Type 8692, 8693

Positioner TopControl
Process Controller TopControl

Electropneumatic positioner
Electropneumatic process controller

Operating Instructions

Bedienungsanleitung
Manuel d‘ utilisation

ESE02211EN

We reserve the right to make technical changes without notice.
Technische Änderungen vorbehalten.
Sous réserve de modifications techniques.

Operating Instructions 1202/01_EU-en_00809657 / Original DE

Positioner Type 8692, 8693

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General information and safety instructions

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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 moderately severe 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.

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

→ designates a procedure which you must carry out.

2. AUTHORIZED USE

Incorrect use of the positioner Type 8692 and Type 8693 may be a hazard to people, nearby equipment and the environment.

The device is designed to be mounted on pneumatic actuators of process valves for the control of media.

- Do not expose the device to direct sunlight.
- Use according to the permitted data, operating conditions and conditions of use specified in the contract documents and operating instructions, as described in chapter "Description of system" - "11. 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 Alfa Laval.
- In view of the large number of options for use, it is essential prior to installation to study and, if necessary, to test whether the positioner is suitable for the specific application case.
- Correct transportation, correct storage and installation and careful use and maintenance are essential for reliable and problem-free operation.
- Use the positioner Type 8692 and Type 8693 only as intended.

2.1. Restrictions

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

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!

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!

General hazardous situations.

To prevent injury, ensure 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.
- Do not put any loads on the body (e.g. by placing objects on it or standing on it).
- Do not make any external modifications to the device bodies. Do not paint the body parts or screws.

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 100 015 - 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 8692 and Type 8693 were developed with due consideration given to the accepted safety rules and is state-of-the-art. However, dangers can still arise.

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. Contact address

Contact your local Alfa Laval Company.

4.2. Warranty

The warranty is only valid if the positioner Type 8692 and Type 8693 is used as intended in accordance with the specified application conditions.

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 in the Appendix of these operating instructions in the chapter entitled “Master code”.

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

Description of system

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5. FUNCTION OF THE POSITIONER AND COMBINATION WITH VALVE TYPES

Positioners Type 8692 and Type 8693 are electropneumatic positioner for pneumatically actuated control valves with single-acting or double-acting actuators.

Together with the pneumatic actuator the positioner forms an optical and functional unit.

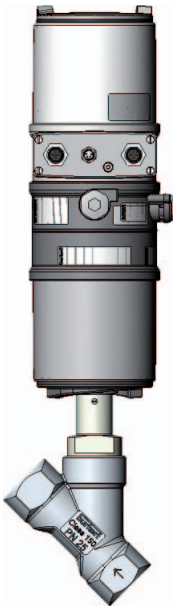
The control valve systems can be used for a wide range of control tasks in fluid technology and, depending on the application conditions, different process valves from the Alfa Laval range can be combined with the positioner. Angle-seat valves, diaphragm valves or ball valves fitted with a control cone are suitable.

"Figure 1" shows an overview of the possible combinations of positioner and different pneumatically actuated valves. Different actuator sizes and valve nominal widths, not illustrated here, are available for each type. More precise specifications can be found on the respective data sheets. The product range is being continuously expanded.

Positioner

Type 8692

Type 8693



with slanted seat valve

Type 2300

with diaphragm valve

Type 2103

Figure 1: Overview of possible combinations

5.1. Models of the positioner

The positioner is available in 2 versions:

Type 8692 - Positioner with positioning control

The position of the actuator (stroke) 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).

Type 8693 - Positioner with process control

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.

Pneumatically actuated piston actuators and rotary actuators can be used as a actuator. Both single-acting and double-acting actuators are offered in combination with the positioner.

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.

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.

5.2. Features of the valve types

	Slanted seat control valves / screw-down stop globe control valves	Diaphragm valves	Ball valves	Flap valves
Types	▪ 2702 ▪ 2712 ▪ 2300 ▪ 2301	▪ 2730 ▪ 2103 ▪ 2731	▪ 2652 ▪ 2655 ▪ 2658	▪ 2672 ▪ 2675
Features	▪ incoming flow under seat ▪ closes smoothly ▪ straight flow path of the medium ▪ self-adjusting stuffing box for high leak-tightness	▪ medium is hermetically separated from the actuator and environment ▪ cavity-free and self-draining body design ▪ any flow direction with low-turbulence flow ▪ steam-sterilizable ▪ CIP-compliant ▪ closes smoothly ▪ actuator and diaphragm can be removed when the body is installed	▪ scrapable ▪ minimum dead space ▪ unaffected by contamination ▪ little pressure loss compared to other valve types ▪ seat and seal can be exchanged in the three-piece ball valve when installed Information Can be used as process controller only	▪ unaffected by contamination ▪ little pressure loss compared to other valve types ▪ inexpensive ▪ low construction volume
Typical media	▪ water, steam and gases ▪ alcohols, oils, propellants, hydraulic fluids ▪ salt solutions, lyes (organic) ▪ solvents	▪ neutral gases and liquids ▪ contaminated, abrasive and aggressive media ▪ media of higher viscosity	▪ neutral gases and liquids ▪ clean water ▪ slightly aggressive media	▪ neutral gases and liquids ▪ slightly aggressive media

Table 1: Features of the valve types

6. STRUCTURE OF THE POSITIONER

The positioners Type 8692 and Type 8693 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 128x64 dot matrix graphic display.

The pneumatic control system for single or double-acting actuators consists of two or four solenoid valves.

6.1. Representation

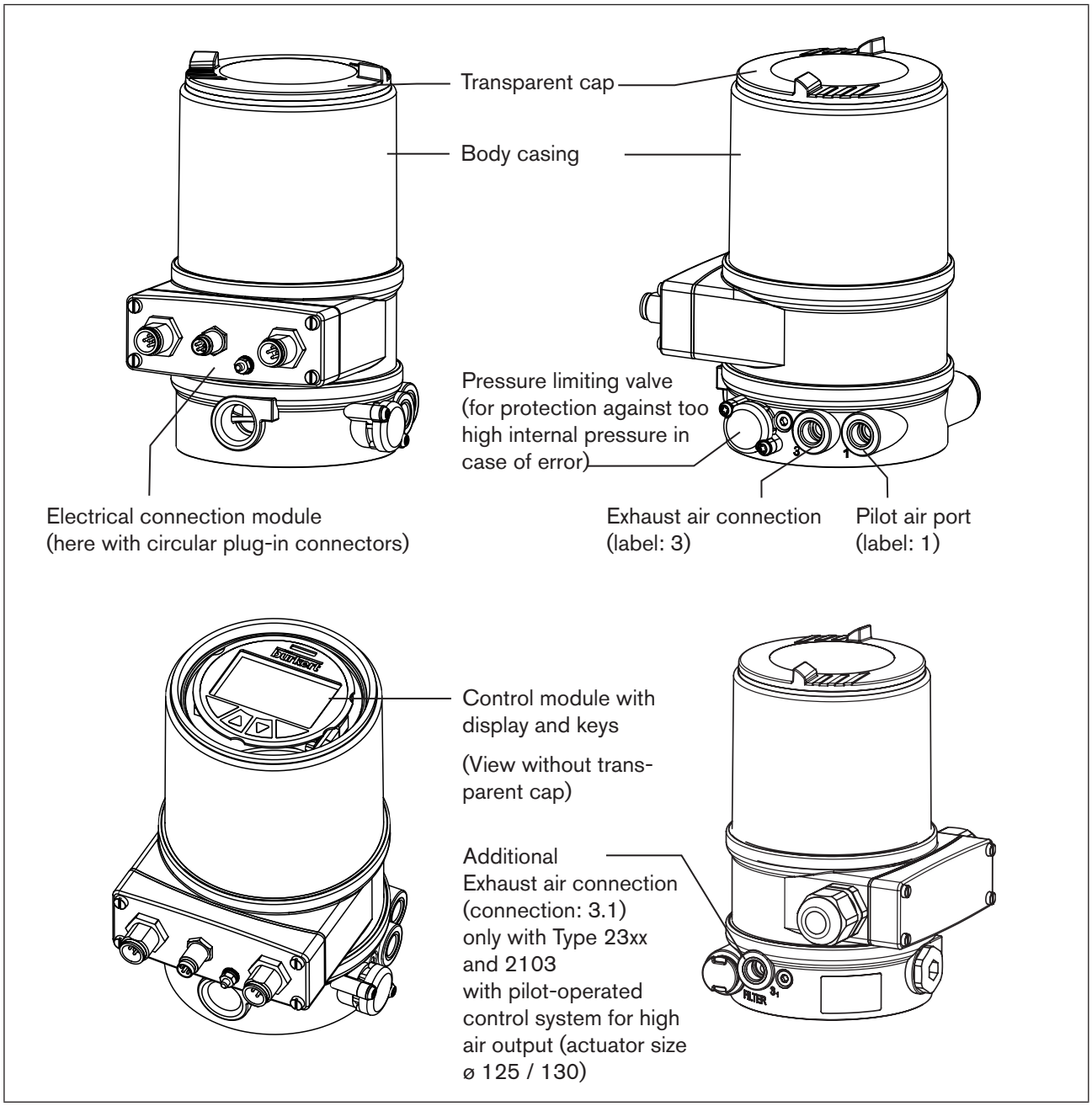


Figure 2: Structure

6.2. Features

- **Models**
  for single-acting or double-acting valve actuators.
- **Position measuring system**
  Non-contact and therefore non-wearing position measuring system.
- **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 for single-acting actuators or four solenoid valves for double-acting actuators. In single-acting actuators, one valve serves for the aeration and another for the deaeration of the pneumatic piston actuator. Double-acting actuators feature 2 valves for aeration and deaeration. The solenoid valves operate according to the rocker principle and are controlled with a PWM voltage via the controller. Doing so achieves a higher flexibility with regard to actuator volume and final control speed. The direct-action model has an orifice of DN 0.6. On larger pneumatic actuators the solenoid valves feature diaphragm reinforcers to increase the maximum flow and therefore improve the dynamics (DN 2.5).
- **Position feedback (optional)**
  One inductive proximity switch.
  When the valve reaches an upper or a lower position, this can be relayed e.g. to a PLC via binary outputs. By means of set-screws, the operator can change the inductive proximity switch or limit positions.
- **Pneumatic interfaces**
  1/4” connections with different thread forms (G, NPT)
  Hose plug-in connection

- **Electrical interfaces**
  Circular plug-in connector or cable gland

- **Body**
  The body of the positioner is protected from excessively high internal pressure, e.g. caused by leaks, by a pressure limiting valve.

6.3. Function diagram of the positioner with single-acting actuator

The black lines describe the function of the position controller (Type 8692). The process controller (Type 8693) includes the position controller and the functions which are illustrated in grey.

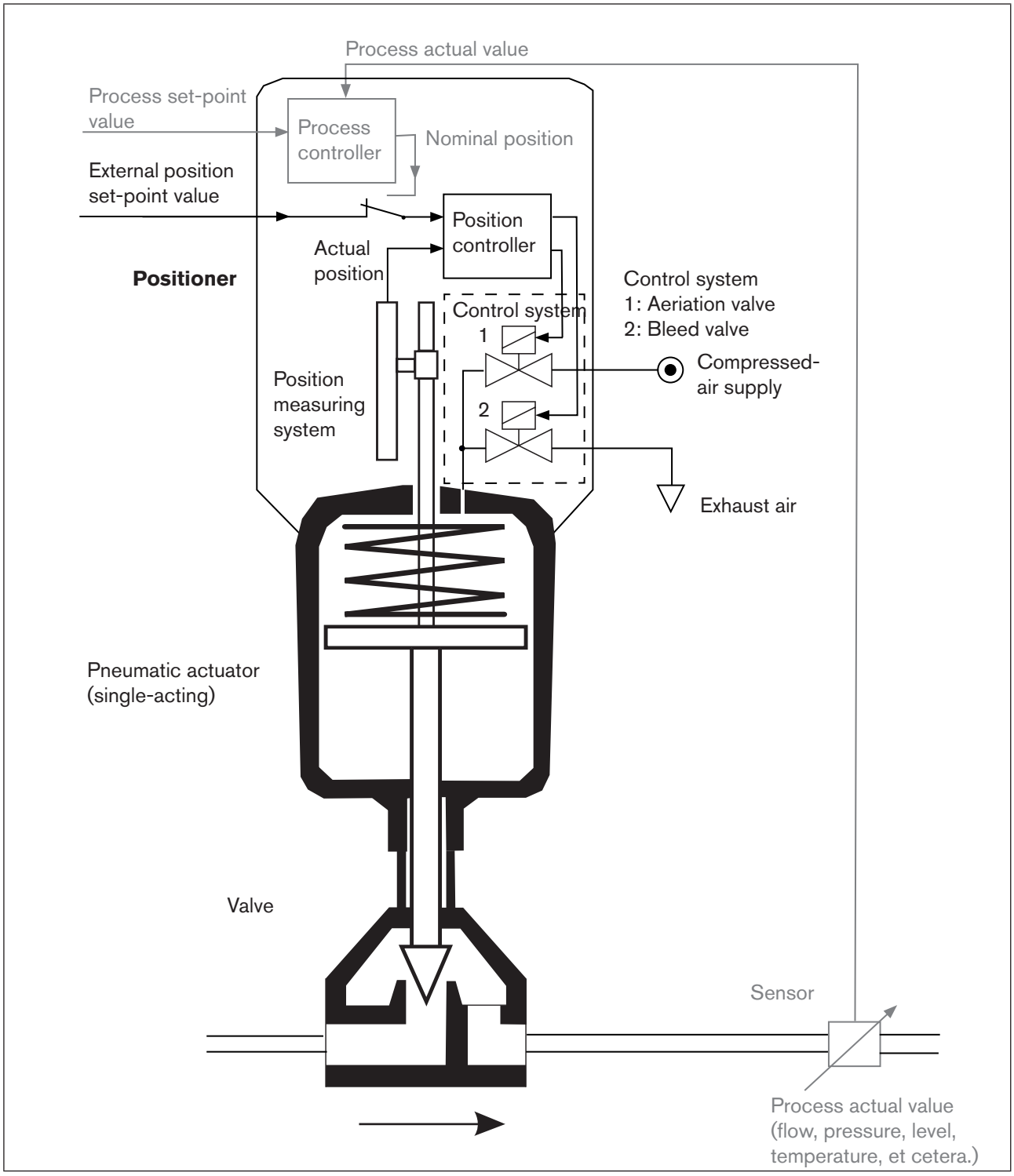


Figure 3: Function diagram

7. TYPE 8692 POSITIONER WITH POSITION CONTROLLER

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 definable as norm signal. In case of a control deviation (Xd1), a pulse-width modulated voltage signal is sent to the control system as a manipulated variable. If there is a positive control difference in single-acting actuators, the air inlet valve is controlled via output B1. If the control difference is negative, the bleed valve is controlled via output E1. In this way the position of the actuator is changed until control difference is 0. Z1 represents a disturbance variable.

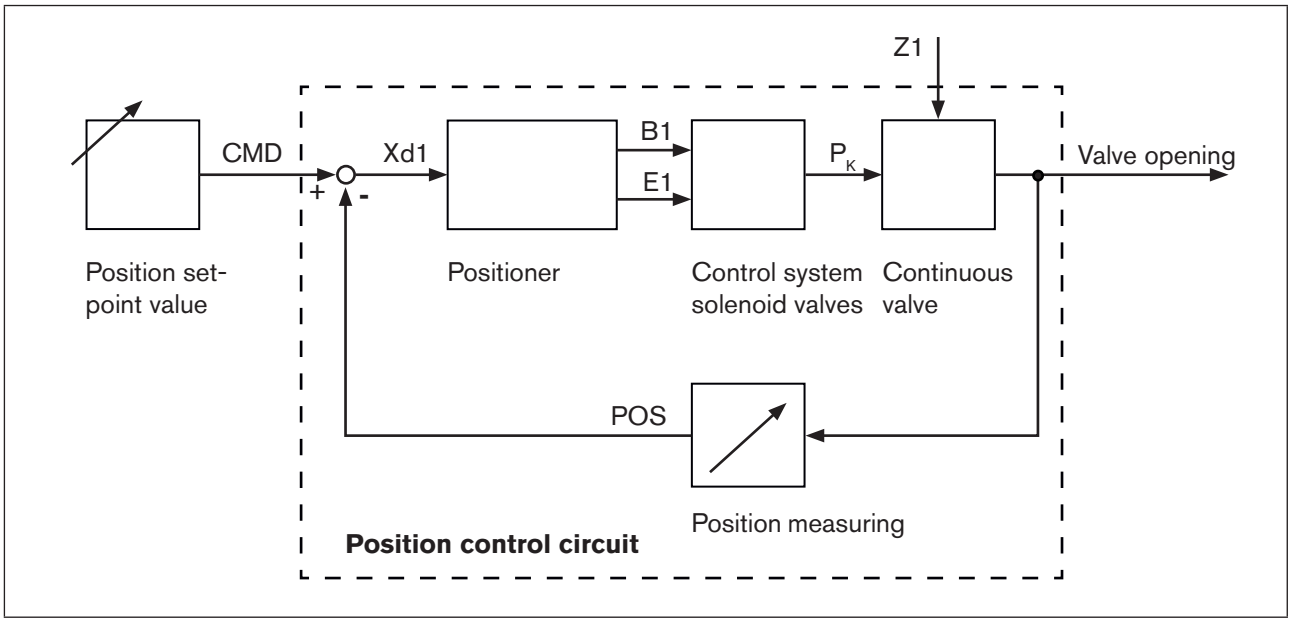


Figure 4: Signal flow plan of position controller

7.1. Schematic representation of the positioner Type 8692

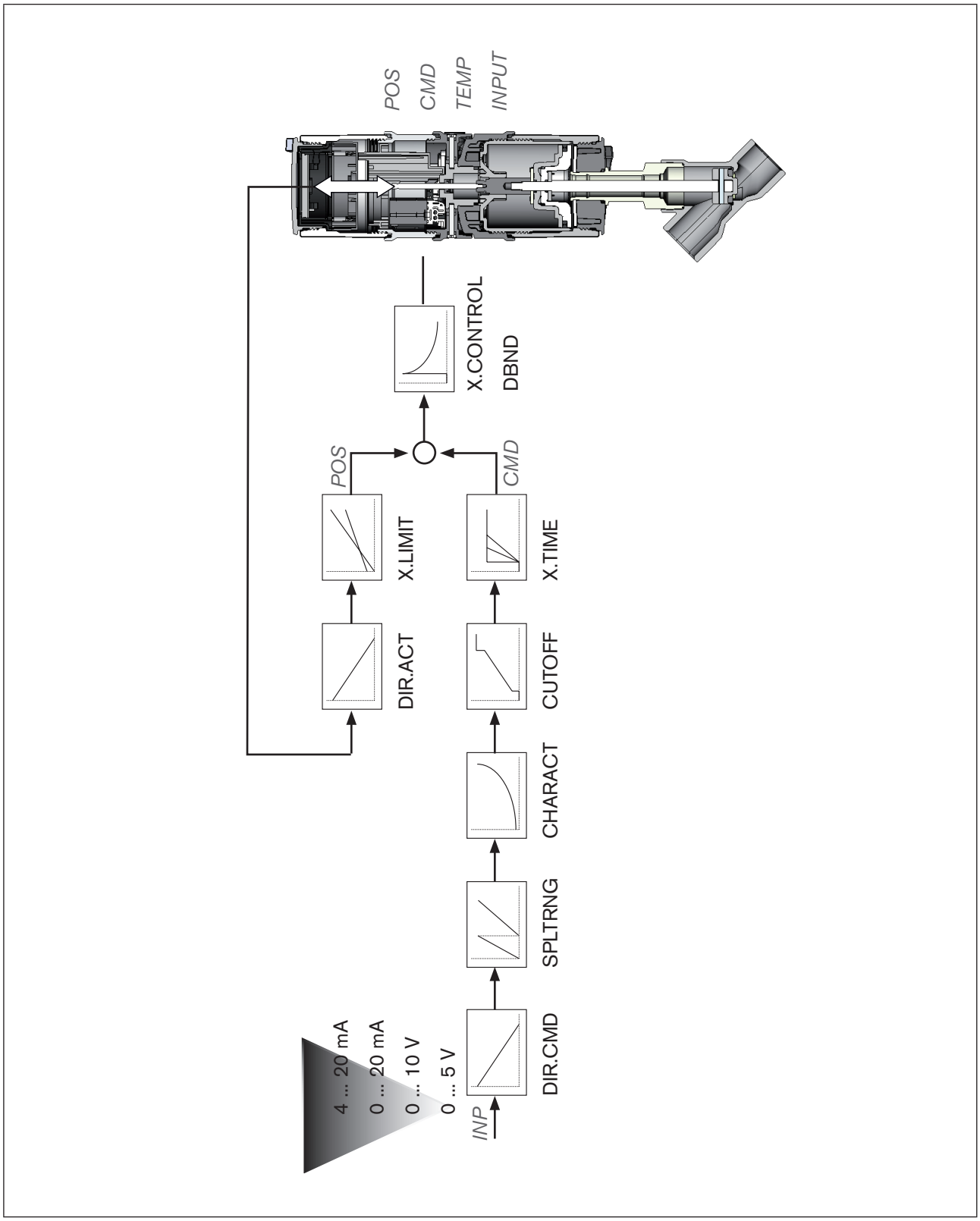


Figure 5: Schematic representation of position control

7.2. Properties of the position controller software

Additional function	Action
Position controller with additional function	
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 standard signal range to two or more positioners
Correction line to adjust the operating characteristic *CHARACT*	The operating characteristic can be linearized
Insensitivity range *X.CONTROL*	The position controller is initially actuated from a control difference to be defined
Effective direction of the controller nominal value *DIR.CMD*	Reversal of the effective direction of the nominal value
Safety position *SAFEPOS*	Definition of the safety position
Limit of the control speed *X.TIME*	Input of the opening and closing time for the entire stroke
Effective direction of the actuator *DIR.ACT*	Adjustment of the effective 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: Functions position controller

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

Table 3: Position controller - hierarchical control concept

8. TYPE 8693 POSITIONER WITH PROCESS CONTROLLER

If the positioner is operated with process controller Type 8693, the aforementioned position control 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. In case of a control deviation (Xd1), a pulse-width modulated voltage signal is sent to the control system as a manipulated variable. If there is a positive control difference in single-acting actuators, the air inlet valve is controlled via output B1. If the control difference is negative, the bleed valve is controlled via output E1. In this way the position of the actuator is changed until control difference is 0. Z2 represents a disturbance variable.

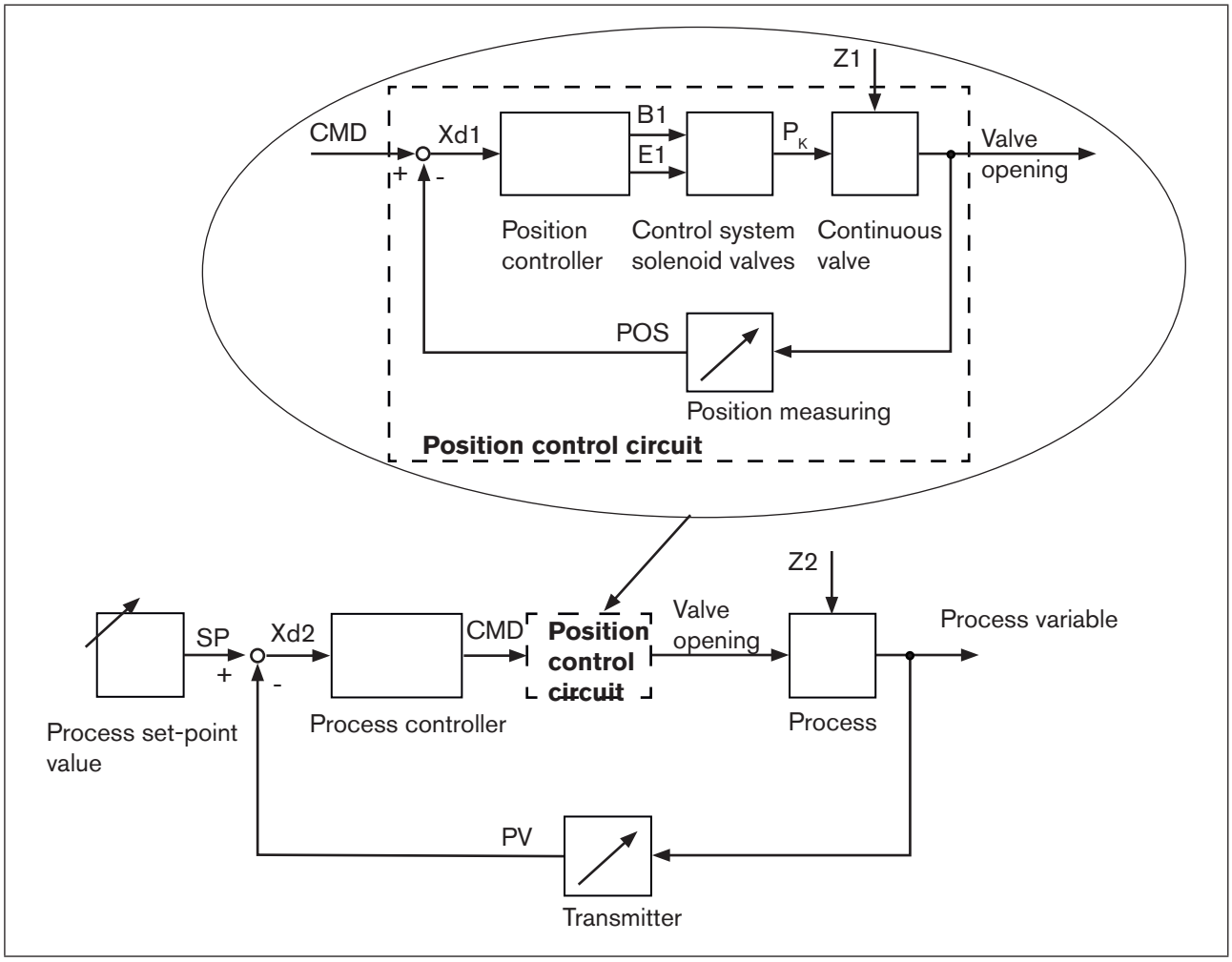


Figure 6: Signal flow plan of process controller

8.1. Schematic representation of the process control

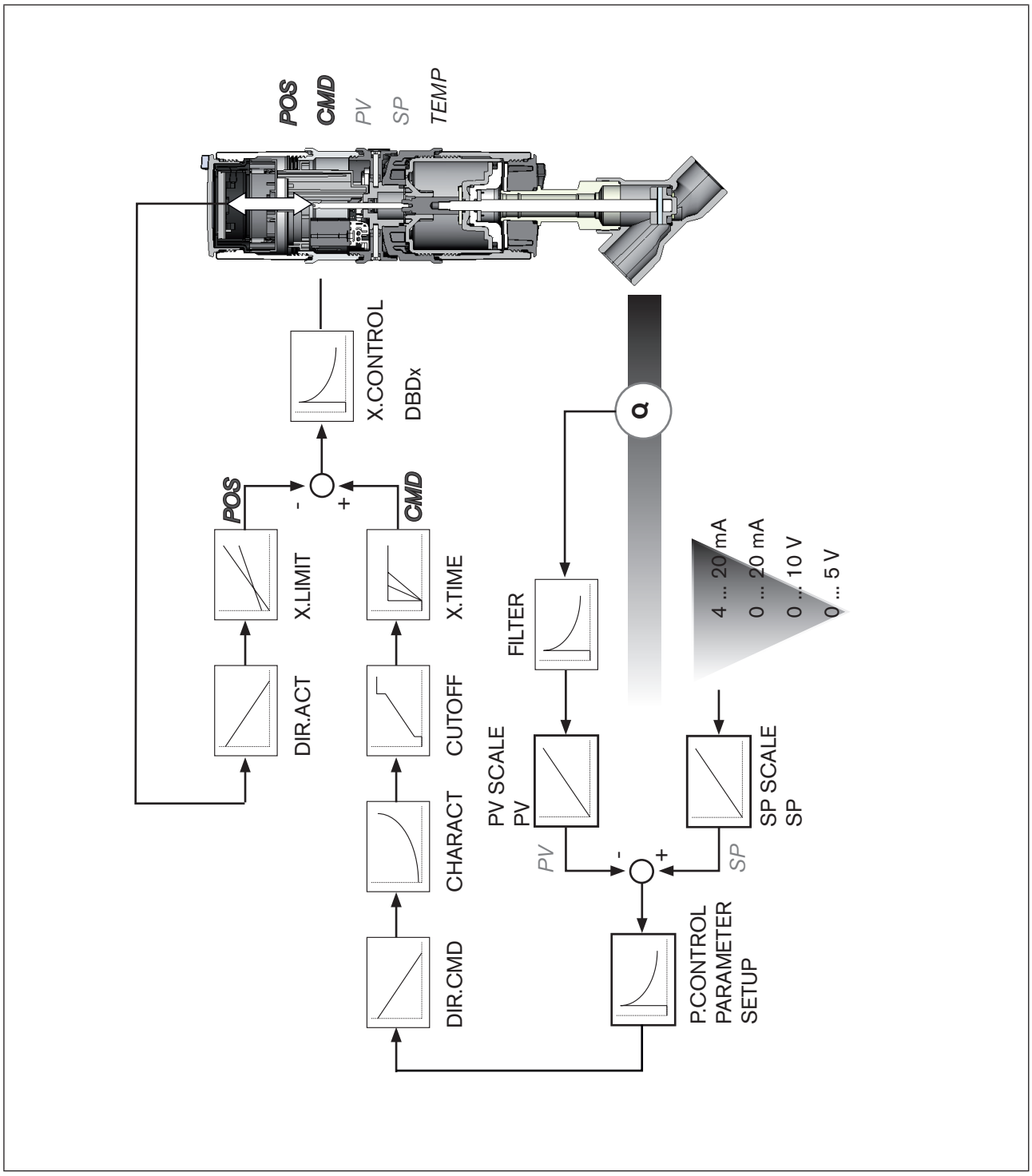


Figure 7: Schematic representation of process control

8.2. Functions of the process controller software

Additional function	Action
Position controller with additional function	
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
Correction line to adjust the operating characteristic *CHARACT*	The operating characteristic can be linearized
Insensitivity range *X.CONTROL*	The position controller is initially actuated from a control difference to be defined
Effective direction of the controller nominal value *DIR.CMD*	Reversal of the effective direction of the nominal value
Safety position *SAFEPOS*	Definition of the safety position
Limit of the control speed *X.TIME*	Input of the opening and closing time for the entire stroke
Effective direction of the actuator *DIR.ACT*	Adjustment of the effective 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 4: Functions position controller

Additional function	Action
Process controller with additional function	
Controller structure *P.CONTROL*	PID
Adjustable parameters *P.CONTROL - PARAMETER*	Proportional coefficient, reset time, hold-back time and operating point
Scalable inputs *P.CONTROL - SETUP*	Position of the decimal points, lower and upper scale values of the actual process value and the process set-point value
Selection of the nominal value specification *P.CONTROL - SETUP - SP INPUT*	Set-point value specification either via standard 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: Functions 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: Process controller - hierarchical control concept

9. INTERFACES OF THE POSITIONER FOR THE MULTIPOLE MODEL

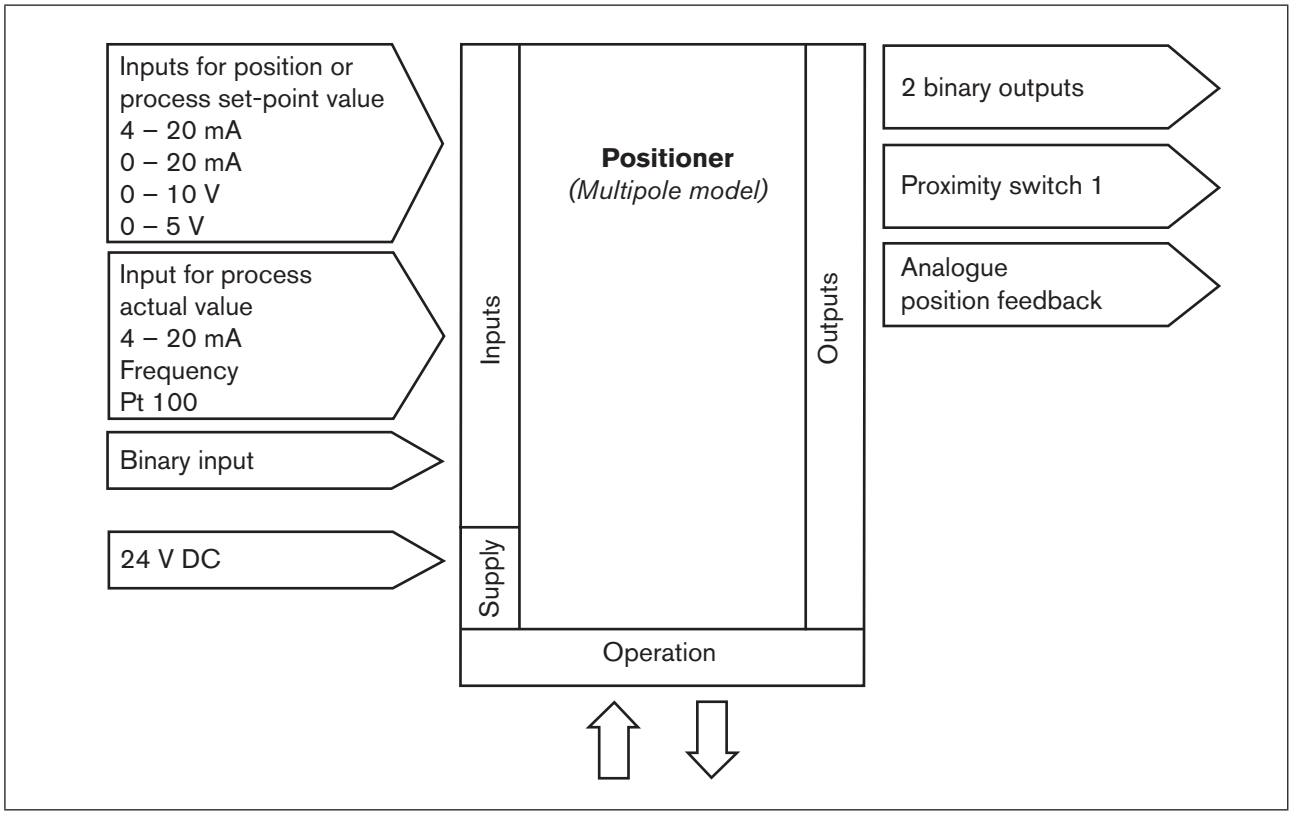


Figure 8: Interfaces for the multipole model

The positioners Type 8692 and Type 8693 are 3-wire devices, i.e. the power (24 V DC) is supplied separately from the set-point value signal.

10. INTERFACES OF THE POSITIONER FOR THE MODELS WITH CABLE GLAND

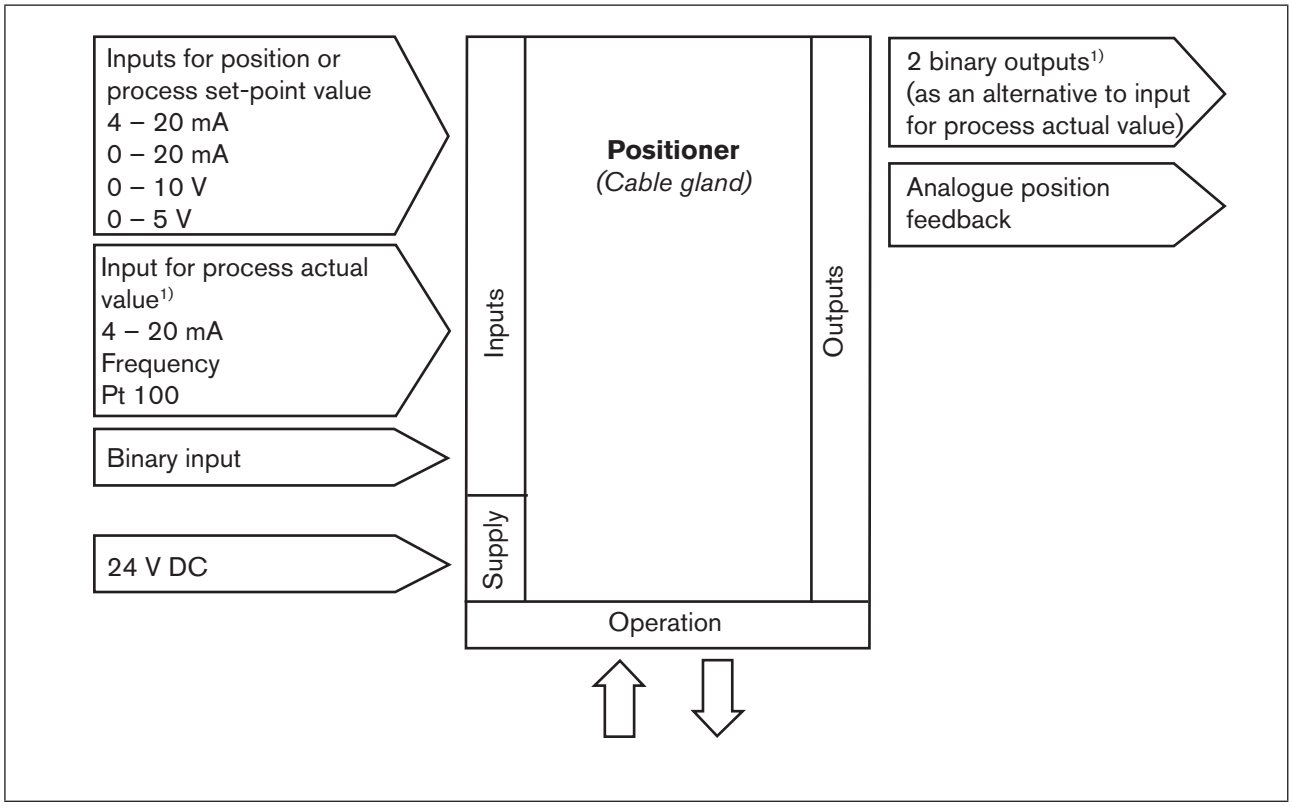


Figure 9: Interfaces for the model with cable gland

The positioners Type 8692 and Type 8693 are 3-wire devices, i.e. the power (24 V DC) is supplied separately from the set-point value signal.

1) *Type 8693: The switch can be used to supply power to a connected sensor (description see "18.5.1 Terminal assignment when selecting the process actual value input")*

11. TECHNICAL DATA

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

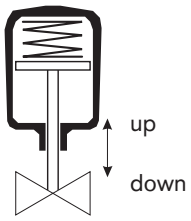
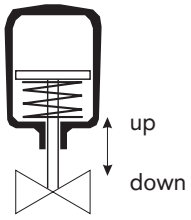
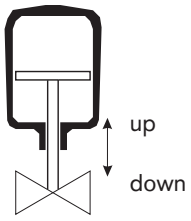
Actuator system	Designation	Safety positions after failure of the auxiliary power	
		electrical	pneumatic
	single-acting control function A	down	pilot-controlled control system: down direct-acting control system: not defined
	single-acting control function B	up	pilot-controlled control system: up direct-acting control system: not defined
	double-acting control function I	down / up (depending on the connection of the control cables)	not defined

Table 7: Safety positions

11.2. Factory settings of the positioner

Function	Factory setting	Function	Factory setting
ACTUATOR	*SINGLE* or *DOUBLE*[2)]	*X.CONTROL*	
		DBND	*1.0 %*
INPUT	*4-20 mA*	*KXopn*	(1) Values of *X.TUNE* determined
		KXcls	(1) Values of *X.TUNE* determined
CHARACT	*linear*	After executing of *SET.FACTORY: 1*	
DIR.CMD	*Rise*	*SECURITY*	
		Access Code 1	*0000*
CUTOFF	*Min 0 %*		
	Max 100 %	*SAFEPOS*	*0 %*
DIR.ACT	*Rise*	*SIG.ERROR*	
		SP/CMD Input	*Error off*
SPLTRNG	*Min 0 %*		
	Max 100 %	*P.CONTROL*	
		PARAMETER	
X.LIMIT	*Min 0 %*	*DBND*	*1.0 %*
	Max 100 %	*KP*	*1.00*
		TN	*999.9*
X.TIME		*TV*	*0.0*
Open	*(1s)* Values of *X.TUNE* determined	*X0*	*0.0 %*
Close	*(1s)* Values of *X.TUNE* determined	*FILTER*	*0*
After executing of *SET.FACTORY: 1s*		*SETUP*	
		SP-INPUT	*intern*
OUTPUT		*PV-INPUT*	*4-20 mA*
OUT ANALOG	*Out POS*	*PV-SCALE*	*PVmin 0.0*
	OUT type 4-20 mA	*PV-SCALE*	*PVmax 100.0*
OUT BIN1	*Out DEV.X*	*P.CO-INIT*	*bumpless*
	Lim. DEV.X 1.0 %		
	OUT.BIN1 type normally open		
OUT BIN2	*Out DEV.X*		
	Lim. DEV.X 1.0 %		
	OUT.BIN1 type normally open		
BINARY. IN	*SafePos*		
BIN. IN type	*normally open*		

Table 8: Factory settings

2) *preset at the factory according to the actuator*

11.3. Specifications of the positioner

11.3.1. Conformity

In accordance with the EC Declaration of conformity, the positioner Type 8692 and 8693 are compliant with the EC Directives.

11.3.2. Standards

Conformity with the EC Directives is verified by the following standards.

EN 61000-6-3, EN 61000-6-2, EN 61010-1

11.3.3. Operating conditions

CAUTION!

Solar radiation and temperature fluctuations 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.

Ambient temperature	0 – + 55 °C
Protection class	IP 65 / IP 67 in accordance with EN 60529 (only if cables, plugs and sockets have been connected correctly and in compliance with the exhaust air concept in chapter “17.3. Pneumatic connection of the positioner“)

11.3.4. Mechanical data

Dimensions	see data sheet
Body material	exterior: PPS, PC, VA, interior: PA 6; ABS
Sealing material	NBR / EPDM
Stroke range of valve spindle	3 – 28 mm

11.3.5. Electrical data

Connections	cable gland (24 V DC) or circular plug-in connector (Profibus DP, DeviceNet, 24 V DC)
Supply voltage	24 V DC ± 10 % max. residual ripple 10 %
Power input	< 5 W

Input resistance for actual value signal	180 Ω at 4 – 20 mA / 12 bit resolution 17 kΩ at frequency, 0 – 1000 Hz / 1‰ of measured value > 300 mV_{ss} sine, square, triangle Pt 100 -20 – +220 °C, resolution < 0.1 °C
Input resistance for nominal value signal	180 Ω at 0/4 – 20 mA / 12 bit resolution 19 kΩ at 0 – 5/10 V / 12 bit resolution
Protection class	3 in accordance with VDE 0580
Analogue position feedback max. current for voltage output 0 – 5/10 V max. load for current output 0/4 – 20 mA	 10 mA 560 Ω
Inductive proximity switches current limitation	 100 mA
Binary outputs Current limiting	galvanically isolated 100 mA, output is clocked
Binary input	galvanically isolated 0 – 5 V = log "0", 10 – 30 V = log "1" input inverted accordingly

11.3.6. Pneumatic Data

Control medium	neutral gases, air 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	0 – +50 °C
Pressure range	3 – 7 bar
Air output, pilot valve	7 l_N / min (for aeration and deaeration) (Q_{Nn} value according to definition for pressure drop from 7 to 6 bar absolute) Optional: 130 l_N / min (for aeration and deaeration) (only single-acting)
Connections	Plug-in hose connector Ø 6mm / 1/4” Socket connection G1/8

11.3.7. Type label

Type label (example)

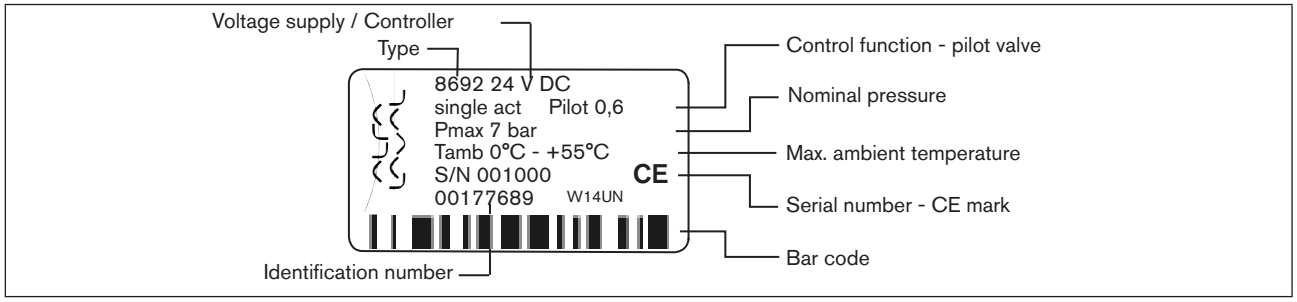


Figure 10: Example of type label

Control and display elements, operating modes

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12. 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 8692” and “Start-up and operation of the process controller Type 8693”.

12.1. Control and display elements of the positioner

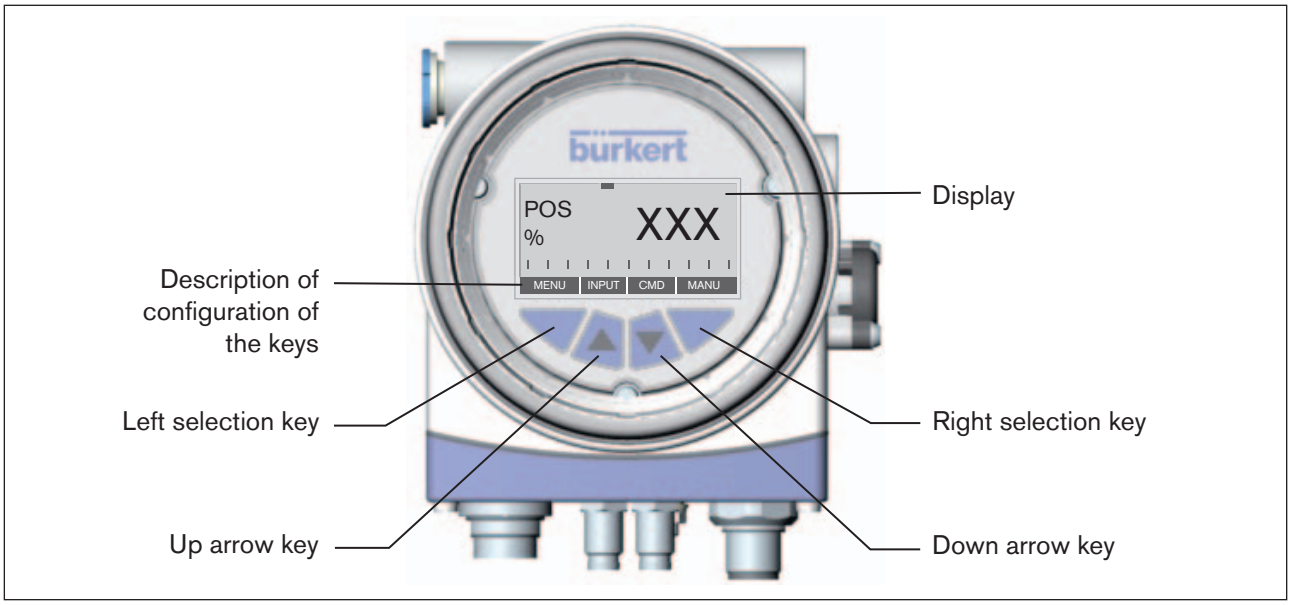


Figure 11: Description of the control module

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

12.2. 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 “13. Operating modes” and “14. 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
	HOLD - CONT Hold / continue of the graphic display of process actual value and set-point value	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: Configuration of the keys

12.3. Information on the display

The following representation describes the information on the display:

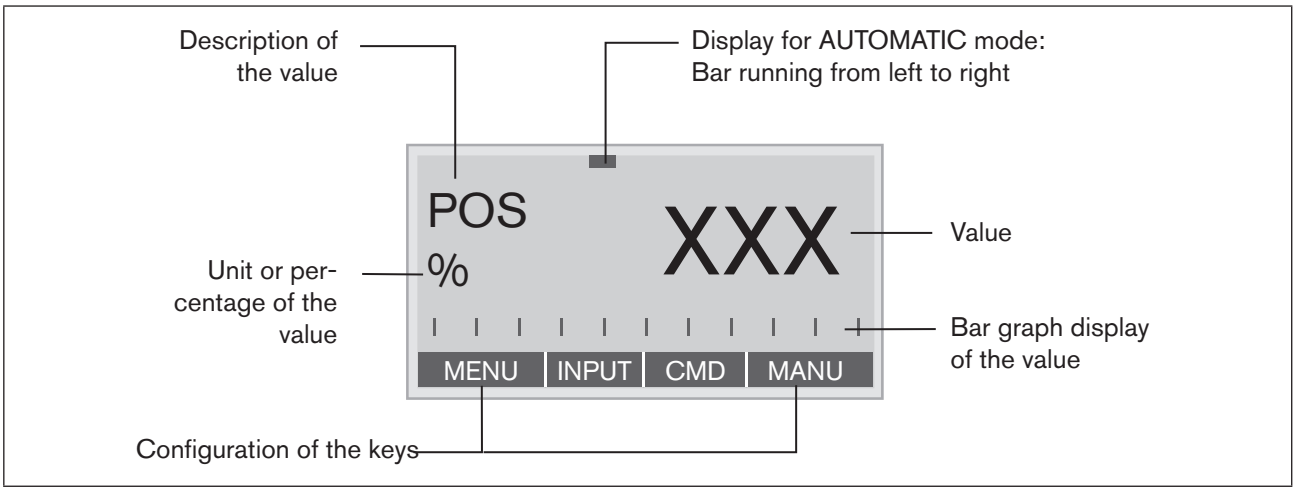


Figure 12: Description of display

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 body 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, Pt 100 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 [3)]	Process set-point value
SP/PV(t)		Representation of process actual value and set-point value

Table 10: Representation of value

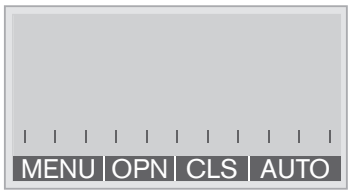
3) *Unit depending on process actual value.*

13. OPERATING MODES

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

AUTOMATIC — Normal controller mode is implemented and monitored in AUTOMATIC operating state.

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



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 8693. On the *SP* display only for external process set-point value (see also “12.2. Configuration of the keys”).

