It has a constant control difference, i.e. it does not fully correct the effects of malfunctions and is therefore statically relatively unfavourable.

44.2.   I-portion

Function:

$$Y = \frac{1}{Ti} \int X\, d\, d\, t \qquad (5)$$

Ti is the integral action time or actuating time. It is the time which passes until the actuating variable has run through the whole adjustment range.

Characteristic and step response of the I portion of a PID controller

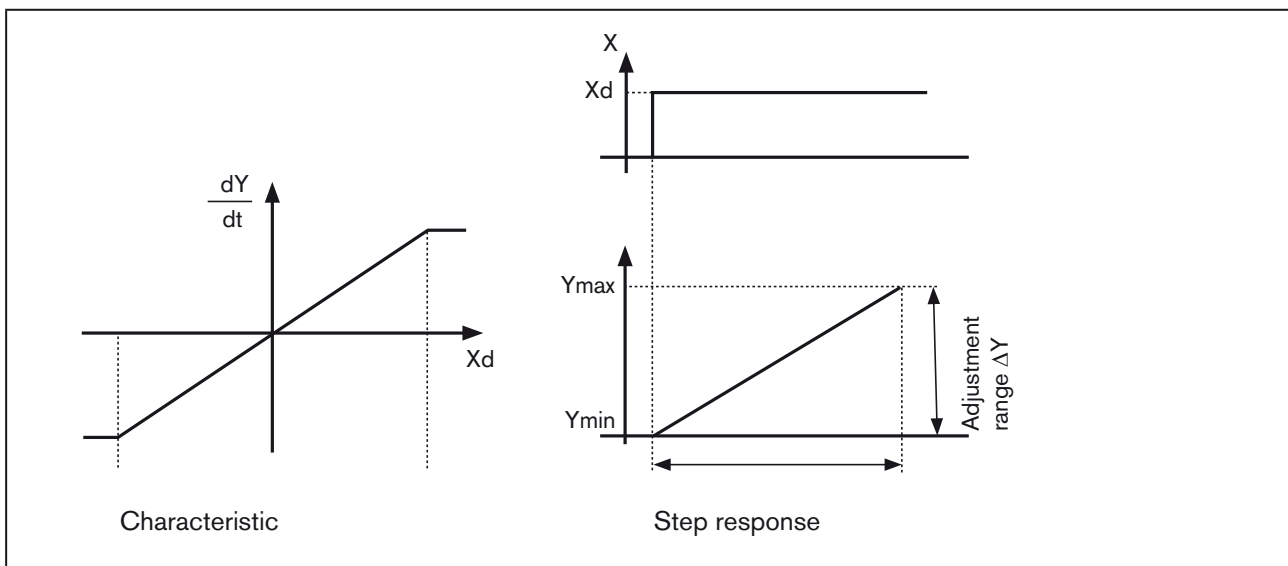*Fig. 118:   Characteristic and step response of the I portion of a PID controller*

Properties

A pure I-controller completely eliminates the effects of any malfunctions which occur. It therefore has a favourable static behaviour. On account of its final actuating speed control it operates slower than the P-controller and has a tendency to oscillate. It is therefore dynamically relatively unfavourable.

44.3. D-portion

Function:

$$Y = K\,d \cdot \frac{d\,X\,d}{d\,t} \qquad (6)$$

Kd is the derivative action coeffficient. The larger Kd is, the greater the D-effect is.