13.1. AUTOMATIC operating state for Type 8692

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

Normal controller 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:

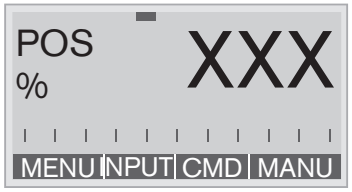
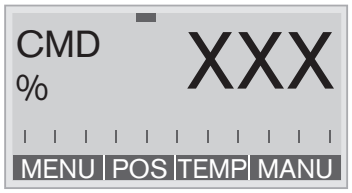
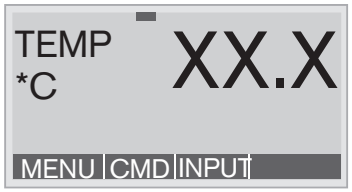
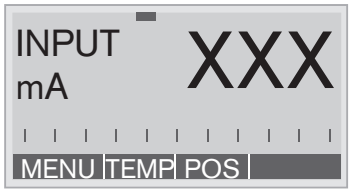
		Display of actual position of the valve actuator (0 - 100%)
▽		▪ Display of nominal position of the valve actuator or ▪ Display of nominal position of the valve actuator after rescaling by possibly activated split range function or correction characteristic (0 - 100%)
▽		Internal temperature in the housing of the positioner (°C)
▽		Input signal for nominal position (0 - 5/10 V or 0/4 – 20 mA)

Table 11: AUTOMATIC operating state for Type 8692

13.2. AUTOMATIC operating state for Type 8693

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

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

If the *P.CONTROL* additional function is activated for Type 8693, it is possible to switch between the following states in AUTOMATIC operating state:

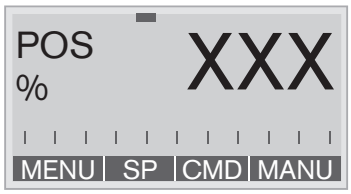
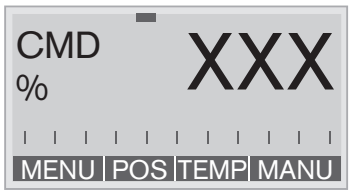
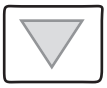
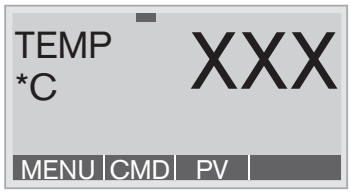
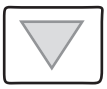
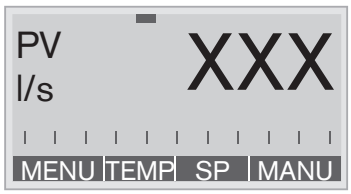
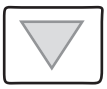
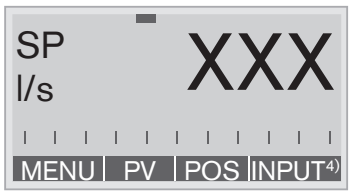
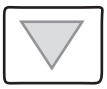
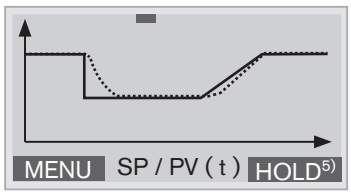
		Display of actual position of the valve actuator (0 - 100%)
		▪ Display of nominal position of the valve actuator or ▪ Display of nominal position of the valve actuator after rescaling by possibly activated split range function or correction characteristic (0 - 100%)
		Internal temperature in the body of the positioner (°C)
		Process actual value
		Process set-point value
		Representation of process actual value and set-point value

Table 12: AUTOMATIC operating state for Type 8693

 If the *P.CONTROL* additional function is not active, the displays are represented as under Type 8692.

4) *INPUT is indicated here if the internal set-point value default has been selected (P.CONTROL - SP-INPUT - internal).*
MANU is indicated here if the external set-point value default has been selected (P.CONTROL - SP-INPUT - external).
5) *HOLD: hold the display - CONT: continue the display*

13.3. 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 (CFA): Valve opens Control function B (CFB): Valve closes Control function I (CFI): Connection 2.1 aerated
	Press the down arrow key: Deaerate the actuator Control function A (CFA): Valve closes Control function B (CFB): Valve opens Control function I (CFI): Connection 2.2 aerated

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

CFA: Actuator closes by spring force

CFA: Actuator opens by spring force

CFI: Actuator double-acting

14. 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

14.1. 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 (Parameterization), press the selection key on the left (MENU) for approx. 3 seconds. During these 3 seconds (Countdown) 2 bars converge (see "Figure 13").

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

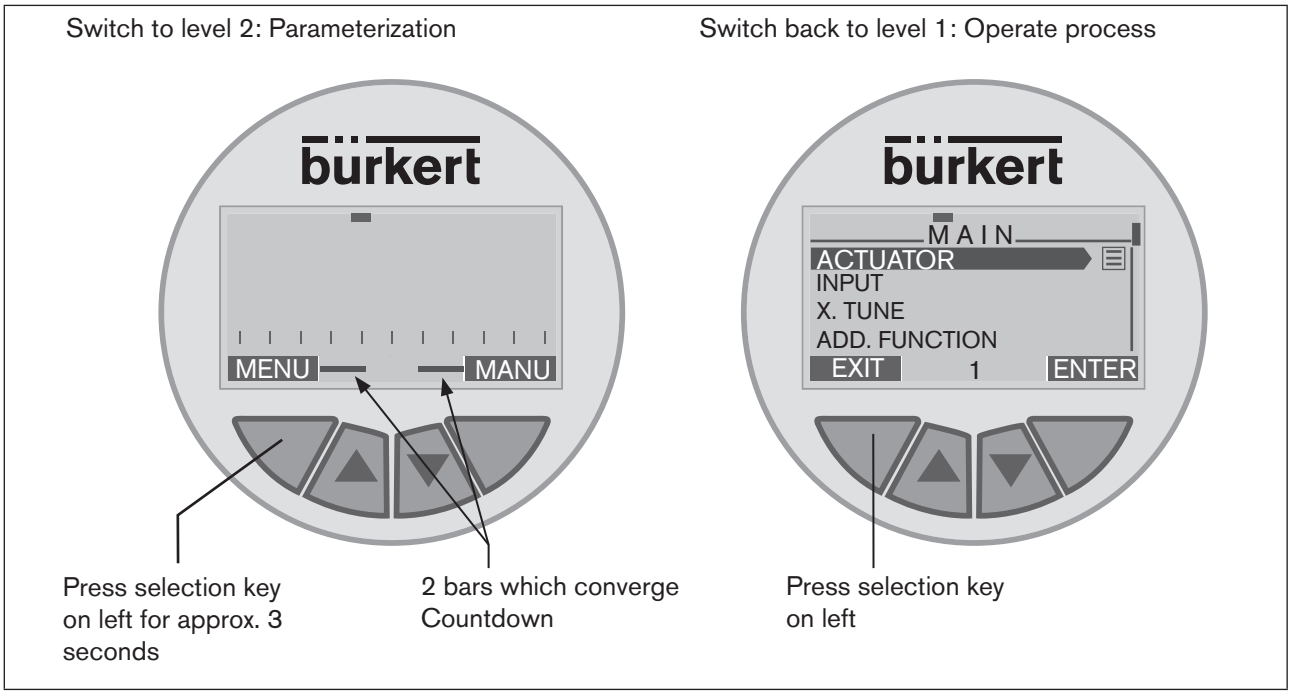


Figure 13: Switch operating level

Installation

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15. INSTALLATION

15.1. Safety instructions

DANGER!

Danger – high pressure in the equipment!

There is a serious risk of injury when reaching into the equipment.

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

WARNING!

Danger - improper installation!

Improper installation may result in injuries as well as damage to the device and the area around it.

- Fluid and electrical installations may be carried out by authorized technicians only and with the appropriate tools!

Danger due to unintentional activation of the equipment!

Unintentional activation of the equipment during installation may result in injuries and damage.

- Take appropriate measures to prevent the equipment from being unintentionally activated.

15.2. Installation of the positioner Type 8692 and 8693 on process valves of series 2103, 2300 and 2301

DANGER!

Danger – high pressure in the equipment!

There is a serious risk of injury when reaching into the equipment.

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

Procedure:

1. Install switch spindle

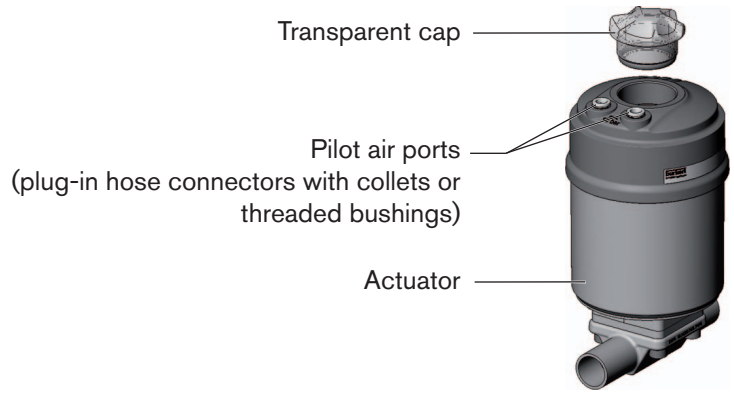


Figure 14: Installation of the switch spindle (1), series 2103, 2300 and 2301

→ Unscrew the transparent cap on the actuator and unscrew the position display (yellow cap) on the spindle extension (if present).

→ For version with plug-in hose connector, remove the collets (white nozzles) from both pilot air ports (if present).

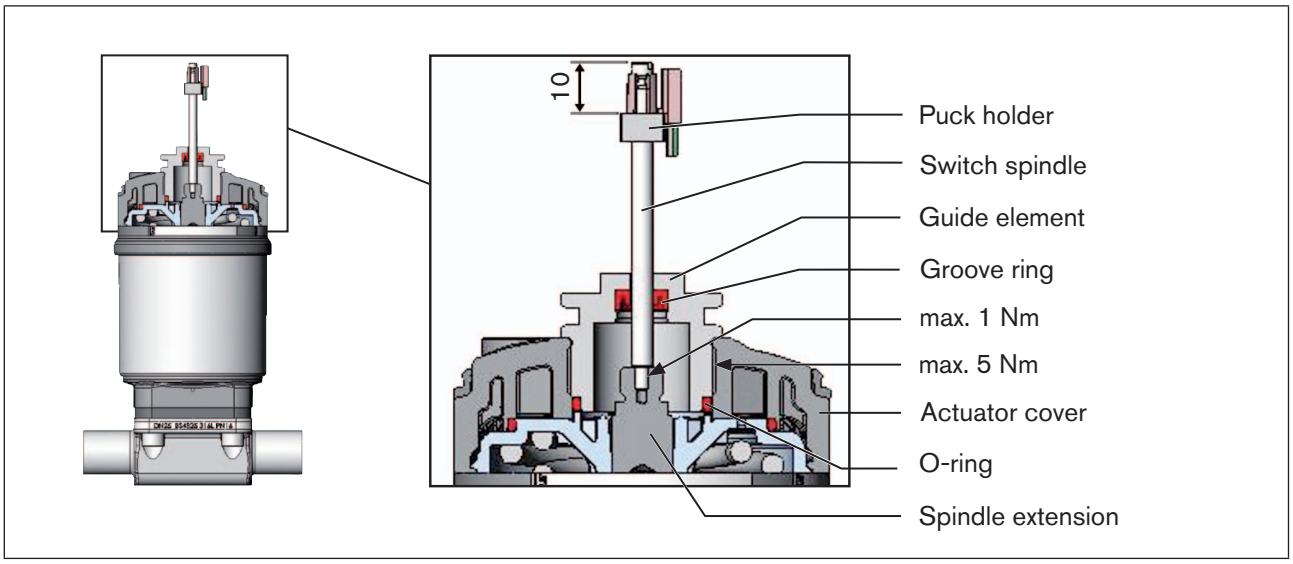


Figure 15: Installation of the switch spindle (2), series 2103, 2300 and 2301

NOTE!

Improper installation may damage the groove ring in the guide element!

The groove ring is already be pre-assembled in the guide element and must be “locked into position” in the undercut.

- When installing the switch spindle, do not damage the groove ring.

→ Push the switch spindle through the guide element.

NOTE!

Screw locking paint may contaminate the groove ring!

- Do not apply any screw locking paint to the switch spindle.

→ To secure the switch spindle, apply some screw locking paint (Loctite 290) in the tapped bore of the spindle extension in the actuator.

→ Check that the O-ring is correctly positioned.

→ Screw the guide element to the actuator cover (maximum torque: 5 Nm).

→ Screw switch spindle onto the spindle extension. To do this, there is a slot on the upper side (maximum torque: 1 Nm).

→ Push puck holder onto the switch spindle and lock into position.

2. Install sealing rings

→ Pull the form seal onto the actuator cover (smaller diameter points upwards).

→ Check that the O-rings are correctly positioned in the pilot air ports.

When the positioner is being installed, the collets of the pilot air ports must not be fitted to the actuator.

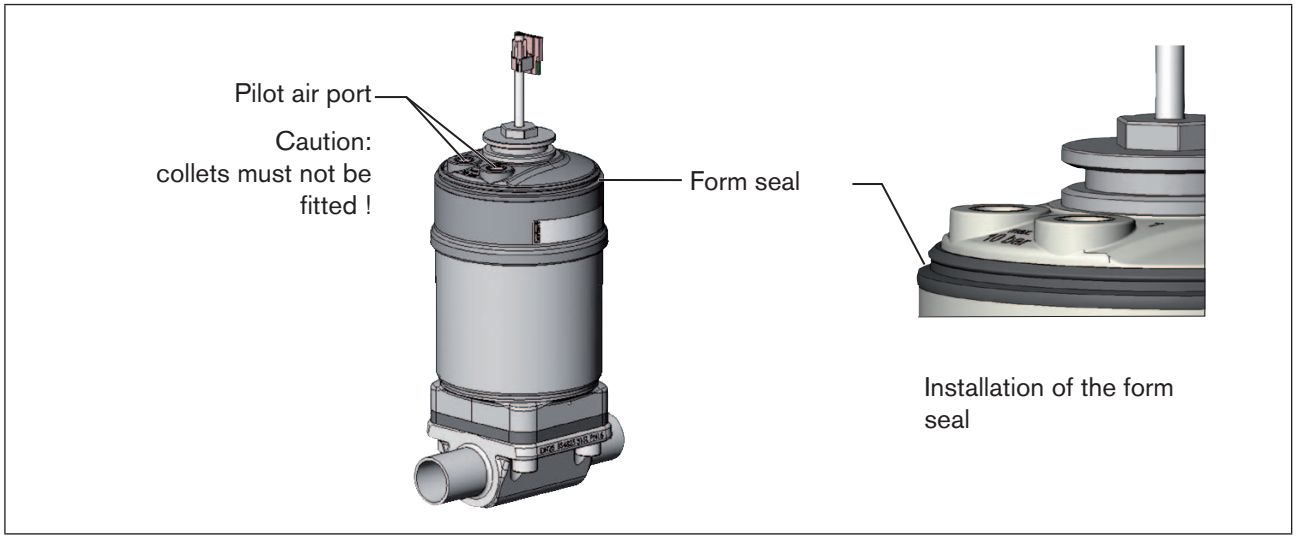


Figure 16: Installation of the sealing rings, series 2103, 2300 and 2301

3. Install positioner

NOTE!

Damaged printed circuit board or malfunction!

- Ensure that the puck holder is situated flat on the guide rail.

→ Align the puck holder and the positioner until
1. the puck holder can be inserted into the guide rail of the positioner (see "Figure 17")
and
2. the supports of the positioner can be inserted into the pilot air ports of the actuator (see also "Figure 18").

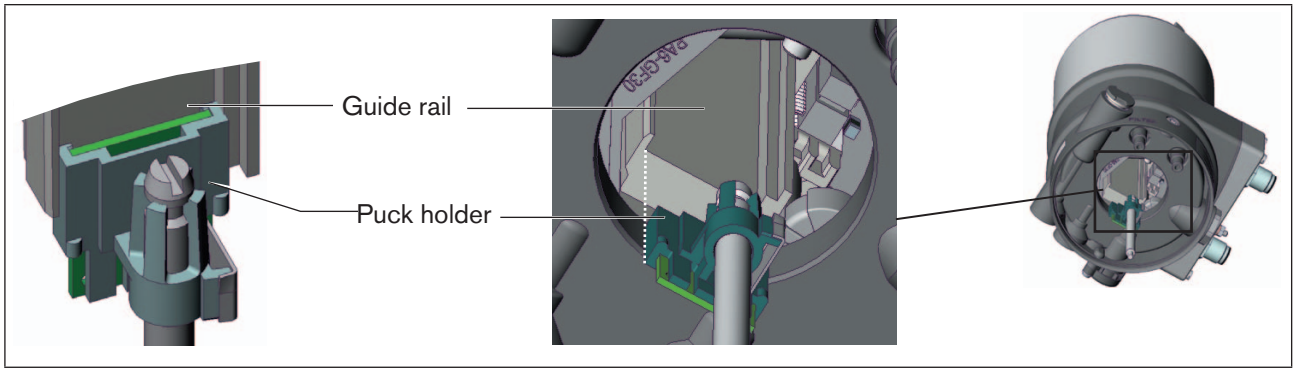


Figure 17: Aligning the puck holder

→ Push the positioner, without turning it, onto the actuator until no gap is visible on the form seal.

NOTE!

Too high torque when screwing in the fastening screw does not ensure protection class IP65 / IP67!

- The fastening screws may be tightened to a maximum torque of 0.5 Nm only.

→ Attach the positioner to the actuator using the two side fastening screws. In doing so, tighten the screws only hand-tight (max. torque: 0.5 Nm).

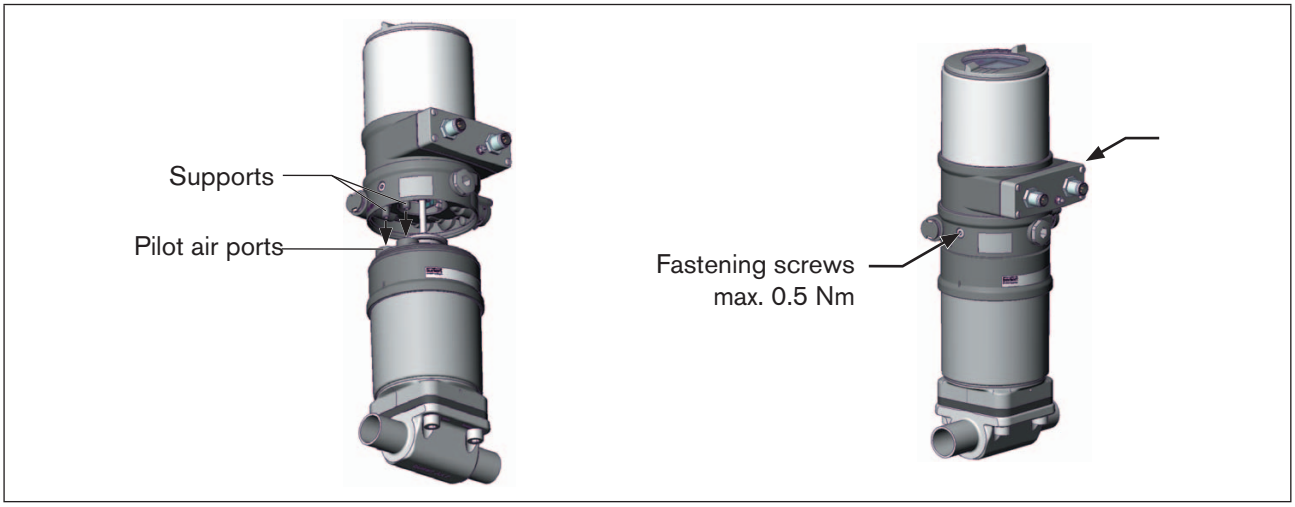


Figure 18: Installation of positioner, series 2103, 2300 and 2301

15.3. Installing the positioner Type 8694 and Type 8693 on process valves belonging to series 26xx and 27xx

Procedure:

1. Install switch spindle

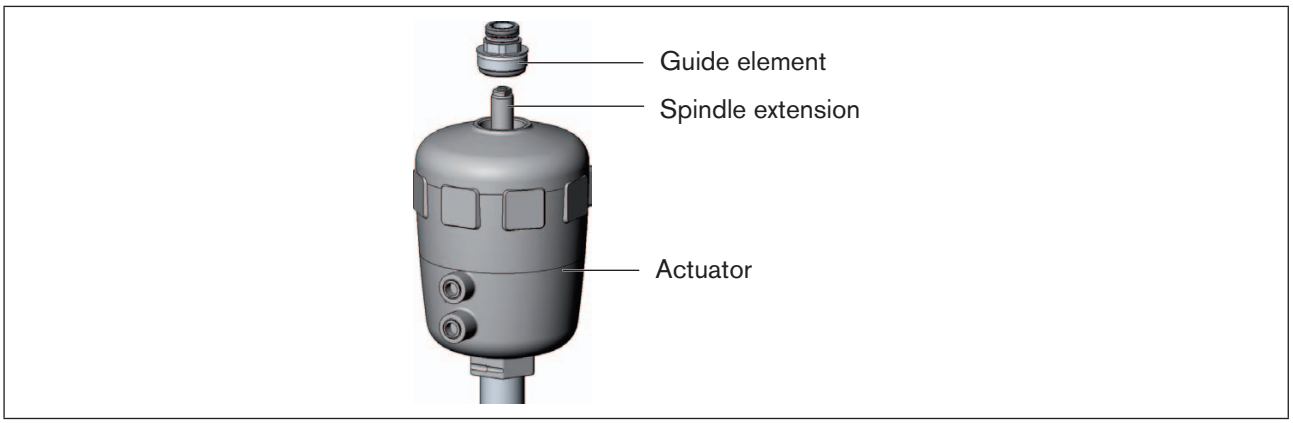


Figure 19: Installing the switch spindle (1), series 26xx and 27xx

→ Unscrew the already fitted guide element from the actuator (if present).

→ Remove intermediate ring (if present).

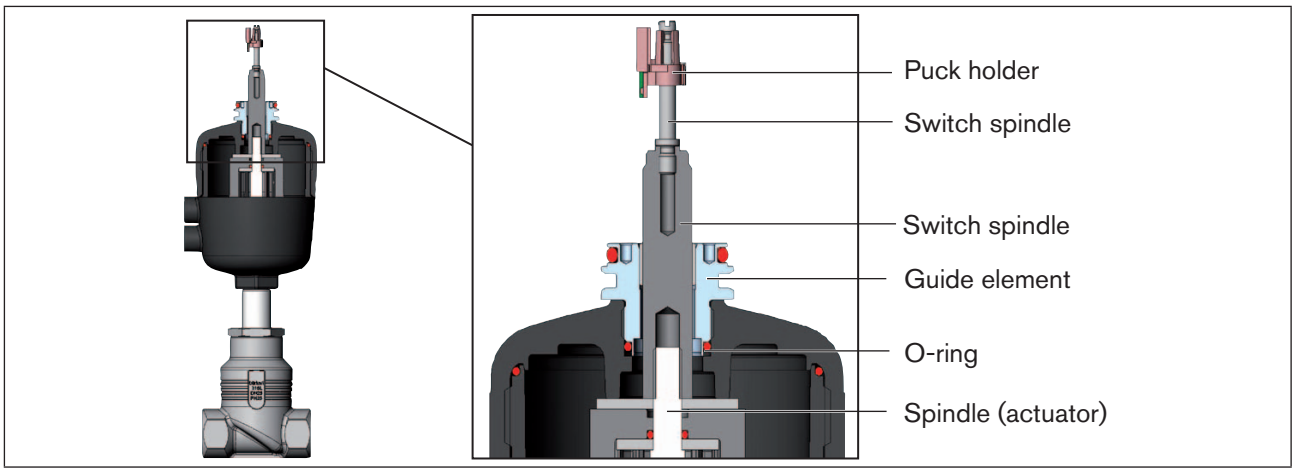


Figure 20: Installing the switch spindle (2), series 26xx and 27xx

→ Press the O-ring downwards into the cover of the actuator.

→ Actuator size 125 and bigger with large air output:
remove existing spindle extension and replace with the new one. To do this, apply some screw locking paint (Loctite 290) in the tapped bore of the spindle extension.

→ Screw the guide element into the cover of the actuator using a face wrench[6)] (torque: 8.0 Nm).

→ To secure the switch spindle, apply some screw locking paint (Loctite 290) to the thread of the switch spindle.

→ Screw the switch spindle onto the spindle extension. To do this, there is a slot on the upper side (maximum torque: 1 Nm).

→ Push the puck holder onto the switch spindle until it engages.

---

6) *Journal Ø: 3 mm; journal gap: 23.5 mm*

2. Install positioner

NOTE!

Damaged printed circuit board or malfunction!

- Ensure that the puck holder is situated flat on the guide rail.

→ Push the positioner onto the actuator. The puck holder must be aligned in such a way that it is inserted into the guide rail of the positioner.

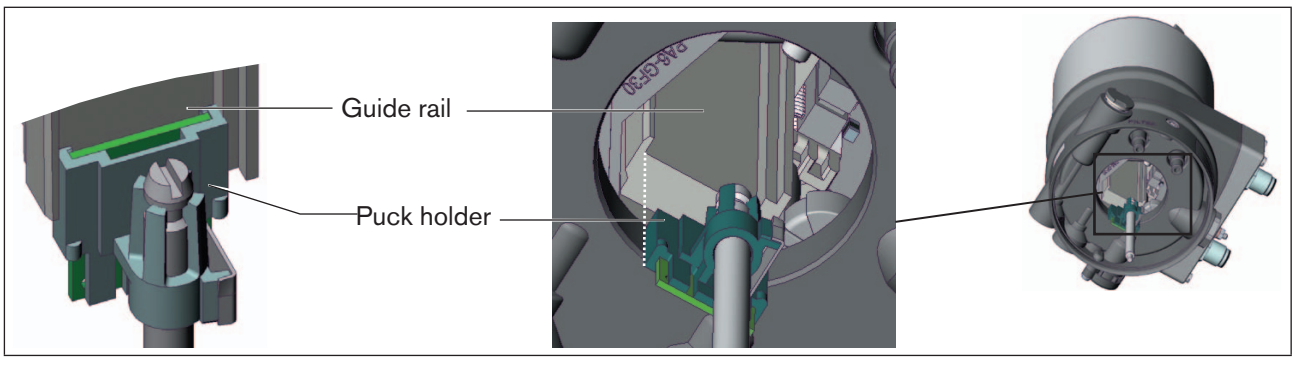


Figure 21: Aligning the puck holder

→ Press the positioner all the way down as far as the actuator and turn it into the required position.

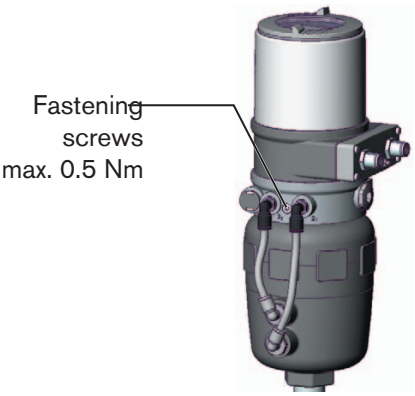


Figure 22: Installing the positioner

Ensure that the pneumatic connections of the positioner and those of the valve actuator are situated preferably vertically one above the other.
If they are positioned differently, longer hoses may be required other than those supplied in the accessory kit.

NOTE!

Too high torque when screwing in the fastening screw does not ensure protection class IP65 / IP67!

- The fastening screws may be tightened to a maximum torque of 0.5 Nm only.

→ Attach the positioner to the actuator using the two side fastening screws. In doing so, tighten the fastening screws hand-tight only (maximum torque: 0.5 Nm).

3. Install pneumatic connection between positioner and actuator

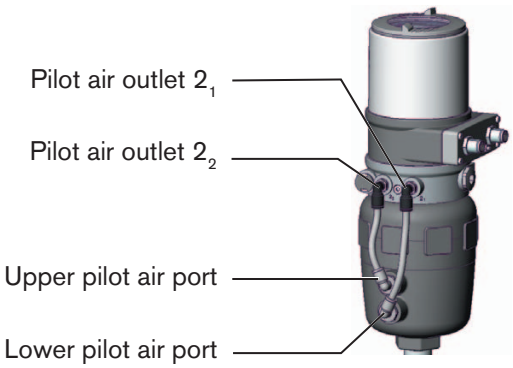


Figure 23: Installing the positioner

→ Screw the plug-in hose connectors onto the positioner and the actuator.

→ Using the hoses supplied in the accessory kit, make the pneumatic connection between the positioner and actuator with the following “Table 14: Pneumatic connection to actuator .

NOTE!

Damage or malfunction due to ingress of dirt and moisture!

- To comply with protection class IP65 / IP67, connect the control air connection which is not required to the free chamber of the actuator or seal with a plug.

Control function		Pneumatic connection Type 8692, 8693 with actuator	
		Pilot air outlet Type 8692, 8693	Pilot air port actuator
A	Process valve closed in rest position (by spring force)	2_1	lower chamber of the actuator
		2_2	should be connected to the upper chamber of the actuator
B	Process valve open in rest position (by spring force)	2_1	upper chamber of the actuator
		2_2	should be connected to the lower chamber of the actuator
I	Process valve closed in rest position	2_1	lower chamber of the actuator
		2_2	upper chamber of the actuator
	Process valve open in rest position	2_1	upper chamber of the actuator
		2_2	lower chamber of the actuator

Table 14: Pneumatic connection to actuator

"In rest position" means that the pilot valves of the positioner Type 8694 are isolated or not actuated.

If the ambient air is humid, a hose can be connected between control air connection 22 of the positioner and the unconnected chamber of the actuator for control function A or control function B. As a result, the spring chamber of the actuator is supplied with dry air from the vent duct of the positioner.

15.4. Rotating the actuator module

The actuator module cannot be rotated unless there are straight seat and slanted seat valves!

Following installation of the process valve, if the positioner display is only partially visible or the connection cables or hoses cannot be fitted properly, the actuator module (positioner and actuator) can be rotated into a position suitable for the connection.

Only the entire actuator module can be rotated. The positioner cannot be rotated contrary to the actuator. The process valve must be in the open position for alignment of the actuator module!

DANGER!

Danger – high pressure in the equipment!

There is a serious risk of injury when reaching into the equipment.

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

Procedure:

→ Clamp valve body in a holding device (only required if the process valve has not yet been installed).

NOTE!

Damage to the seat seal or the seat contour!

- When removing the actuator module, ensure that the valve is in open position.

→ Control function A: Open process valve.

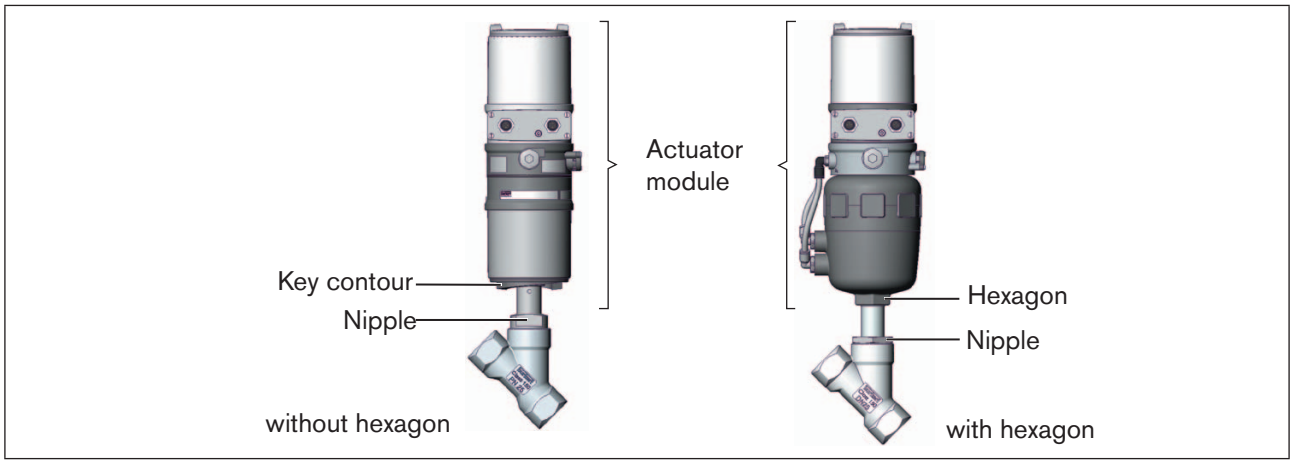


Figure 24: Rotating the actuator module

→ Using a suitable open-end wrench, counter the wrench flat on the pipe.

→ Actuator module without hexagon: Fit special key[7)] exactly in the key contour on the underside of the actuator.

→ Actuator module with hexagon: Place suitable open-end wrench on the hexagon of the actuator.

WARNING!

Risk of injury from discharge of medium and pressure!

If the direction of rotation is wrong, the body interface may become detached.

- Rotate the actuator module in the specified direction only (see "Figure 25") !

→ Actuator module without hexagon:
Rotate clockwise (as seen from below) to bring the actuator module into the required position.

→ Actuator module with hexagon:
Rotate counter-clockwise (as seen from below) to bring the actuator module into the required position.

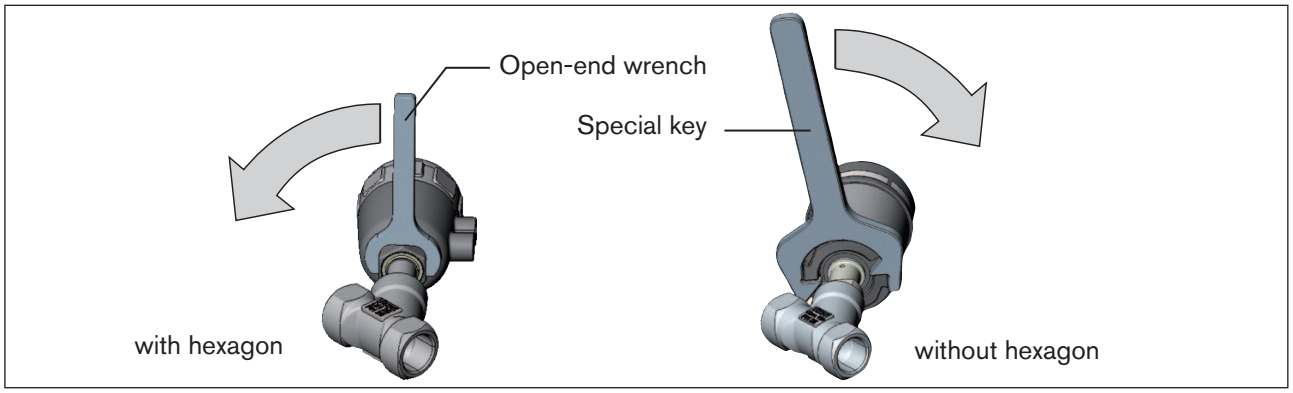


Figure 25: Rotating with special key / open-end wrench

7) *The special key (665702) is available from your Bürkert sales office.*

15.5. Rotating the positioner for process valves belonging to series 26xx and 27xx

If the connecting cables or hoses cannot be fitted properly following installation of the process valve, the positioner can be rotated contrary to the actuator.

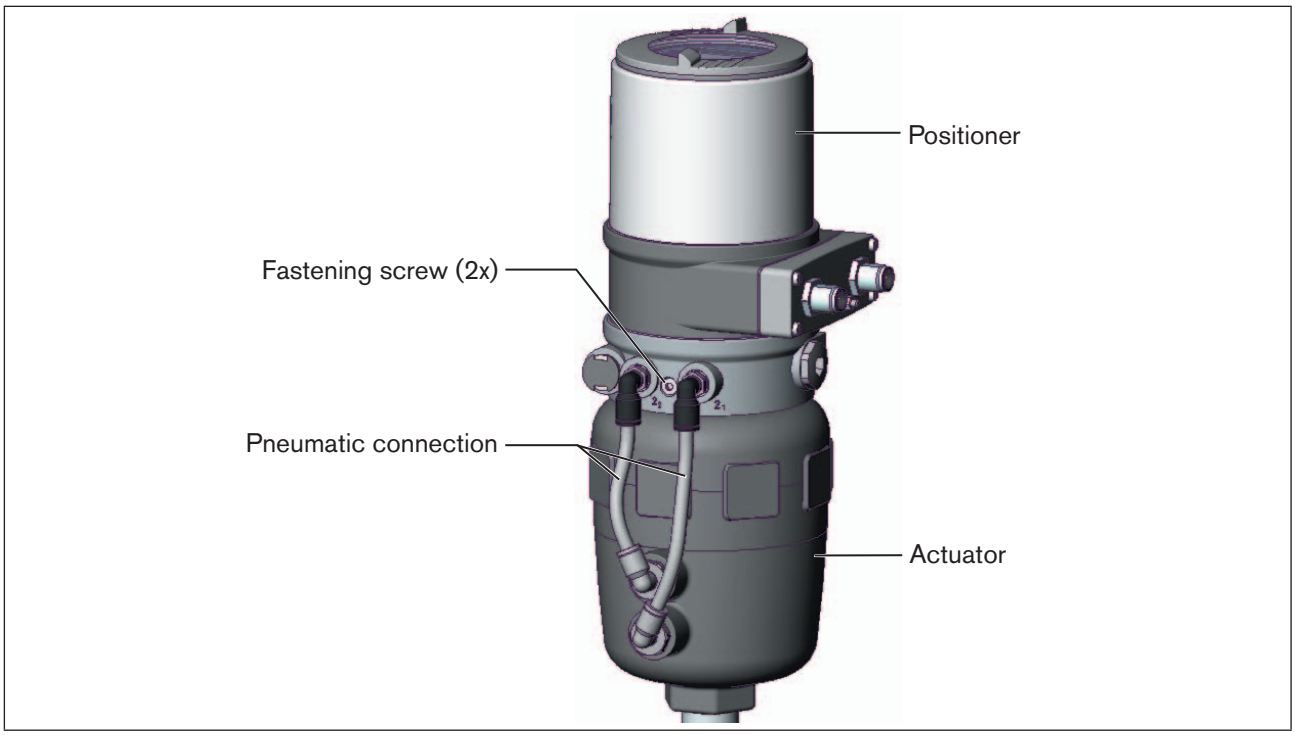


Figure 26: Rotating the positioner, series 26xx and 27xx

Procedure

→ Loosen the pneumatic connection between the positioner and the actuator.

→ Loosen the fastening screws (hexagon socket wrench size 2.5).

→ Rotate the positioner into the required position.

NOTE!

Too high torque when screwing in the fastening screw does not ensure protection class IP65 / IP67!

- The fastening screw may be tightened to a maximum torque of 0.5 Nm only.

→ Tighten the fastening screws hand-tight only (maximum torque: 0.5 Nm).

→ Re-attach the pneumatic connections between the positioner and the actuator. If required, use longer hoses.

16. FLUID CONNECTION

The dimensions of the positioner and the different complete device models, consisting of positioner, actuator and valve, can be found in the relevant data sheets.

16.1. Safety instructions

DANGER!

Danger – high pressure in the equipment!

There is a serious risk of injury when reaching into the equipment.

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

WARNING!

Danger - improper installation!

Improper installation may result in injuries as well as damage to the device and the area around it.

- Fluid and electrical installations may be carried out by authorized technicians only and with the appropriate tools!

Danger due to unintentional activation of the equipment!

Unintentional activation of the equipment during installation may result in injuries and damage.

- Take appropriate measures to prevent the equipment from being unintentionally activated.

16.2. Installation of the process valve

Thread type and dimensions can be found in the corresponding data sheet.

→ Connect the valve according to the operating instructions for the valve.

16.3. Pneumatic connection of the positioner

DANGER!

Risk of injury from high pressure!

- Before dismounting pneumatic lines and valves, turn off the pressure and vent the lines.

Procedure:

→ Connect the control medium to the pilot air port (1)
(3 – 7 bar; instrument air, free of oil, water and dust).

→ Attach the exhaust air line or a silencer to the exhaust air port (3)
and, if available to the exhaust air port (3.1)

Important information for the problem-free functioning of the device:

- The installation must not cause back pressure to build up.
- Select a hose for the connection with an adequate cross-section.
- The exhaust air line must be designed in such a way that no water or other liquid can get into the device through the exhaust air port (3) or (3.1).

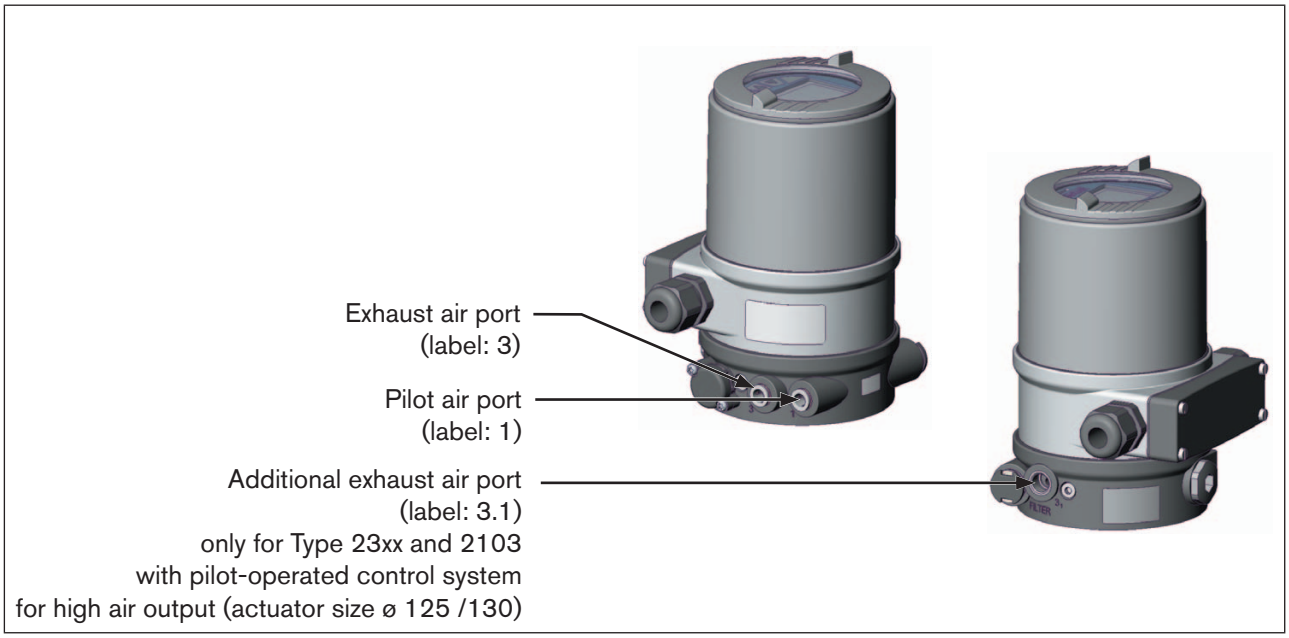


Figure 27: Pneumatic Connection

Caution:(Exhaust air concept)**:**
In compliance with protection class IP67, an exhaust air line must be installed in the dry area.

Keep the adjacent supply pressure **always** at least 0.5 – 1 bar above the pressure which is required to move the actuator to its end position. This ensures that the control behavior is not extremely negatively affected in the upper stroke range on account of too little pressure difference.

During operation keep the fluctuations of the pressure supply as low as possible (max. ±10 %). If fluctuations are greater, the control parameters measured with the *X.TUNE* function are not optimum.

17. ELECTRICAL CONNECTION 24 V DC WITH CIRCULAR PLUG-IN CONNECTOR (MULTI-POLE MODEL)

17.1. Safety instructions

DANGER!

Danger - electrical voltage in the equipment!

There is a serious risk of injury when reaching into the equipment.

- Before starting work, always switch off the power supply and safeguard to prevent re-activation!

WARNING!

Danger - improper installation!

Improper installation may result in injuries as well as damage to the device and the area around it.

- Fluid and electrical installations may be carried out by authorized technicians only and with the appropriate tools!

Danger due to unintentional activation of the equipment!

Unintentional activation of the equipment during installation may result in injuries and damage.

- Take appropriate measures to prevent the equipment from being unintentionally activated.

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 Alfa Laval Service directly.

If PROFIBUS DP or DeviceNet: The designation of the circular plug-in connectors and sockets and the contacts can be found in the respective chapters.

17.2. Type 8692 - designation of the circular plug-in connectors and the contacts

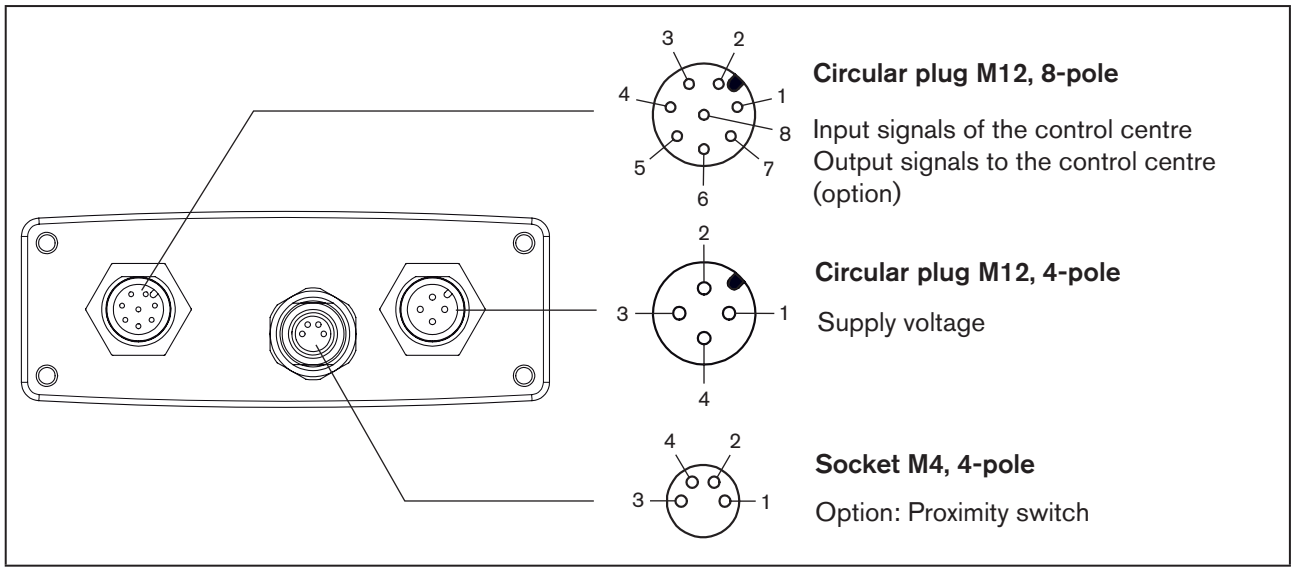


Figure 28: Designation of the circular plug-in connectors and contacts 8692

17.3. Connection of the position controller Type 8692

17.3.1. Input signals of the control centre (e.g. PLC) - circular plug M 12, 8-pole

Pin	Wire color[8)]	Configuration	External circuit / signal level
8	red	Set-point value + (0/4 – 20 mA or 0 – 5 / 10 V)	8 ○——— + (0/4 - 20 mA or 0 - 5 / 10 V) completely galvanically isolated
7	blue	Set-point value GND	7 ○——— GND
1	white	Binary input + (only option)	1 ○——— + ——— 0 - 5 V (log. 0) / 10 - 30 V (log. 1)

Table 15: Pin assignment - Input signals of the control centre - circular plug M 12, 8-pole

17.3.2. Output signals to the control centre (e.g. PLC) - circular plug M12 - 8-pole (required for analogue output and/or binary output option only)

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

Pin	Wire color[8)]	Configuration	external circuit / signal level
6	pink	Analogue position feedback +	6 → + (0/4 - 20 mA or 0 - 5 / 10 V) completely galvanically isolated
5	grey	Analogue position feedback GND	5 → GND
4	yellow	Binary output 1	4 → 24 V / 0 V
3	green	Binary output 2	3 → 24 V / 0 V
2	brown	Binary outputs GND	2 → GND

Table 16: Pin assignment -Output signals to the control centre - circular plug M 12 - 8-pole

17.3.3. Supply voltage (circular plug M12 - 4-pole)

Pin	Wire color[9)]	Configuration	External circuit
1	brown	+ 24 V	1 and 3 → 24 V DC ± 10 % max. residual ripple 10 %
2		not assigned	
3	blue	GND	
4		not assigned	

Table 17: Pin assignment - Supply voltage - (circular plug M 12 - 4-pole)

17.3.4. Option: with proximity switch - socket M8, 4-pole

Pin	Wire color[10)]	Configuration	External circuit
1	brown	Proximity switch 1 out	3, 1, 2 → Proximity switch
2	white	GND	
3	blue	+ 24 V DC	
4		not assigned	

Table 18: Pin assignment - proximity switch - socket M 8, 4-pole

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

→ Now implement the required basic settings and activate automatic adjustment of the positioner as described in the chapter entitled “19. Initial start-up” or “Starting and setting up the position controller Type 8692”.

---

8) *The indicated colors refer to the connecting cable available as an accessory (919061)*
9) *The indicated colors refer to the connecting cable available as an accessory (918038)*
10) *The indicated colors refer to the connecting cable available as an accessory (92903475)*

17.4. Type 8693 - Designation of the circular plug-in connectors and the contacts

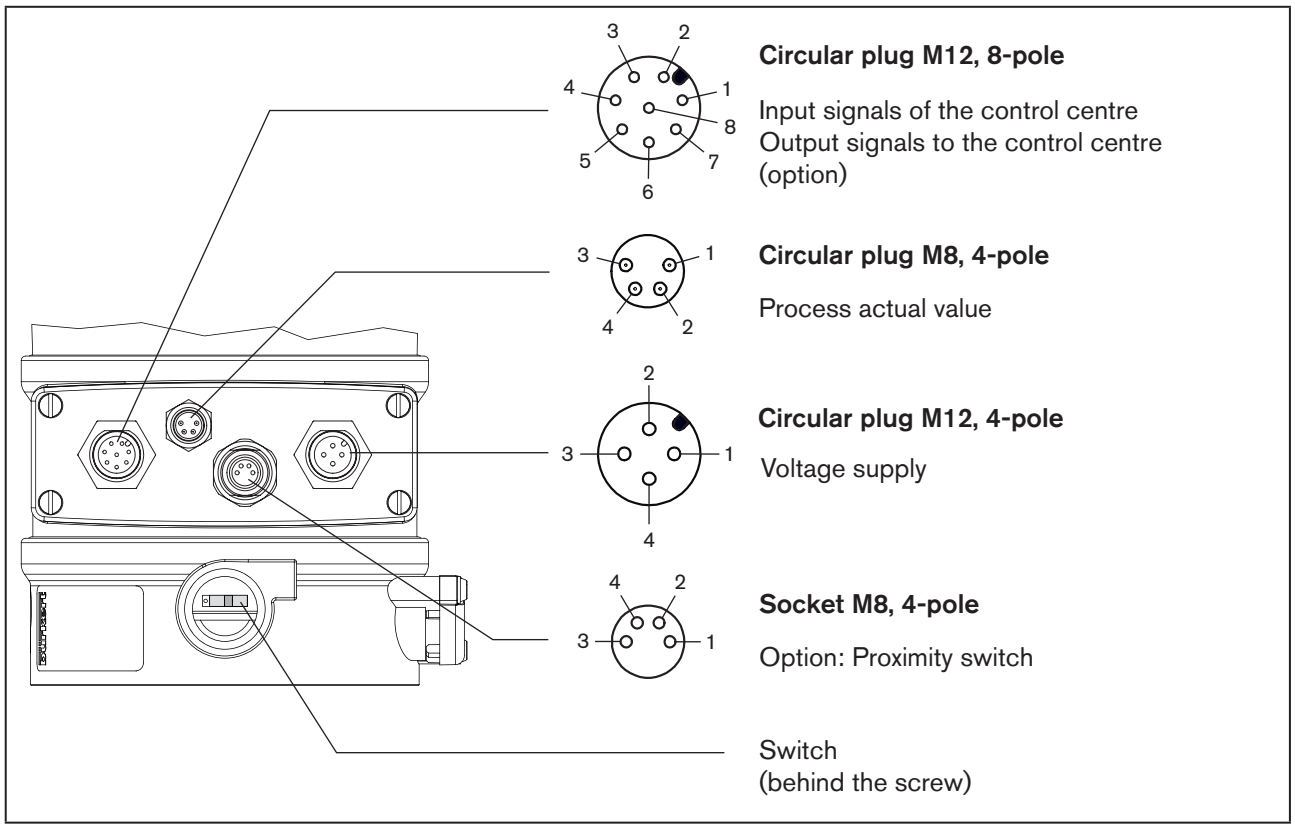


Figure 29: Designation of the circular plugs and contacts 8693

17.5. Connection of the process controller Type 8693

→ First connect the process controller as described in the chapter entitled “17.3 Connecting the position controller Type 8692”.