Characteristic and step response of the I portion of a PID controller
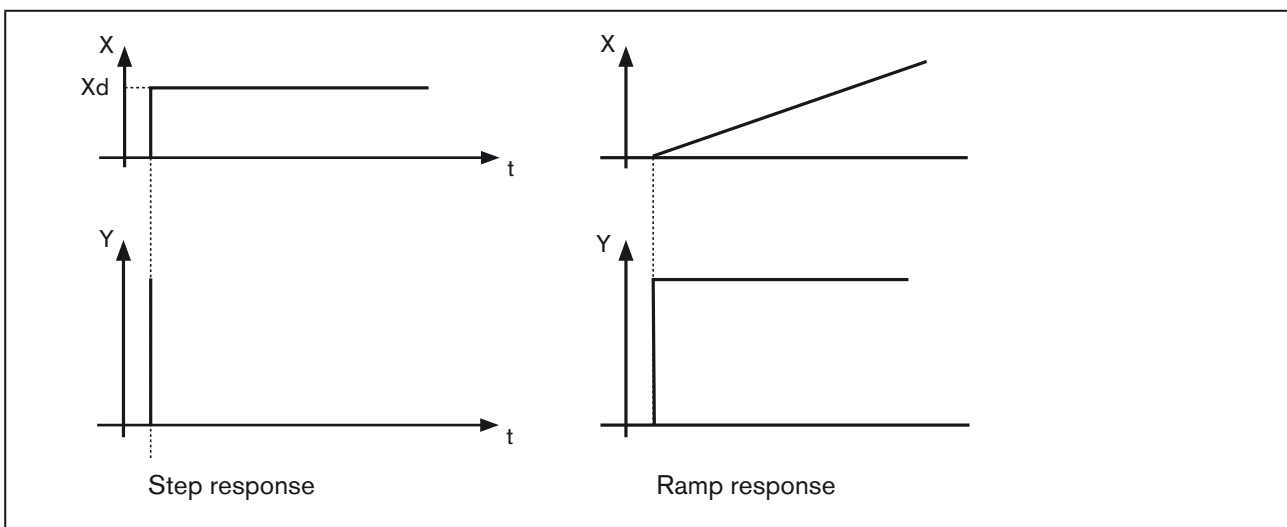

Fig. 119: Characteristic and step response of the D portion of a PID controller

Properties

A controller with a D portion responds to changes in the control variable and may therefore reduce any control differences more quickly.

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44.4. Superposition of P, I and D Portions

Function:

$$Y = Kp \cdot Xd + \frac{1}{Ti} \int Xd\, dt + Kd \frac{dXd}{dt} \qquad (7)$$

Where $Kp \cdot Ti = Tn$ and $Kd/Kp = Tv$ the **function of the PID controller** is calculated according to the following equation:

$$Y = Kp \cdot (Xd + \frac{1}{Tn} \int Xd\, dt + Tv \frac{dXd}{dt}) \qquad (8)$$

Kp   Proportional coefficient / amplification factor

Tn   Reset time
(Time which is required to obtain an equally large change in the actuating variable by the I portion, as occurs due to the P portion)

Tv   Derivative time
(Time by which a certain actuating variable is reached earlier on account of the D portion than with a pure P-controller)

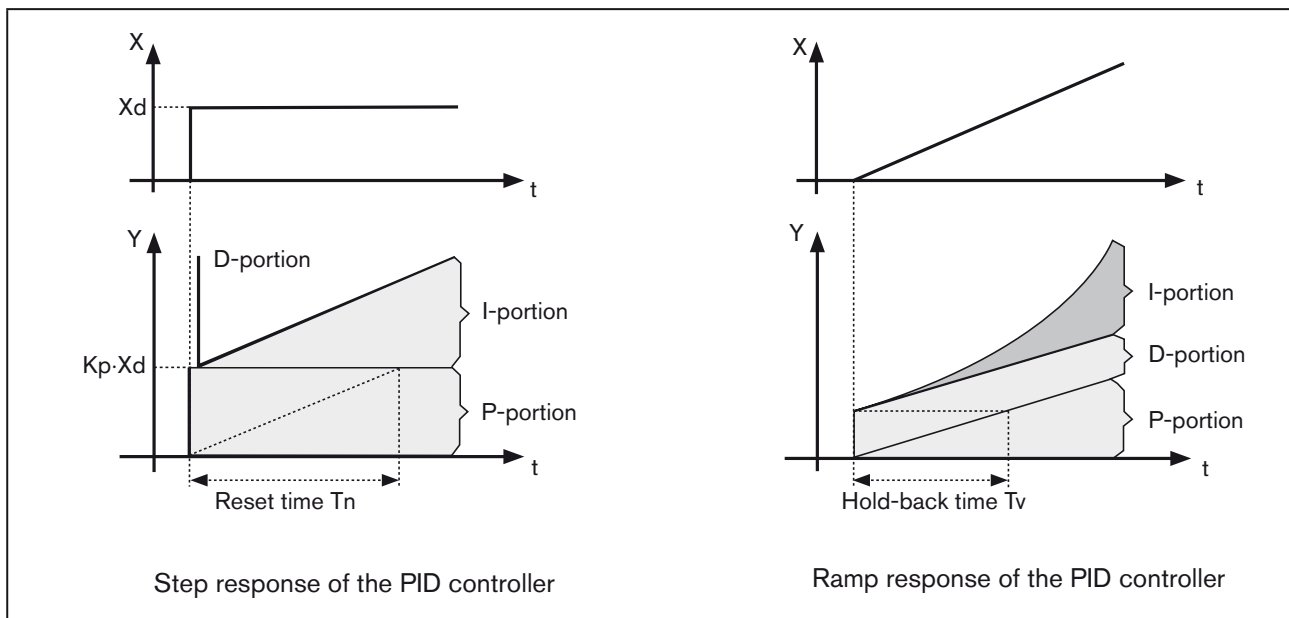**Step response and ramp response of the PID controller**