17.5.1. Process actual value (circular plug M 8, 4 pole)

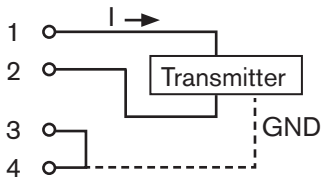
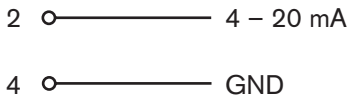
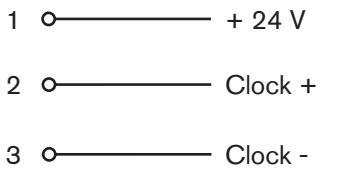
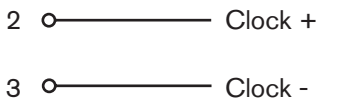
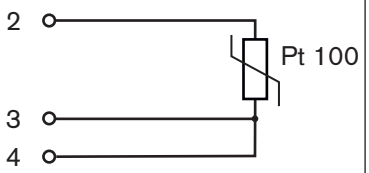
Input type[11)]	Pin	Wire color[12)]	Configuration	Switch	External circuit
4 – 20 mA - internally supplied	1 2 3 4	brown white blue black	+ 24 V transmitter supply Output from transmitter GND Bridge after GND (GND from 3-wire transmitter)	Switch on left	
4 – 20 mA - externally supplied	1 2 3 4	brown white blue black	Not assigned Process actual + Not assigned Process actual -	Switch on right	
Frequency - internally supplied	1 2 3 4	brown white blue black	+ 24 V sensor supply Clock input + Clock input - (GND) Not assigned	Switch on left	
Frequency - externally supplied	1 2 3 4	brown white blue black	Not assigned Clock input + Clock input - Not assigned	Switch on right	
Pt 100 (see information below)	1 2 3 4	brown white blue black	Not assigned Process actual 1 (current feed) Process actual 2 (GND) Process actual 3 (compensation)	Switch on right	

Table 19: Process actual value

For reasons of wire compensation connect the Pt 100 sensor via 3 wires. Always bridge Pin 3 and Pin 4 on the sensor.

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

→ Now implement the required basic settings and activate automatic adjustment of the positioner as described in the chapter entitled "19. Initial start-up" or "Starting and setting up the process controller Type 8693".

---

11) Can be adjusted by software (see chapter entitled "19.3 Specifying the basic settings")
12) The indicated colors refer to the connecting cable available as an accessory (918718)

17.6. Setting the proximity switch - optional

In the positioner with proximity switch option, the latter can be set to the bottom or the top end position.

DANGER!

Risk of electric shock!

- Before reaching into the system, switch off the power supply and secure to prevent reactivation!
- Observe applicable accident prevention and safety regulations for electrical equipment!

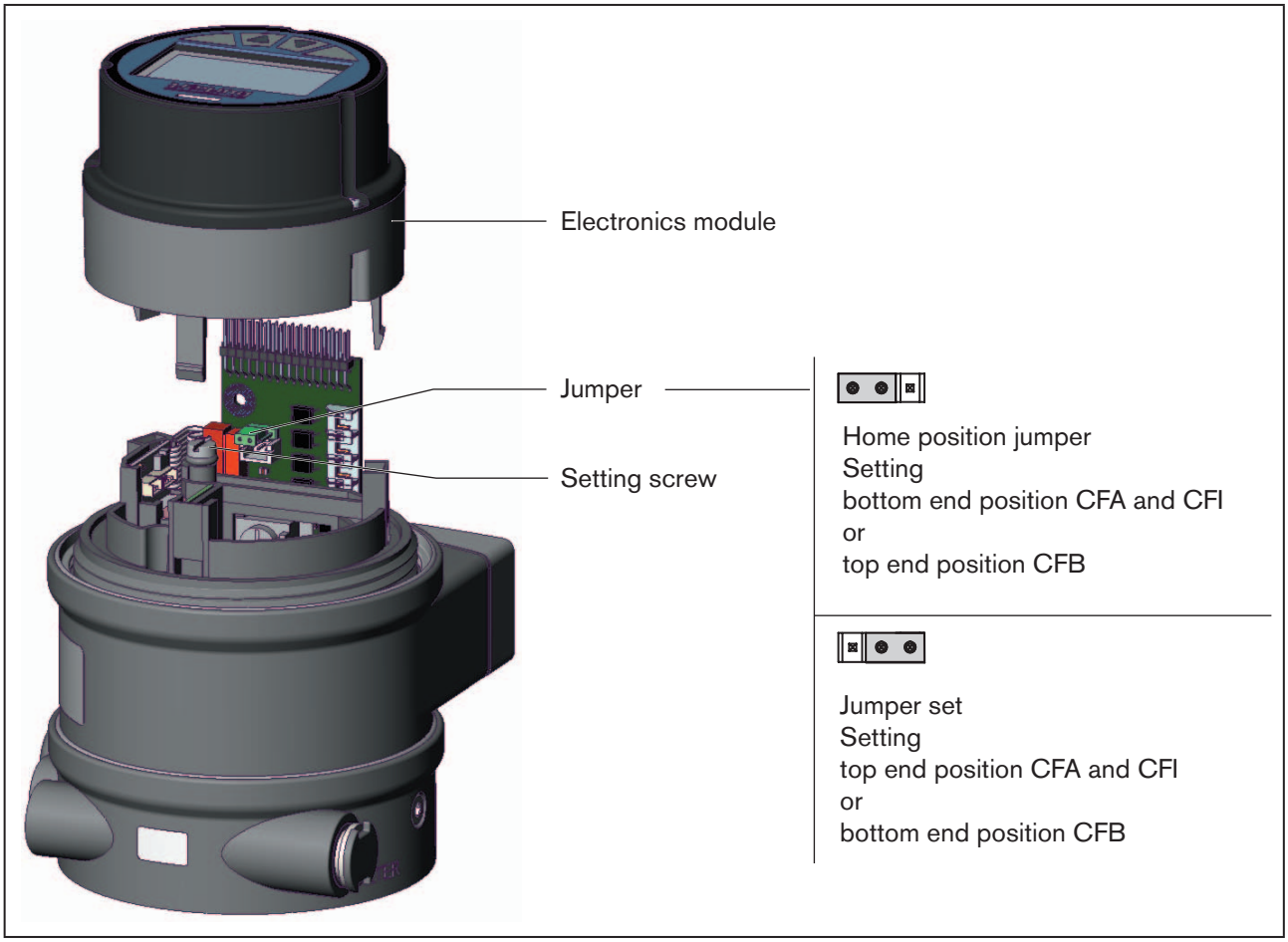


Figure 30: Setting the proximity switches

Procedure:

1. Open body and take off electronics module:

→ ⚠ Disconnect supply voltage at the positioner and proximity switch connector.

→ Unscrew body casing (with transparent hood).

→ Remove electronics module.

2. Setting the proximity switches (depending on the control function):

Bottom end position for control function A or top end position for control function B

→ Switch on supply voltage at the proximity switch connector.

→ Using a screwdriver, set proximity switch at the setting screw to end position.

→ ⚠ Switch off supply voltage at the proximity switch connector.

Bottom end position for control function I

→ Connect the pilot air.

WARNING!

Valve moves after electrical voltage has been connected!

After connecting the electrical voltage, the actuator moves to the set end position!

- Never perform setting of the proximity switch while a process is running!

→ Switch on supply voltage at the positioner and proximity switch connector.

→ Move actuator to the bottom end position.

→ Using a screwdriver, set proximity switch at the setting screw to end position.

→ ⚠ Switch off the pilot air.

→ ⚠ Disconnect supply voltage at the positioner and proximity switch connector.

Top end position for control function A and I or bottom end position for control function B

→ Set jumper (see “Figure 30: Setting the proximity switches”).

→ Connect the pilot air.

WARNING!

Valve moves after electrical voltage has been connected!

After connecting the electrical voltage, the actuator moves to the set end position!

- Never perform setting of the proximity switch while a process is running!

→ Switch on supply voltage at the positioner / process controller and proximity switch connector.

→ Move actuator to the top end position (CFA and I) or bottom end position (CFB).

→ Using a screwdriver, set proximity switch at the setting screw to end position.

→ ⚠ Switch off the control air.

→ ⚠ Switch off supply voltage at the unit and the proximity switch connector.

→ Return jumper to home position (“Figure 30: ”).

3. Attach electronics module and close body:

NOTE!

Be careful not to damage the pins at the PCB!

- When installing the electronics module, observe positioning of the pins to the PCB on the electronics module.

→ Attach electronics module carefully and insert the pins in the PCB on the electronics module.

→ Screw in body casing (with transparent cap).

→ Switch on supply voltage at the unit and the proximity switch connector.

→ Restart operation of positioner.

18. ELECTRICAL CONNECTION 24 V DC WITH CABLE GLAND

18.1. Safety instructions

DANGER!

Danger - electrical voltage in the equipment!

There is a serious risk of injury when reaching into the equipment.

- Before starting work, always switch off the power supply and safeguard to prevent re-activation!

WARNING!

Danger - improper installation!

Improper installation may result in injuries as well as damage to the device and the area around it.

- Fluid and electrical installations may be carried out by authorized technicians only and with the appropriate tools!

Danger due to unintentional activation of the equipment!

Unintentional activation of the equipment during installation may result in injuries and damage.

- Take appropriate measures to prevent the equipment from being unintentionally activated.

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 Alfa Laval Service directly.

18.2. Terminal board of the positioner with screw terminals and switches

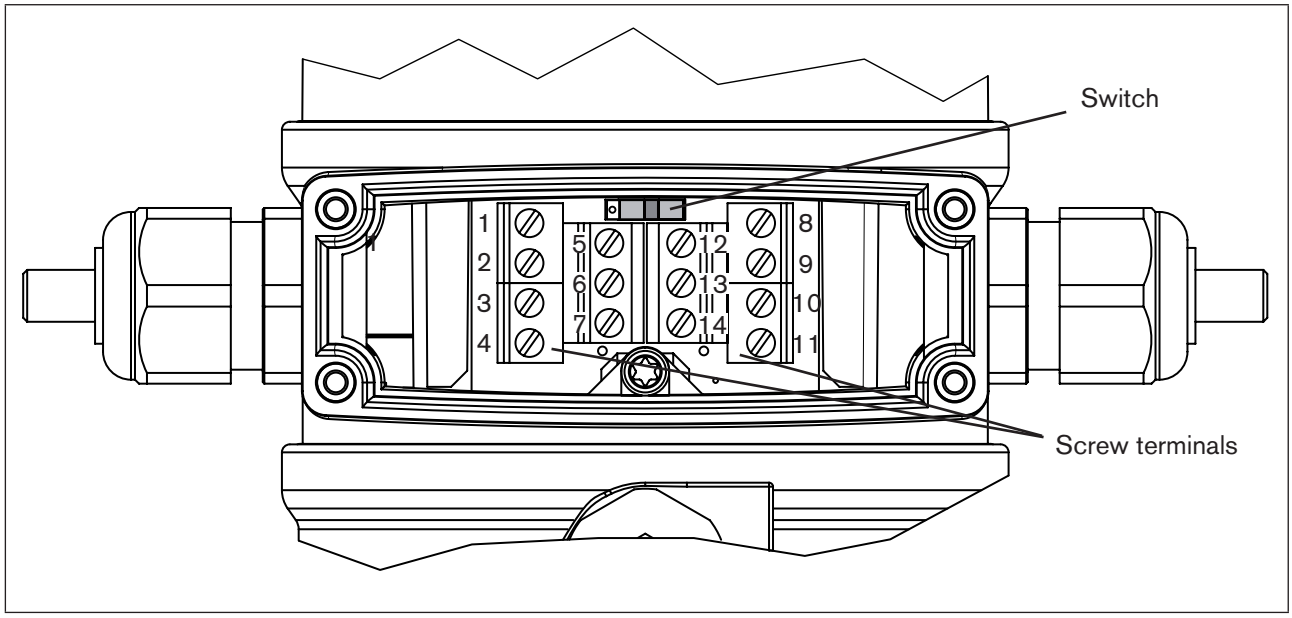


Figure 31: Terminal board with screw terminals and switch

Procedere:

→ The connection terminals can be accessed by removing the cover from the cable glands. To do this, unscrew the 4 screws.

→ Connect the positioner accordingly:
Type 8692: see chapter entitled "18.3 Terminal assignment for cable gland - position controller Type 8692"
Type 8693: see chapter entitled "18.4 Terminal assignment for cable gland - process controller Type 8693"

18.3. Terminal assignment for cable gland - position controller Type 8692

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

Terminal	Configuration	External circuit
11	Set-point value +	11 ○——— + (0/4 – 20 mA or 0 – 5 / 10 V)
10	Set-point value GND	10 ○——— GND
12	Binary input + (optional only)	12 ○——— + ——— 0 – 5 V (log. 0) 10 – 30 V (log. 1)
13	Binary input GND (optional only)	13 ○——— GND

Table 20: Configuration screw terminals - input signals from the control centre

18.3.2. Output signals to the control centre (e.g. PLC) (required for analogue output and/or binary output option only)

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

Terminal	Configuration	External circuit
9	Analogue position feedback +	9 ⟶ + (0/4 – 20 mA or 0 – 5 / 10 V) completely galvanically isolated
8	Analogue position feedback GND	8 ⟶ GND
5	Binary output 1	5 — 24 V / 0 V NC / NO
6	Binary output GND	6 — GND
7	Binary output 2	7 — 24 V / 0 V NC / NO
6	Binary output GND	6 — GND

Table 21: Configuration screw terminals - Output signals to the control centre

18.3.3. Supply voltage

Terminal	Configuration	External circuit
14	Supply voltage +	14 — 24 V DC ± 10 %max. residual ripple 10 %
13	Supply voltage GND	13 —

Table 22: Configuration screw terminals - Supply voltage

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

→ Now implement the required basic settings and activate automatic adjustment of the positioner as described in the chapter entitled “19. Initial start-up” or “Starting and setting up the position controller Type 8692”.

18.4. Terminal assignment for cable gland - process controller Type 8693

→ First connect the process controller as described in the chapter entitled “18.3 Terminal assignment for cable gland - position controller Type 8692”.

→ Connect the screw terminals of the process actual value input.

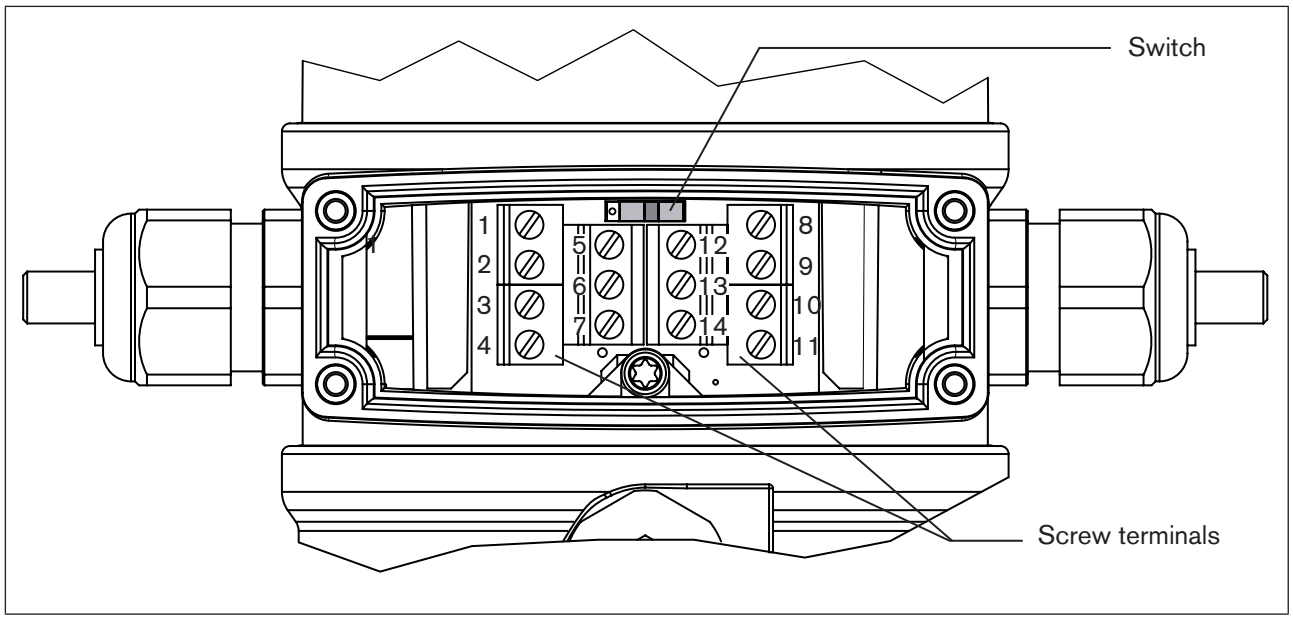


Figure 32: Terminal board with screw terminals and switch

18.4.1. Terminal assignment when selecting the process actual value input

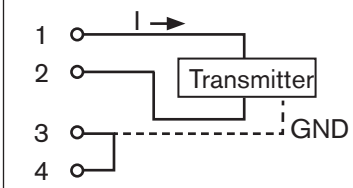
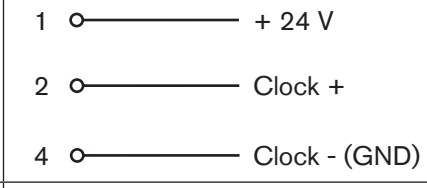
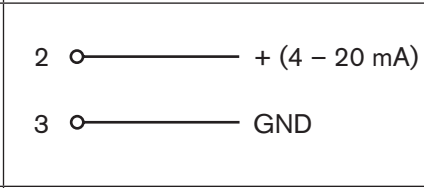
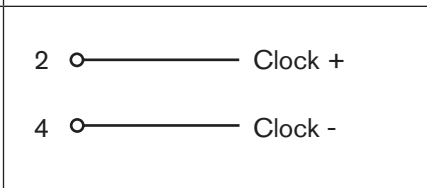
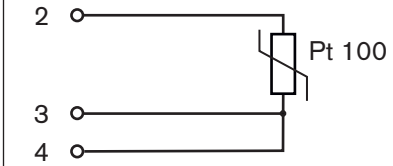
Input type[13]	Switch[14]	Terminal	Configuration	External circuit
4 – 20 mA - internally supplied	Switch on left	1	+ 24 V transmitter input	
		2	Transmitter output	
		3	Bridge after GND (GND from 3-wire transmitter)	
		4	GND	
Frequency - internally supplied		1	+ 24 V sensor supply	
		2	Clock input +	
		3	Not assigned	
		4	Clock input - (GND)	
4 – 20 mA - externally supplied	Switch on right	1	Not assigned	
		2	Process actual +	
		3	Process actual -	
		4	Not assigned	
Frequency - externally supplied		1	Not assigned	
		2	Clock input +	
		3	Not assigned	
		4	Clock input -	
Pt 100 (see information below)		1	Not assigned	
		2	Process actual 1 (current feed)	
		3	Process actual 2 (compensation)	
		4	Process actual 3 (GND)	

Table 23: Process actual value input

For reasons of wire compensation connect the Pt 100 sensor via 3 wires.
Always bridge Terminal 3 and Terminal 4 on the sensor.

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

→ Now implement the required basic settings and activate automatic adjustment of the positioner as described in the chapter entitled "19. Initial Start-up" or "Starting and setting up the process controller Type 8693".

[13] *Can be adjusted by software (see chapter entitled "19. 3 Specifying the Basic Settings")*
[14] *The switch is situated on the terminal board of the positioner (see "Figure 32")*

19. 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 context.

19.1. Safety instructions

DANGER!

Danger – high pressure in the equipment!

There is a serious risk of injury when reaching into the equipment.

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

WARNING!

Danger - improper installation!

Improper installation may result in injuries as well as damage to the device and the area around it.

- Fluid and electrical installations may be carried out by authorized technicians only and with the appropriate tools!

Danger due to unintentional activation of the equipment!

Unintentional activation of the equipment during installation may result in injuries and damage.

- Take appropriate measures to prevent the equipment from being unintentionally activated.

19.2. 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.

19.3. Specifying the basic 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 selecion key (ENTER).

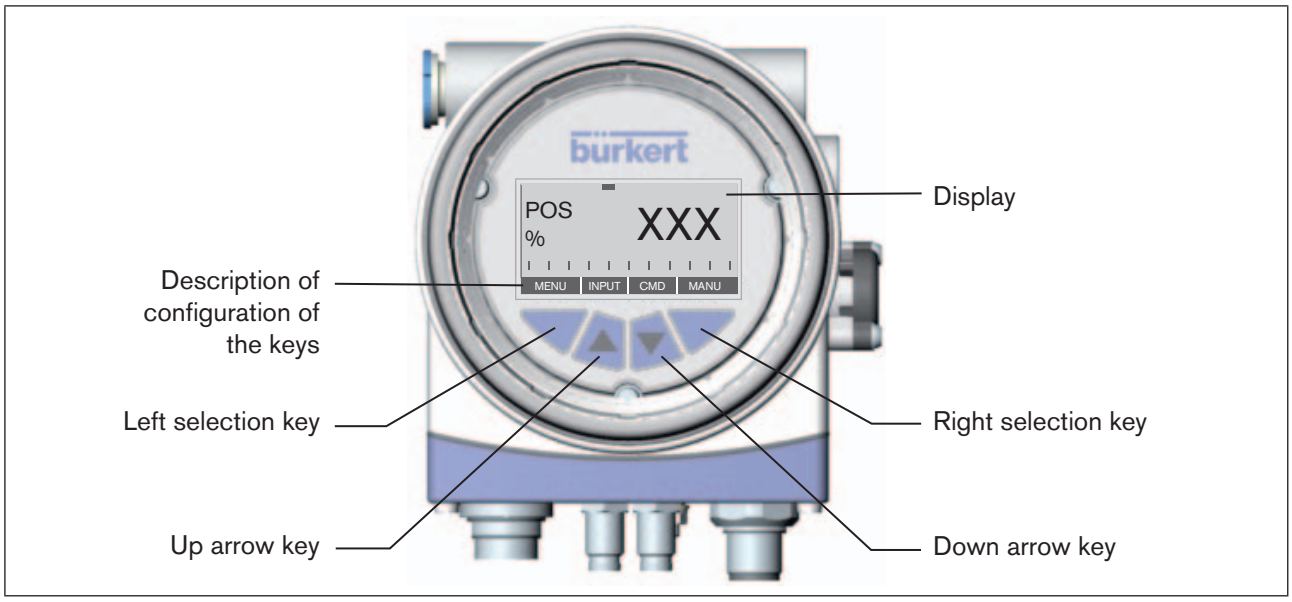


Figure 33: Description of the control module

An overview of the operating structure of the basic settings can be found in the chapter entitled "19.3.3 Overview of operating structure – initial start-up".

19.3.1. 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, mark 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 button (EXIT).

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

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.

19.3.2. Running the automatic adjustment *X.TUNE*:

An exact description of the *X.TUNE* function can be found in the chapters entitled "Start-up and operating the position controller Type 8692"

WARNING!

Danger due to the valve position changing when the X.TUNE function is running!

When the X.TUNE is running under operating pressure, there is an acute risk of injury.

- Never run X.TUNE while a process is running!
- Take appropriate measures to prevent the equipment from being accidentally actuated!

NOTE!

Avoid maladjustment of the controller due to an incorrect pilot pressure or applied operating medium pressure!

- Run X.TUNE whenever the pilot pressure (= pneumatic auxiliary energy) is available during subsequent operation.
- 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 button (MENU) for approx. 3s (countdown on the display).

→ Using the arrow buttons, mark the *X.TUNE*menu option.

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

→ Press any key to return to the main menu.

→ To leave the main menu, press the left selection button (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.

19.3.3. Overview of operating structure initial start-up

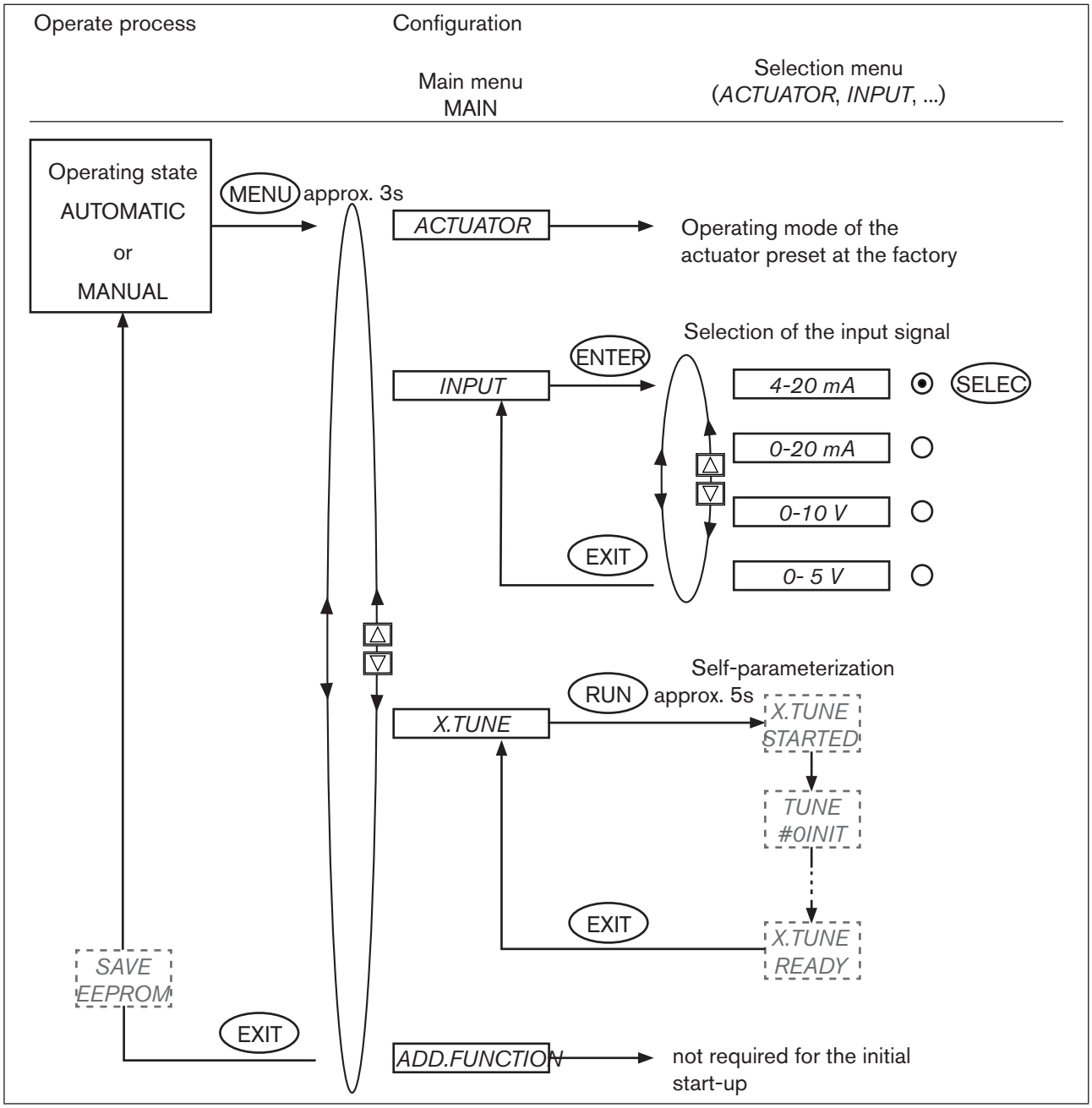


Figure 34: Operating structure - initial start-up

Start-up and operation of the position controller Type 8692

TABLE OF CONTENTS

20. STARTING UP AND INSTALLING THE POSITION CONTROLLER TYPE 8692

20.1. Safety instructions

DANGER!

Danger – high pressure in the equipment!

There is a serious risk of injury when reaching into the equipment.

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

WARNING!

Danger - improper installation!

Improper installation may result in injuries as well as damage to the device and the area around it.

- Fluid and electrical installations may be carried out by authorised technicians only and with the appropriate tools!

Danger due to unintentional activation of the equipment!

Unintentional activation of the equipment during installation may result in injuries and damage.

- Take appropriate measures to prevent the equipment from being unintentionally activated.

20.2. Description of the procedure

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

To specify the basic settings, you must 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).

→ Press the arrow keys to switch between the main menu options and select a menu option with the right selection key (ENTER/RUN).

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

→ Press the arrow keys to switch between these sub-options and select the required settings. Press the right selection key (SELEC/ENTER) to confirm the selection (the point after the selected parameter is now marked). Return to the main menu by pressing the left selection key (EXIT).

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

You are back at 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"*).

20.3. Factory settings of the position controller

Function	Factory setting	Function	Factory setting
ACTUATOR	*SINGLE* or *DOUBLE*[15)]	*X.CONTROL*	
		DBND	*1.0 %*
INPUT	*4-20 mA*	*KXopn*	(1) Values of *X.TUNE* determined
CHARACT	*linear*	*KXcls*	(1) Values of *X.TUNE* determined
		After running *SET.FACTORY: 1*	
DIR.CMD	*Rise*		
		SECURITY	
CUTOFF	*Min 0 %*	*Access Code 1*	*0000*
	Max 100 %		
		SAFEPOS	*0 %*
DIR.ACT	*Rise*		
		SIG.ERROR	
SPLTRNG	*Min 0 %*	*SP/CMD Input*	*Error off*
	Max 100 %		
		OUTPUT[16)]	
X.LIMIT	*Min 0 %*	*OUT*	
	Max 100 %	*ANALOGUE*	*Out POS*
			OUT type 4-20 mA
X.TIME		*OUT BIN1*	*Out DEV.X*
Open	*(1s)* Values of *X.TUNE* determined		*Lim. DEV.X 1.0 %*
Close	*(1s)* Values of *X.TUNE* determined		*OUT.BIN1 type normally open*
After running *SET.FACTORY: 1s*		*OUT BIN2*	*Out DEV.X*
			Lim. DEV.X 1.0 %
BINARY. IN	*SafePos*		*OUT.BIN1 type normally open*
BIN. IN type	*normally open*		

Table 24: Factory settings of the position controller

15) *Preset at the factory*
16) *Option only*

20.4. Specifying the basic 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 functions *INPUT* and *X.TUNE* can be found in the chapter entitled "20. 5 Description of the functions of 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 *X.CONTROL* is in the main menu while the auxiliary function *X.TUNE* is running, the position controller dead band *DBND* is determined automatically depending on the friction behaviour of the actuator (see chapter entitled "22.3.9 Auxiliary functions - *X.CONTROL*")

20.5. Description of the basic functions in the main menu

20.5.1. Main menu of the positioner

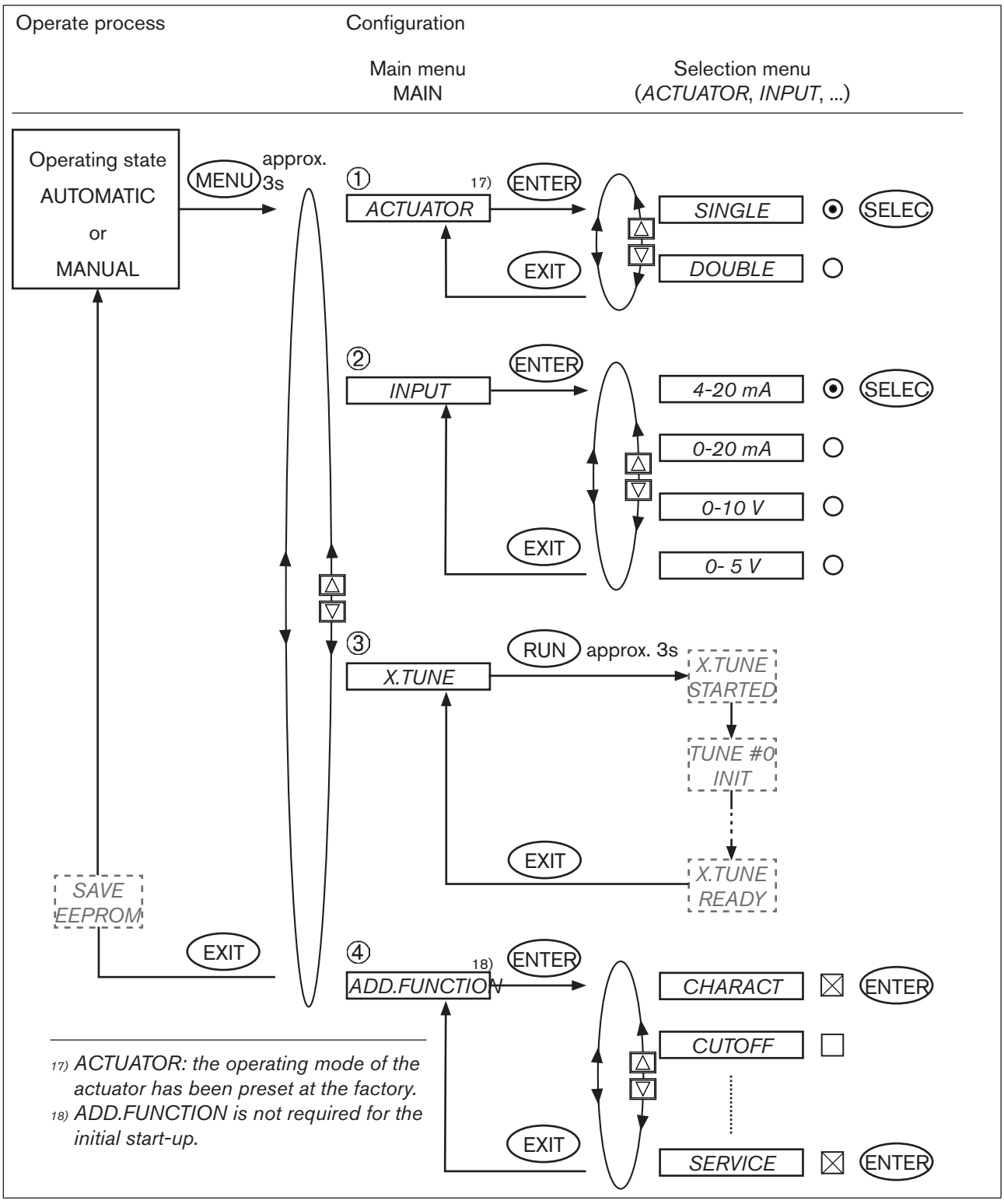


Figure 35: Operating structure of basic settings

20.5.2. Inputting the operating mode of the pneumatic actuator

① ***ACTUATOR*** - Operating mode of the actuator

The operating mode of the pneumatic valve actuator used in combination with the positioner can be input in this menu option.

The operating mode of the actuator has been preset at the factory.

CFA and CFB: single-acting

CFI: double-acting

The control function of the actuator can be found on the type label**.**

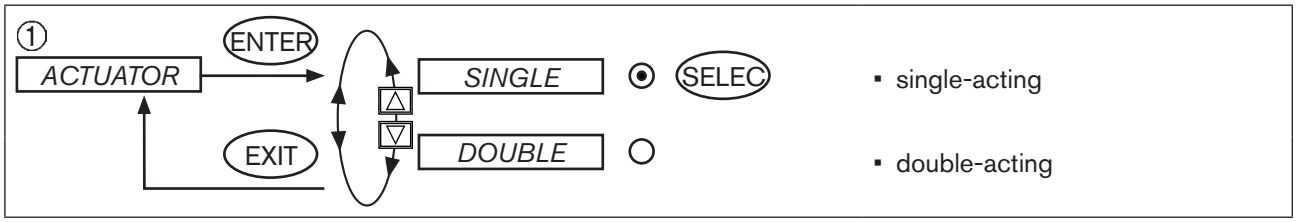


Figure 36: Operating structure of ACTUATOR

20.5.3. Inputting the input signal

② ***INPUT*** - Selected unit input signal

→ Under this menu option input the unit signal used for the set-point value.

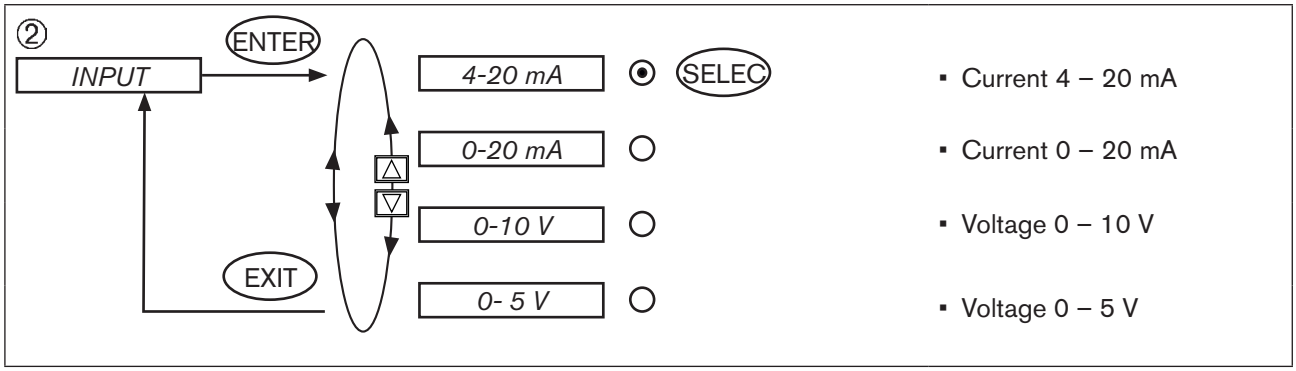


Figure 37: Operating structure of INPUT

20.5.4. Automatic adjustment (*X.TUNE*) of the position controller

③ ***X.TUNE*** - Automatic adjustment for position controller

WARNING!

Danger due to the valve position changing when the *X.TUNE* function is running!

When the *X.TUNE* is running under operating pressure, there is an acute risk of injury.

- Never run *X.TUNE* while a process is running!
- Take appropriate measures to prevent the equipment from being accidentally actuated!

NOTE!

Avoid maladjustment of the controller due to an incorrect pilot pressure or applied operating medium pressure!

- Run X.TUNE whenever the pilot pressure (= pneumatic auxiliary energy) is available during subsequent operation.
- 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. Optimisation occurs according to the criteria of a shortest possible correction time with a simultaneous freedom from overshoot.

Procedure:

→ You 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).

When the automatic adjustment completes, the message "*X.TUNE READY*" [19] is indicated.

→ Press any key to return to the main menu.

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

[19] *If a fault occurs: "TUNE err/break"*

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.TUN Eready or	Display at the end of *X.TUNE*
TUNE err/break	Display when a fault occurs

Table 25: Sequence for X.TUNE

20.5.5. Adding auxiliary functions

④ *ADD.FUNCTION*

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

See chapter entitled "22. Configuration of auxiliary functions".

→ Skip this menu option during the initial start-up.

20.5.6. Leaving the main menu

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

In doing so, the changes are transferred to the memory (EEPROM). *"save EEPROM"* is indicated on the display.

The device is then returned to the operating state in which it was before you switched to the main menu (MANUAL or AUTOMATIC).

21. OPERATION OF THE POSITION CONTROLLER

A precise description of the control and display elements, as well as the configuration of the keys can be found in the chapter entitled "13. Control and display elements".

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

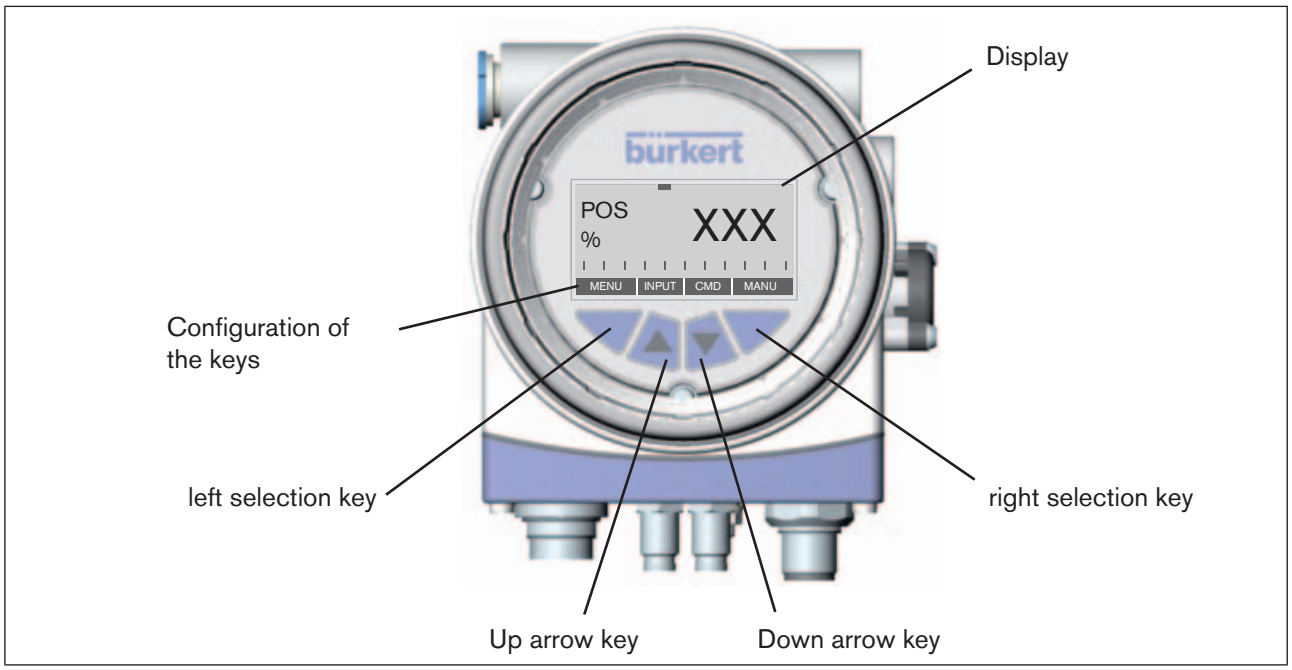


Figure 38: Description of the control module

21.1. 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.

21.2. Switching between the operating levels

Process operating level ► Configuration level

Both in the MANUAL and AUTOMATIC operating state you switch to the configuration level by pressing the left selection key (MENU) for approx. 3 seconds. During these 3 seconds 2 bars converge on the display (Countdown).

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 the chapters entitled "20.4. Specifying the basic settings" and in "22. 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.

21.3. 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.

21.3.1. 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	INPUT POS CMD TEMP	Switch between the individual displays
Down arrow key	CMD TEMP INPUT POS	

Table 26: AUTOMATIC operating state; Meaning of the keys

21.3.2. 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 27: AUTOMATIC operating state; Information on the display

21.3.3. Operating structure

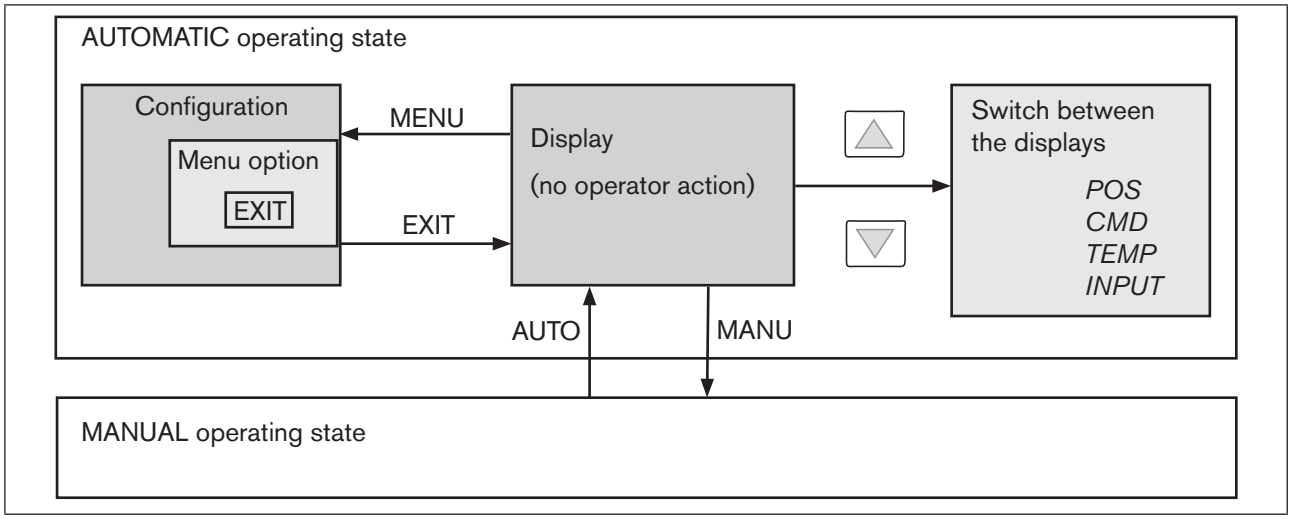


Figure 39: AUTOMATIC operating structure

21.4. 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.

21.4.1. 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 CLS[20)]	Aerate the actuator Control function A (CFA): Valve opens Control function B (CFB): Valve closes Control function I (CFI): Connection 2.1 aerated
Down arrow key	CLS OPN[20)]	Deaerate the actuator Control function A (CFA): Valve closes Control function B (CFB): Valve opens Control function I (CFI): Connection 2.2 aerated

Table 28: MANUAL operating state; Meaning of the keys

CFA: Actuator closes by spring force

CFB: Actuator opens by spring force

CFI: Actuator double-acting

21.4.2. 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) Only if "Fall" is set in the DIR.ACT auxiliary function

21.4.3. Operating structure

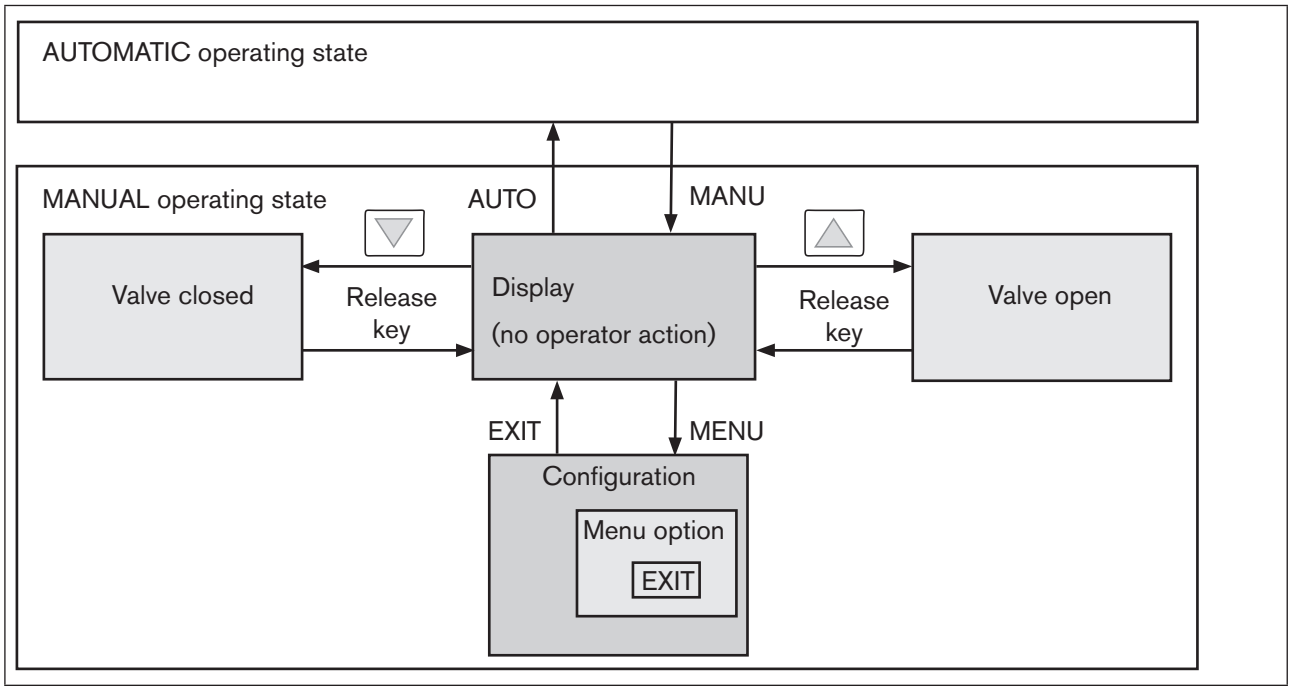


Figure 40: Fig. 6: Operating structure MANUAL

22. 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 specifiy auxiliary functions at the configuration level.

22.1. Keys at the configuration level

Press the key	**in the menu**	**in a selected and confirmed menu option**
	Scroll up (select)	Increment (increase) numerical values
	Scroll down (select)	Decrement (reduce) numerical values
Press the key	**in the menu**	**in the *ADD.FUNCTION***
Selection keyon 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 keyon 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 keyon left EXIT	The configuration level is left and the data is saved in the memory (EEPROM).	Leave a sub-menu option.

Table 29: Keys at the configuration level

22.2. 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.

22.2.1. Switching between process operating level and configuration level

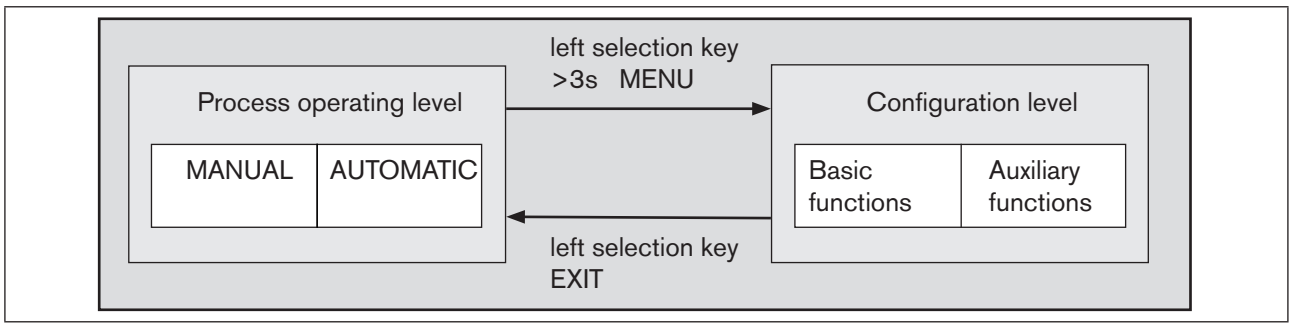


Figure 41: Operating levels

→ To activate the Configuration menu, press the left selection key (MENU) at the Process operating level for approx. 3 seconds (wait for countdown).

22.2.2. Including auxiliary functions in the main menu

→ Press the arrow keys to select the *ADD.FUNCTION* menu option in the main menu and press the right selection key (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).

→ All marked functions are transferred to the main menu when the selection key on the left (EXIT) is pressed.

→ In the main menu input the parameters of the auxiliary functions.

22.2.3. 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.

→ Press the arrow keys to select the *ADD.FUNCTION* menu option in the main menu.

→ Enter the submenu by pressing the selection key on the right (ENTER).

→ 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.

22.2.4. Setting numerical values

You set numerical values in the designated menu options by pressing once or several times the

- up arrow key (increase numerical value) or
- down arrow key (reduce 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 "Figure 42").

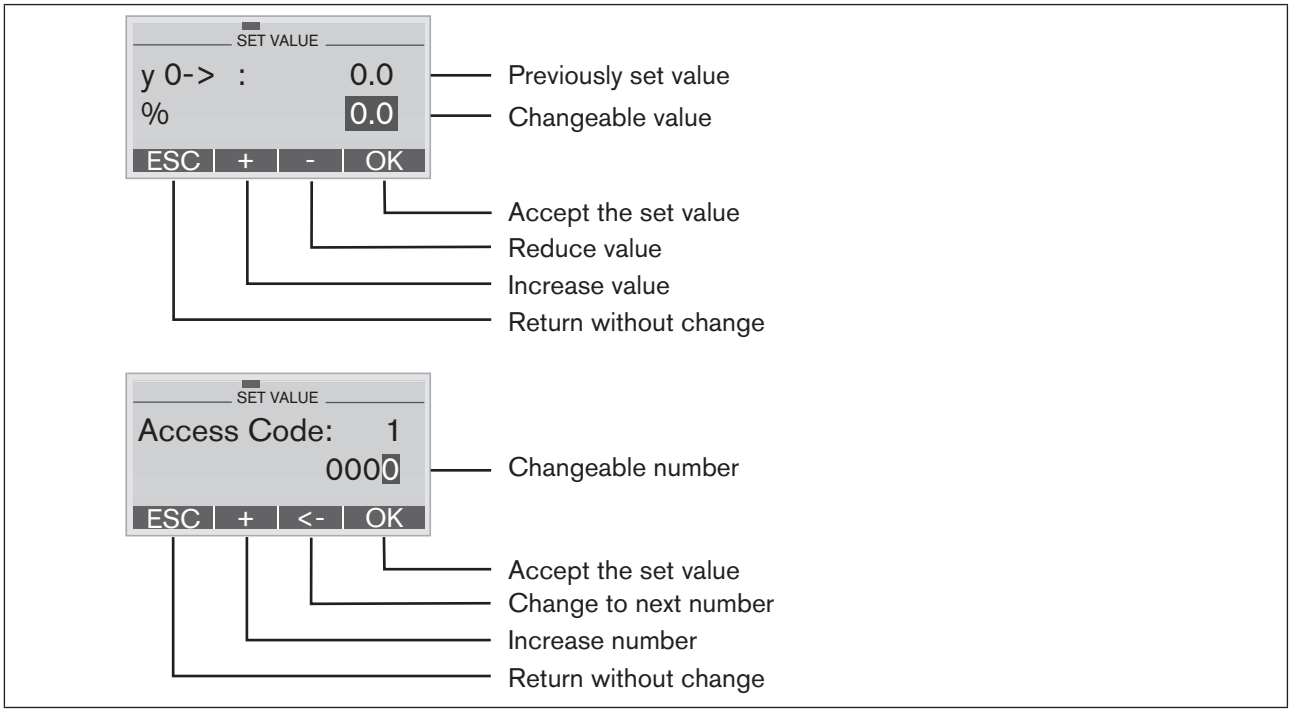


Figure 42: Setting numerical values

22.2.5. Principle of including auxiliary functions in the main menu

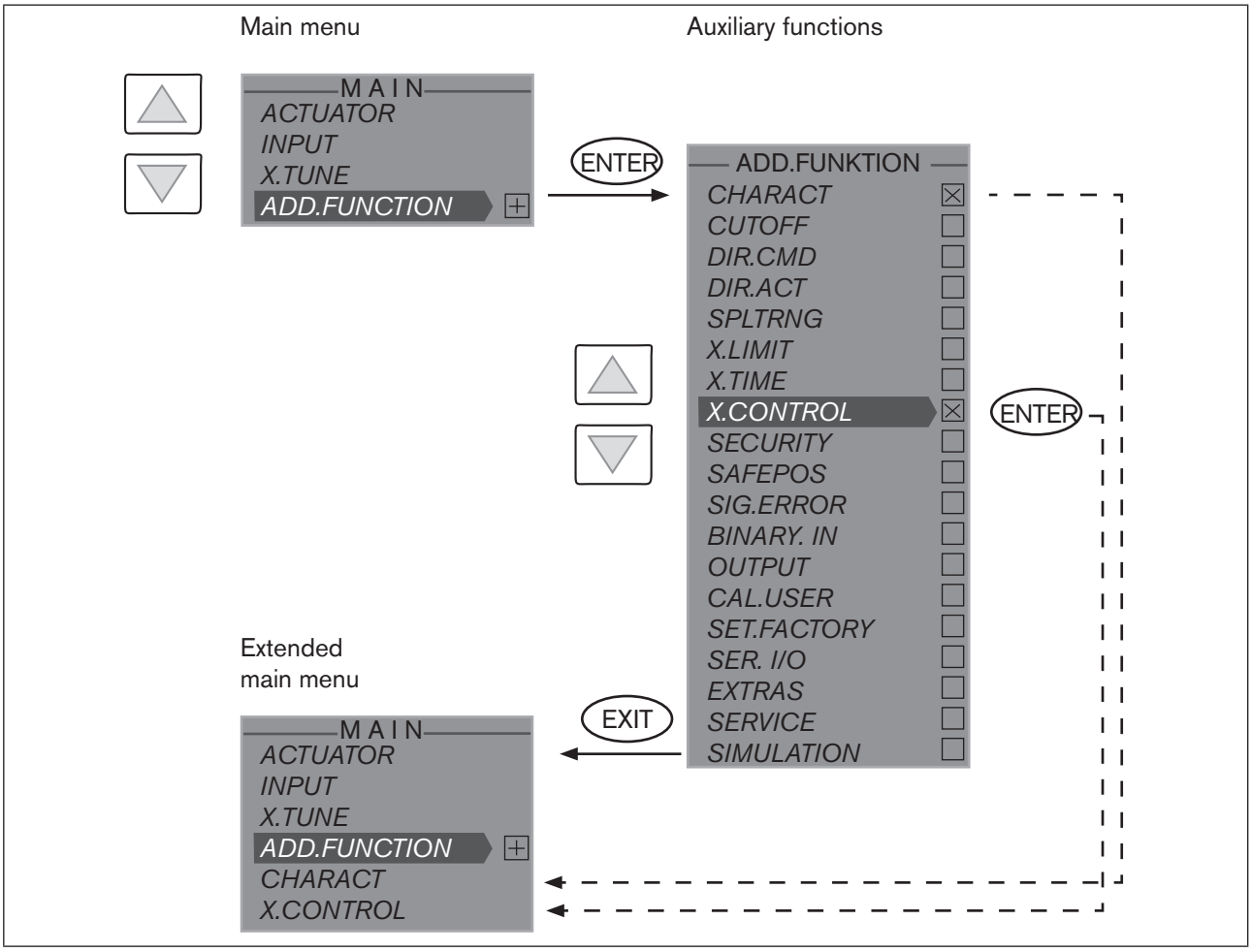


Figure 43: Including auxiliary functions

22.3. Auxiliary functions

22.3.1. Overview of auxiliary functions for the position controller Type 8692

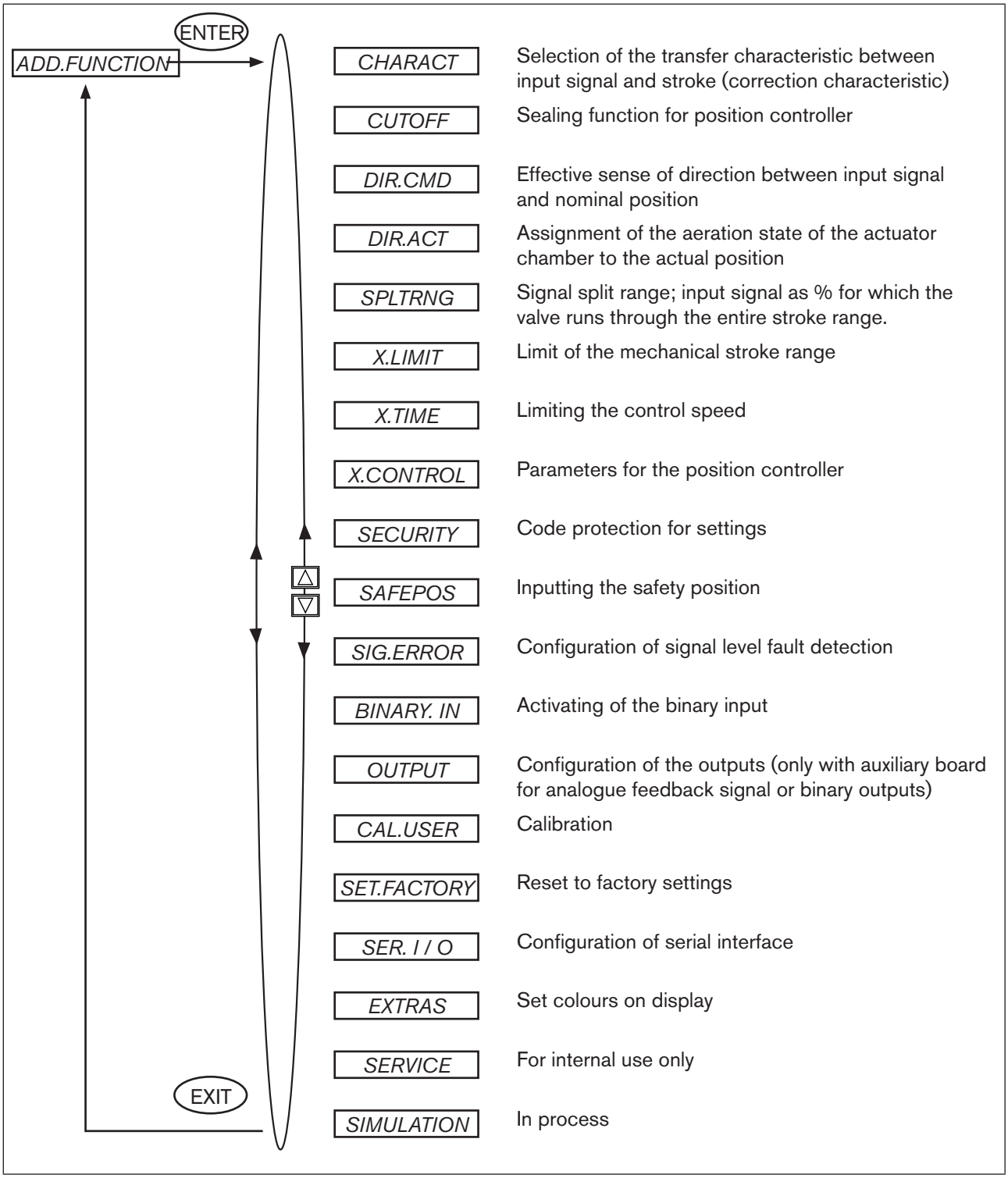


Figure 44: Overview - auxiliary functions, position controller Type 8692

22.3.2. *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 or operating characteristic.

Factory setting: *linear*

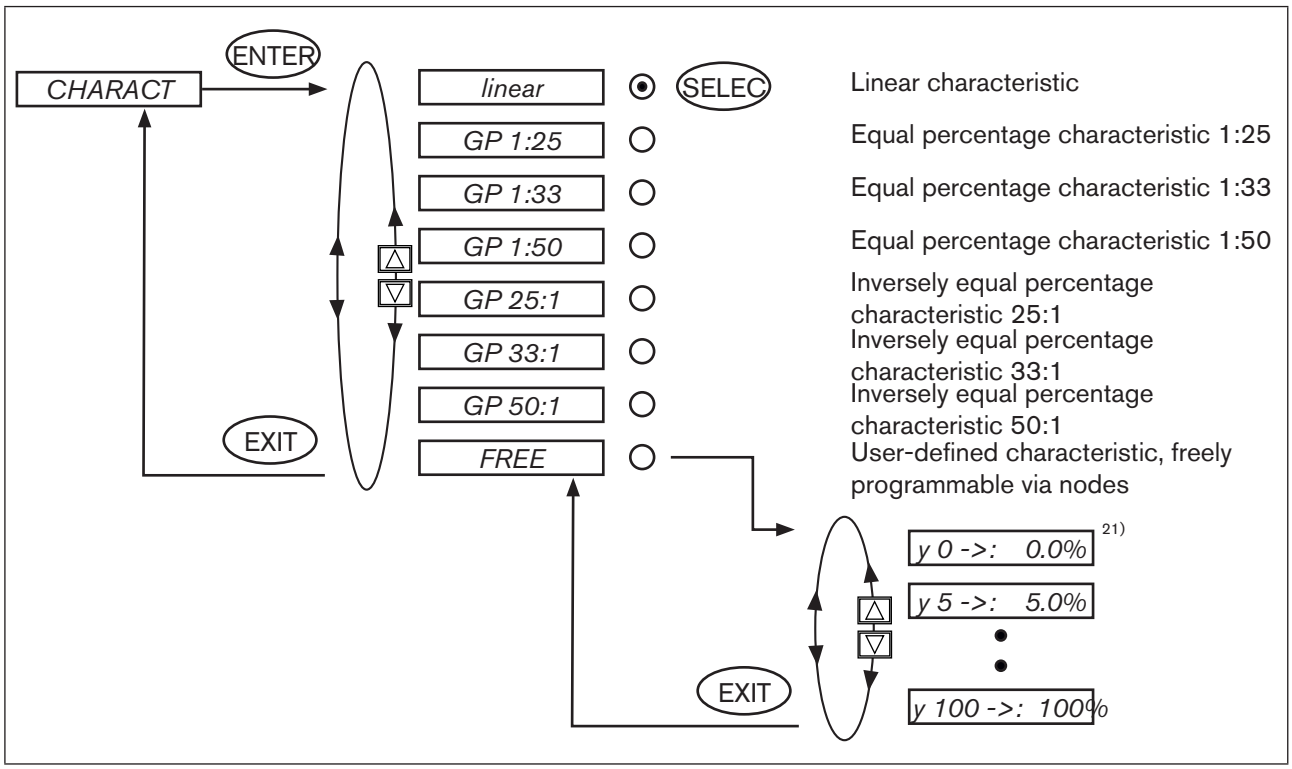


Figure 45: Operating structure CHARACT

The flow characteristic k_V = f(s) indicates the flow 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.

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

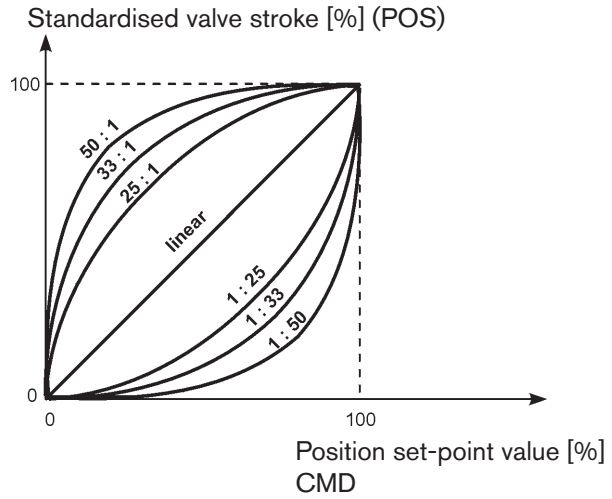
In the case of an equal percentage characteristic an equal percentage change of the k_V value corresponds to a stroke change ds.

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

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.

---

21) *Input the nodes see "Inputting the freely programmable characteristic"*



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.

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 %.

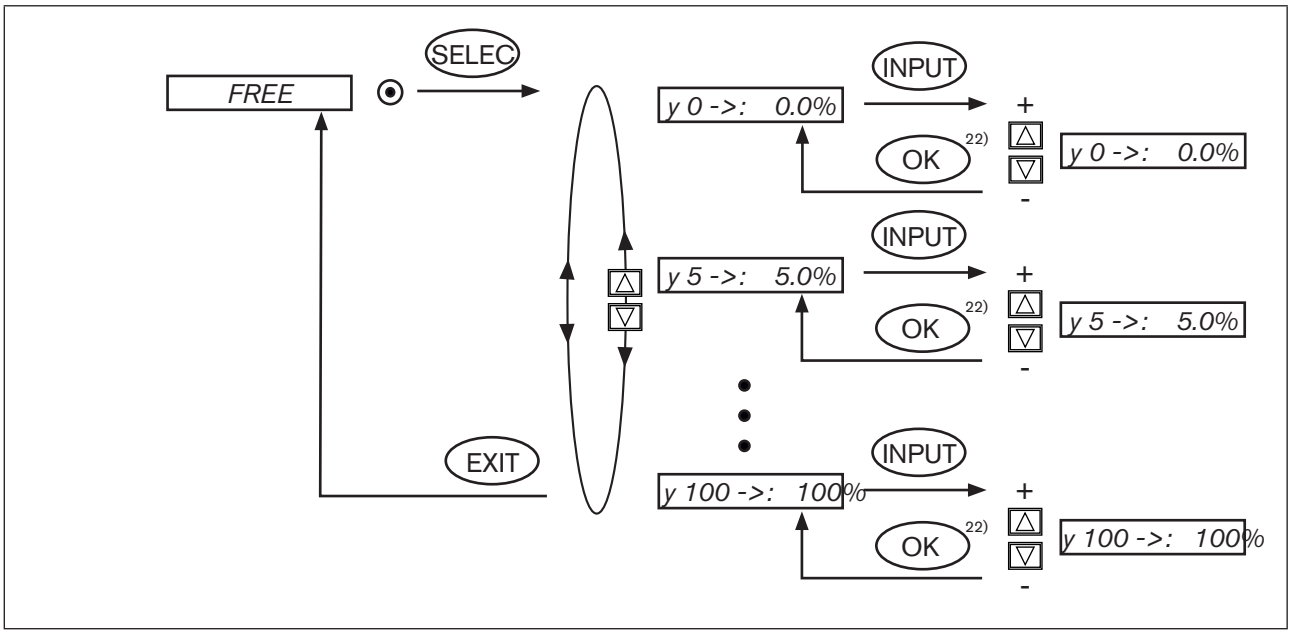


Figure 46: Operating structure CHARACT FREE

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

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.

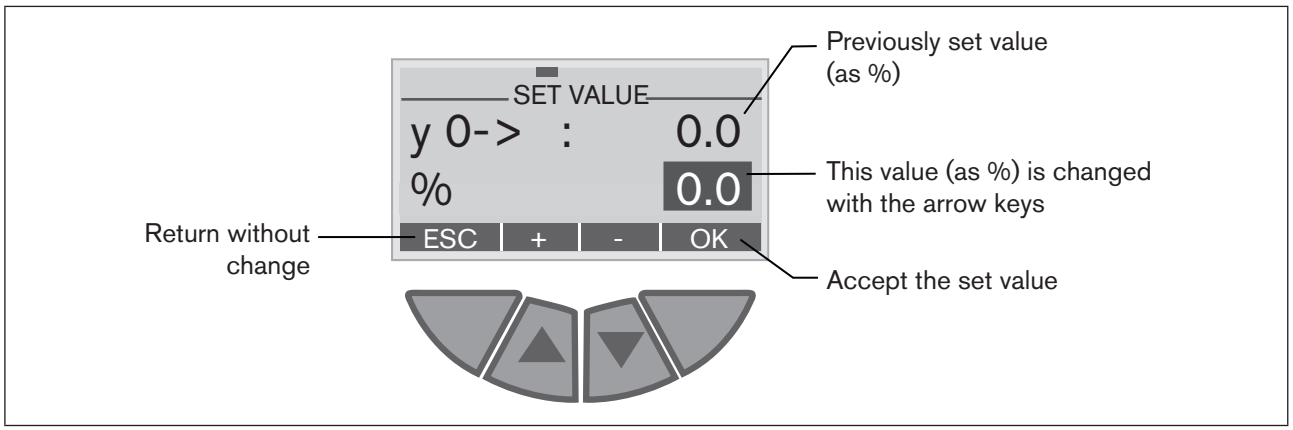


Figure 47: Display CHARACT FREE

→ 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

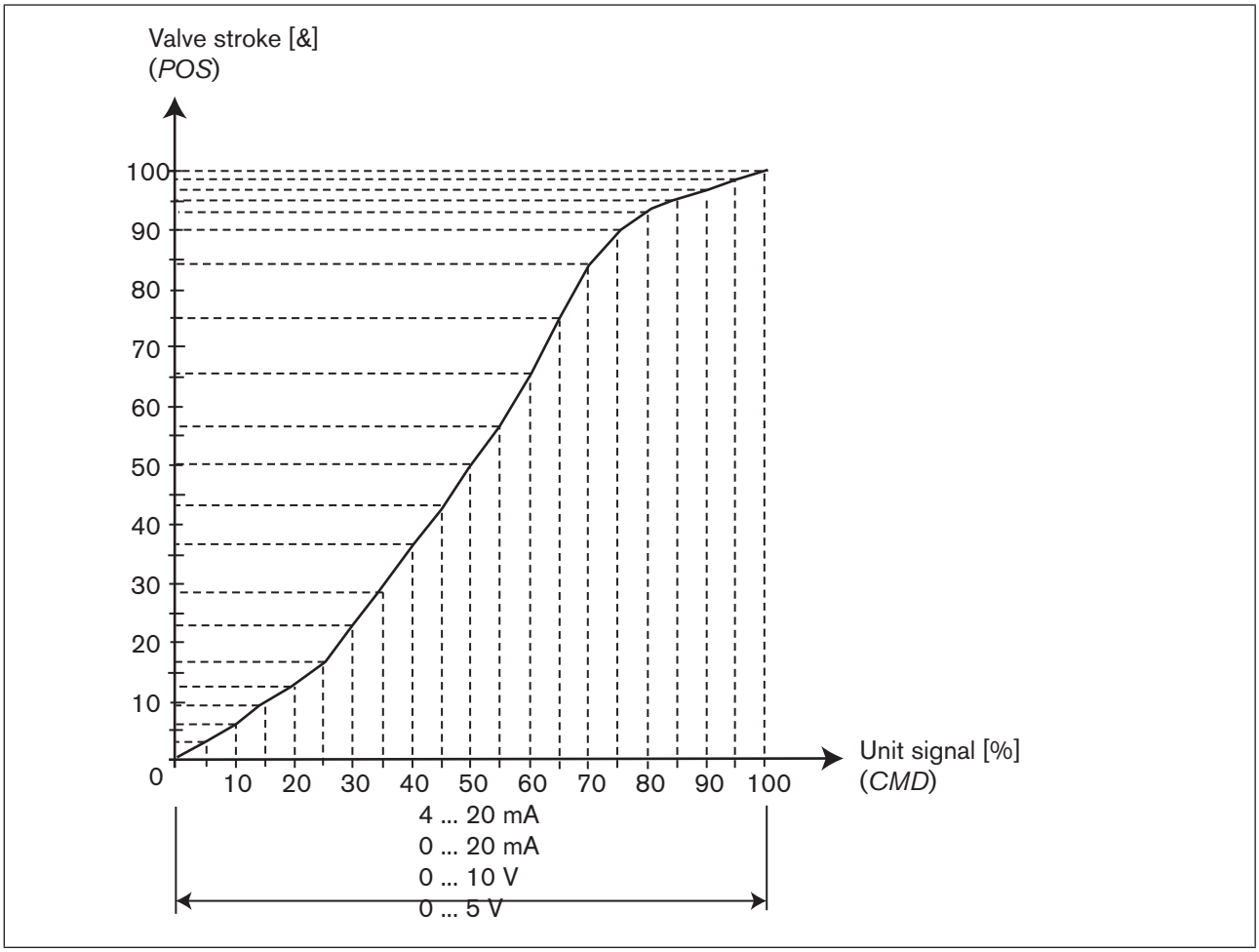


Figure 48: Example of a programmed characteristic

In the Appendix "Tables for customer-specific settings" there is a table in which you can enter your settings for the freely programmable characteristic.

22.3.3. *CUTOFF*
Sealing function for the position controller Type 8692

The sealing function for the process controller Type 8693 can be found in the chapter entitled "25. 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 %*

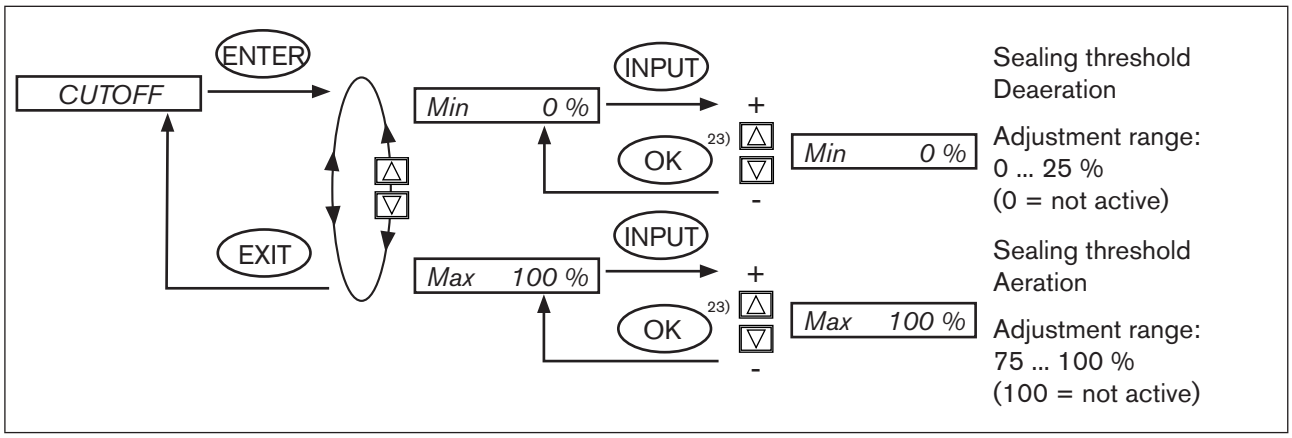


Figure 49: Operating structure CUTOFF

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

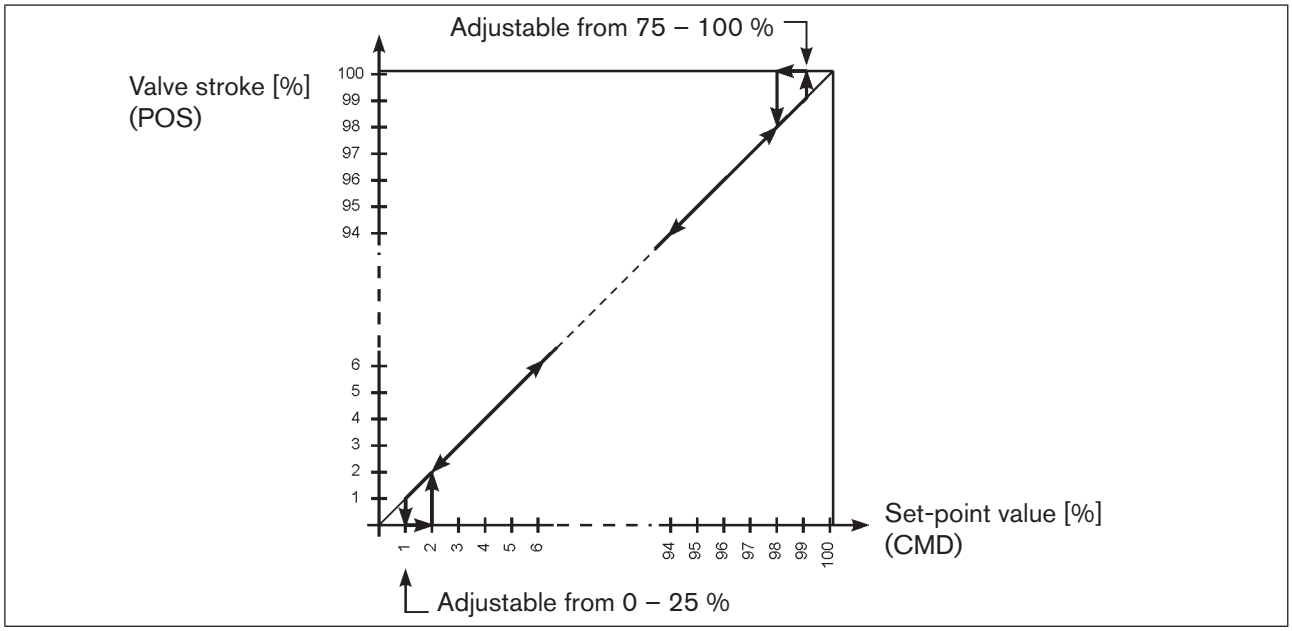


Figure 50: Graph - CUTOFF

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

22.3.4. *DIR.CMD*
Effective sense of 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*

Figure 51: Operating structure DIR.CMD

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

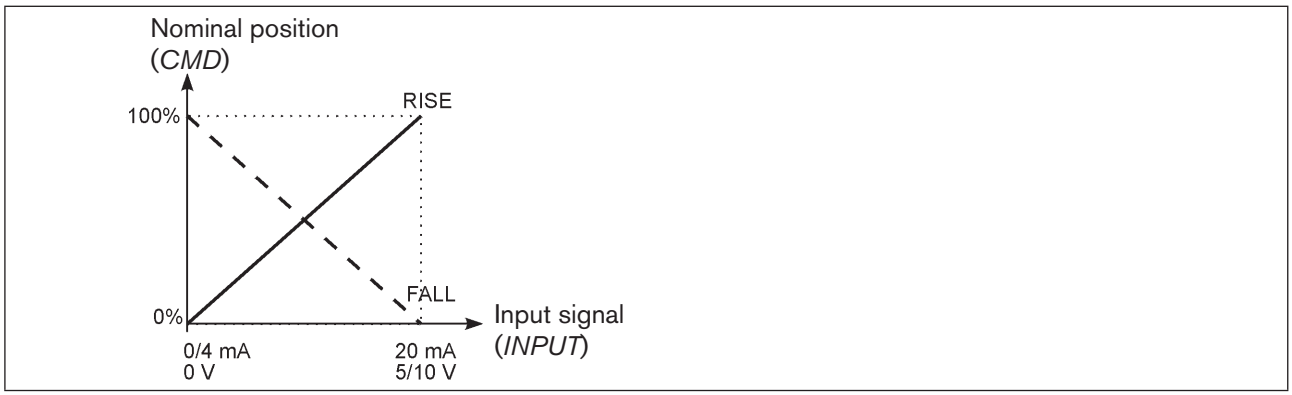


Figure 52: Graph DIR.CMD

22.3.5. *DIR.ACT*
Effective sense of direction of the actuator

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*

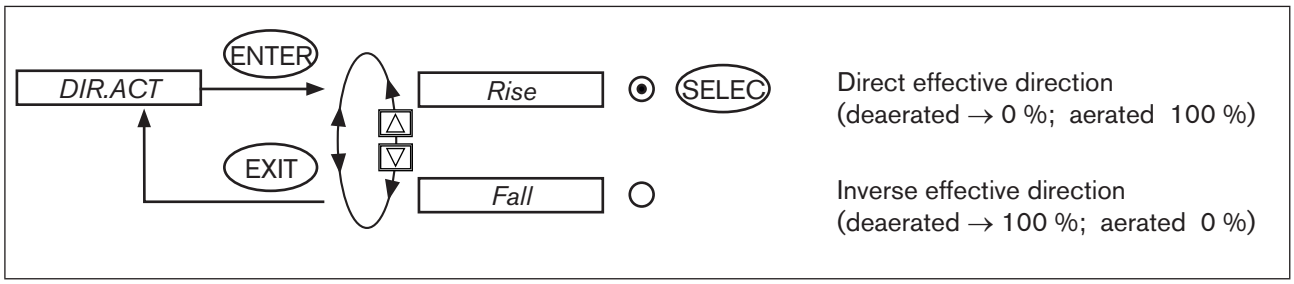


Figure 53: Operating structure DIR.ACT

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.

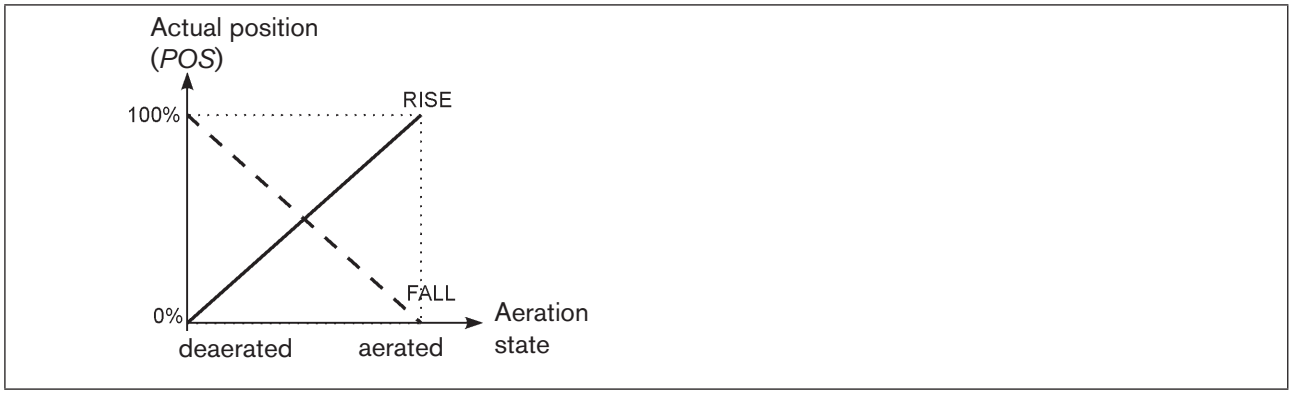


Figure 54: Graph DIR.ACT

22.3.6. *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 during operation 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.

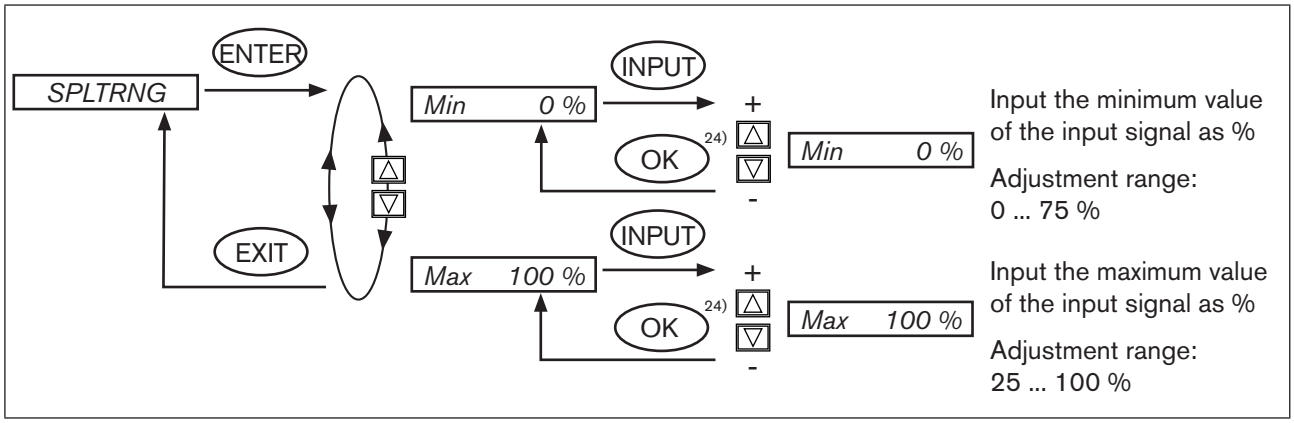


Figure 55: Operating structure SPLTRNG

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

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

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

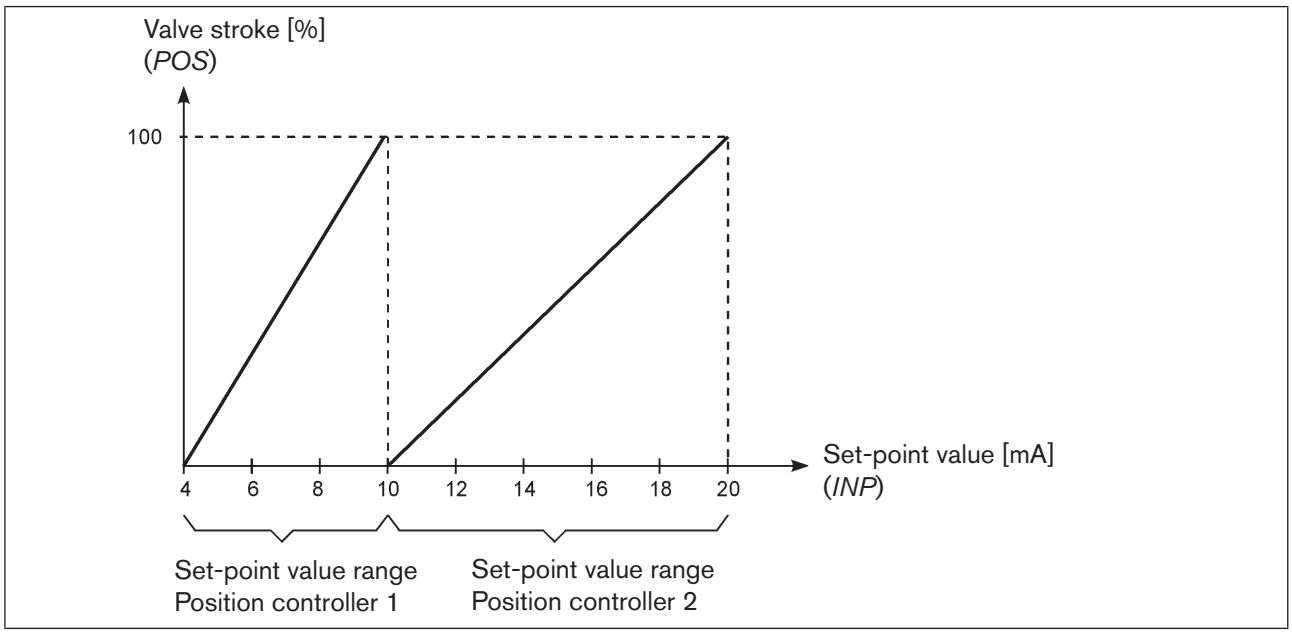


Figure 56: Graph SPLTRNG

22.3.7. *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 are indicated greater than 100 %.

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

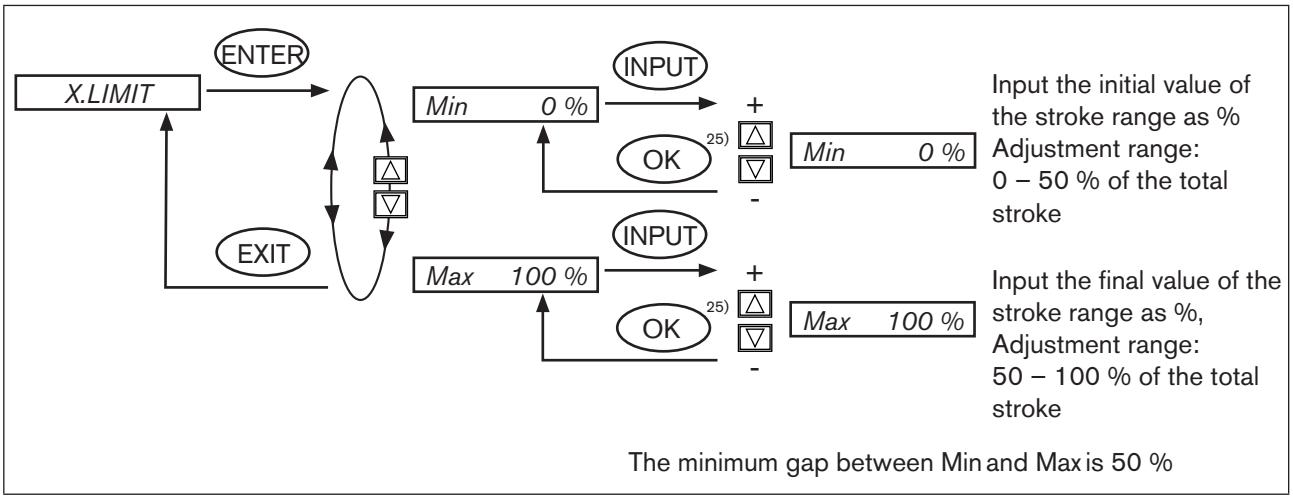


Figure 57: Operating structure X.LIMIT

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

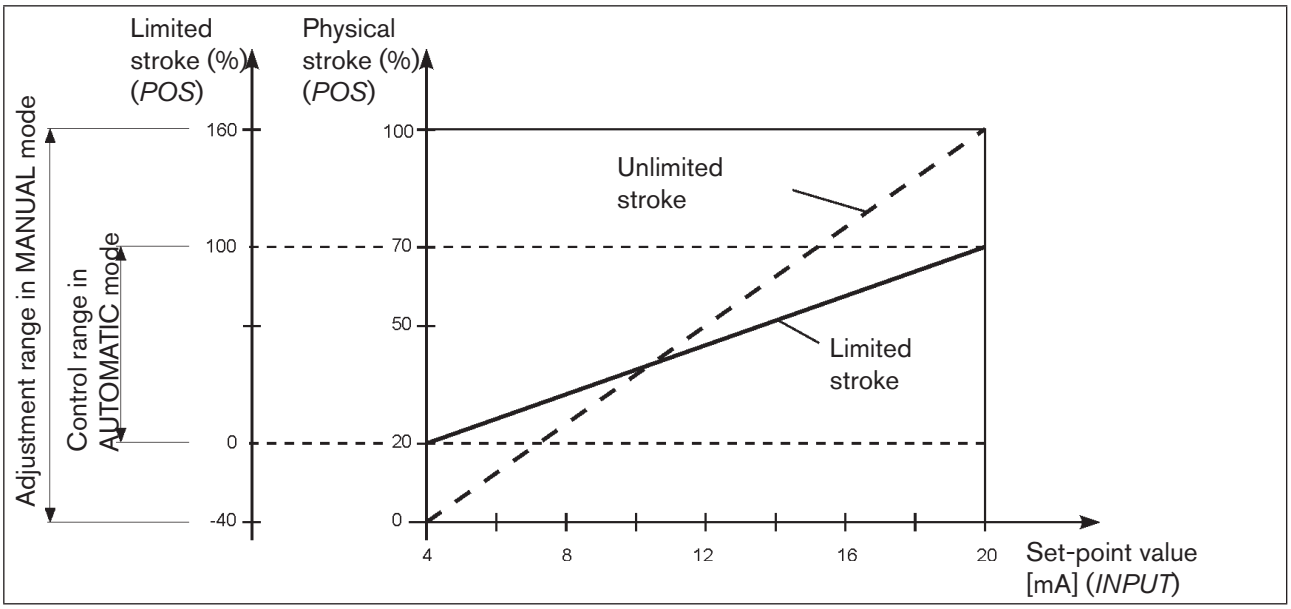


Figure 58: Graph X.LIMIT

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

22.3.8. *X.TIME* 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.

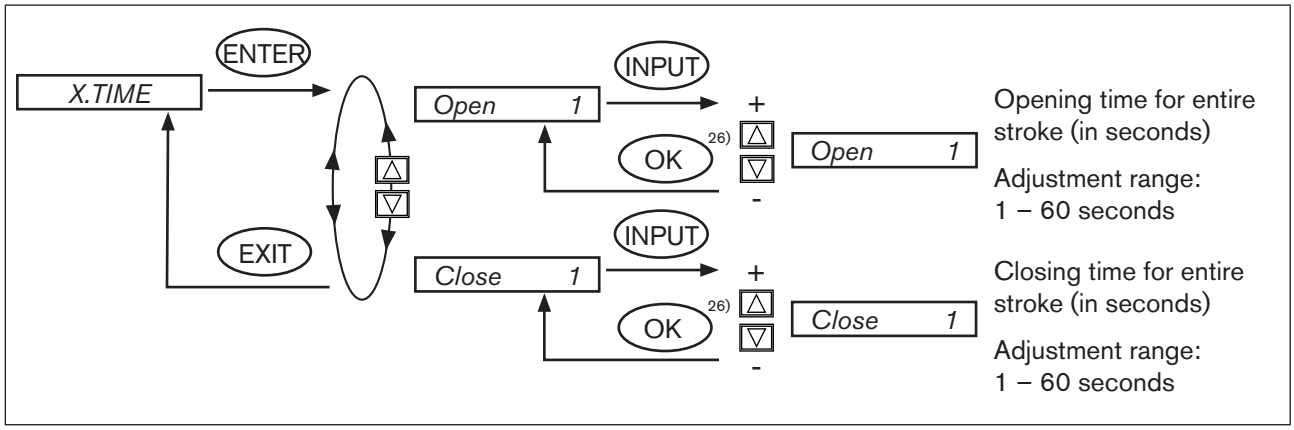


Figure 59: Operating structure X.TIME

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

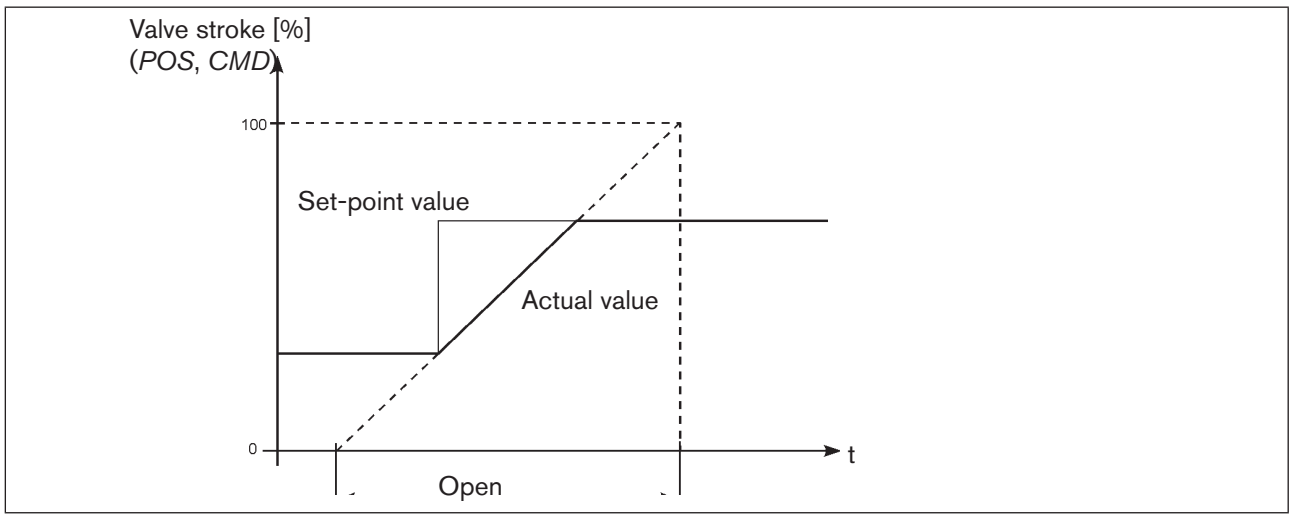


Figure 60: Graph X.TIME

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

22.3.9. *X.CONTROL*
Parameterisation of the position controller

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

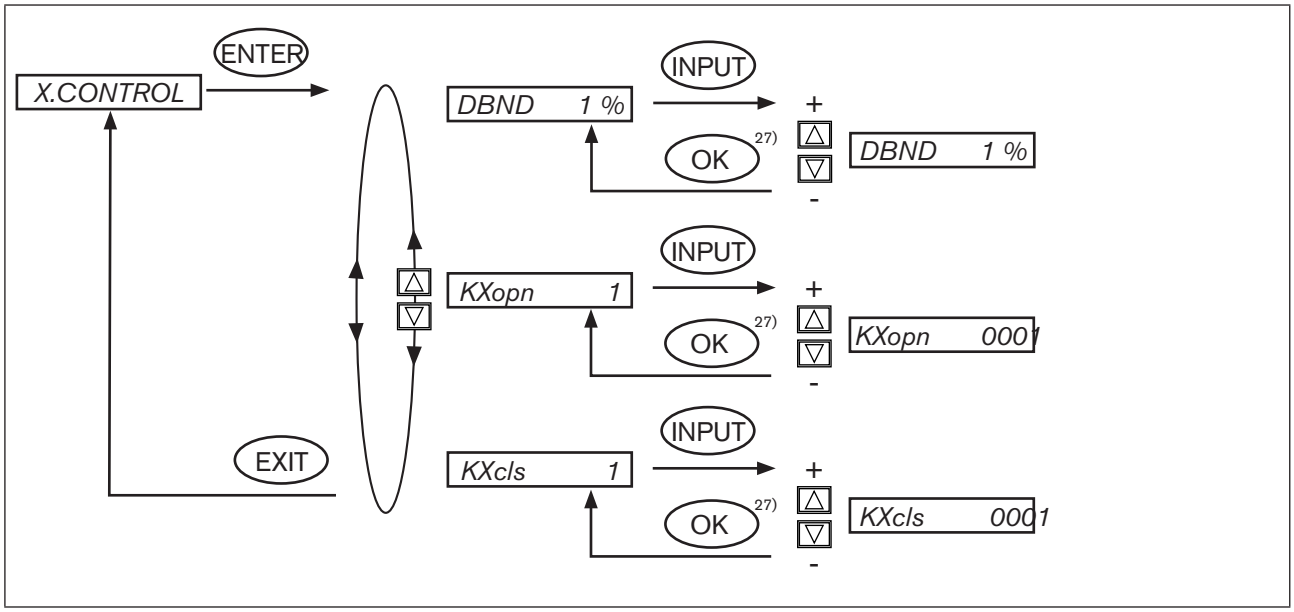


Figure 61: Operating structure X.CONTROL

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 *X.LIMIT*).

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

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. The value determined in this way is an approximate value. You can re-adjust it manually.

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

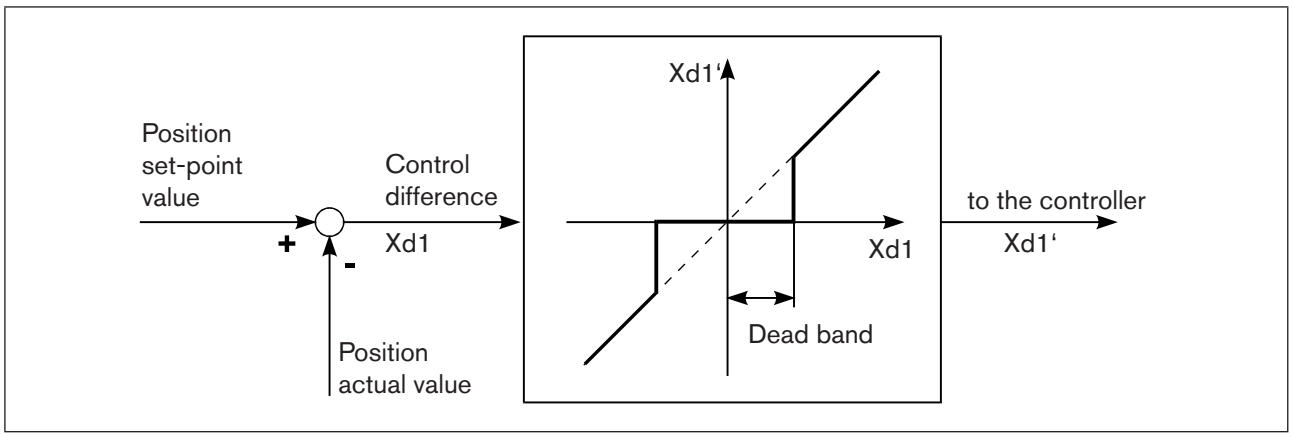


Figure 62: Graph X.CONTROL

KX XXX **Parameters for 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)

22.3.10. *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".