Fig. 120:   *Characteristic of step response and ramp response of PID controller*

44.5. Implemented PID controller

44.5.1. D Portion with Delay

In the process controller of the positioner the D portion is implemented with a delay T.

Function:

$$T \cdot \frac{dY}{dt} + Y = Kd \cdot \frac{dXd}{dt} \qquad (9)$$

Superposition of P, I and DT Portions

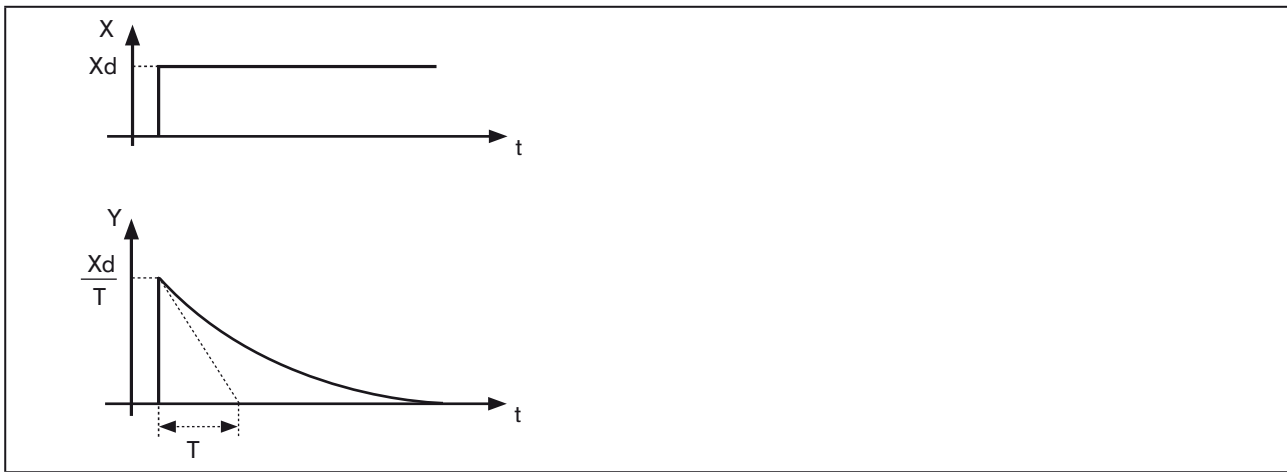*Fig. 121:   Characteristic of superposition of P, I and DT Portions*

44.5.2. Function of the Real PID Controller

$$T \cdot \frac{dY}{dt} + Y = Kp\left(Xd + \frac{1}{Tn}\int Xd\,dt + Tv\,\frac{dXd}{dt}\right) \qquad (10)$$