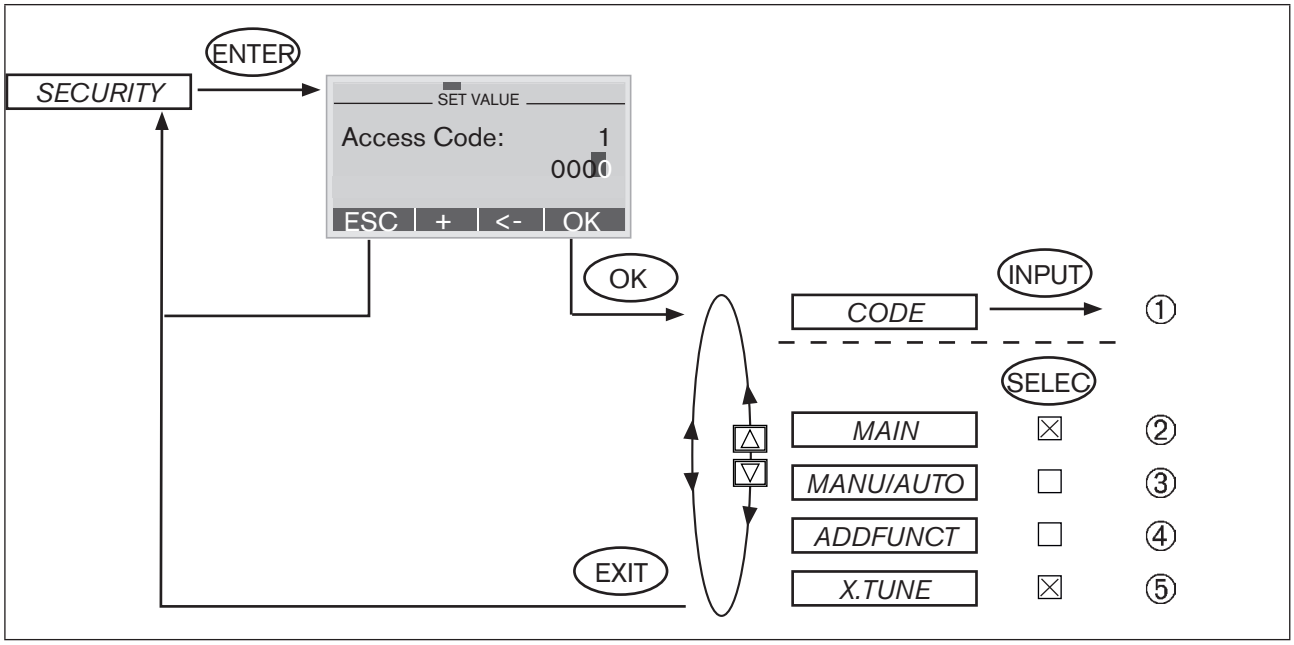


Figure 63: Operating structure SECURITY

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 functions

⑤ Blocking the activation of self-parameterisation (Autotune)

Inputting the access code:

→ Press the selection key on the right (INPUT) to access the input screen when the *CODE* selection menu is marked.

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.

22.3.11. *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 "22.3.13. *BINARY-IN* Activation of the binary input") or
- if a signal fault occurs
  (Configuration see chapter "22.3.12. *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 %

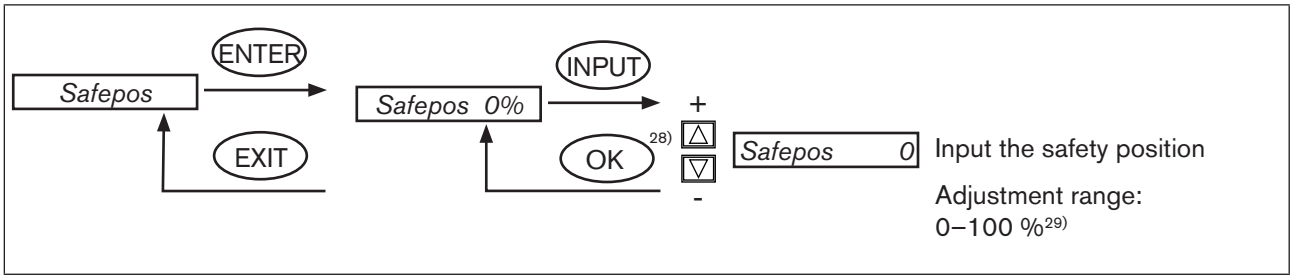


Figure 64: Operating structure SAFEPOS

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

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

29) If the safety position is 0 % or 100 %, the actuator is completely deaerated or aerated as soon as the safety position SIG-ERROR or BINARY-IN is active in the auxiliary functions.

22.3.12. *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.

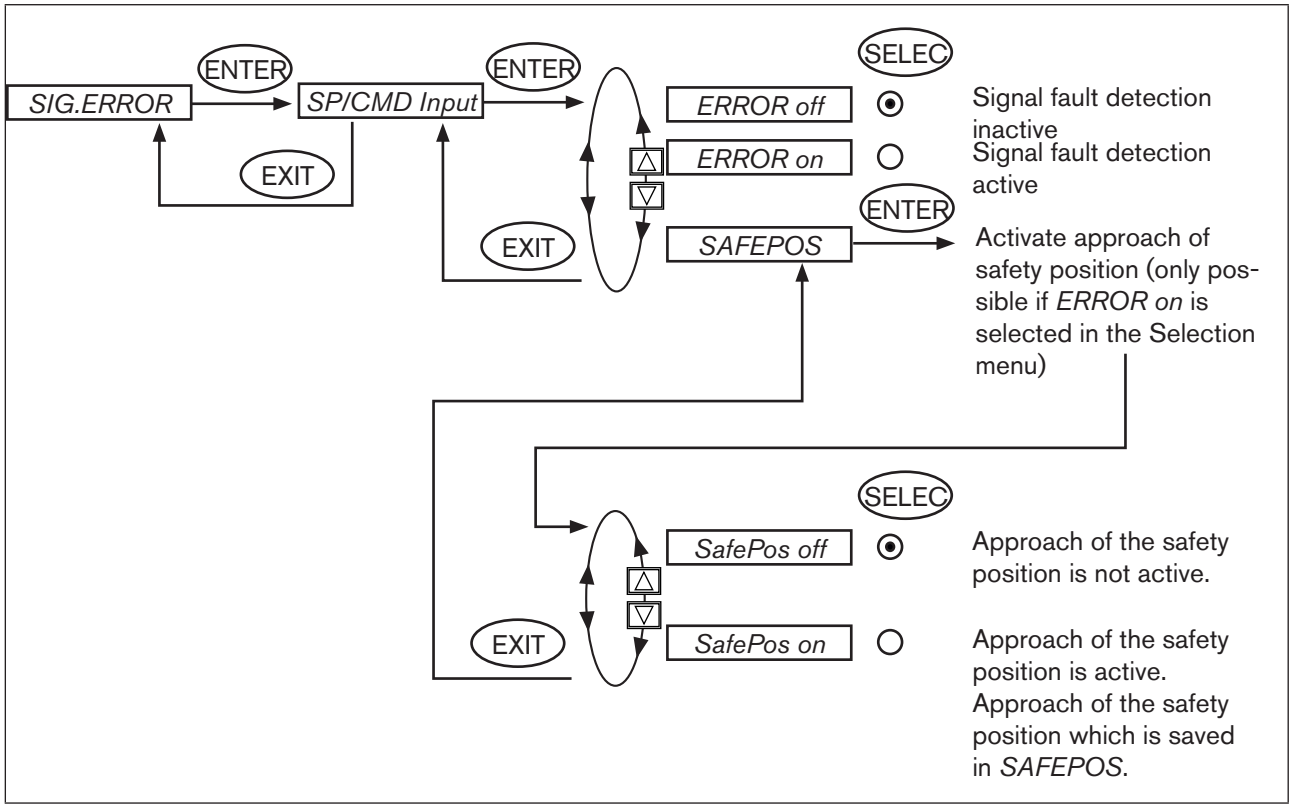


Figure 65: Operating structure SIG-ERROR

If signal fault detection is activated, the respective fault is indicated on the display.
(see chapter entitled "50.1. Maintenance and troubleshooting")

Safety position *SAFEPOS on*

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

- Active *SAFEPOS* menu option
  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 it would specify in the isolated state.

22.3.13. *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

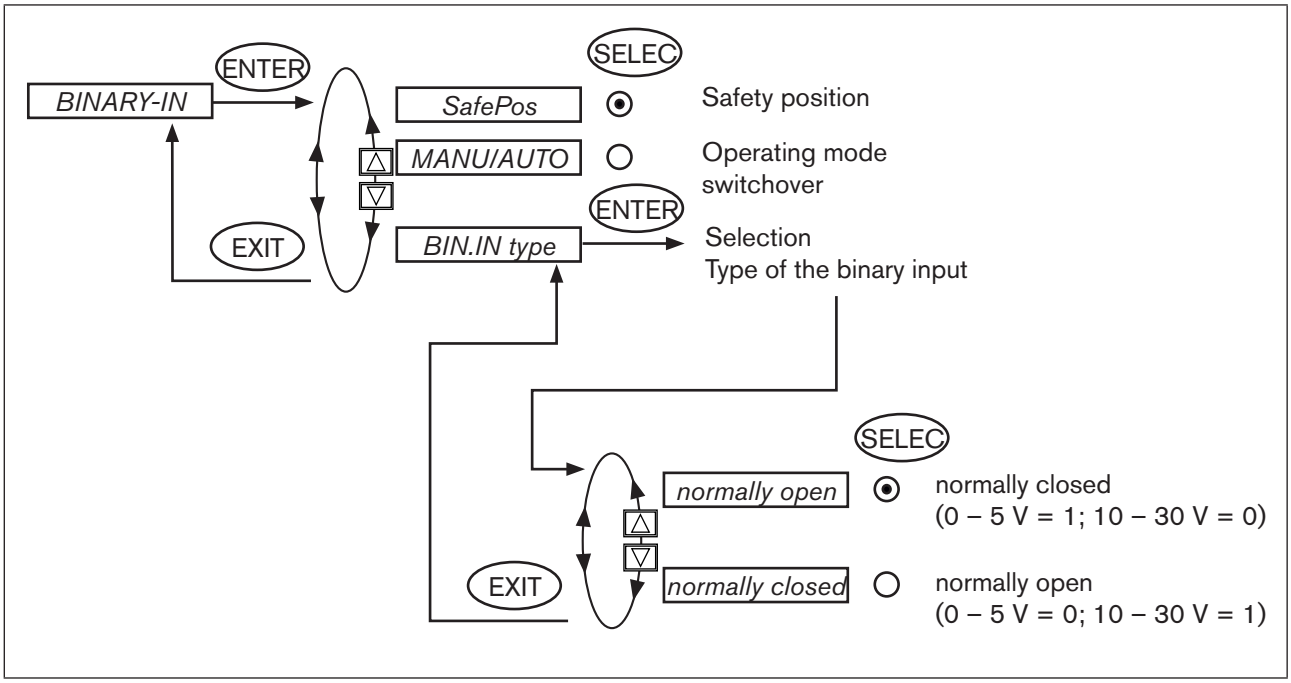


Figure 66: Operaring structure BINARY-IN

Safety position *SAFEPOS*

Approach of a safety position.

- Active *SAFEPOS* menu option
  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).

22.3.14. *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 or

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

for the output: actuator in safety position or

for the output: sensor break or

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.

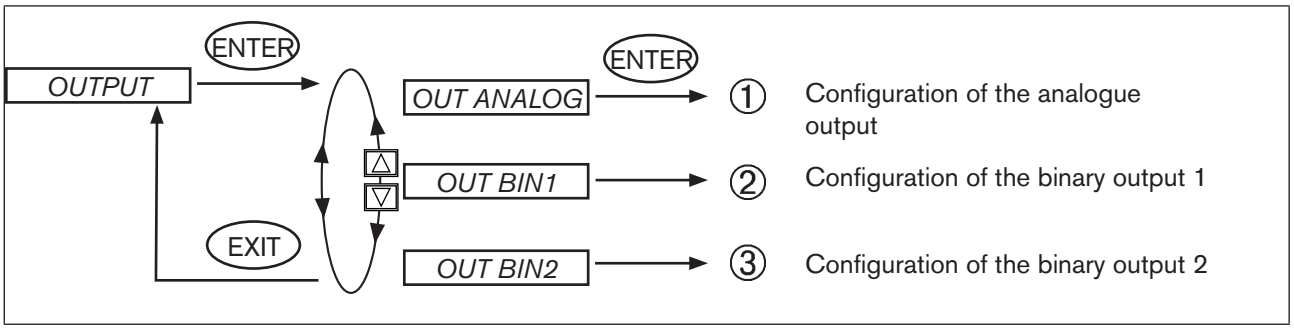


Figure 67: Operating structure OUTPUT

① *OUT ANALOG* - Configuration of 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.

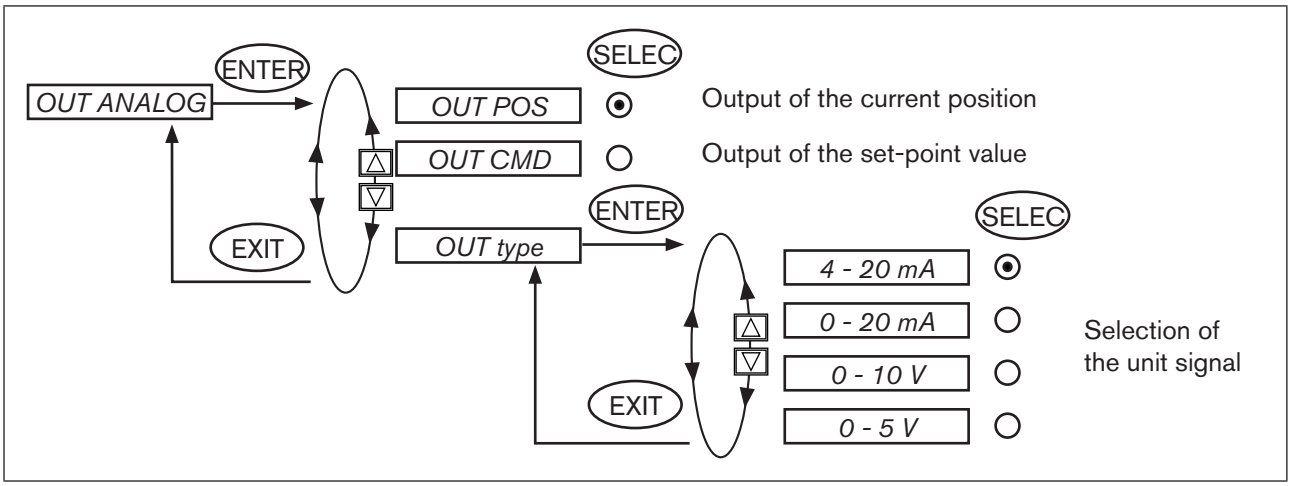


Figure 68: Operating structure OUTPUT-ANALOGUE

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

② *OUT BIN1* - Configuration of the binary output 1

③ *OUT BIN2* - Configuration of 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)

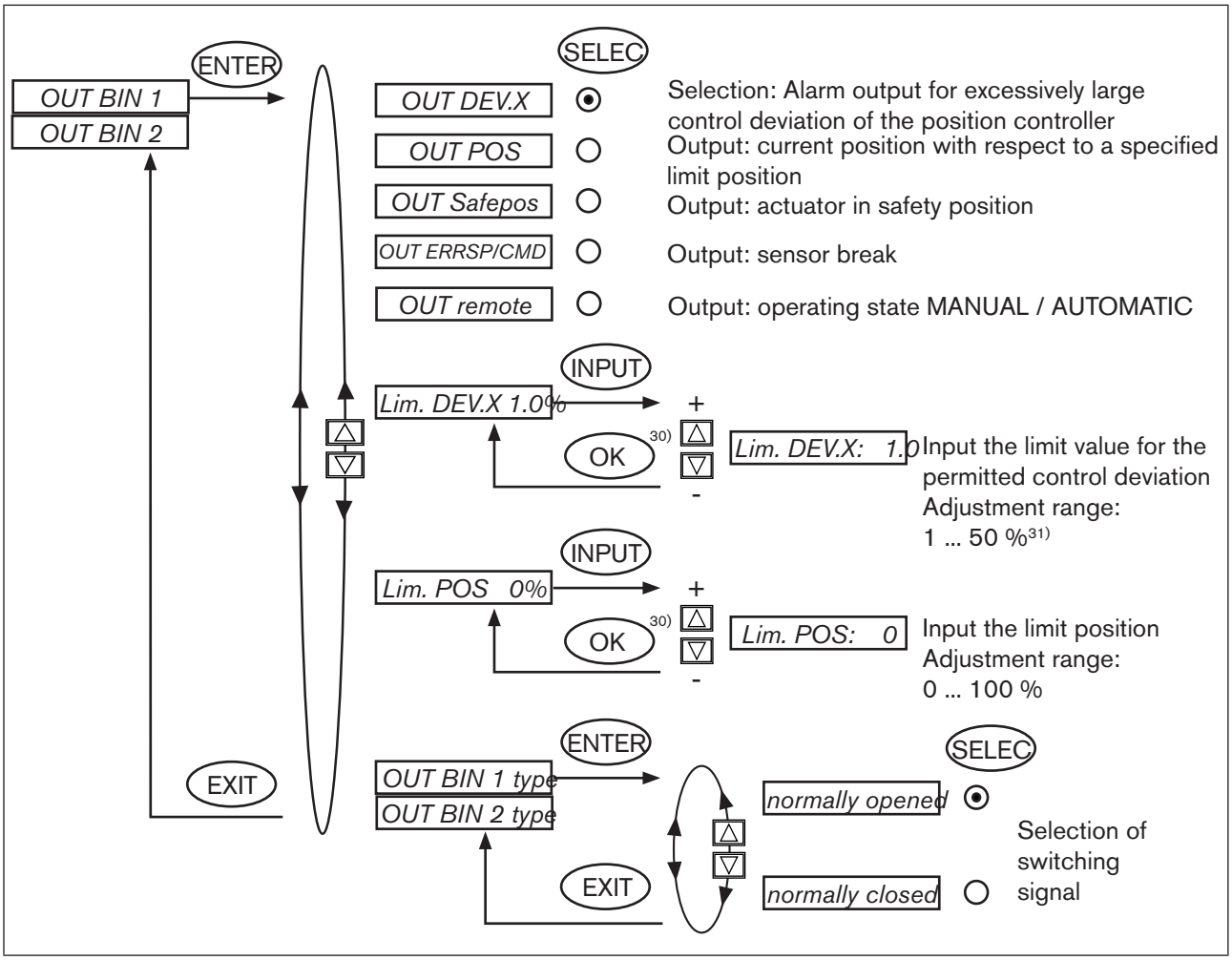


Figure 69: Operating structure OUTPUT-BIN1

Normally closed output, in switched state *low* (≙ 0 V)

Normally opened output, in switched state *high* (≙ 24 V)

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

30) *If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.*
31) *The permitted control deviation Lim DEV.X XX must not be less than the dead band.*

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 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 BIN type* menu option input the required switching status (*normally open* / *normally closed*)[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 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 BIN type* menu option input the required switching status (*normally open* / *normally closed*) [32].

OUT BIN1	*normally open*	*normally closed*
POS > LIM	0 V 	24 V 
POS < LIM	24 V 	0 V 

Table 30: Switching status

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*)[32].

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

→ Using the arrow keys, 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*)[32].

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

→ Using the arrow keys, 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*) [32].

OUT BIN1	*normally open*	*normally closed*
AUTOMATIC operating state	0 V 	24 V 
MANUAL operating state	24 V 	0 V 

Table 31: Switching status

[32] *Normally closed* output, in switched state *low* (≅ 0 V)
Normally open output, in switched state *high* (≅ 24 V)

22.3.15. *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*)

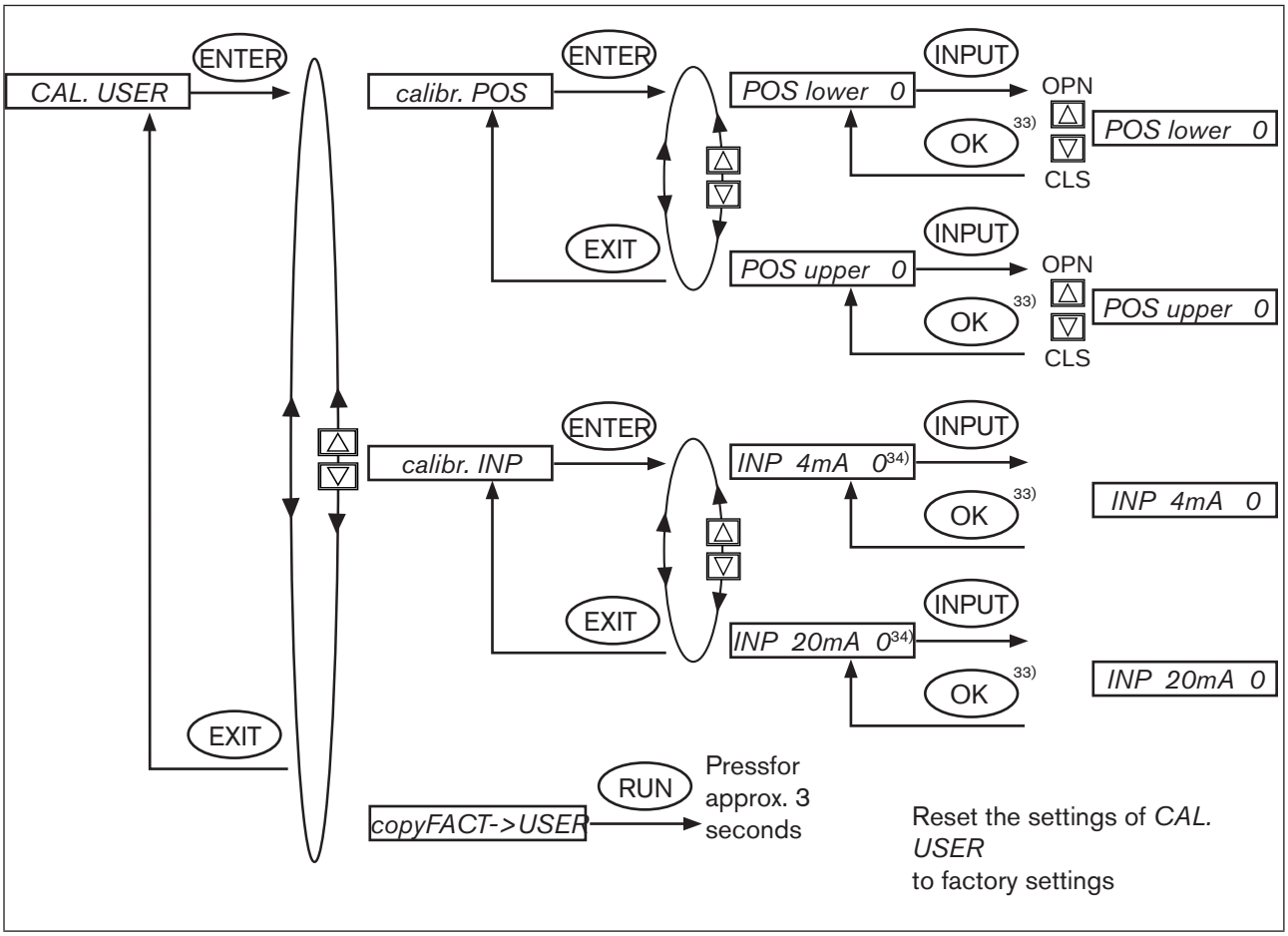


Figure 70: Operating structure CAL.USER

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

33) If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.
34) The signal type is displayed which is selected in the INPUT menu (4 – 20 mA; 0 – 20 mA; 0 – 5 V; 0 – 10 V).

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* menu option and confirm with the selection key on the right (ENTER).

Accept the minimum position:

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

→ 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 select the *POS upper X* menu option and confirm with the selection key on the right (INPUT).

→ 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* menu option 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).

→ Apply the minimum value of the unit signal on the input and confirm by pressing 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).

→ Apply the maximum value of the unit signal on the input and confirm by pressing 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.

22.3.16. *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.

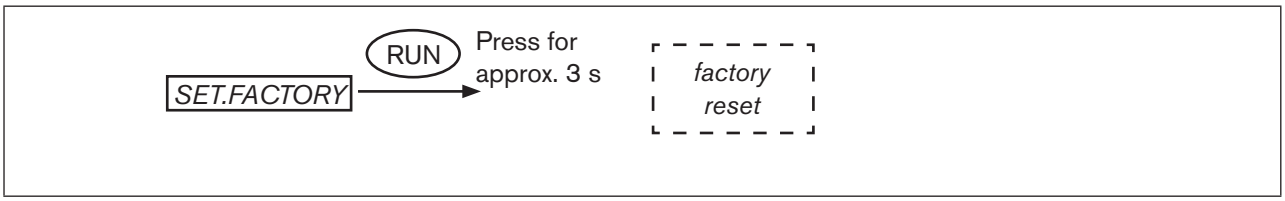


Figure 71: Operating structure SET.FACTORY

→ 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-parameterisation of the position controller (*X.TUNE*).

22.3.17. *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.

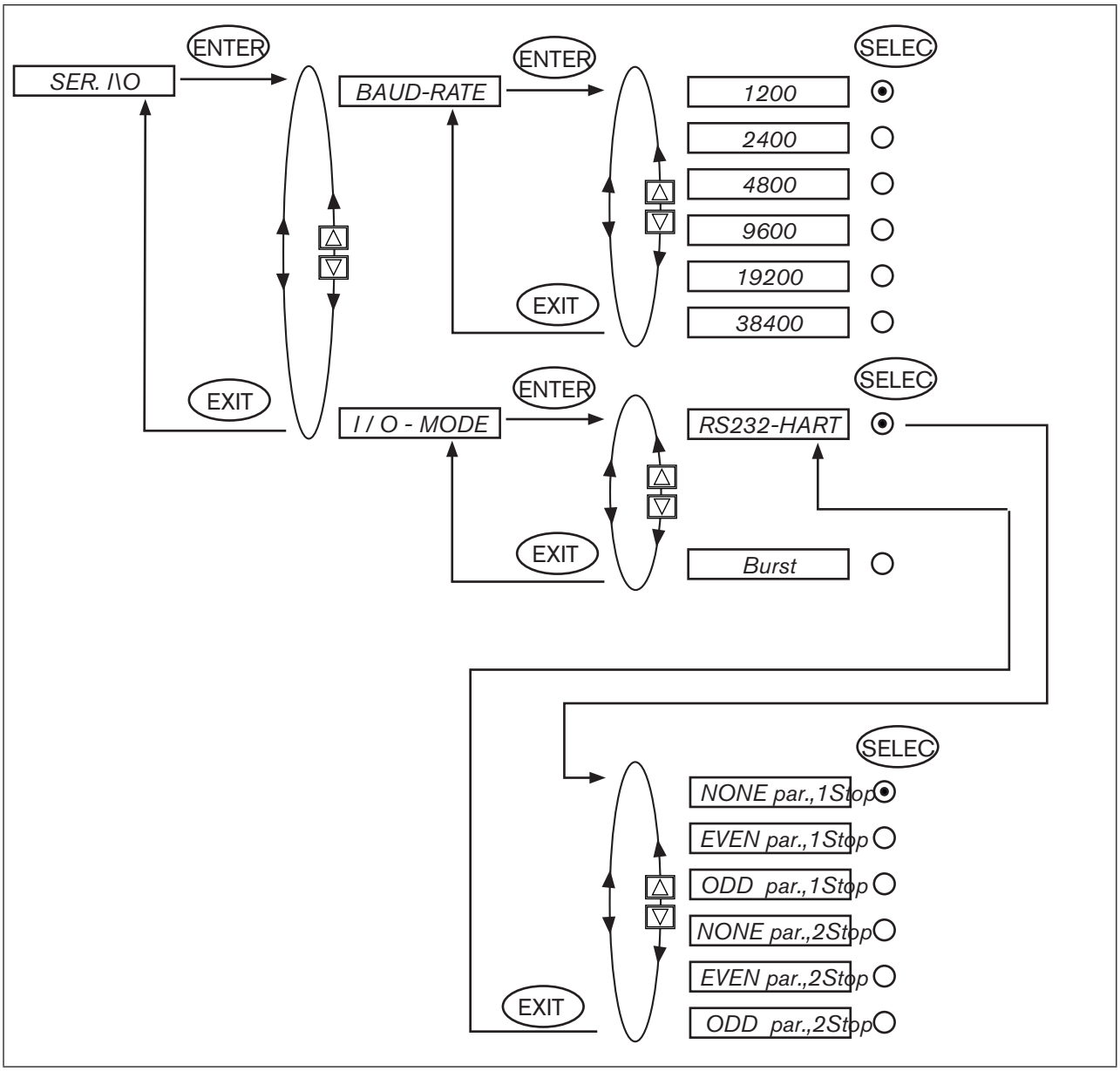


Figure 72: Operating structure SER. I\O

22.3.18. *EXTRAS*

This function can be used to set the representation on the display.

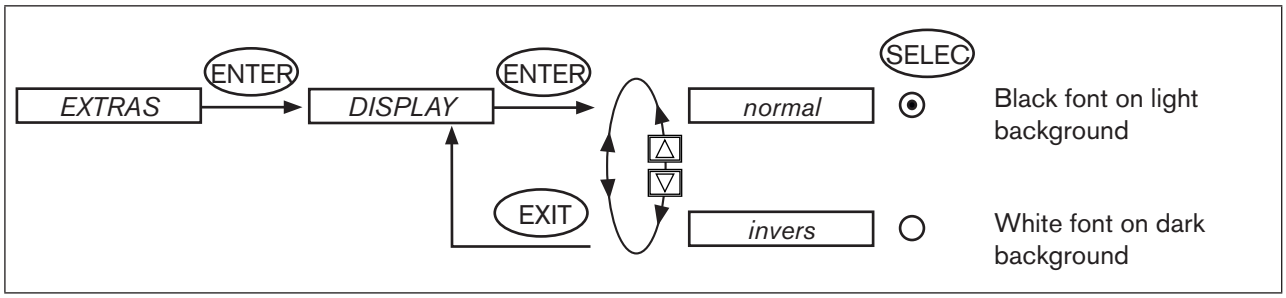


Figure 73: Operating structure EXTRAS

22.3.19. *SERVICE*

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

22.3.20. *SIMULATION - in process....*

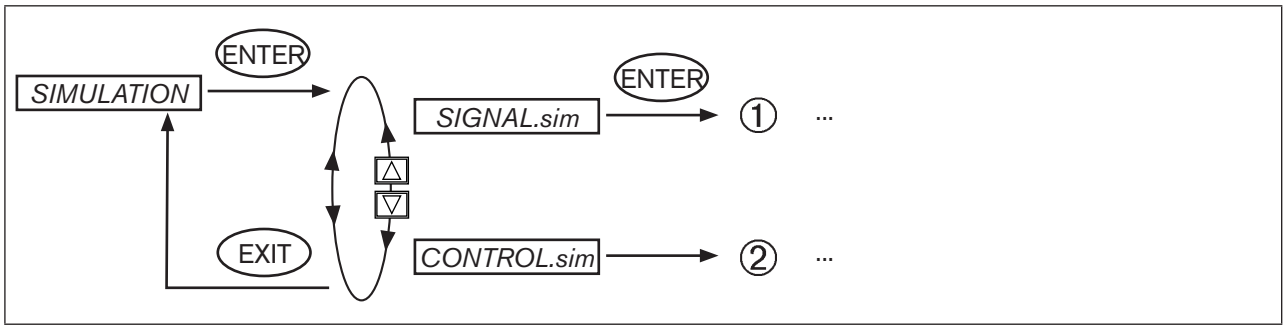


Figure 74: Operating structure SIMULATION

This chapter is in process.

Start-up and operation of the position controller Type 8693

TABLE OF CONTENTS

23. STARTING UP AND SETTING UP THE PROCESS CONTROLLER TYPE 8693

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.

23.1. Safety instructions

DANGER!

Danger – high pressure in the equipment!

There is a serious risk of injury when reaching into the equipment.

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

WARNING!

Danger - improper installation!

Improper installation may result in injuries as well as damage to the device and the area around it.

- Fluid and electrical installations may be carried out by authorised technicians only and with the appropriate tools!

Danger due to unintentional activation of the equipment!

Unintentional activation of the equipment during installation may result in injuries and damage.

- Take appropriate measures to prevent the equipment from being unintentionally activated.

23.2. Description of the procedure

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

To specify the basic settings, you must 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).

→ Press the arrow keys to switch between the main menu options and select a menu option with the right selection key (ENTER/RUN).

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

→ Press the arrow keys to switch between these sub-options and select the required settings. Press the right selection key (SELEC/ENTER) to confirm the selection (the point after the selected parameter is now marked). Return to the main menu by pressing the left selection key (EXIT).

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

You are back at 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"*).

23.3. 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 32: Factory settings of the process controller

The factory settings of the position controller can be found in the chapter entitled "21.3. Factory settings of the position controller".

23.4. Procedure for setting up a process control

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

Always observe the following sequence: *X.TUNE* → *P.Q'LIN* → *P.TUNE*.

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

Setting up the position controller:

A → Specify the standard settings of the positioner and automatically adjust 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* function into the main menu.

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

D Linearisation of the process characteristic

If this is a flow control process, the process characteristic can be linearised automatically:

→ Implement the *P.Q'LIN* function.

E Self-optimization of the process controller

→ Implement the *P.TUNE* function.

23.5. Setting up the position controller

A

Specification of the basic settings is described in the chapter entitled "21.4. Specifying the basic 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 functions *INPUT* and *X.TUNE* can be found in the chapter entitled "21.5. Description of the functions of 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.

23.6. Setting up the process controller

23.6.1. Starting the *P.CONTROL* auxiliary function

B

How to start the auxiliary functions is described in the chapter entitled "22. Configuring the auxiliary functions".

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

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

→ Press the arrow keys to select the *ADD.FUNCTION* 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.

23.6.2. Basic settings for the *P.CONTROL* function

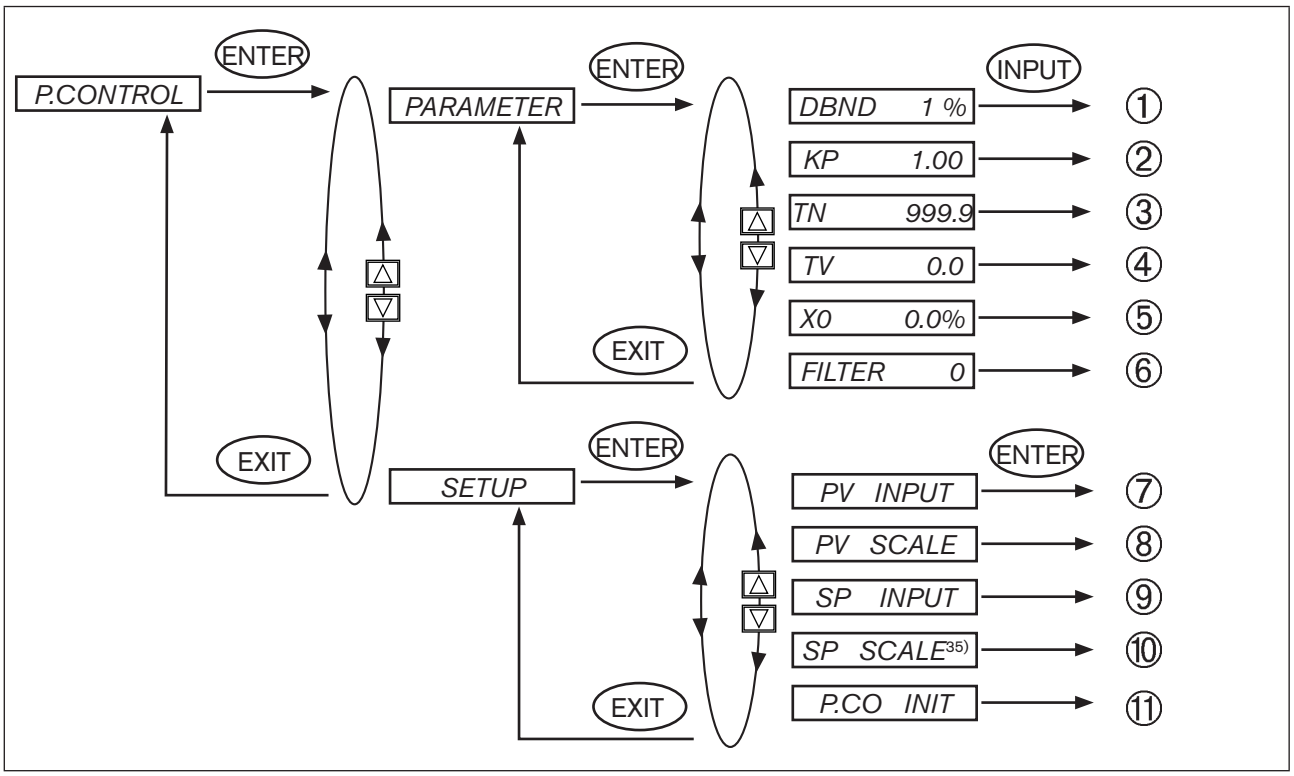


Figure 75: Operating structure P.CONTROL

①	Insensitivity area (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	Indication of the signal type for process actual value
⑧	Scaling the process controller
⑨	Type of the set-point value default (internal or external)
⑩	Scaling the position controller (for external set-point value default only)
⑪	Enables a smooth switchover between AUTOMATIC and MANUAL mode

Table 33: P.CONTROL

35) *The SP SCALE function is indicated only if the external set-point value default (external) menu option is activated under SP INPUT.*

23.6.3. *PARAMETER* - Parameter setting of the process controller

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

The setting can be implemented automatically by means of the *P.TUNE* function (see chapter "23.6.6. *P.TUNE* - Self-optimization of the process controller (process tune)").

The basic principles of setting a controller can be found in the chapter entitled "57. 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*)

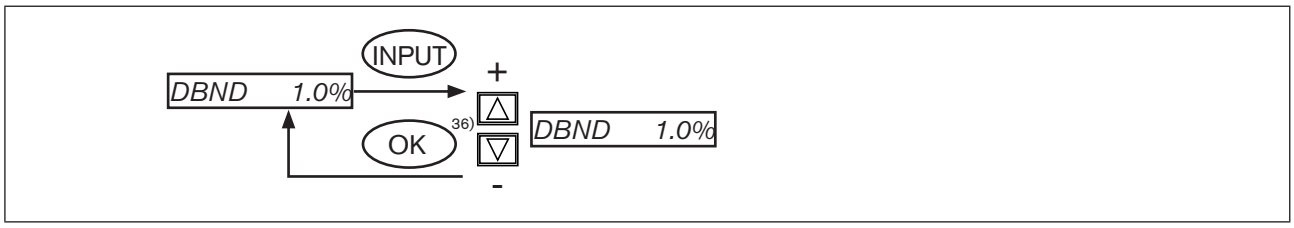


Figure 76: Operating structure P.CONTROL - DBND

Insensitivity area for process control

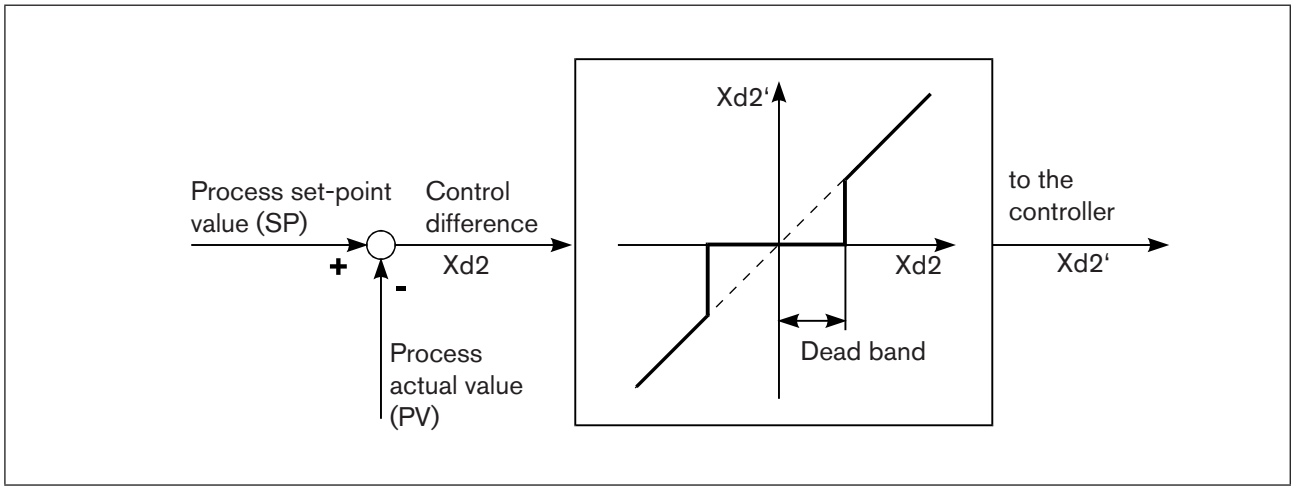


Figure 77: Operating structure P.CONTROL - DBND

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

② *KP - Amplification factor of the process controller*

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

Factory setting: 1.00

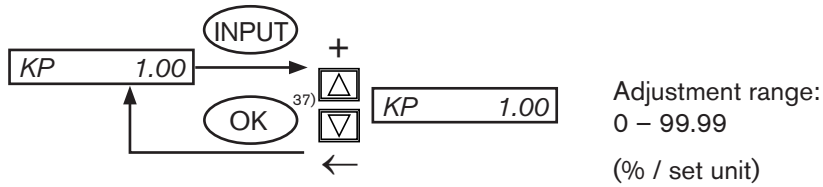


Figure 78: Operating structure P.CONTROL - KP

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

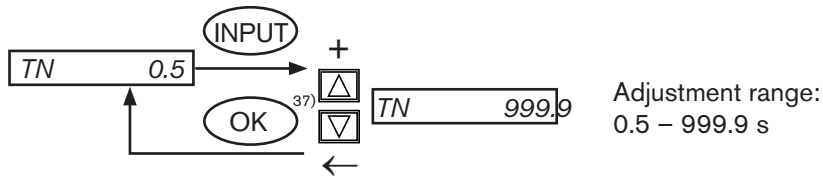


Figure 79: Operating structure P.CONTROL - TN

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

Specifies the D-contribution of the PID controller.

Factory setting: 0.0 s

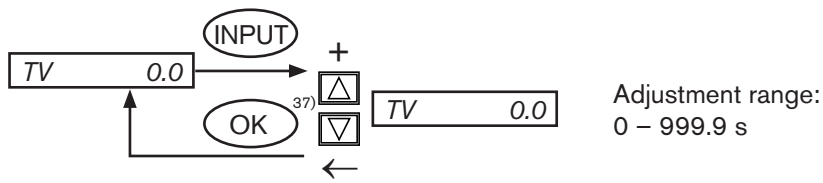


Figure 80: Operating structure P.CONTROL - TV

37) 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 in rest state.

Factory setting: 0.0 %

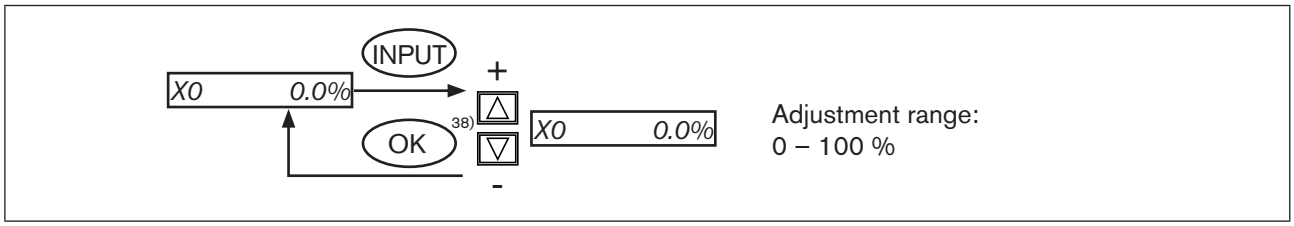


Figure 81: Operating structure P.CONTROL - X0

The "Tables for customer-specific settings" appendix contains a table "61. Set parameters of the process controller" 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

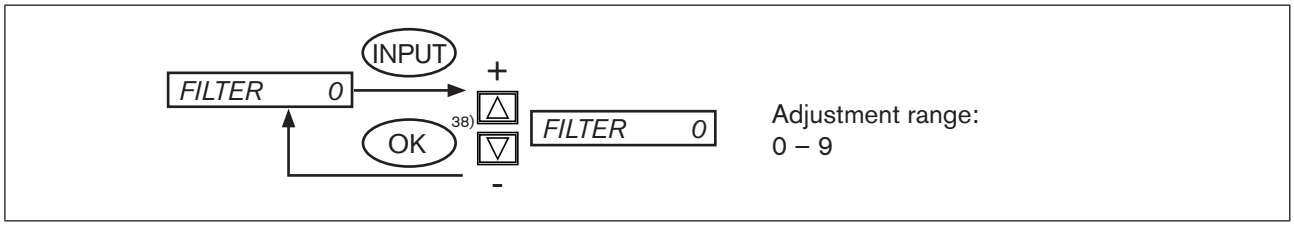


Figure 82: Operating structure P.CONTROL - FILTER

Setting 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 34: Setting of filter effect

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

23.6.4. *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, pressure, level
▪ Frequency signal	0 – 1,000 Hz	Flow
▪ Circuit with Pt 100	-20 °C – +220 °C	temperature

Factory setting: 4 ... 20 mA

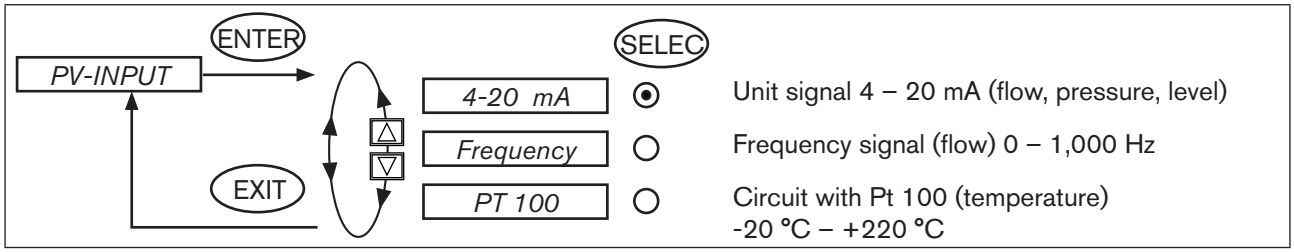


Figure 83: Operating structure P.CONTROL - PV-INPUT

⑧ *PV-SCALE - Scaling of the process controller*

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):

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

→ Press the right selection key (INPUT) to enter 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)[39] of the scaling values.

→ Press the down arrow key (←) to change the dark highlighted background to the decimal point of the value which specifies the position of the decimal point with the aid of the up arrow key (+).

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 individual digits of the value and switch to the next digit with the down arrow
key (←).

→ When all input values have been specified, confirm by pressing the right selection key (OK) and jump back to the selection screen.

⑧ -1- *PV-SCALE - 1 - Scaling of the process controller 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*).

[39] *The units indicated here depend on the signal type (PV INPUT).*

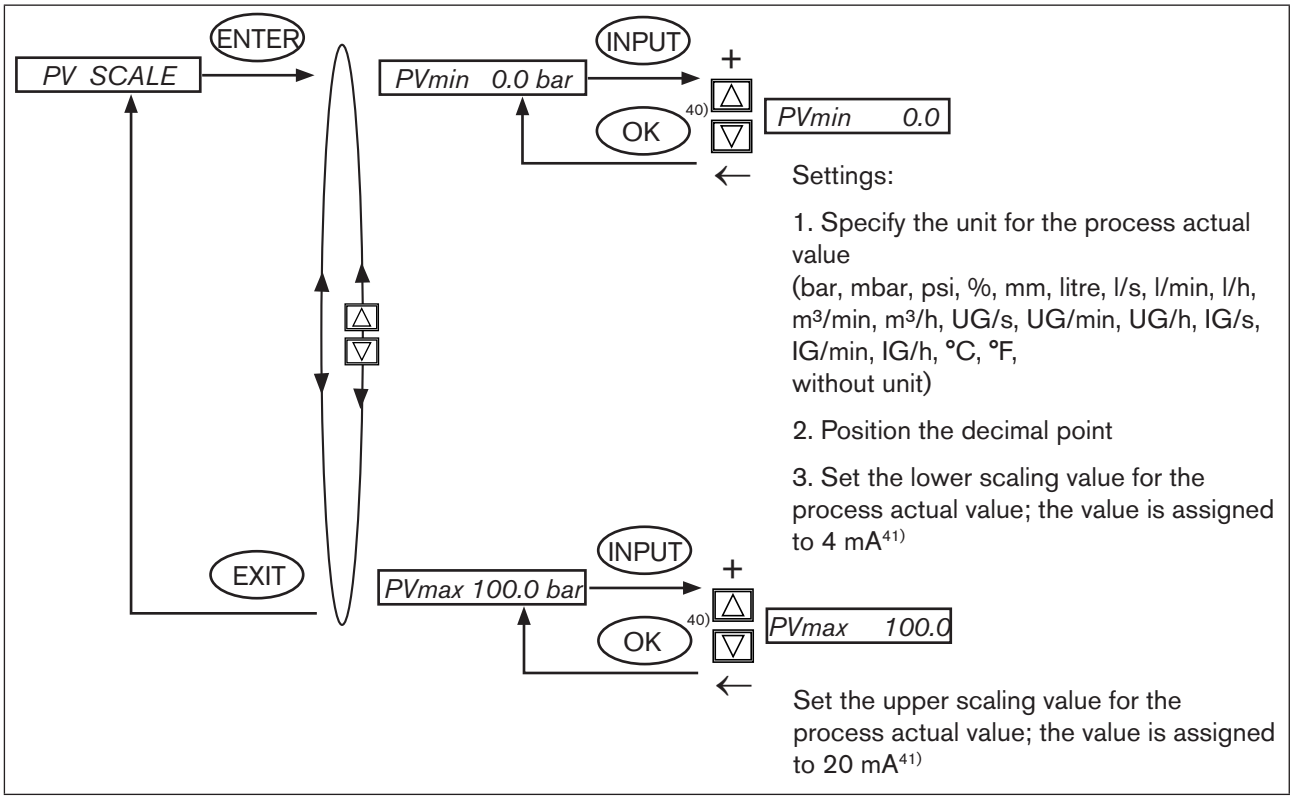
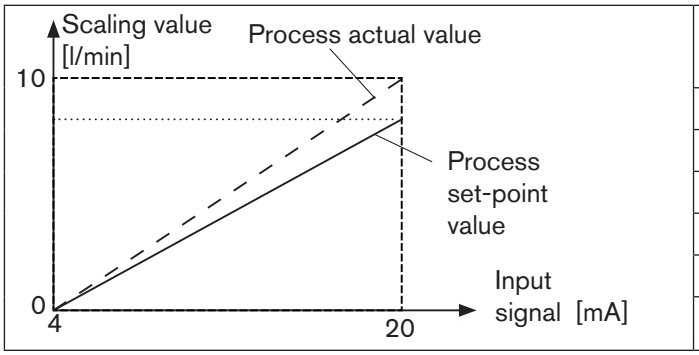


Figure 84: Operating structure P.CONTROL - PV-SCALE - 4-20mA

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

Figure 85: 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).

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

41) 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).

⑧ -2- *PV-SCALE - 2 - Scaling of the process controller 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*).

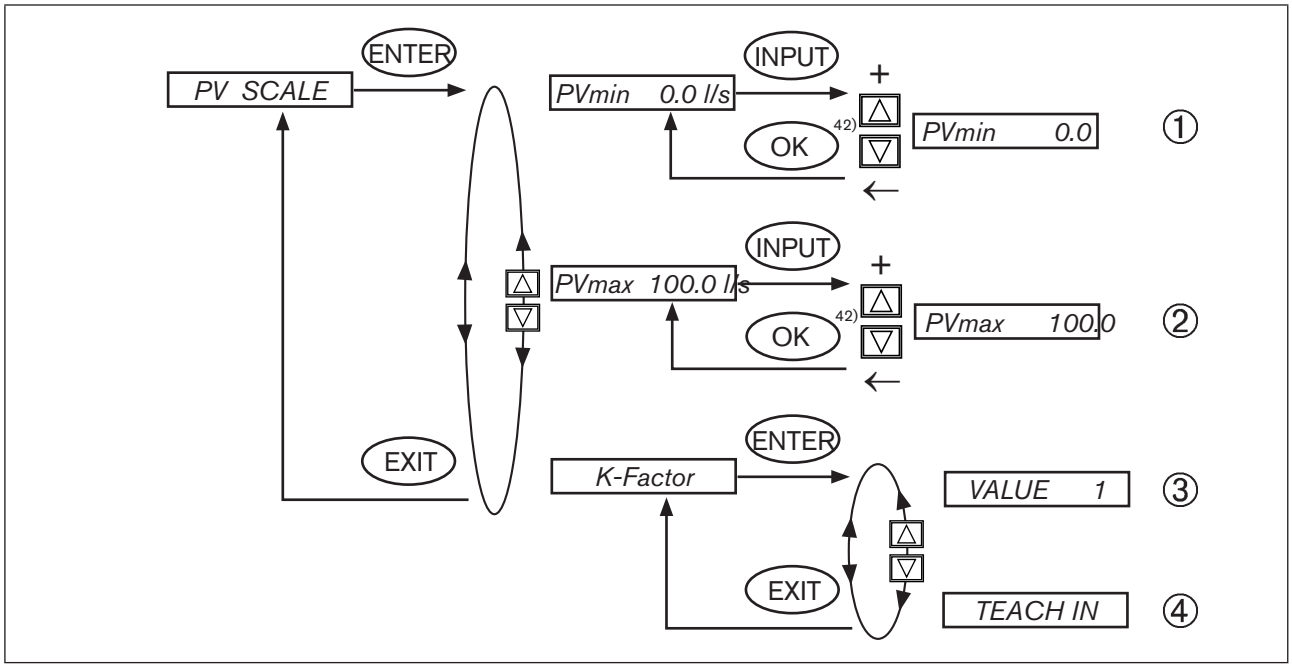


Figure 86: Operating structure P.CONTROL - PV-SCALE - Frequency

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

① *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).

② *PVmax X x/x* **Upper scaling value for the process actual valu**

The unit for flow 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 positions 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).

③ *K-Factor* *VALUE X* **Manually inputting 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 has a dark background. Press the up arrow key (+) to specify the position.

Adjustment range: 1 or 2

2. Input the K-factor

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

Adjustment range: 0 ... 9999

④ *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)

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 displayed 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 complete the measurement and to display the input screen for the volume.

Inputting the position of the decimal point

The decimal point on the display has a dark background.

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

Inputting the measured volume

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

Adjustment range: 0 ... 9999

⑧ -3- *PV-SCALE - 3 - Scaling of the process controller 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*).

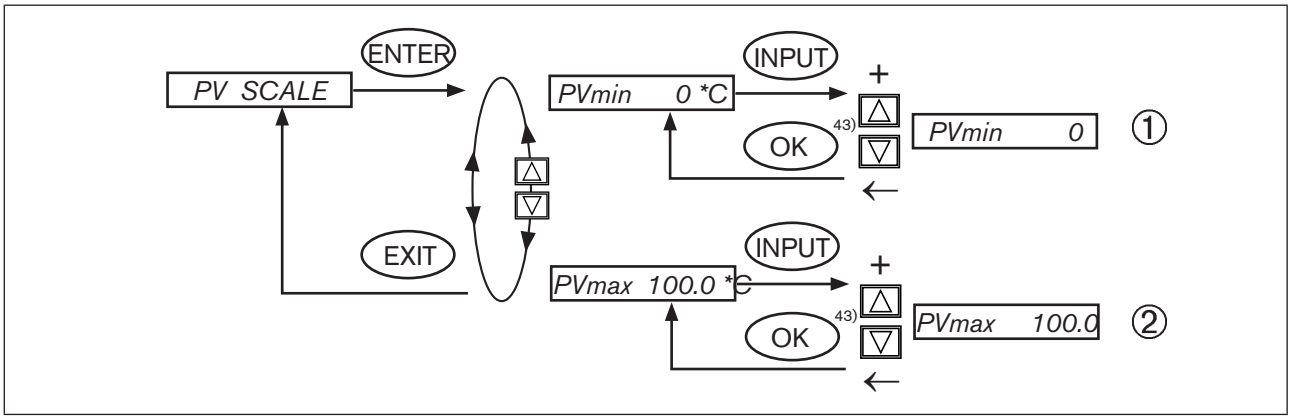


Figure 87: Operating structure P-CONTROL-PV-SCALE - Pt100

① PVmin X *X **Lower scaling value for the process actual value**

1. Select the unit for the temperature
The unit on the display has 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 positions 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).

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

② 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 positions 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*

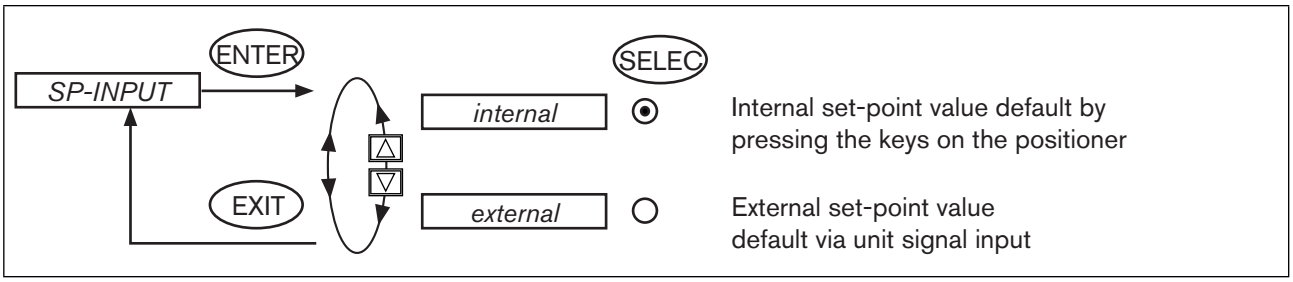


Figure 88: Operating structure P.CONTROL - SP-INPUT

⑩ *SP - SCALE - Scaling of the position controller*

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.

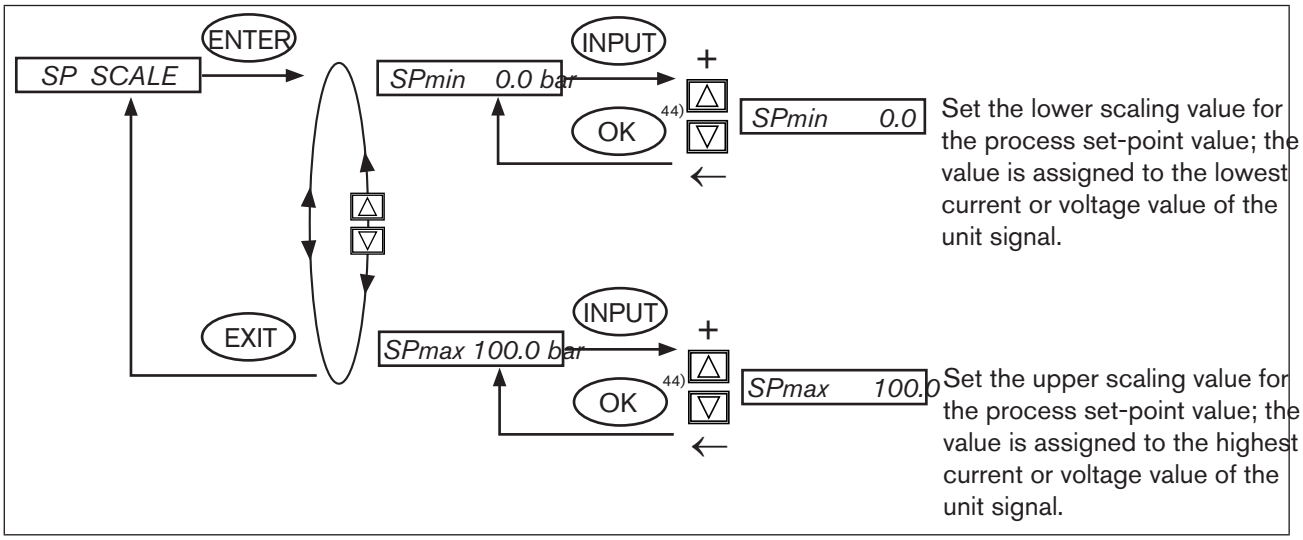


Figure 89: Operating structure P.CONTROL - SP-SCALE

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

→ Press the right selection key (INPUT) to enter 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 individual digits of the value and switch to the next digit with the down arrow key (←).

→ When all input values have been specified, confirm by pressing the right selection key (OK) and jump back to the selection screen.

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

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

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

Factory setting: *bumpless*

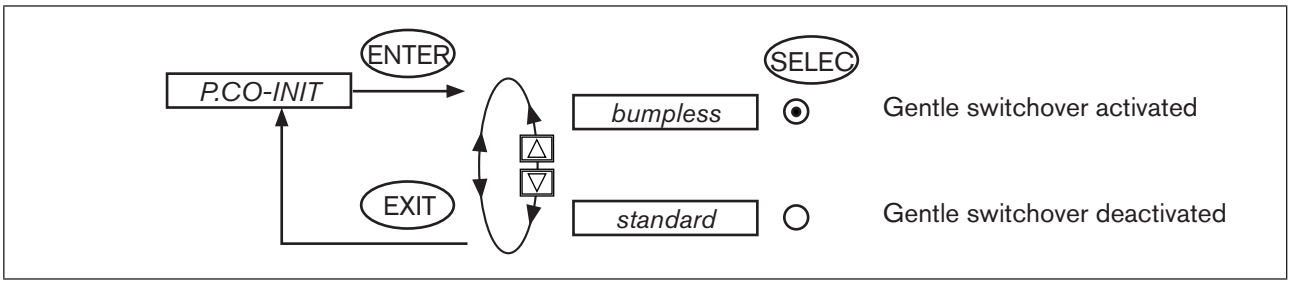


Figure 90: Operating structure P.CO INIT

23.6.5. *P.Q'LIN* - Linearization of the process characteristic

This function automatically linearizes the process characteristic of a flow control.

Ⓓ

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 increases 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%*	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 #1 *CMD=10%*	
:	
Q.LIN #10 *CMD=100%*	
Q.LIN *ready*	Display at the end of the routine
or	
Q.LIN *err/break*	Display if an error occurs

Table 35: Display P.Q'LIN

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

The control system of the Type 8693 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 (*P.CONTROL - PARAMETER*) and modified at will.

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.

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 “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).

Start the P.TUNE function

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 36: ”. 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.

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 determined 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. Operation of the process controller.

Table 36: Sequence of the self-optimization function

24. 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 the chapter entitled "13. Control and display elements".

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

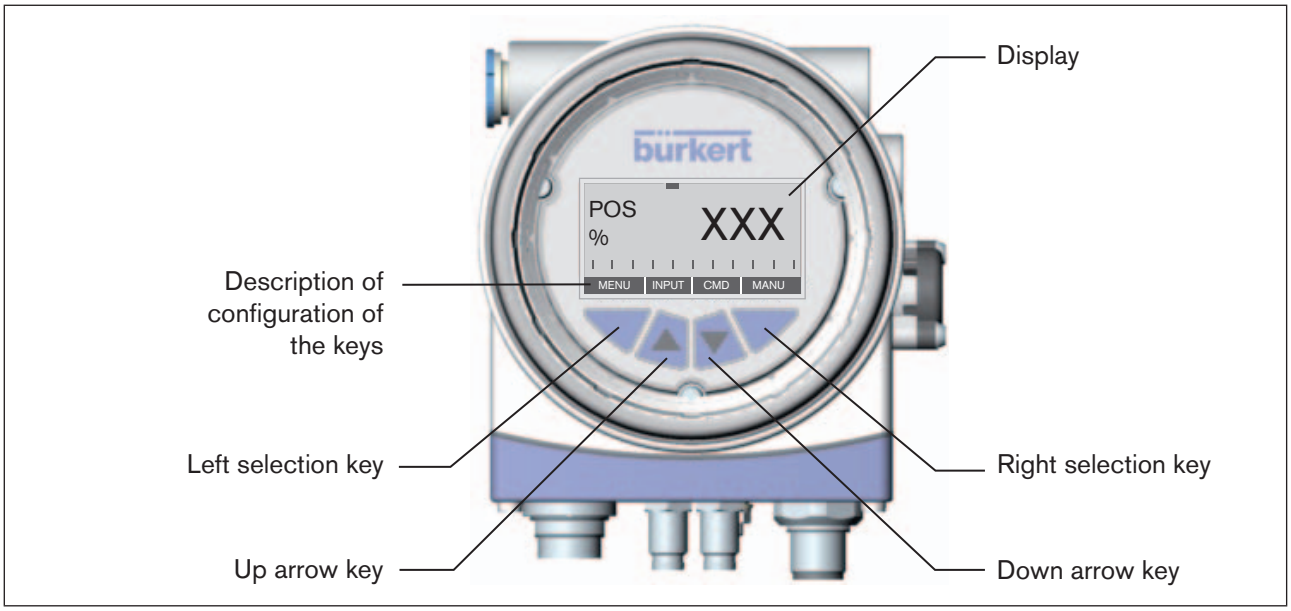


Figure 91: Description of the control module

24.1. 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.

24.2. Switching between the operating levels

Process operating level ► Configuration level

Both in the MANUAL and AUTOMATIC operating state you switch to the configuration level by pressing the left selection key (MENU) for approx. 3 seconds. During these 3 seconds 2 bars converge on the display (Countdown).

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 the chapters entitled "20.4. Specifying the basic settings" - "22. Configuring t he auxiliary functions" and in "25. Auxiliary functions for the process controller".

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.

24.3. 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.

24.3.1. Meaning of the keys

Key	Configuration[45)]	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 POS CMD TEMP PV	Switch between the displays
Down arrow key 	CMD TEMP PV SP POS	

Table 37: Meaning of the keys

45) *Displayed only when P.CONTROL auxiliary function activated*

24.3.2. 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[46)]	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 38: Information on the display

24.3.3. Operating structure

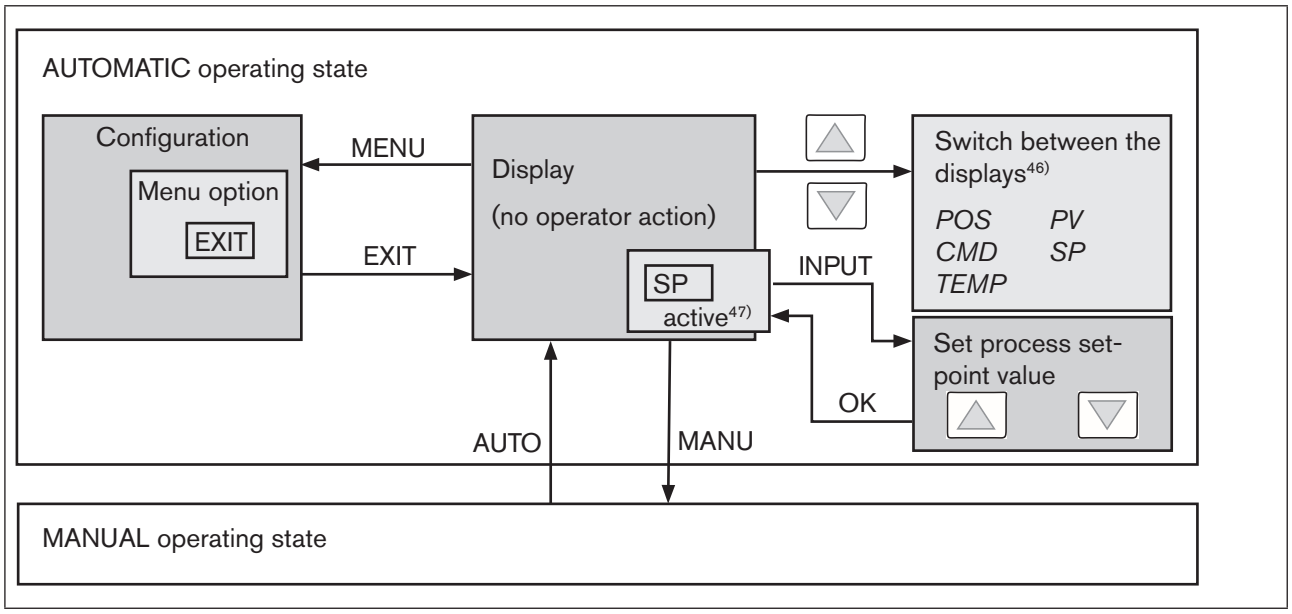


Figure 92: AUTOMATIC operating structure - 8693

46) Displayed only when P.CONTROL auxiliary function activated.
47) only active if the internal set-point value default (P.CONTROL / SETUP / SP INPUT / internal) has been selected.

24.3.4. Manually changing the process set-point value

If the auxiliary function *P.CONTROL* / *SETUP* / *SP INPUT* / *internal* (set the set-point value via keys) is specified during the configuration, the menu to change the process set-point value can be activated when the *SP* (Setpoint) display is set by pressing the right selection key (INPUT). The individual digits can be set by pressing the arrow keys. Press the right selection key (OK) to accept the set value.

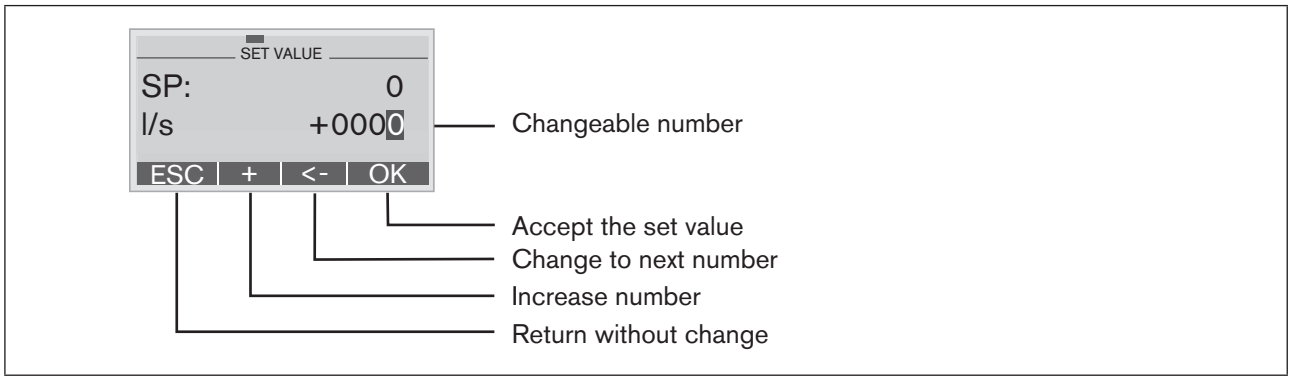


Figure 93: Setting numerical values SP

24.4. 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.

24.4.1. 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 CLS[48)]	Aerate the actuator Control function A (CFA): Valve opens Control function B (CFB): Valve closes Control function I (CFI): Connection 2.1 aerated
Down arrow key	CLS OPN[48)]	Deaerate the actuator Control function A (CFA): Valve closes Control function B (CFB): Valve opens Control function I (CFI): Connection 2.2 aerated

Table 39: Meaning of the keys

CFA:Actuator closes by spring force
CFB:Actuator opens by spring force
CFI:Actuator double-acting

48) *only if "Fall" is set in the DIR.ACT auxiliary function*

24.4.2. Information on the display

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

24.4.3. Operating structure

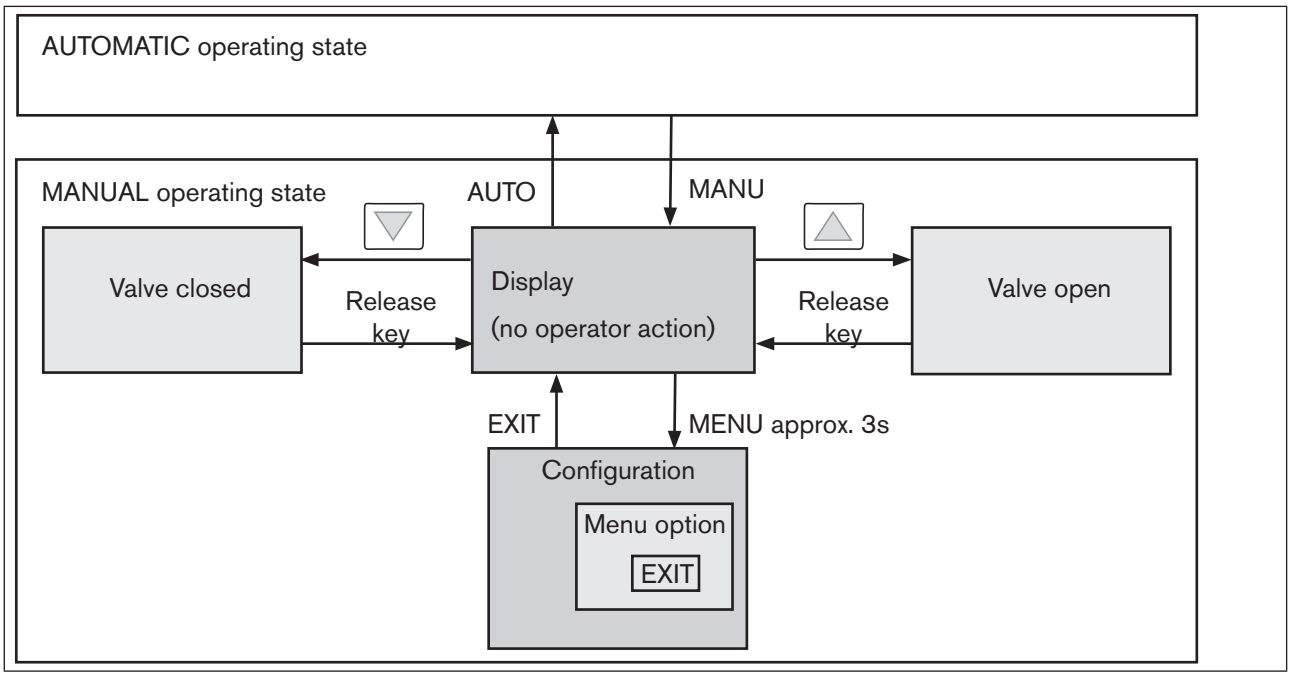


Figure 94: Operating structure MANUAL

25. AUXILIARY FUNCTIONS FOR THE PROCESS CONTROLLER

In this chapter only those auxiliary functions are described which differ from the position controller Type 8692. All other auxiliary functions and their settings can be found in the chapters entitled "22. Configuring the auxiliary functions".

25.1. Overview of the auxiliary functions

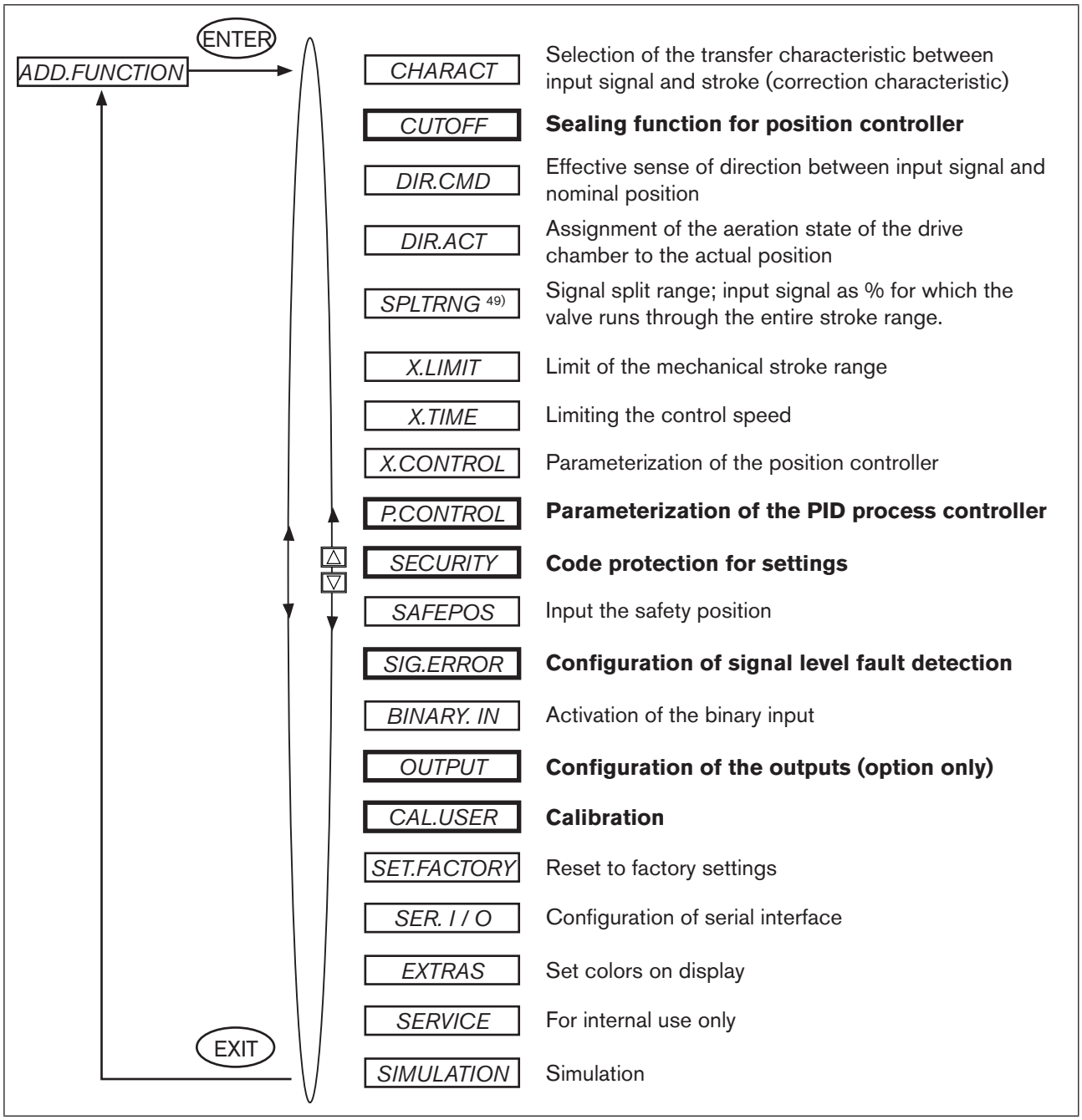


Figure 95: Overview - auxiliary functions 8693

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

If the *P.CONTROL* auxiliary function is active for the process controller Type 8693, the following auxiliary functions differ from those described for the position controller Type 8692 (highlighted in “Figure: 95”):

- *CUTOFF*
- *SECURITY*
- *SIG.ERROR*
- *OUTPUT*
- *CAL. USER*

25.1.1. Including auxiliary functions in the main menu

→ Press the arrow keys to select the *ADD.FUNCTION* menu option in the main menu and press the right selection key
(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).

→ All marked functions are transferred to the main menu when the selection key on the left (EXIT) is pressed.

→ In the main menu input the parameters of the auxiliary functions.

25.1.2. 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.

→ Press the arrow keys to select the *ADD.FUNCTION* menu option in the main menu.

→ Enter the submenu by pressing the selection key on the right (ENTER).

→ Press the arrow keys to 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.

A precise description on the operation of the auxiliary functions can be found in the chapters entitled *"21.4.* Specifying the basic settings" and in "22. Configuring the auxiliary functions".

25.2. *CUTOFF* - Sealing function for the position controller Type 8693

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*

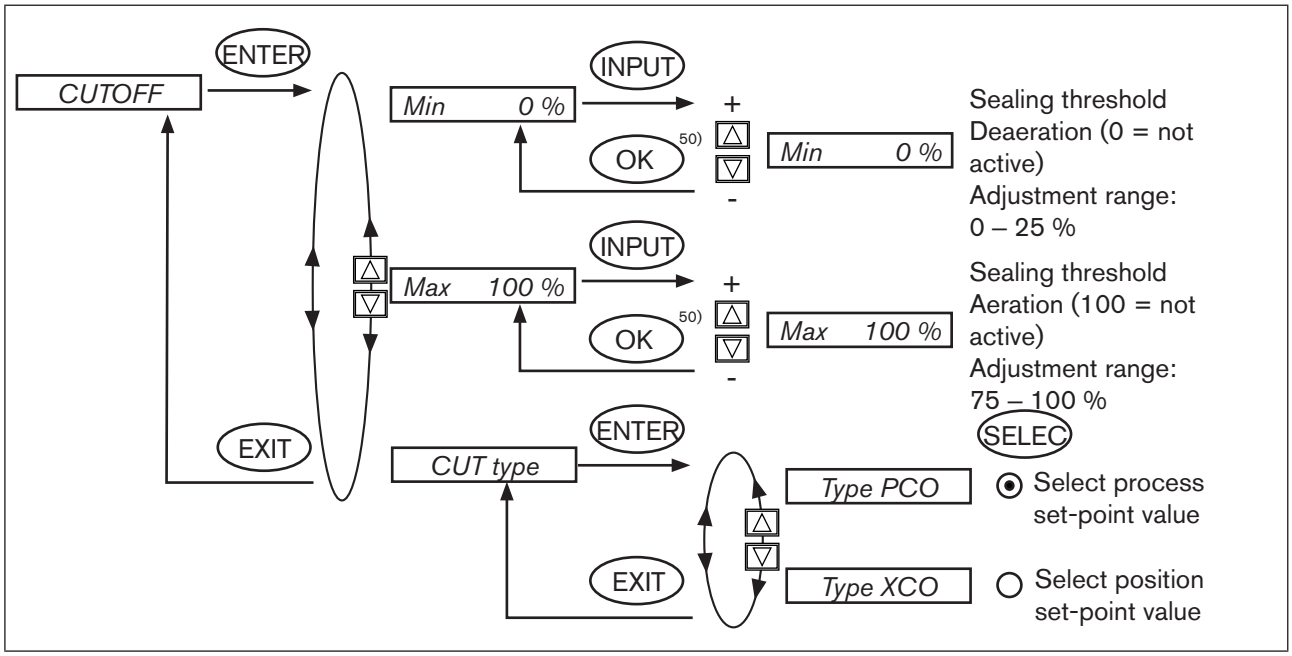


Figure 96: Operating structure CUTOFF-8693

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

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

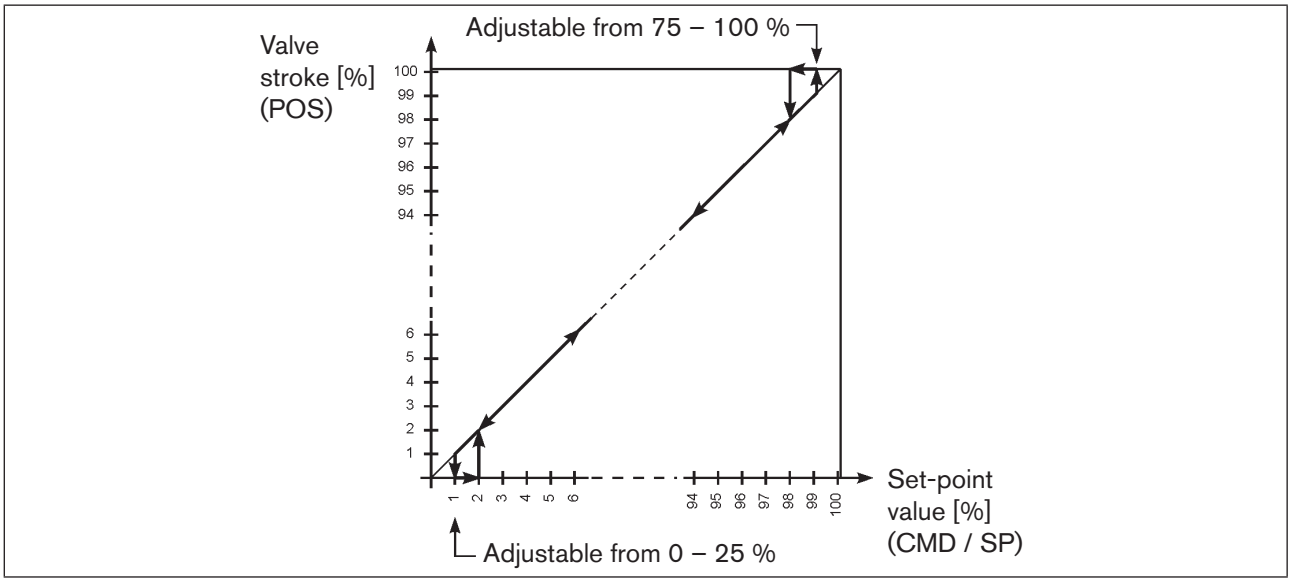


Figure 97: Graph - CUTOFF - 8693

25.3. *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".

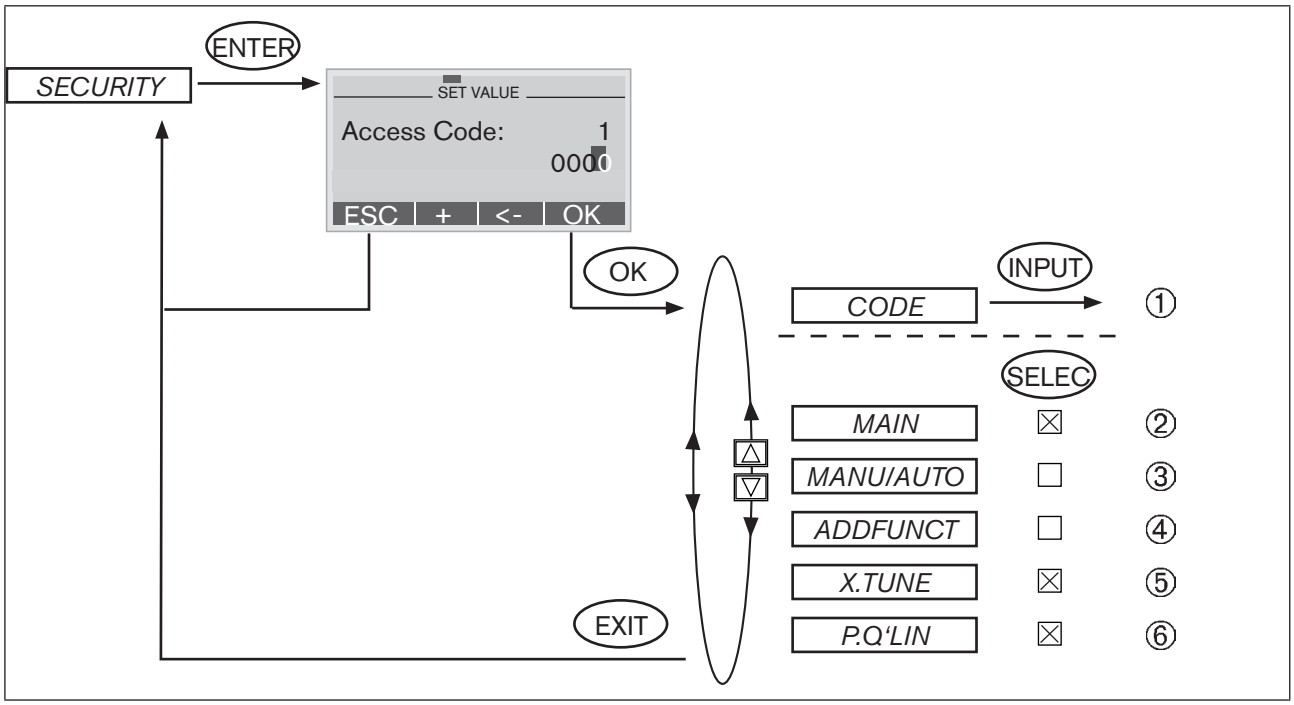


Figure 98: Operating structure SECURITY - 8693

① Input screen for inputting or changing the *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 functions

⑤ Blocking the activation of self-parameterisation (Autotune)

⑥ Blocking the activation of the linearisation of the process characteristic

⑥ Blocking

Inputting the code:

→ Press the selection key on the right (INPUT) to access the input screen when the *CODE* selection menu is marked.

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.

25.4. *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 with a Pt 100 signal.
4 – 20 mA
Fault with input signal ≤ 3.5 mA (± 0.5 % of end value, hysteresis 0.5 % of end value)
Pt 100
Fault with input signal 225 °C (± 0.5 % of end value, hysteresis 0.5 % of end 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.

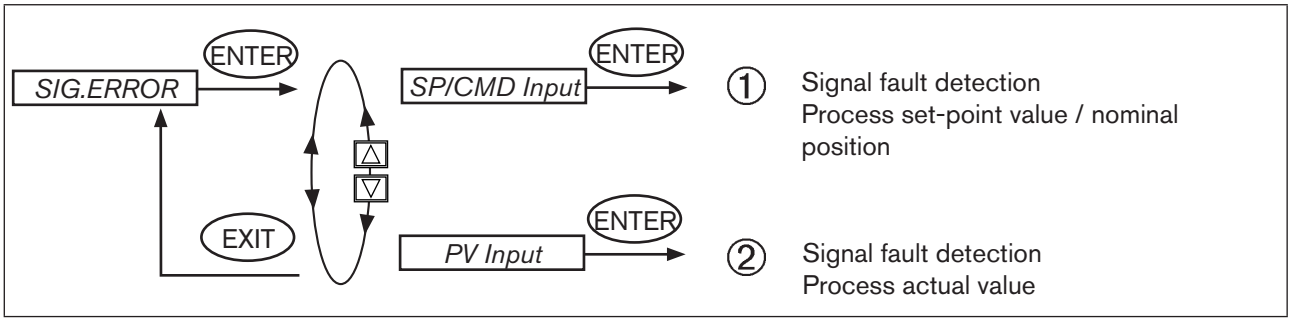


Figure 99: Operating structure SIG-ERROR-8693

The operating structure of the menu options *SP/CMD Input* and *PV Input* is identical and is described in the diagram below:

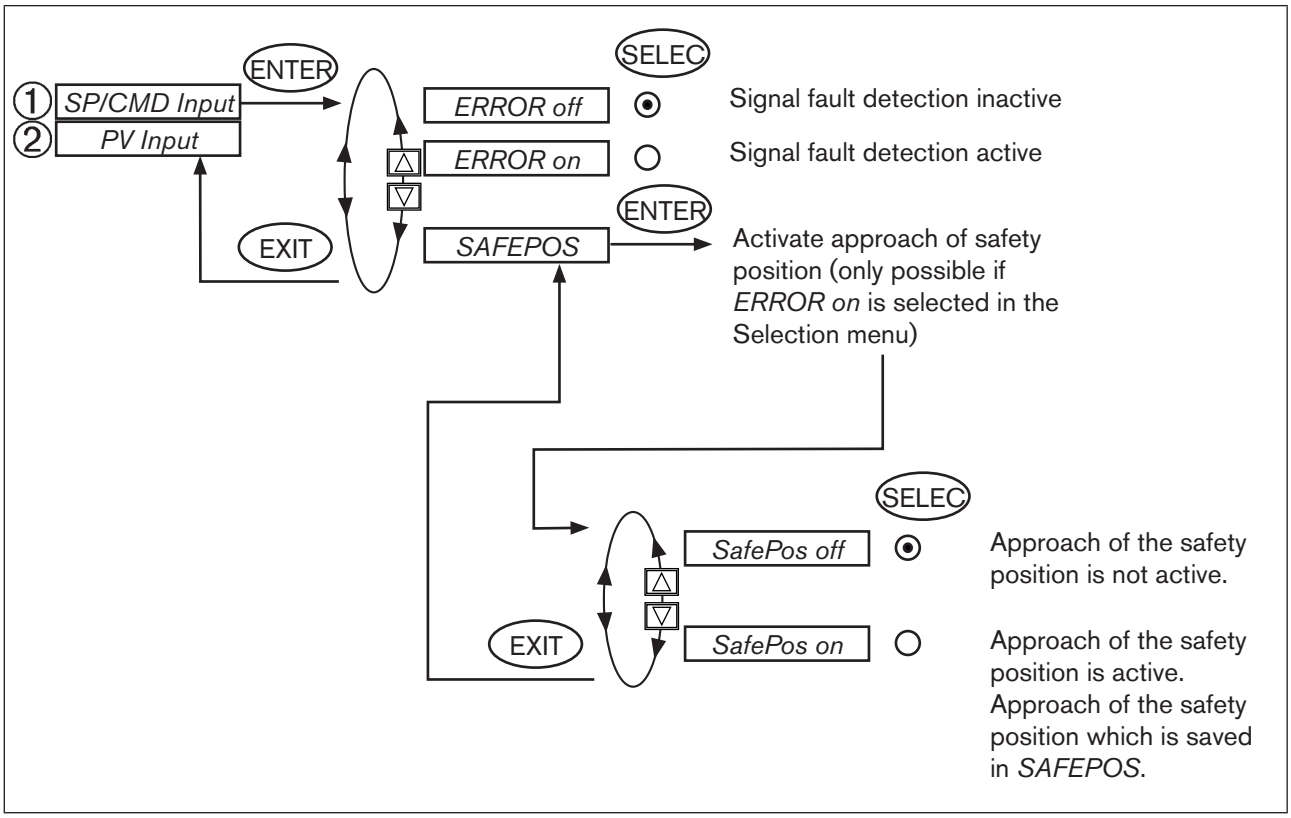


Figure 100: Operating structure SIG-ERROR-8693-SP-CMD-PV

If signal fault detection is activated, the respective fault is indicated on the display.
(see chapter entitled "50.1. Maintenance and troubleshooting")

Safety position *SAFEPOS on*

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

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

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

25.5. *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 of the current position (*POS*), the position set-point value (*CMD*), the process actual value (*PV*) or the process set-point value (*SP*) to the control centre.

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

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

for the output: actuator in safety position or

for the output of a sensor break or

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.

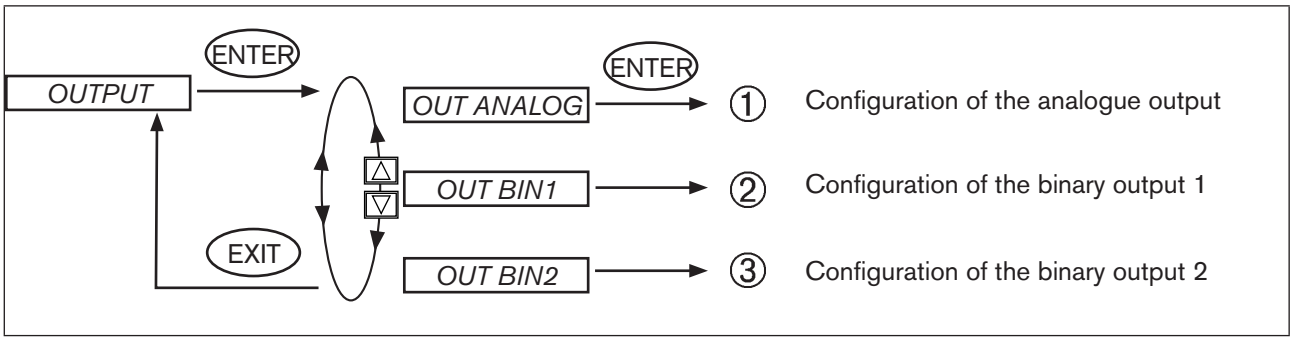


Figure 101: Operating structure OUTPUT

① *OUT ANALOG* - Configuration of the analogue output

Only for the versions:

- one analogue output
- one analogue output and two binary outputs

The feedback of the current position (*POS*), the position set-point value (*CMD*), the process actual value (*PV*) or the process set-point value (*SP*) can be transmitted to the control centre via the analogue output.

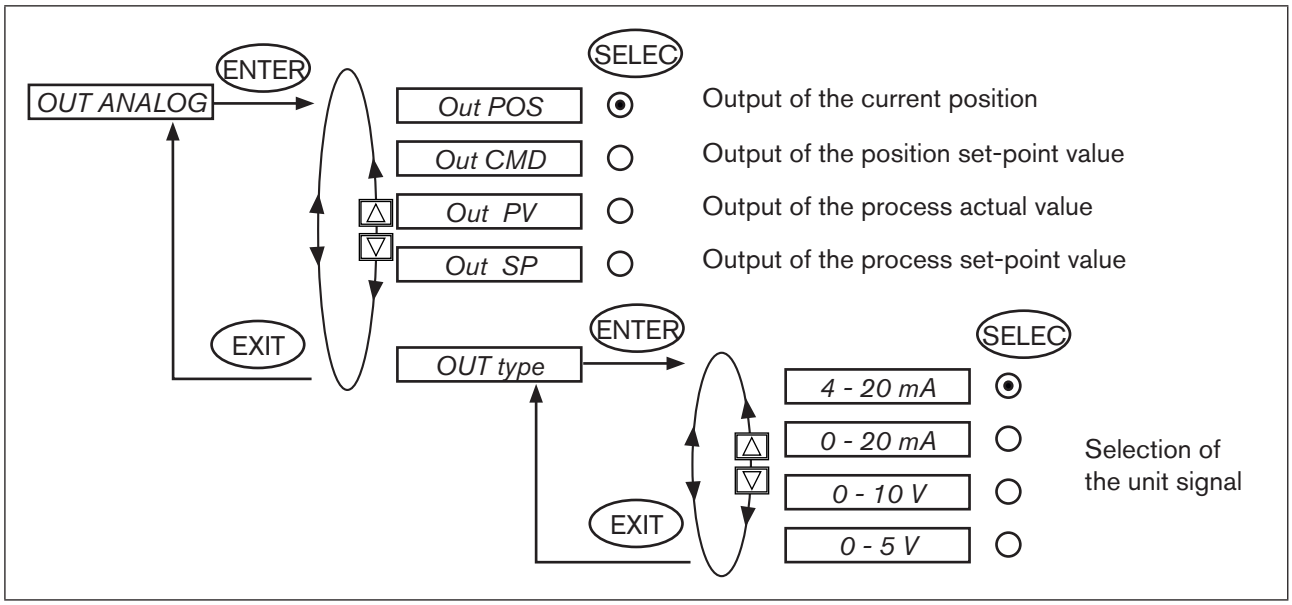


Figure 102: Operating structure OUTPUT-ANALOGUE-8693

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

② ***OUT BIN1*** **- Configuration of the binary output 1**

③ ***OUT BIN2*** **- Configuration of the binary output 2**

Only for the versions:

- one analogue output and two binary outputs
- two binary outputs

The following description applies to both binary outputs *OUT BIN 1* and *OUT BIN 2*.

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[51)]
- for the output: sensor break process actual value[51)]
- for the output: operating state MANUAL / AUTOMATIC.

51) Only possible if signal level fault detection activated (see chapter entitled "25.4. SIG-ERROR Configuration of signal level fault detection")

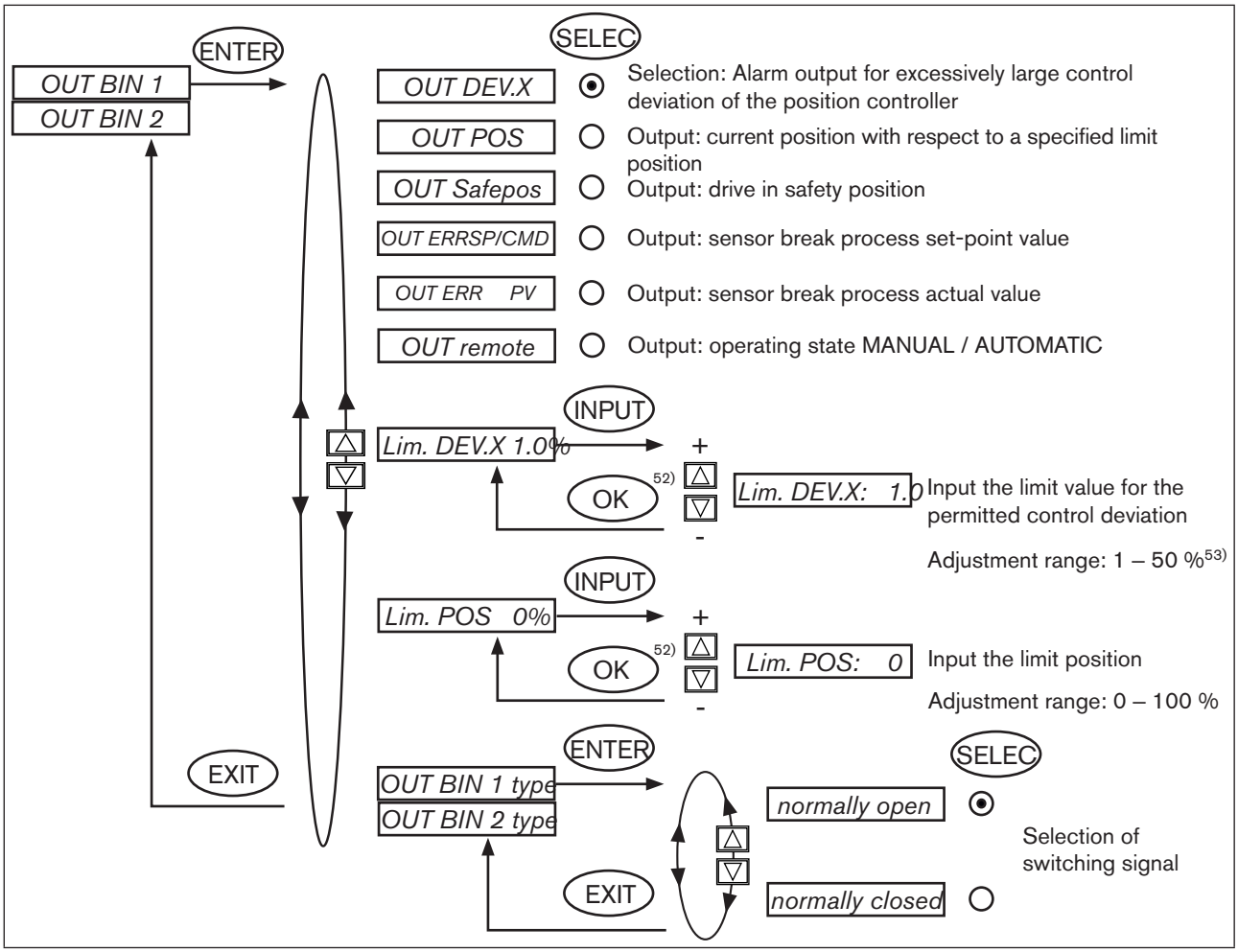


Figure 103: Operating structure OUTPUT-BIN1-8693

Normally closed output, in switched state *low* (≙ 0 V)

Normally open output, in switched state *high* (≙ 24 V)

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

52) *If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.*
53) *The permitted control deviation Lim DEV.X XX must not be less than the dead band.*

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 limit value for the permitted control deviation in the Lim. DEV.X 1.0% 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 BIN type* menu option input the required switching status (*normally open* / *normally closed*, *see* "Table 40: ").

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 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 BIN type* menu option input the required switching status (*normally open* / *normally closed*, *see* "Table 40: ").

OUT BIN1	*normally open*	*normally closed*
POS > LIM	0 V	24 V
POS < LIM	24 V	0 V

Table 40:

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*).

OUT ERR SP/CMD [54] **Output sensor break:**

→ 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*).