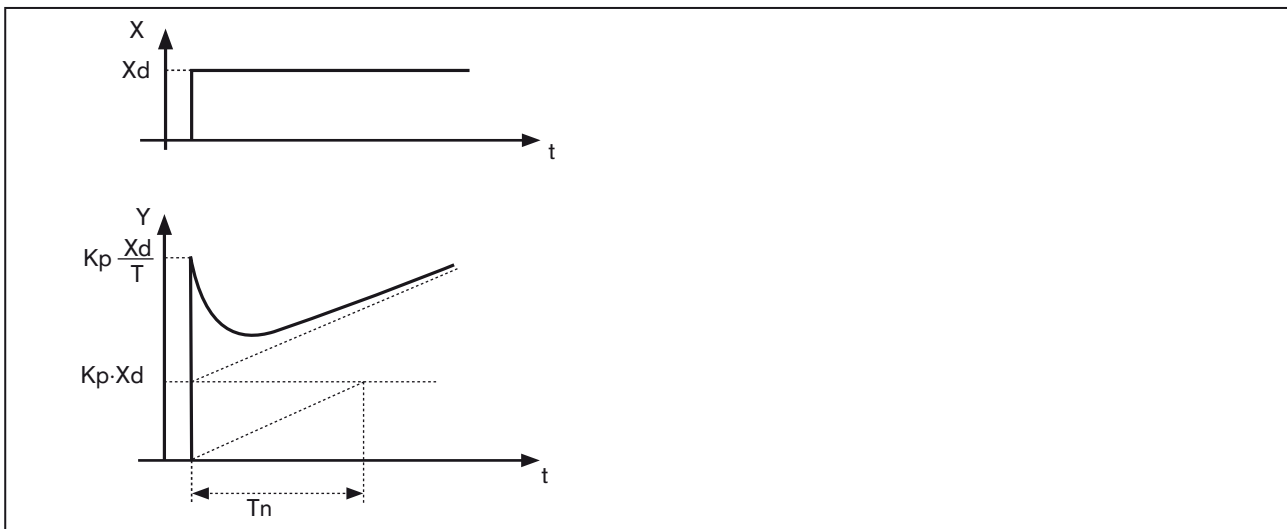**Superposition of P, I and DT Portions**

Fig. 122:   Characteristic of step response of the real PID controller; adjustment rules for PID controllers

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45. ADJUSTMENT RULES FOR PID CONTROLLERS

The control system 8793 features a self-optimization function for the structure and parameters of the integrated process controller. The determined PID parameters can be seen via the operating menu and re-optimized at will for an empirical path.

The regulatory literature includes a series of adjustment rules which can be used in experimental ways to determine a favourable setting for the controller parameters. To avoid incorrect settings, always observe the conditions under which the particular adjustment rules have been drawn up. Apart from the properties of the control process and the controller itself, the aspect whether a change in the disturbance variable or command variable is to be corrected plays a role.

45.1. Adjustment Rules according to Ziegler and Nichols (Oscillation Method)

With this method the controller parameters are adjusted on the basis of the behaviour of the control circuit at the stability limit. The controller parameters are first adjusted so that the control circuit starts to oscillate. The occurring critical characteristic values suggest a favourable adjustment of the controller parameters. A prerequisite for the application of this method of course is that the control circuit is oscillated.

Procedure

$\rightarrow$ Set controller as P-controller (i.e. Tn = 999, Tv = 0), first select a low value for Kp

$\rightarrow$ Set required set-point value

$\rightarrow$ Increase Kp until the control variable initiates an undamped continuous oscillation.

The proportionality coefficient (amplification factor) set at the stability limit is designated as K_{krit}. The resulting oscillation duration is designated as T_{krit}.

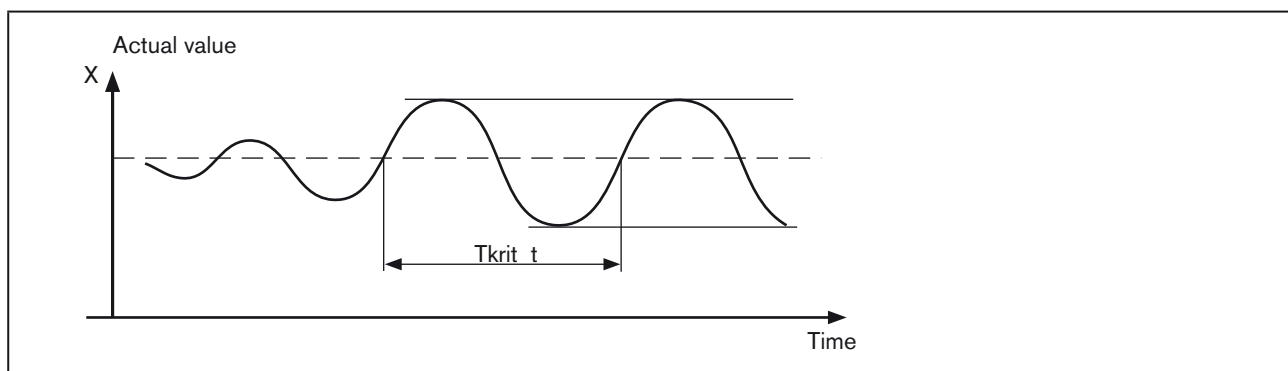**Progress of the control variable at the stability limit**

Fig. 123: Progress of the control variable PID

The controller parameters can then be calculated from K_{krit} and T_{krit} according to the following table.

Adjustment of the parameters according to Ziegler and Nichols

Controller type	Adjustment of the parameters		
P controller	$Kp = 0.5\ K_{krit}$	-	-
PI controller	$Kp = 0.45\ K_{krit}$	$Tn = 0.85\ T_{krit}$	-
PID controller	$Kp = 0.6\ K_{krit}$	$Tn = 0.5\ T_{krit}$	$Tv = 0.12\ T_{krit}$

Table 59:   Adjustment of the parameters according to Ziegler and Nichols

The adjustment rules of Ziegler and Nichols have been determined for P-controlled systems with a time delay of the first order and dead time. However, they apply only to controllers with a disturbance reaction and not to those with a reference reaction.

45.2. Adjustment Rules according to Chien, Hrones and Reswick (Actuating Variable Jump Method)

With this method the controller parameters are adjusted on the basis of the transient behaviour of the controlled system. An actuating variable jump of 100% is output. The times Tu and Tg are derived from the progress of the actual value of the control variable.

Progress of the control variable following an actuating variable jump ΔY
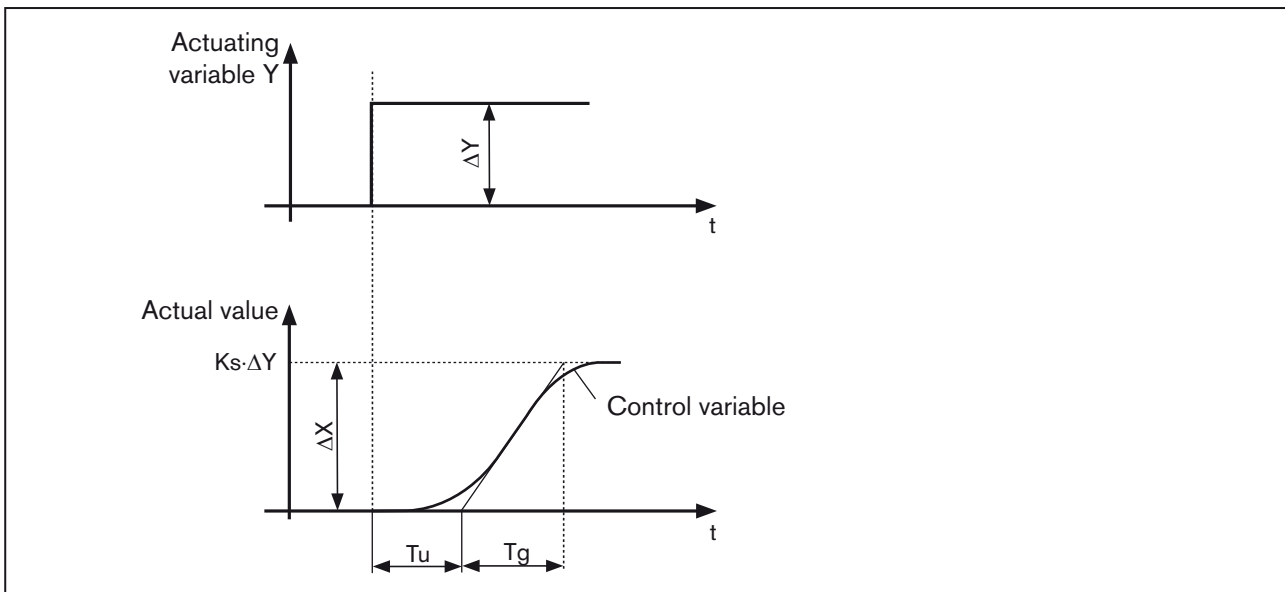