OUT ERR PV [54] **Output sensor break:**

→ 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 BIN type* menu option input the required switching status (*normally open* / *normally closed*).

[54] *Only possible if signal level fault detection activated (see chapter entitled "SIG-ERROR")*

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*).

OUT BIN1	*normally open*	*normally closed*
AUTOMATIC operating state	0 V 	24 V 
MANUAL operating state	24 V 	0 V 

Table 41:

Normally closed output, in switched state *low* (≅ 0 V)

Normally opened output, in switched state *high* (≅ 24 V)

25.6. *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*)[55)]
- Process actual value display (*PV*)

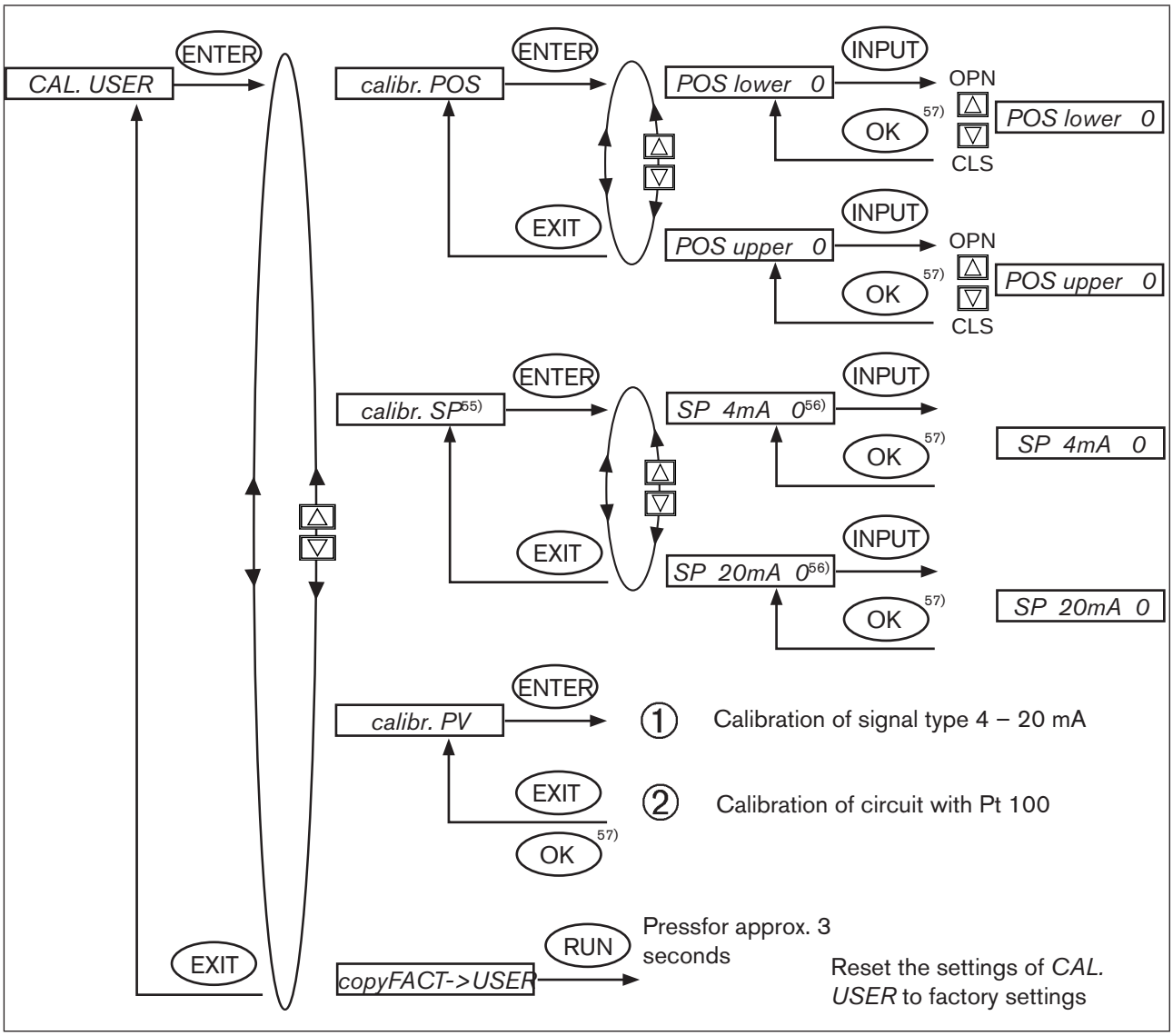


Figure 104: Operating structure CAL.USER-8693

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

55) If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.
56) The signal type is displayed which is selected in the INPUT menu (4 – 20 mA; 0 – 20 mA; 0 – 5 V; 0 – 10 V).
57) Only if external set-point value default is set in the P.CONTROL / SETUP / SP-INPUT

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* menu option and confirm with the selection key on the right (ENTER).

Accept the minimum position:

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

→ 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 select the *POS upper X* menu option and confirm with the selection key on the right (INPUT).

→ 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[58)] **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. SP* menu option and confirm with the selection key on the right (ENTER).

Accept the minimum input signal (0 mA; 4 mA; 0 V)[59)]:

→ Press the arrow keys to select the S*P (0 mA; 4 mA; 0 V)*[59)] menu option and confirm with the selection key on the right (INPUT).

→ Apply the minimum value of the unit signal on the input and confirm by pressing the selection key on the right (OK).

Accept the maximum input signal (20 mA; 5 V; 10 V)[59)]:

→ Press the arrow keys to select the SP (20 mA; 5 V; 10 V) menu option and confirm with the selection key on the right (INPUT).

→ Apply the maximum value of the unit signal on the input and confirm by pressing the selection key on the right (OK).

---

58) If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.
59) The signal type is displayed which is selected in the INPUT menu (4 – 20 mA; 0 – 20 mA; 0 – 5 V; 0 – 10 V).

calibr. PV **Calibrating the process actual value (4 – 20 mA or Pt 100):**

① 4 – 20 mA:

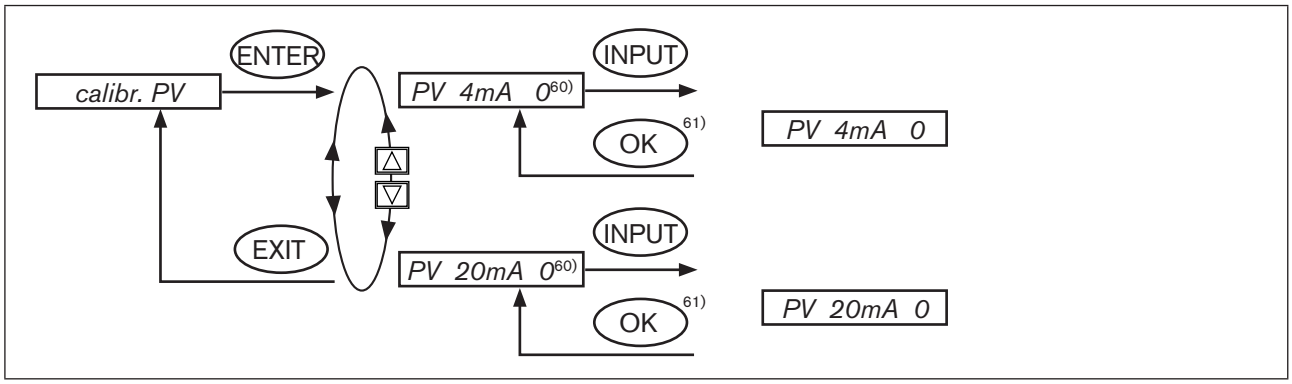


Figure 105: Operating structure CAL.USER-8693-PV-4-20

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

Accept the minimum input signal (4 mA):

→ Press the arrow keys to select the *PV 4 mA* menu option and confirm with the selection key on the right (INPUT).

→ Apply the minimum value of the unit signal on the input and confirm by pressing the selection key on the right (OK).

Accept the maximum input signal (20 mA):

→ Press the arrow keys to select the *PV 20 mA* menu option and confirm with the selection key on the right (INPUT).

→ Apply the maximum value of the unit signal on the input and confirm by pressing the selection key on the right (OK).

60) The signal type is displayed which is selected in the INPUT menu (4 – 20 mA; 0 – 20 mA; 0 – 5 V; 0 – 10 V).
61) If the sub-menu is left by pressing the selection key on the left (ESC), the value remains unchanged.

② **Pt 100:**

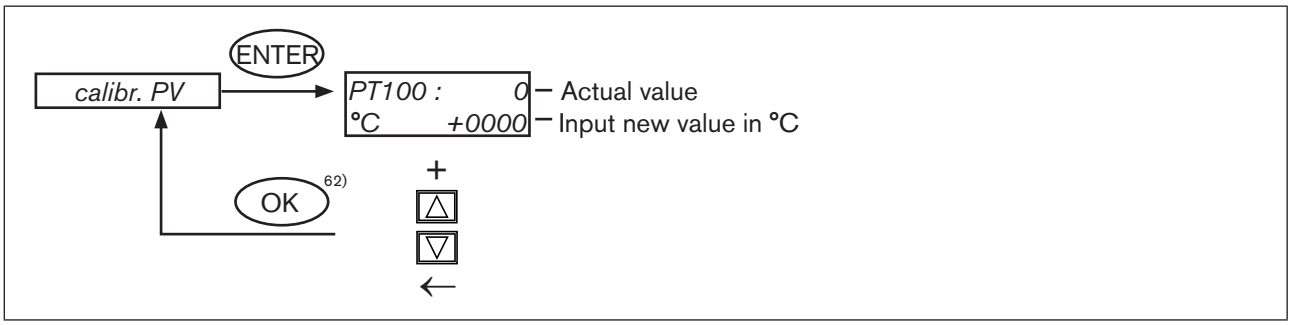


Figure 106: Operating structure CAL.USER-8693-PV-PT100

An offset value calculated from the actual value and the new value is added to all calculated values.

→ Press the right selection key (INPUT) to enter the input screen for *PT 100*.

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

→ Press the up arrow key (+) to specify the individual digits of the value and switch to the next digit with the down arrow key (←).

→ When all input values have been specified, confirm by pressing the right selection key (OK) and jump back to the selection screen.

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

→ In the *CAL. USER* menu press the arrow keys to select the *copy FACT→USER* menu option 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.

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

25.7. *SIMULATION - in process ...*

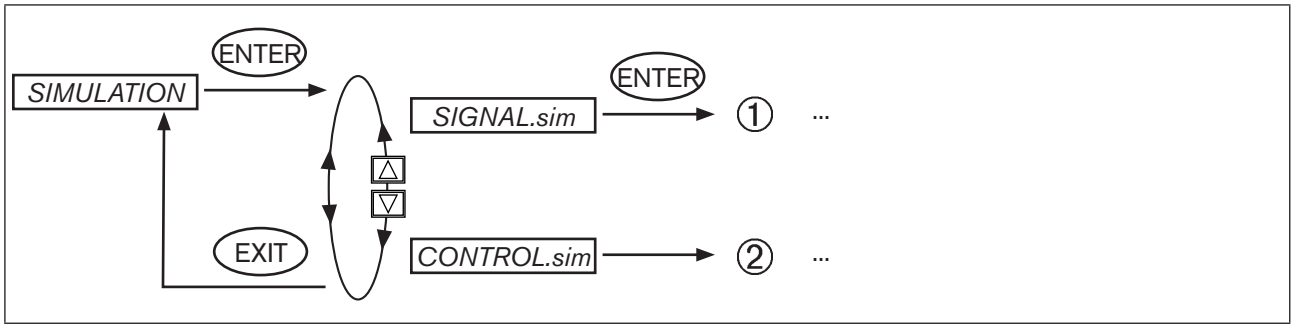


Figure 107: Operating structure SIMULATION

This chapter is in process!

PROFIBUS-DP

Table of 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	BUE2C630.GSD
Bitmap files	BUE2C630.BMP
PNO-ID	C630 Hex
Baudrate	max. 12 Mbaud (is set automatically by the positioner)
Sync and Freeze modes	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 entitled “31. Settings on the positioner”).

29. INTERFACES

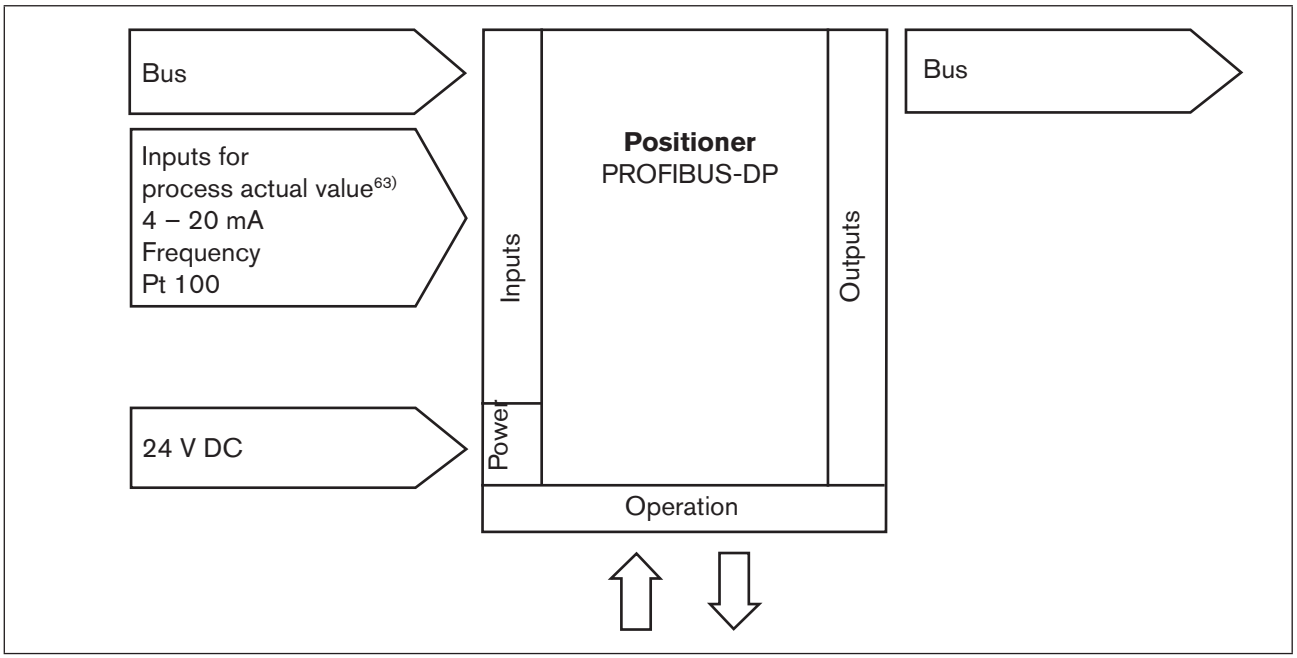


Figure 108: Interfaces PROFIBUS-DP

63) only for process controller Type 8693

30. ELECTRICAL CONNECTIONS

DANGER!

Danger - electrical voltage in the equipment!

There is a serious risk of injury when reaching into the equipment.

- Before starting work, always switch off the power supply and safeguard to prevent re-activation!

WARNING!

Danger - improper installation!

Improper installation may result in injuries as well as damage to the device and the area around it.

- Fluid and electrical installations may be carried out by authorised technicians only and with the appropriate tools!

Danger due to unintentional activation of the equipment!

Unintentional activation of the equipment during installation may result in injuries and damage.

- Take appropriate measures to prevent the equipment from being unintentionally activated.

→ For operation of the device always connect the 5-pole, inversely coded M12 round socket and the 4-pole M12 circular plug (supply voltage).

The connection module of Type 8692 and 8693 features a setscrew with nut which is used to connect the technical earth (see "Figure 109:").

→ Connect the setscrew to a suitable earthing point.
To ensure electromagnetic compatibility (EMC), ensure that the cable is as short as possible (max. 30 cm, Ø 1.5 mm²).

30.1. Connection diagram Type 8692

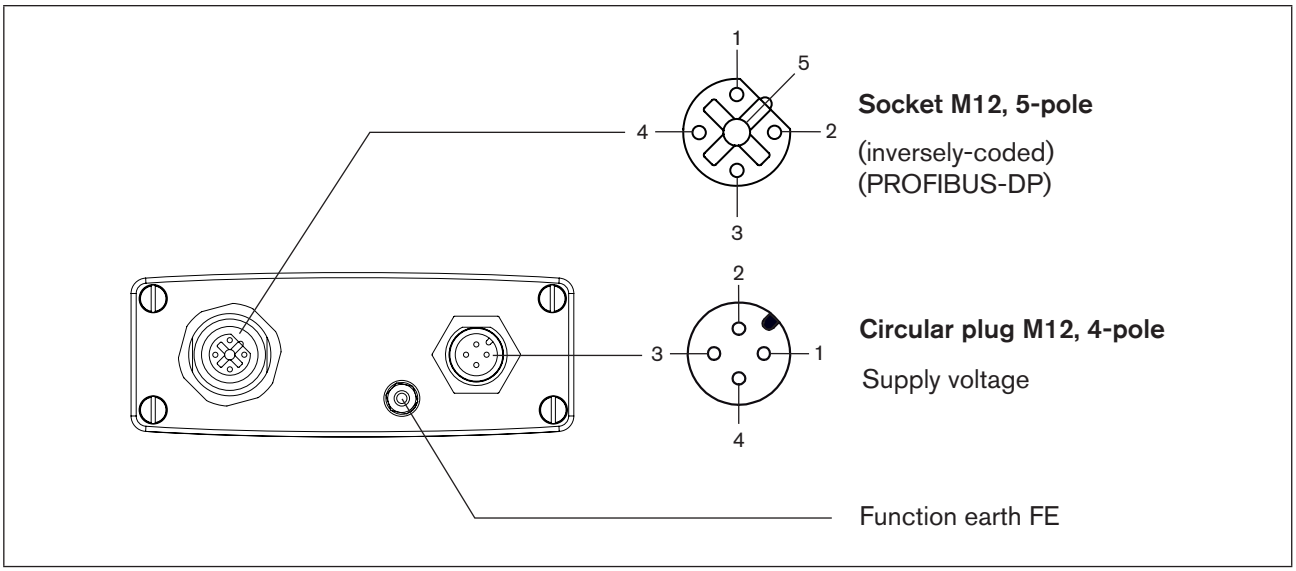


Figure 109: Connection PROFIBUS-DP - Type 8692

30.2. Connection diagram Type 8693

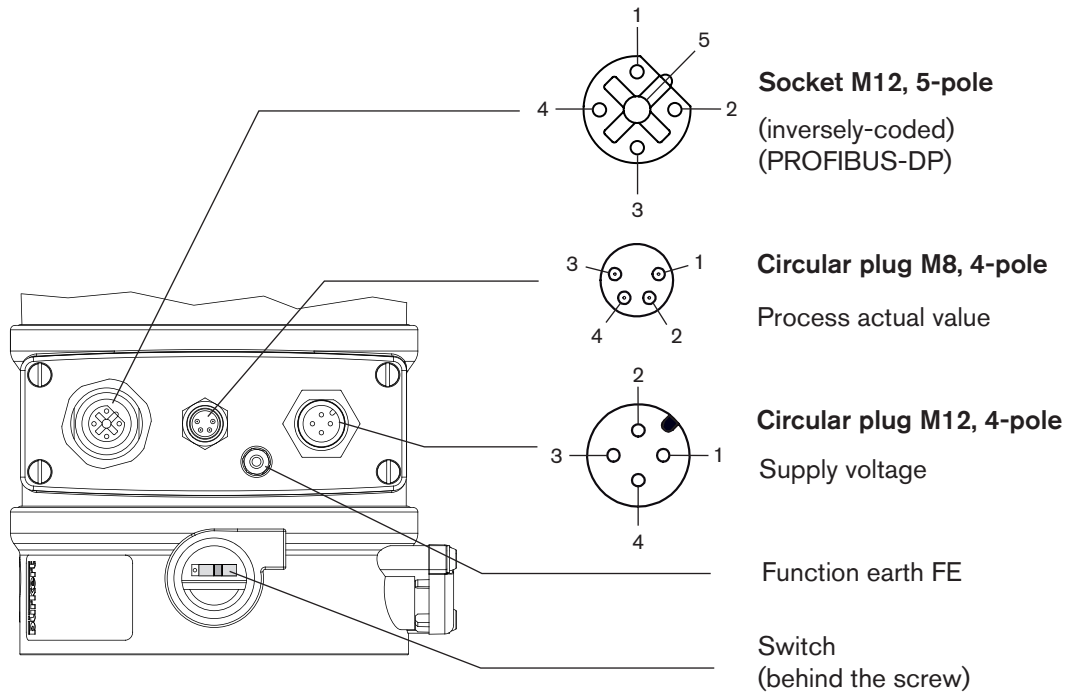


Figure 110: Connection PROFIBUS-DP - Type 8693

30.3. Supply voltage (circular plug M12, 4-pole)

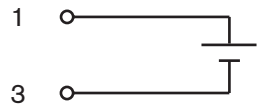
PIN	Configuration	External circuit
1	+ 24 V	 24 V DC ± 10 % max. residual ripple 10 %
2	not used	
3	GND	
4	not used	

Table 42: Supply voltage

30.4. Bus connection (round socket/plug M12, 5-pole)

PIN	Signal	External circuit
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 43: Bus Connection

30.5. Process actual value (circular plug M8, 4-pole) - only Type 8693

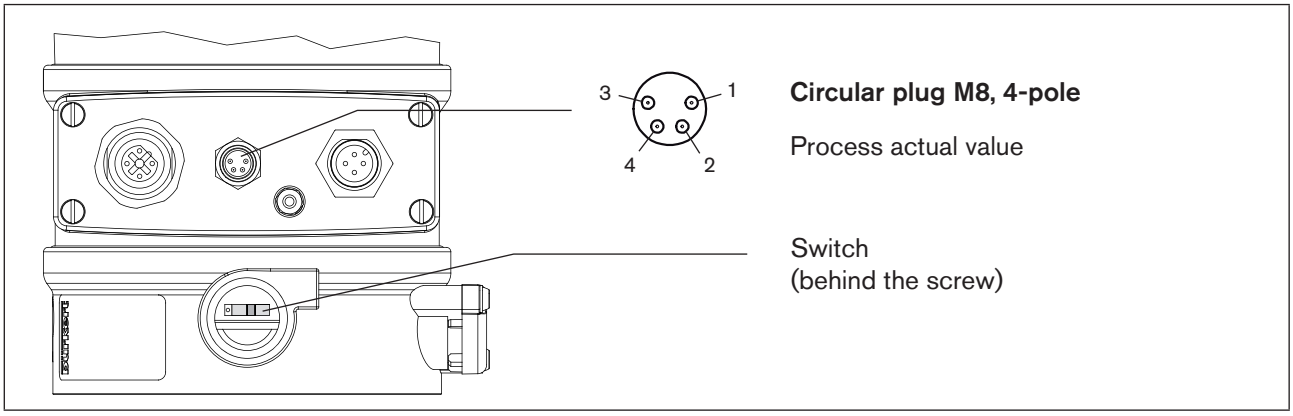


Figure 111: Connection - PROFIBUS-DP - Type 8693 - process actual value

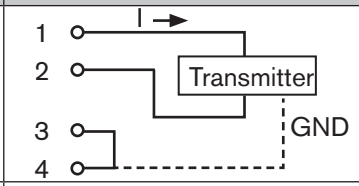
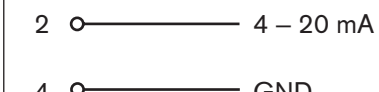
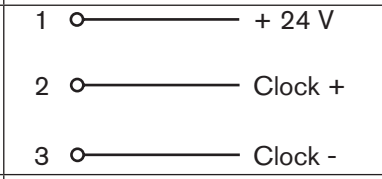
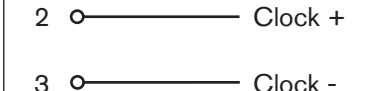
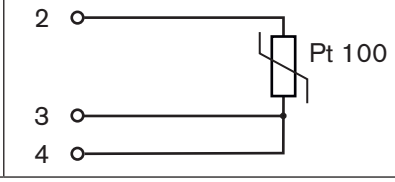
Input type[64]	Pin	Wire color[65]	Configuration	Switch[66]	External circuit
4 – 20 mA - internally supplied	1 2 3 4	brown white blue black	+ 24 V transmitter supply Output from transmitter GND Bridge after GND (GND from 3-wire transmitter)	Switch on left	
4 – 20 mA - externally supplied	1 2 3 4	brown white blue black	not assigned Process actual + not assigned Process actual -	Switch on right	
Frequency - internally supplied	1 2 3 4	brown white blue black	+ 24 V sensor supply Clock input + Clock input - (GND) not assigned	Switch on left	
Frequency - externally supplied	1 2 3 4	brown white blue black	not assigned Clock input + Clock input - not assigned	Switch on right	
Pt 100 (see information below)	1 2 3 4	brown white blue black	not assigned Process actual 1 (current feed) Process actual 2 (GND) Process actual 3 (compensation)	Switch on right	

Table 44: Process actual value - Type 8693

For reasons of wire compensation connect the Pt 100 sensor via 3 wires. Always bridge PIN 3 and PIN 4 on the sensor.

64) Can be adjusted by software (see chapter entitled "20.4. Procedure for specifying the basic settings")
65) The indicated colors refer to the connecting cable available as an accessory (92903474)
66) The switch is situated behind the screw (see "Figure 111: ")

31. SETTINGS ON THE POSITIONER

The specification of the basic settings on the positioner can be found in the following chapters:

- Type 8692: "20. Starting up and setting up the position controller Type 8692"
- Type 8693: "23. Starting up and setting up the process controller Type 8693"

→ Specify the basic settings on the positioner (*ACTUATOR* and *X.TUNE*).

→ Implement the settings in the BUS.COMM menu option as described in the chapter entitled "31.1 Explanations of the menu options in the BUS.COMM menu" .

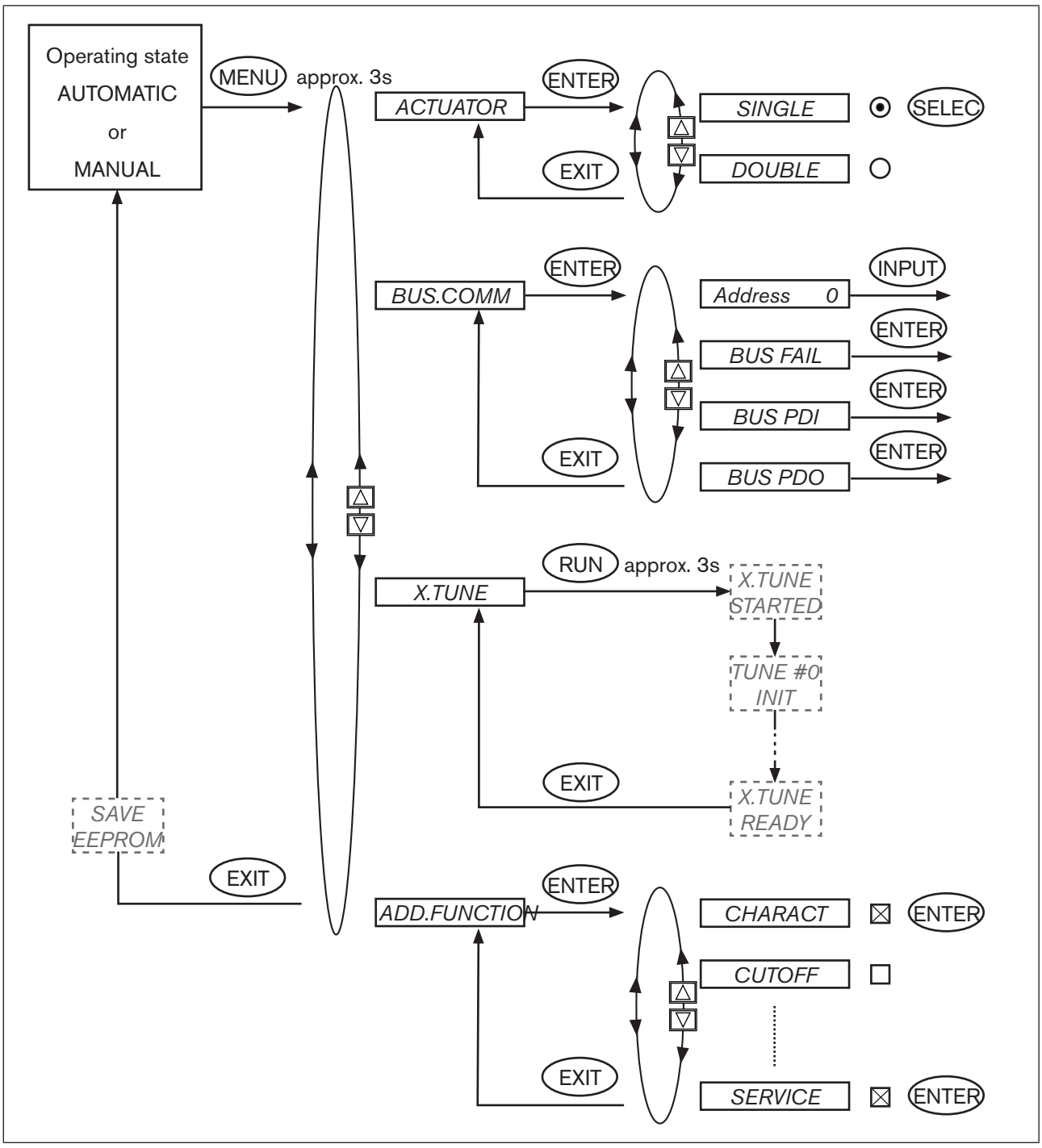


Figure 112: Operating structure - basic settings - PROFIBUS-DP

31.1. Explanations of the menu options in the *BUS.COMM* menu

31.1.1. BUS.COMM menu for Type 8692

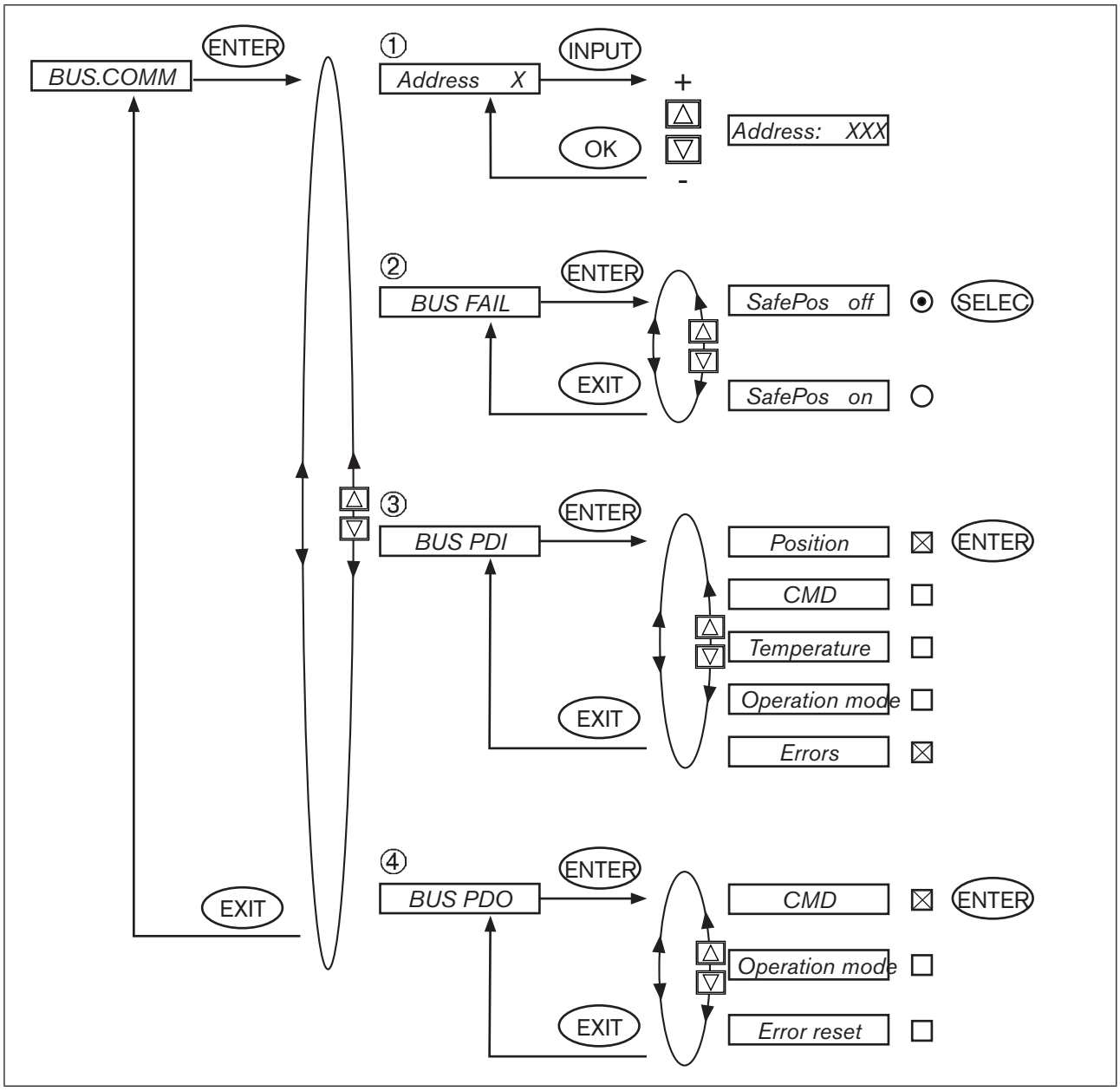


Figure 113: Operating structure - BUS-COMM

31.1.2. BUS.COMM menu for Type 8693

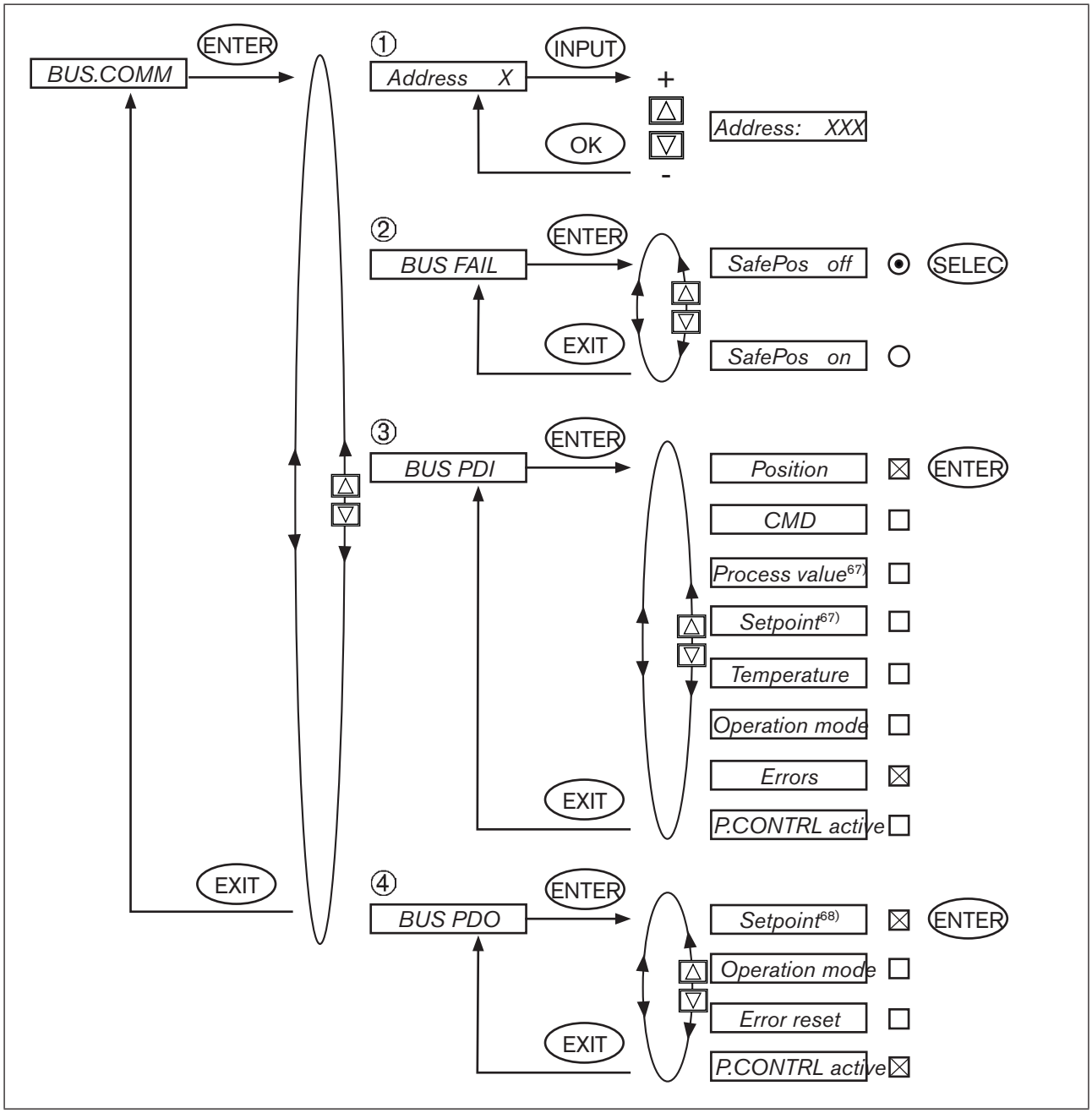


Figure 114: Operating structure - BUS-COMM - 8693

67) *only when process controller activated*
68) *only when process controller activated, otherwise CMD*

①	*Address XXX*	Input the device address Press the arrow keys (+/-) to set values from 0 – 126; Confirm by pressing the selection key on the right (OK).
②	*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	If *SafePos on* is set, the following configurations may occur: ▪ Active *SAFEPOS* menu option If a fault is detected in the bus communication, the drive moves to the lower *SAFEPOS* set position. ▪ Inactive *SAFEPOS* menu option If a fault is detected in the bus communication, the drive moves to the end position which it would specify in the isolated state.
③	*BUS PDI*	Selection of the process values which are to be transferred by the positioner to the controller (master). Press the selection key on the right (ENTER) either to activate (x) or deactivate ( ) the respective process value.
	Position	For meaning of the process values see table *PDI: Process Data Input.*
	CMD	
	Process value [69)]	
	Setpoint [69)]	
	Temperature	
	Operation mode	
	Errors	
	P.CONTRL active [70)]	
④	*BUS PDO*	Selection of the process values which are to be transferred by the controller (master) to the positioner. Press the selection key on the right (ENTER) either to activate (x) or deactivate ( ) the respective process value.
	CMD / Setpoint [69]	For meaning of the process values see table *PDO: Process Data Output.*
	Operation mode	
	Error reset	
	P.CONTRL active [70)]	

69) only for type 8693 and when process controller activated
70) only for type 8693

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

Firstly the PDI (Process Data Input) is input (from the positioner to the controller).

PDI:PV and *PDI:SP* can be selected for Type 8693 (process controller) only and are beneficial only when process controller activated.

PDI:PCONact can be selected for Type 8693 (process controller) only.

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	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	GSD file: *PDI:PV* Identifier (HEX): 41, 40, 02
PDI:SP	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: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* 10: *P.TUNE* 1: *MANUAL* 12: *BUSSAFEPOS* 2: *XTUNE* 9: *P.QLIN*	GSD file: *PDI:MODE* Identifier (HEX): 41, 00, 05
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 (8692) 1: Process controller (8693)	GSD file: *PDI:PCONact* Identifier (HEX): 41, 00, 0A

Table 45: Process Data Input

Then the process data output is input (from the controller to the positioner).

PDO: **Process Data Output**

(From the controller to the positioner)

Name	Description	Identifier
PDO:CMD /SP	**For position controller Type 8692:** Nominal 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 8693:** 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* 12: *BUSSAFEPOS* 1: *MANUAL* 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 (8692) 1: Process controller (8693)	GSD file: *PDO:CONact* Identifier (HEX): 81, 00, 19

Table 46: Process Data Output

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? ▪ Power supply and bus connection of the other nodes correct?

Table 47: Bus status display

35. CONFIGURATION WITH SIEMENS STEP7

35.1. Example 1 for a position controller (Type 8692): transfer of nominal and actual values

Procedure:

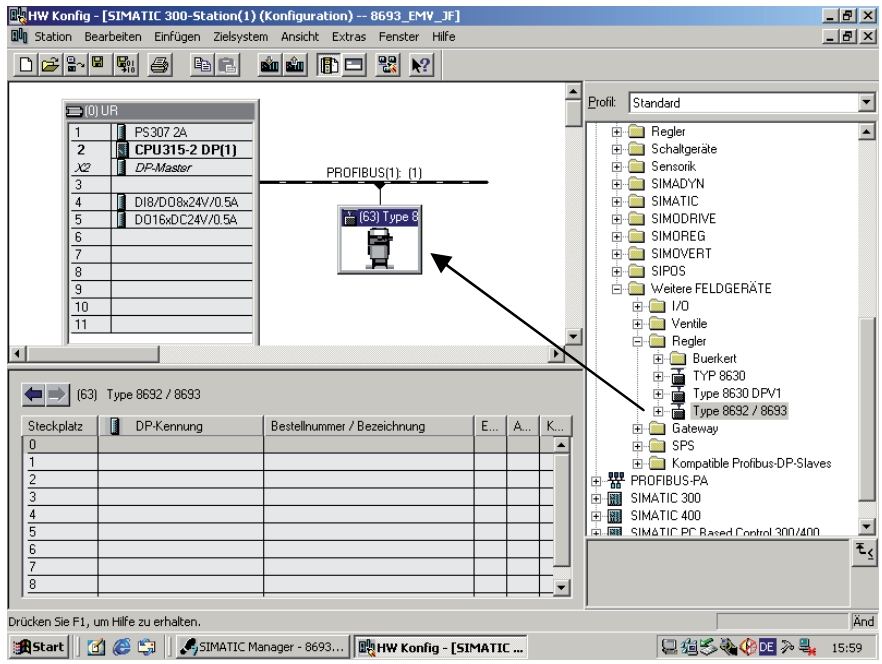


Figure 115: Screenshot of Profibus Fig. 1

→ pull the slave *Type 8692 / 8693* by Drag & Drop to the bus line.

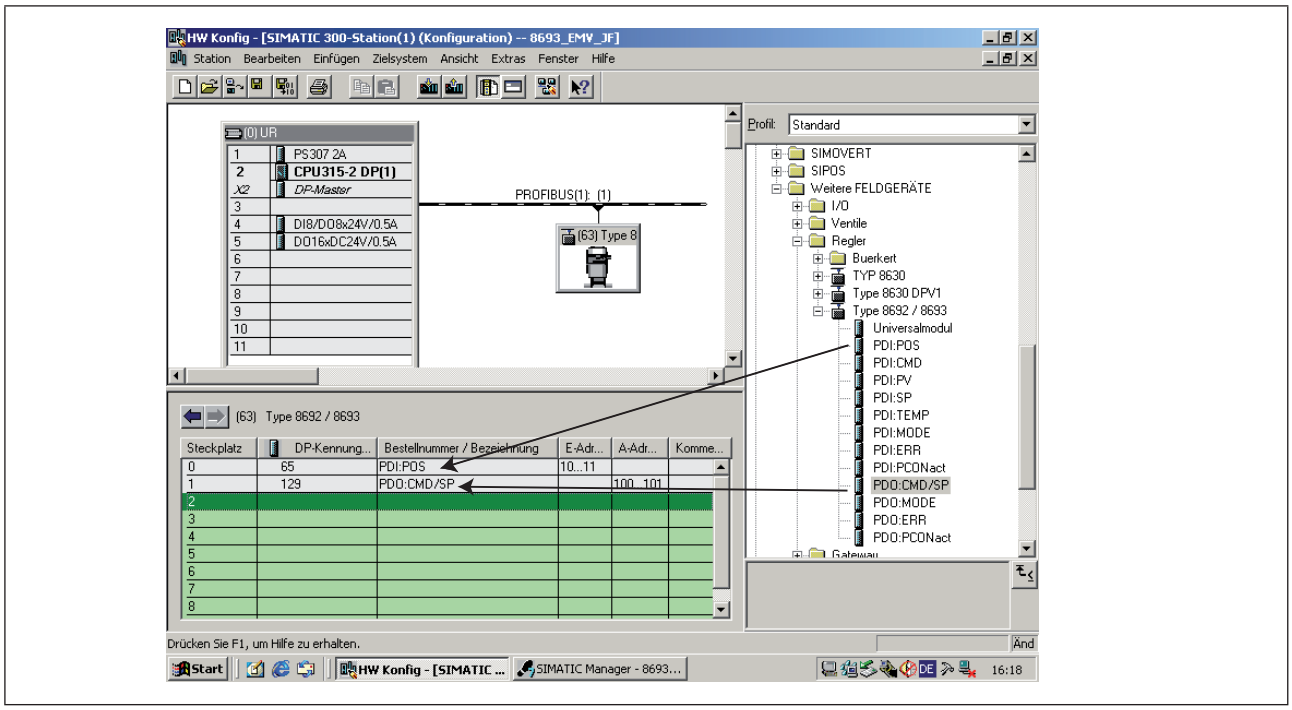


Figure 116: Screenshot of position controller Fig. 2

→ pull the modules PDI:POS and PDO:CMD/SP into the slave Type 8692 / 8693 by Drag & Drop.

35.2. Example 2 for a position controller (Type 8693): transfer of several process values.

Procedure as in example 1.

→ pull the slave Type 8692 / 8693 by Drag & Drop to the bus line.

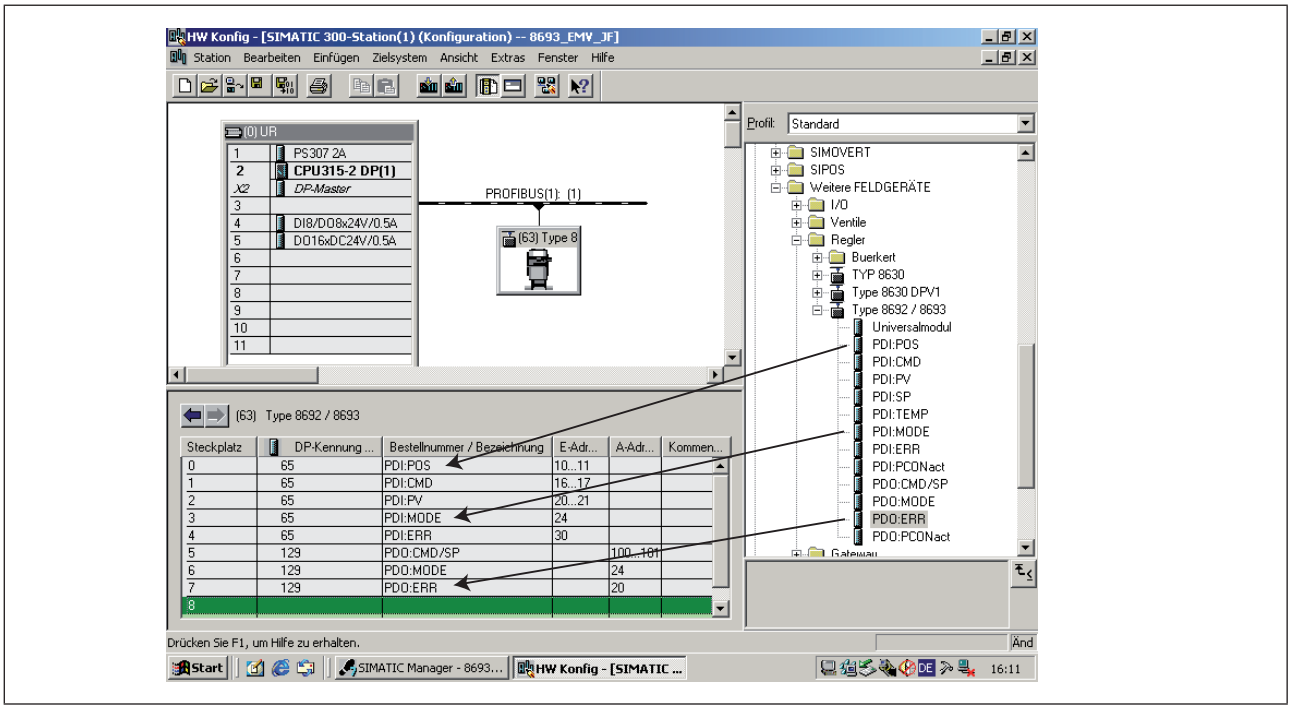


Figure 117: Screenshot of position controller Fig. 3

→ pull the modules into the slave Type 8692 / 8693 by Drag & Drop.

DeviceNet

Table of contents

36. GENERAL INFORMATION

The following sections of the general operating instructions do not apply to the DeviceNet variant of the positioner 8692 / 8693:

- 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*

37. DEFINITION OF TERMS

DeviceNet

- The DeviceNet is a field bus system which is based on the CAN protocol (Controller Area Network). It enables actuators and sensors (slaves) to be networked with higher-level controllers (master).
- The positioner in the DeviceNet is a slave device according to the Predefined Master/Slave Connection Set stipulated in the DeviceNet specification. Polled I/O, Bit Strobed I/O and Change of State (COS) are supported as an I/O connection variant.
- With DeviceNet it is necessary to differentiate between cyclical or event-driven high-priority process messages (I/O Messages) and acyclical low-priority management messages (Explicit Messages).
- The protocol process conforms to the **DeviceNet specification Release 2.0.**

38. TECHNICAL DATA

EDS file BUER8692.EDS

Icons BUER8692.ICO

Baudrate 125 kbit/s, 250 kbit/s, 500 kbit/s (can be adjusted by pressing operator keys on the device or via network);
Factory setting 125 kbit/s

Address 0 – 63; (can be adjusted by pressing operator keys on the device or via network);
Factory setting 63

Process data 7 static input assemblies
(Input: from the positioner to the DeviceNet master/scanner)
4 static output assemblies

Total line length according to DeviceNet Specification

(Total line length = total of all trunk and drop lines)

Baudrate	Maximum total line length	
	Thick cable	Thin cable
125 kbaud	500 m	100 m for all baudrates
250 kbaud	250 m	
500 kbaud	100 m	

Table 48: Total line length

Drop line length

Baudrate	Length of the drop lines	
	Maximum length	Maximum total length Drop lines in the network
125 kbaud	6 m for all baudrates	156 m
250 kbaud		78 m
500 kbaud		39 m

Table 49: Drop line length

39. SAFETY SETTINGS IF THE BUS FAILS

If the bus fails, the position is approached which corresponds to the set-point value last transferred (default setting).

Other setting options (see chapter entitled "42. Settings on the positioner").