Fig. 124:   Progress of the control variable, actuating variable jump

Procedure

→ Switch controller to MANUAL (MANU) operating state

→ Output the actuating variable jump and record control variable with a recorder

→ If progresses are critical (e.g. danger of overheating), switch off promptly.

> ❗ Note that in thermally slow systems the actual value of the control variable may continue to rise after the controller has been switched off.

In the following *Table 60:* the adjustment values have been specified for the controller parameters, depending on Tu, Tg and Ks for reference and disturbance reaction, as well as for an aperiodic control process and a control process with a 20% overshoot. They apply to controlled systems with P-behaviour, with dead time and with a delay of the first order.

Adjustment of the parameters according to Chien, Hrones and Reswick

Controller type	Adjustment of the parameters			
	for aperiodic control process (0% overshoot)		for control process with 20% overshoot	
	Reference	Malfunction	Reference	Malfunction
P controller	$Kp = 0{,}3 \cdot \dfrac{Tg}{Tu \cdot Ks}$	$Kp = 0{,}3 \cdot \dfrac{Tg}{Tu \cdot Ks}$	$Kp = 0{,}7 \cdot \dfrac{Tg}{Tu \cdot Ks}$	$Kp = 0{,}7 \cdot \dfrac{Tg}{Tu \cdot Ks}$
PI controller	$Kp = 0{,}35 \cdot \dfrac{Tg}{Tu \cdot Ks}$ $Tn = 1{,}2 \cdot Tg$	$Kp = 0{,}6 \cdot \dfrac{Tg}{Tu \cdot Ks}$ $Tn = 4 \cdot Tu$	$Kp = 0{,}6 \cdot \dfrac{Tg}{Tu \cdot Ks}$ $Tn = Tg$	$Kp = 0{,}7 \cdot \dfrac{Tg}{Tu \cdot Ks}$ $Tn = 2{,}3 \cdot Tu$
PID controller	$Kp = 0{,}6 \cdot \dfrac{Tg}{Tu \cdot Ks}$ $Tn = Tg$ $Tv = 0{,}5 \cdot Tu$	$Kp = 0{,}95 \cdot \dfrac{Tg}{Tu \cdot Ks}$ $Tn = 2{,}4 \cdot Tu$ $Tv = 0{,}42 \cdot Tu$	$Kp = 0{,}95 \cdot \dfrac{Tg}{Tu \cdot Ks}$ $Tn = 1{,}35 \cdot Tg$ $Tv = 0{,}47 \cdot Tu$	$Kp = 1{,}2 \cdot \dfrac{Tg}{Tu \cdot Ks}$ $Tn = 2 \cdot Tu$ $Tv = 0{,}42 \cdot Tu$

Table 60: Adjustment of the parameters according to Chien, Hrones and Reswick

The proportionality factor Ks of the controlled system is calculated as follows:

$$Ks = \frac{\Delta X}{\Delta Y} \qquad (11)$$

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Tables for customer-specific settings

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46. TABLE FOR YOUR SETTINGS ON THE POSITION CONTROLLER

46.1. Settings of the Freely Programmable Characteristic

Node (position set-point value as %)	Valve stroke [%]			
	Date:	Date:	Date:	Date:
0				
5				
10				
15				
20				
25				
30				
35				
40				
45				
50				
55				
60				
65				
70				
75				
80				
85				
90				
95				
100				

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47.   TABLE FOR YOUR SETTINGS ON THE PROCESS CONTROLLER 8793

47.1.   Set Parameters of the Process Controller

	Date:	Date:	Date:	Date:
KP				
TN				
TV				
X0				
DBND				
DP				
PVmin				
PVmax				
SPmin				
SPmax				
UNIT				
K factor				
FILTER				
INP				

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Master code

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48.   MASTER CODE

Master code

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