40. INTERFACES

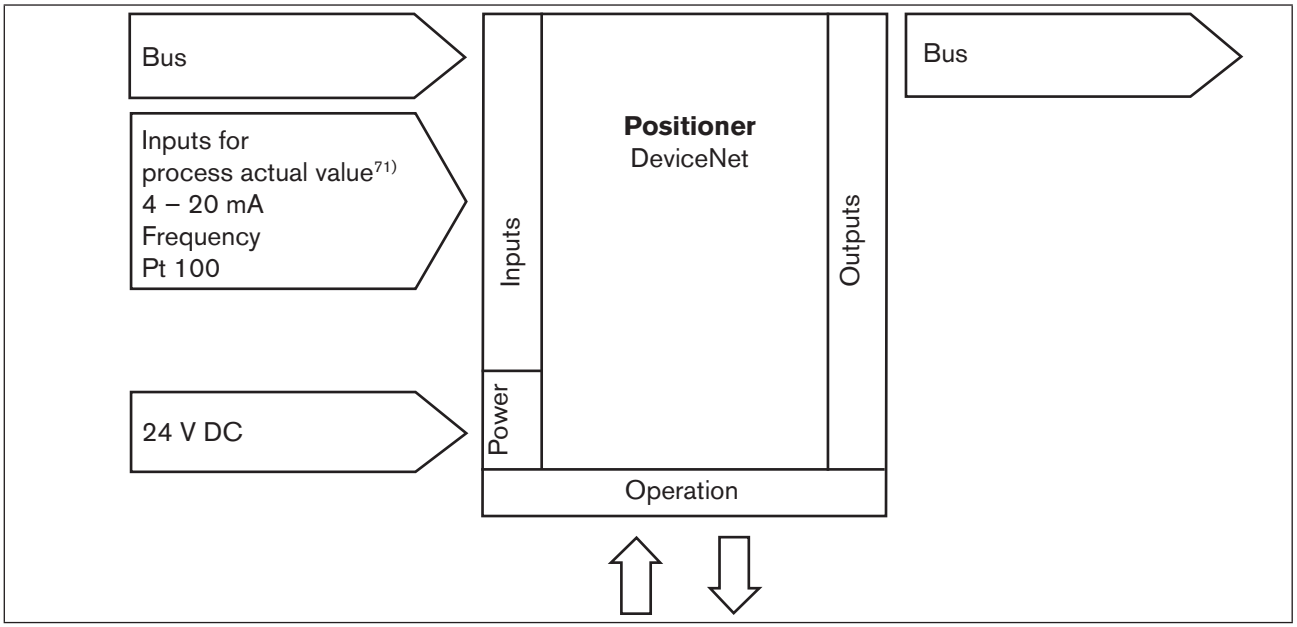


Figure 118: DeviceNet interfaces

71) *only for process controller Type 8693*

41. ELECTRICAL CONNECTIONS

DANGER!

Danger - electrical voltage in the equipment!

There is a serious risk of injury when reaching into the equipment.

- Before starting work, always switch off the power supply and safeguard to prevent re-activation!

WARNING!

Danger - improper installation!

Improper installation may result in injuries as well as damage to the device and the area around it.

- Fluid and electrical installations may be carried out by authorised technicians only and with the appropriate tools!

Danger due to unintentional activation of the equipment!

Unintentional activation of the equipment during installation may result in injuries and damage.

- Take appropriate measures to prevent the equipment from being unintentionally activated.

→ For operation of the device always connect the 5-pole (bus) and the 4-pole M12 circular plug (supply voltage).

The connection module of Type 8692 and 8693 features a setscrew with nut which is used to connect the function earth (see “Figure 119: “).

→ Connect the setscrew to a suitable earthing point.
To ensure electromagnetic compatibility (EMC), ensure that the cable is as short as possible (max. 30 cm, Ø 1.5 mm²).

41.1. Connection diagram Type 8692

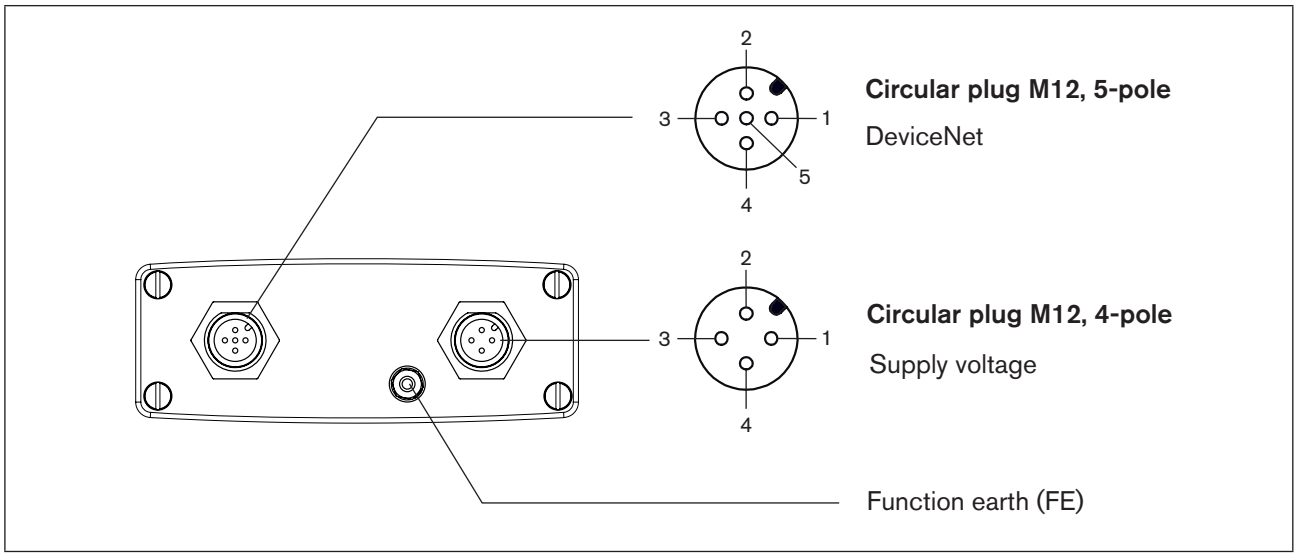


Figure 119: Connection of DeviceNet - Type 8692

41.2. Connection diagram Type 8693

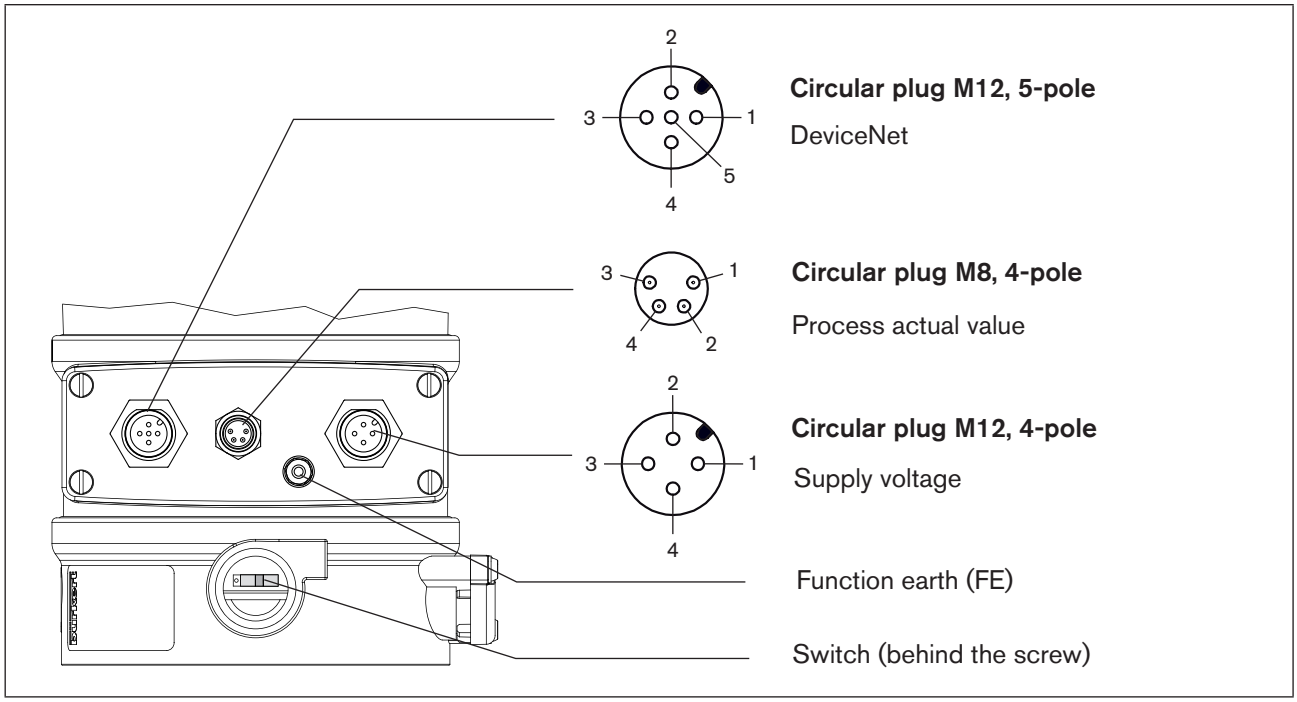


Figure 120: Connection of DeviceNet - Type 8693

The supply voltage to the device is not supplied via the DeviceNet voltage V+ und V-, but via the supply voltage galvanically isolated from the DeviceNet.

41.3. Supply voltage (circular plug M12, 4-pole)

PIN	Configuration	External circuit
1	+ 24 V	 24 V DC ± 10 % max. residual ripple 10 %
2	not used	
3	GND	
4	not used	

Table 50: Supply voltage

41.4. Bus connection (circular plug M12, 5-pole)

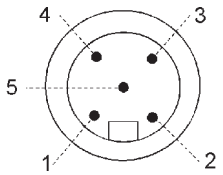
PIN	Signal	Colour	
1	Shielding	not used	
2	V +	not used	
3	V-	not used	
4	CAN H	white	
5	CAN L	blue	

Table 51: Bus connection

41.5. Process actual value (circular plug M8, 4-pole) - only Type 8693

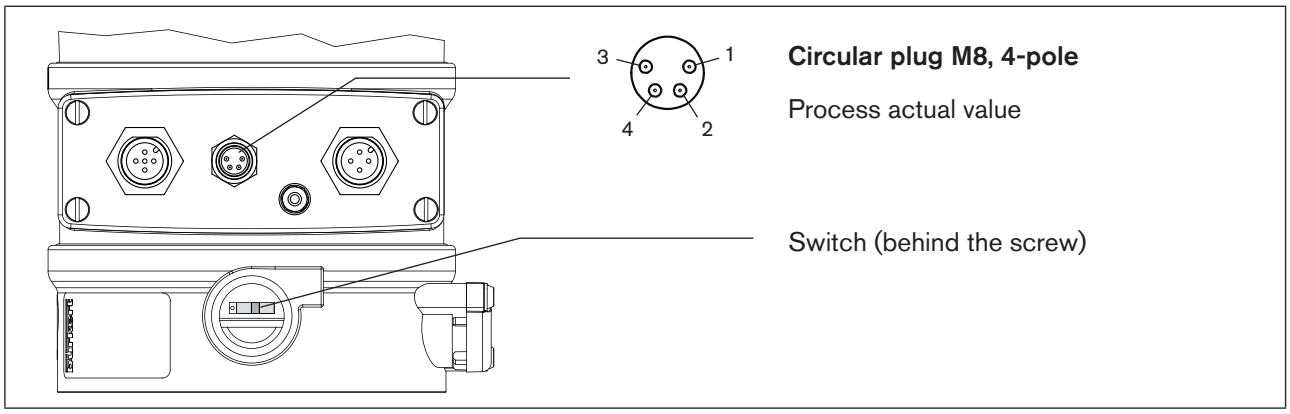


Figure 121: Connection DeviceNet - Process actual value - Type 8693

Input type[72]	Pin	Wire color[73]	Configuration	Switch[74]	External circuit
4 – 20 mA - internally supplied	1 2 3 4	brown white blue black	+ 24 V transmitter supply Output from transmitter GND Bridge after GND (GND from 3-wire transmitter)	Switch on left	1 2 3 4 Transmitter GND
4 – 20 mA - externally supplied	1 2 3 4	brown white blue black	not assigned Process actual + not assigned Process actual -	Switch on right	2 — 4 – 20 mA 4 — GND
Frequency - internally supplied	1 2 3 4	brown white blue black	+ 24 V sensor supply Clock input + Clock input - (GND) not assigned	Switch on left	1 — + 24 V 2 — Clock + 3 — Clock -
Frequency - externally supplied	1 2 3 4	brown white blue black	not assigned Clock input + Clock input - not assigned	Switch on right	2 — Clock + 3 — Clock -
Pt 100 (see information below)	1 2 3 4	brown white blue black	not assigned Process actual 1 (current feed) Process actual 2 (GND) Process actual 3 (compensation)	Switch on right	2 Pt 100 3 4

Table 52: Process actual value

For reasons of wire compensation connect the Pt 100 sensor via 3 wires.
Always bridge PIN 3 and PIN 4 on the sensor.

72) Can be adjusted by software.
73) The indicated colors refer to the connecting cable available as an accessory (92903474)
74) The switch is situated behind the srew (see "Figure 121 : ").

41.6. Terminating circuit for DeviceNet systems

When installing a DeviceNet system, ensure that the terminating circuit of the data lines is correct. The circuit prevents the occurrence of interference caused by signals reflected onto the data lines. The trunk line must be terminated at both ends with resistors of 120 Ω each and 1/4 W power loss.

(see “Figure 122: Network topology, DeviceNet”)

41.7. Network topology of a DeviceNet system

Line with one trunk line and several drop lines.

Trunk lines and drop lines consist of identical material (see diagram).

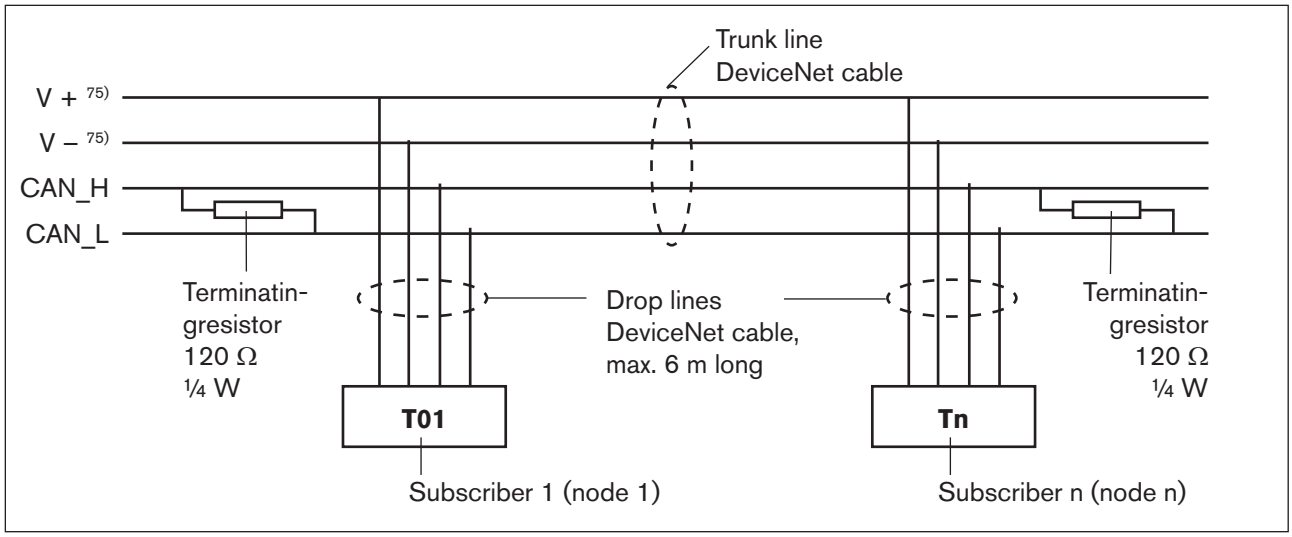


Figure 122: Network topology, DeviceNet

75) not assigned, as separate supply voltage

42. SETTINGS ON THE POSITIONER IN THE MAIN MENU

The specification of the basic settings on the positioner can be found in the following chapters:

- Type 8692: "20. Starting up and setting up the position controller Type 8692"
- Type 8693: "23. Starting up and setting up the process controller Type 8693"

→ Specify the basic settings on the positioner (*ACTUATOR* and *X.TUNE*).

→ Implement the settings in the BUS.COMM menu option as described in the chapter entitled "42.1 Explanations of the menu options in the BUS.COMM" menu.

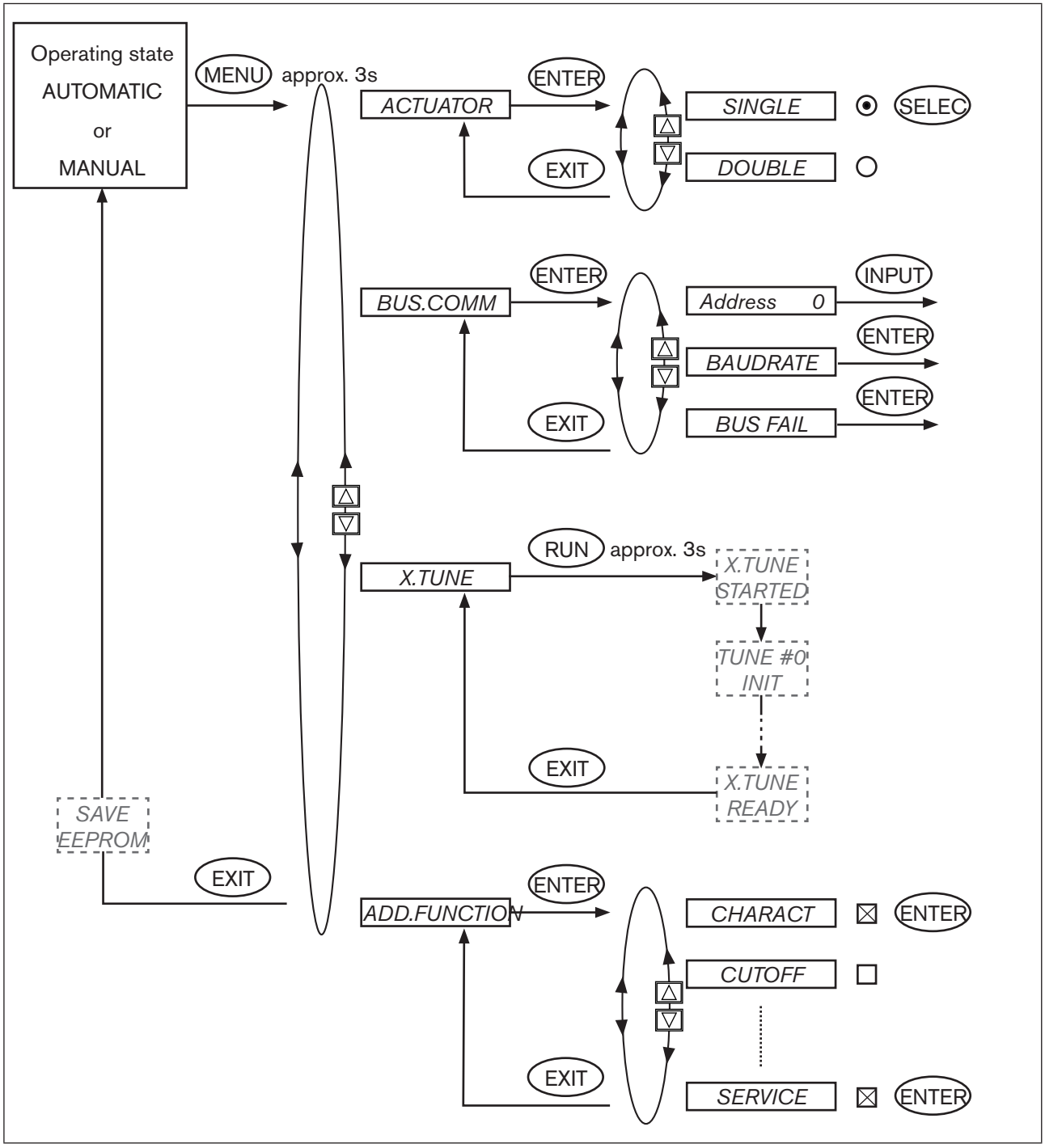


Figure 123: Operating structure of basic settings, DeviceNet

42.1. Explanations of the menu options in the *BUS.COMM* menu

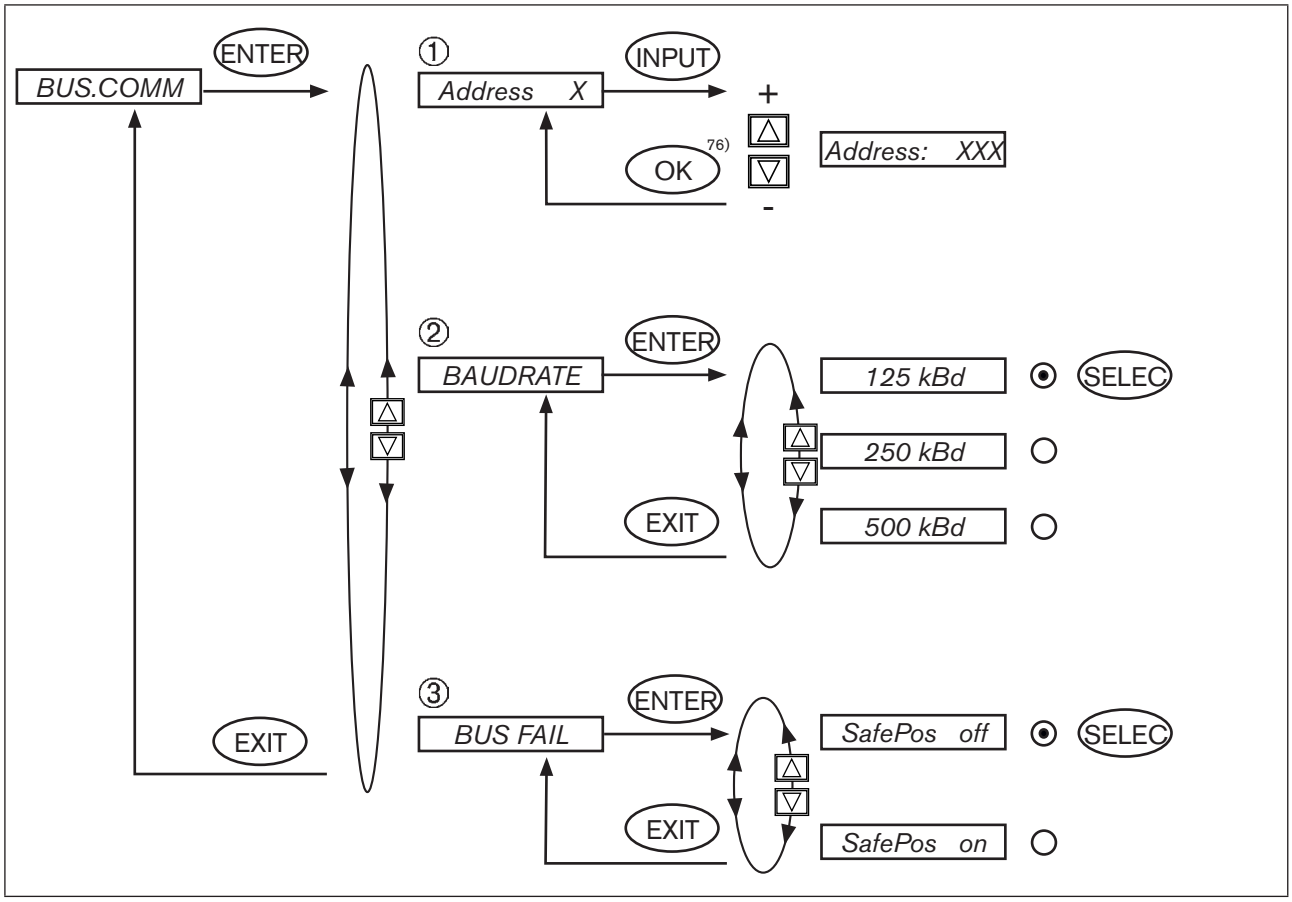


Figure 124: Operating structure - BUS-COMM - DeviceNet

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

①	*Address XXX*	Input the device address Press the arrow keys (+/-) to set values from 0 – 63; Confirm by pressing the selection key on the right (OK).
②	*BAUDRATE* *SafePos off* *SafePos on*	The baudrate can be changed either by pressing the operator keys on the device or via the bus. In either case a change has no effect until a reset (send a reset message to the identity object) or power up is implemented. This means if the changed baudrate attribute is accessed before a reset or power up, the read (changed) value does not agree with the still current baudrate (to be changed) of the network. Select 125 kbit/s, 250 kbit/s or 500 kbit/s
③	*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	If *SafePos on* is set, the following configurations may occur: ▪ Active *SAFEPOS* 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.

43. 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.

44. CONFIGURATION OF THE PROCESS DATA

To **transmit process data** via an I/O connection, 5 static input and 2 static output assemblies can be selected. These assemblies contain selected attributes combined into one object so that process data can be transmitted collectively via an I/O connection.

The **process data** is selected by setting the device parameters Active Input Assembly and Active Output Assembly or - if supported by the DeviceNet-Master/Scanner - by setting Produced Connection Path and Consumed Connection Path when an I/O connection is initialised according to the DeviceNet specification.

44.1. Static input assemblies

Name	Address of data attribute of the assemblies for read access. Class, Instance, Attribute	Format of the data attribute
POS+ERR (factory setting)	4, 1, 3	Byte 0: POS low Byte 1: POS high Byte 2: ERR
POS+CMD+ERR	4, 2, 3	Byte 0: POS low Byte 1: POS high Byte 2: CMD low Byte 3: CMD high Byte 4: ERR
PV+ERR	4, 3, 3	Byte 0: PV low Byte 1: PV high Byte 2: ERR
PV+SP+ERR	4, 4, 3	Byte 0: PV low Byte 1: PV high Byte 2: SP low Byte 3: SP high Byte 4: ERR
PV+SP+CMD+ERR	4, 5, 3	Byte 0: PV low Byte 1: PV high Byte 2: SP low Byte 3: SP high Byte 4: CMD low Byte 5: CMD high Byte 6: ERR

Table 53: Static input assemblies

The addresses indicated in the Static Input Assemblies table can be used to specify a path for the Produced Connection Path attribute of an I/O connection, whereby the attributes described in more detail in the following table can be transferred as input process data via this I/O connection. Nevertheless, by using this address data, the attributes combined in the assemblies can also be accessed acyclically via Explicit Messages .

Name	Description of the input data attributes	Attribute Address Class, Instance, Attribute; Data type, Length
POS	Actual position Actual value of position controller as ‰. Value range 0–1000. However, values <0 or >1000 also possible if e.g. Autotune has not run through correctly.	111, 1, 59; INT, 2 byte
CMD	Nominal position Set-point value of position controller as ‰. Value range 0–1000.	111, 1, 58; UINT, 2 byte
PV [77)]	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.	120, 1, 3; INT, 2 byte
SP [77)]	Process set-point value 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.	120, 1, 2; INT, 2 byte
ERR	Error Indicates the number of the process value (output) which was not written. The value is retained until it is deleted with “1” by acyclically writing the “Error” attribute (access via Explicit Message – Set Attribute Single). HEX 0X14 INP 0X15 SP	100, 1, 1; USINT, 1 byte

Table 54:

77) *relevant only for type 8693 and when process controller activated.*

44.2. Static output assemblies

Name	Address of data attribute of the assemblies for read access. Class, Instance, Attribute	Format of the data attribute
INP (factory setting)	4, 21, 3	Byte 0: INP low Byte 1: INP high
SP	4, 22, 3	Byte 0: SP low Byte 1: SP high

Table 55: Static output assemblies

The addresses indicated in the *Static Output Assemblies* table can be used to specify a path for the *Consumed Connection Path* attribute of an I/O connection, whereby the attributes described in more detail in the following table can be transferred as output process data via this I/O connection. Nevertheless, by using this address data, the attributes combined in the assemblies can also be accessed acyclically via *Explicit Messages* .

Name	Description of the output data attributes	Attribute Address Class, Instance, Attribute; Data type, Length
INP	Nominal position Set-point value of position controller as ‰. Value range 0–1000. In "pure" position controller mode (*P.CONTRL* inactive) the transfer of the nominal position *INP* is required; as a process controller (*PCONTRL* active) the transfer of *INP* is not possible. If the value is too small or too large, the last valid value is used and is indicated in *ERR* with HEX 14.	111, 1, 58; UINT, 2 byte
SP [78)]	Process set-point value 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 15.	120, 1, 2; INT, 2 byte

Table 56:

78) *relevant only for type 8693 and when process controller activated.*

45. 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, 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 no 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 57: Bus status display

46. CONFIGURATION EXAMPLE 1

The example describes the principle procedure when configuring the device using the software *RSNetWorx for DeviceNet* (Rev. 4.12.00).

46.1. Installation of the EDS file

The EDS file supplied on the CD is installed with the aid of the EDS Installation Wizard Tool associated with RSNetWorx.

During the installation procedure the icon also supplied on CD can be assigned (if this does not occur automatically).

46.2. Address assignment

There are two options of assigning an address to the devices.

On the one hand the address can be set by pressing the operator keys on the device to the required value within the range 0 – 63 (see chapter entitled "42. Settings on the Positioner in the Main Menu"), on the other hand the address can be changed from connected devices via the bus with the aid of the Node Commissioning Tool associated with RSNetWorx. Therefore devices with the default address 63 can also be inserted sequentially into an existing network without difficulty.

"Figure 125: " indicates how the new address 2 is assigned to a device with address 63.

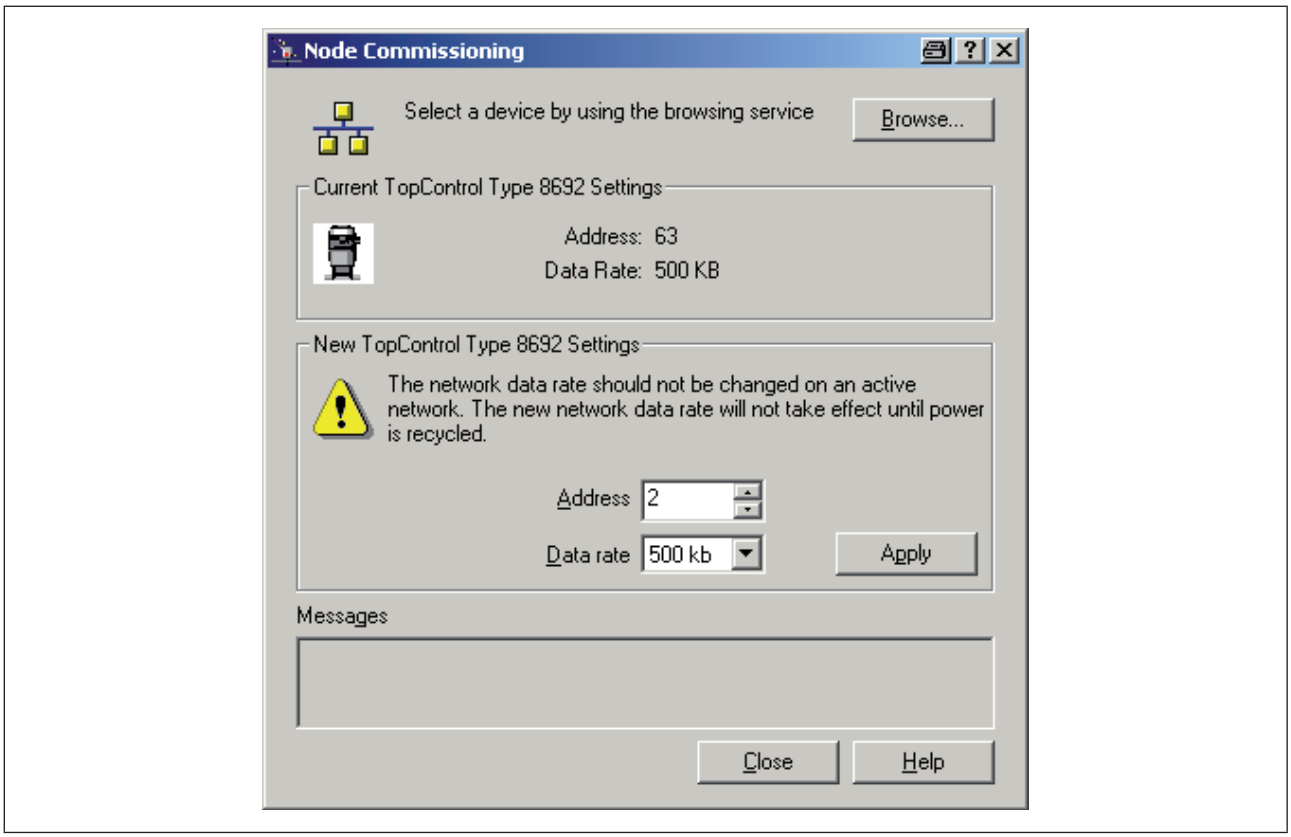


Figure 125: Screenshot - DeviceNet - Figure 1

46.3. Offline parameterization of the device

When a device has been inserted into the DeviceNet configuration of *RSNetWorx*, the device can be parameterized offline.

"Figure 126:" indicates how, for example, an input assembly which deviates from the factory setting (input process data can be transferred via I/O connection) can be selected. However, ensure that the length of the process data during a subsequent configuration of the DeviceNet master/scanner is adjusted accordingly (see chapter entitled "47. Configuration Example 2").

All parameter changes implemented offline must become operative for the real device at a later date by a download process.

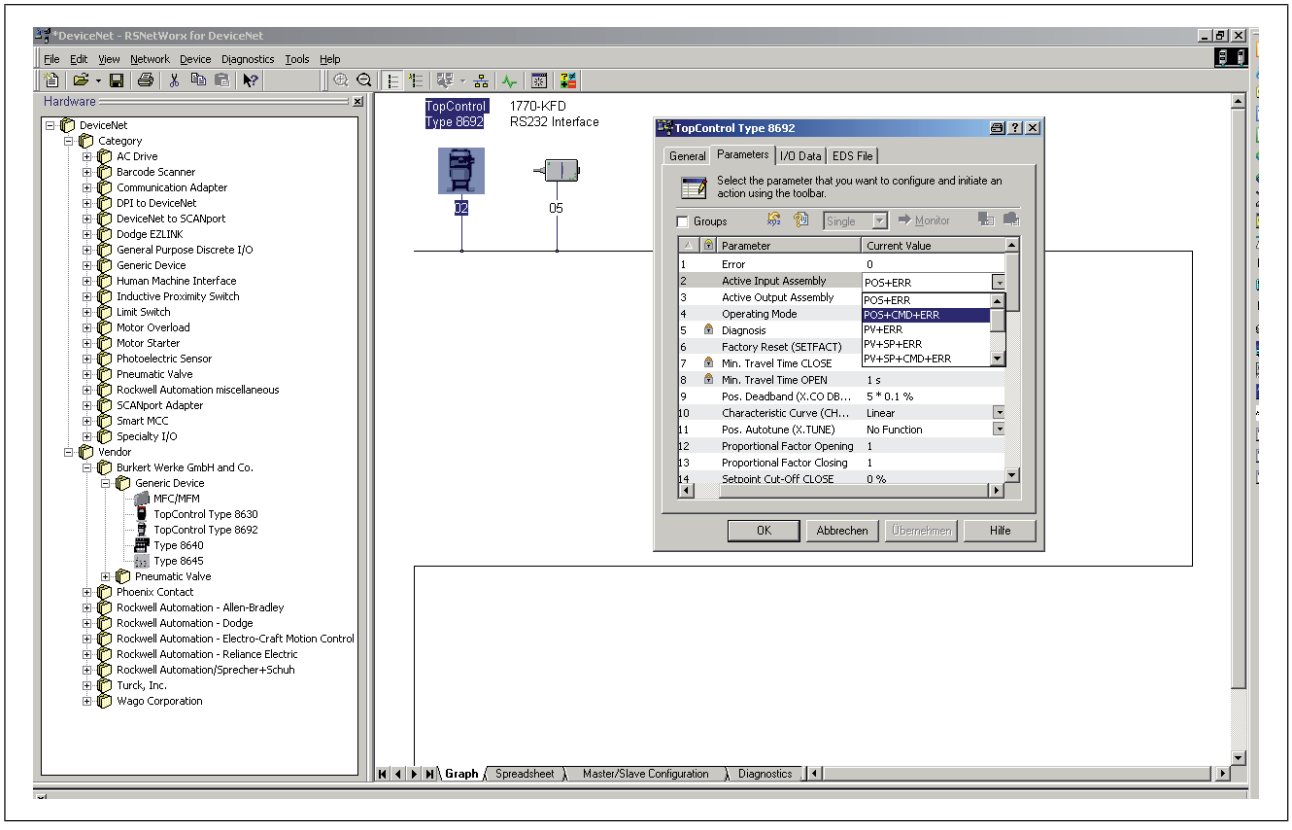


Figure 126: Screenshot - DeviceNet - Figure 2

46.4. Online parameterization of the device

Devices can also be parameterized online. In doing so, you can also select whether only individual parameters (single) or all parameters (all) of a group are read from the device (upload) or are loaded into the device (download).

It is also possible to transfer individual parameters or all parameters of a group cyclically in monitor mode. This may be helpful particularly for start-up purposes.

"Figure 127:" indicates the group of the process values or diagnosis information. If *Monitor* is actuated, these values are updated cyclically. However, Explicit Messages are used for this cyclical access (no I/O connections).

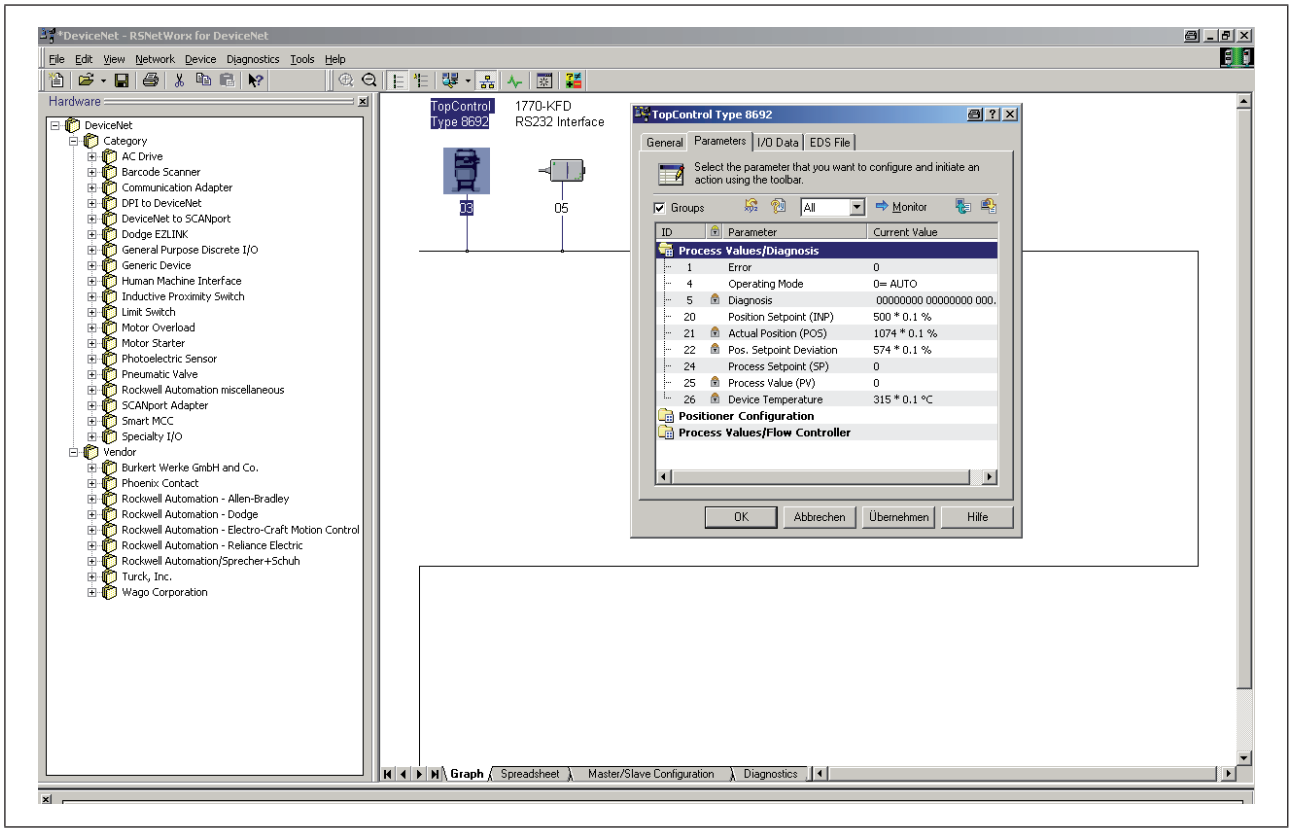


Figure 127: Screenshot - DeviceNet - Figure 3

47. CONFIGURATION EXAMPLE 2

This example describes the principle procedure for setting up the process image of a DeviceNet master/scanner using the software *RSNetWorx for DeviceNet* (Rev. 4.12.00).

Setting up the *scan list* and setting the I/O parameters

First of all the *scan list* of the DeviceNet master/scanner is set up. To do this, the devices listed in the left part of the corresponding window are included in the scan list in the right part of the window. Then the I/O parameters can be changed for each device included in the scan list. This is required if assemblies which differ from the default settings were selected during configuration of the positioner in question.

"Figure 128: " indicates the setting of the I/O parameters when

Input Assembly *POS+CMD+ERR* (5 bytes long) is selected and when

Output Assembly *INP* (2 bytes long; Default Assembly - no change required) is selected

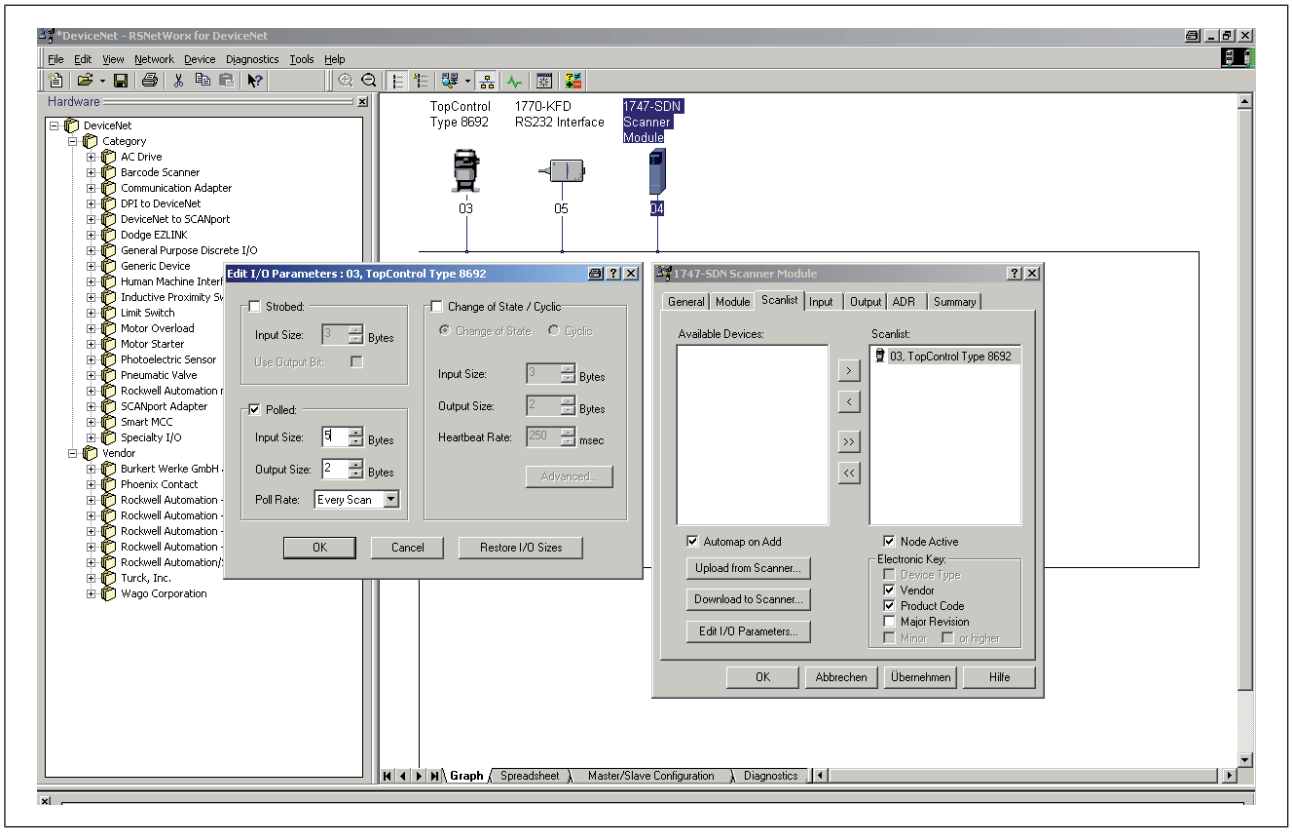


Figure 128: Screenshot - DeviceNet - Figure 4

47.1. Setting up the process image (mapping)

The *AUTOMAP* function is used to assign the input data of the devices specified in the scan list to the process image of the DeviceNet master/scanner.

Our example of the assignment is indicated in “Figure 129: ”.

For example the input process values of the positioner with address 3 are assigned to the internal addresses of the scanner as follows:

Actual position	I:1.1
Nominal position	I:1.2
Error	I:1.3

Therefore, if the actual position of the positioner with address 3 is to be read from a control program, this is done by accessing I:1.1.

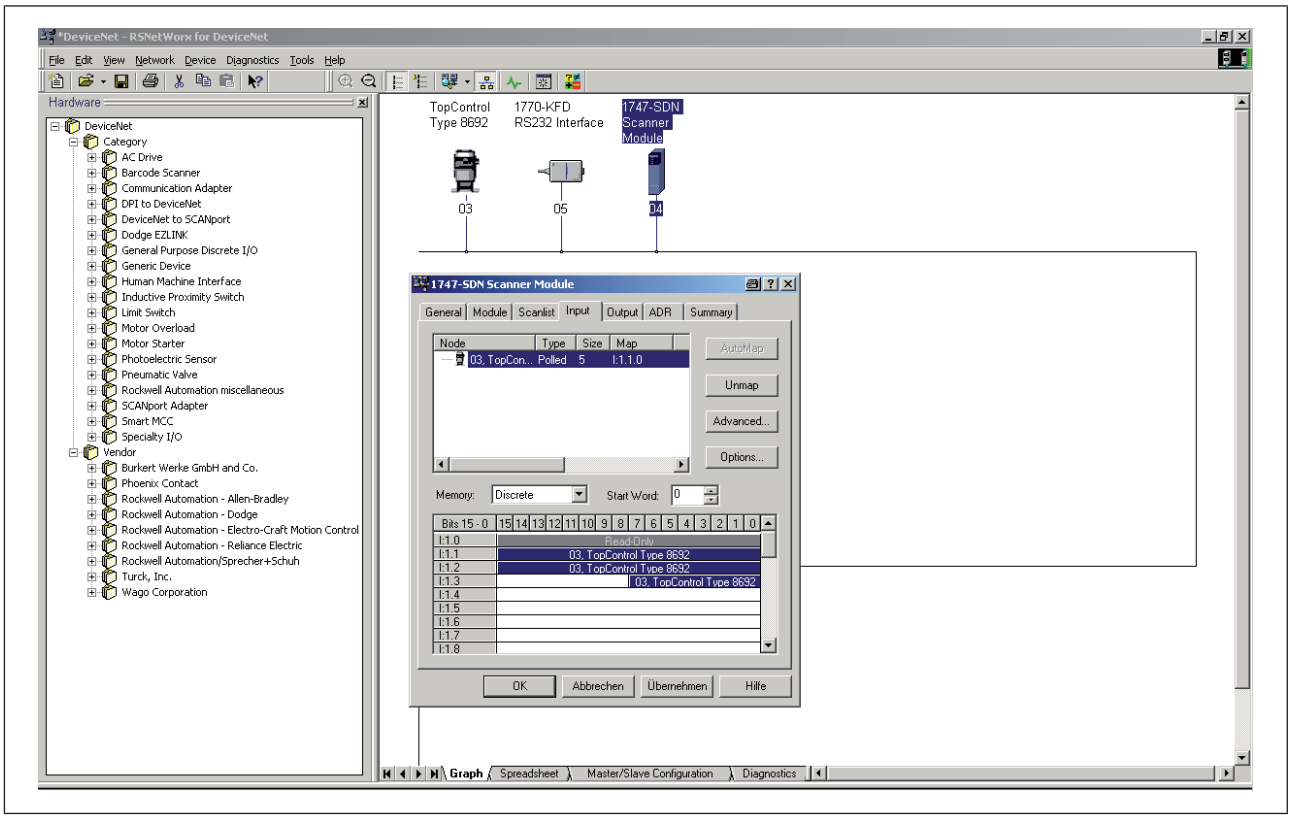


Figure 129: Screenshot - DeviceNet - Figure 5

Maintenance and troubleshooting

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48. MAINTENANCE

48.1. Safety instructions

DANGER!

Danger – high pressure in the equipment!

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

Risk of injury due to electrical shock!

- Before reaching into the system, 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 maintenance!

- Maintenance may be performed by authorised technicians only!

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

- Secure system from unintentional activation.
- Following maintenance, ensure a controlled restart.

48.2. Service at the air intake filter

DANGER!

Risk of injury from high pressure in the equipment!

- Before dismounting pneumatic lines and valves, turn off the pressure and vent the lines.

To protect the internal solenoid valves and the actuator, the pilot air is filtered.

The direction of flow of the air intake filter in installed state is from the inside to the outside through the filter material.

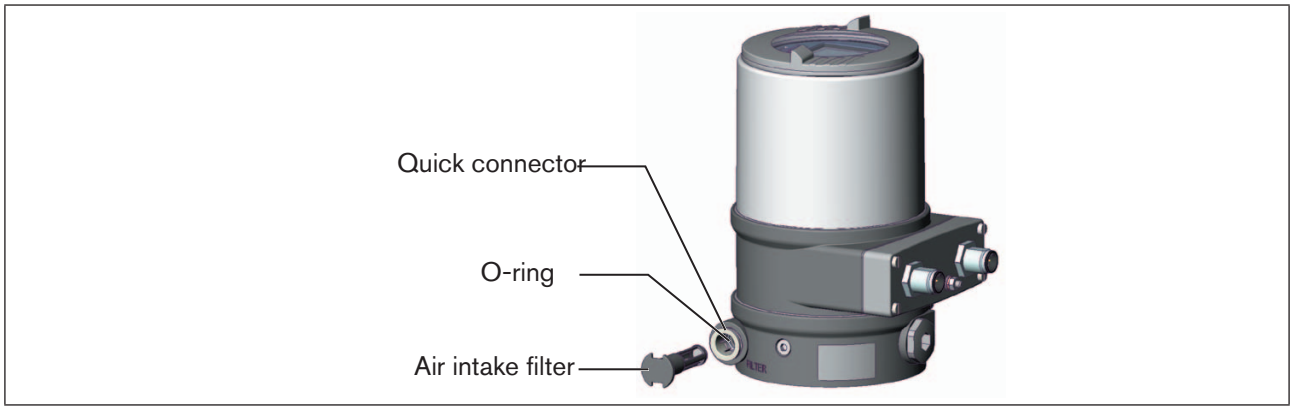

Figure 130: Service on the air intake filter

Procedure:

→ Unlock the quick connector by pressing the holding element and pulling out the air intake filter (if necessary, use a suitable tool in between the recesses in the head of the filter).

→ Clean the filter or, if necessary, replace the filter.

→ Check inner O-ring and, if required, clean.

→ Insert the air intake filter all the way into the quick connector.

DANGER!

Risk of injury due to improper installation!

- Ensure that the air intake filter is installed correctly.

→ Check that the air intake filter is secure.

49. ERROR MESSAGES AND MALFUNCTIONS TYPE 8692

49.1. Error messages on the display

49.1.1. General error messages

Display	Causes of error	Remedial action
	Minimum input value has been reached	Do not reduce value further
	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 [79)]	Field bus board defective	
invalid code	Incorrect access code	Input correct access code

Table 58: General error messages, Type 8692

79) *only field bus*

49.1.2. Error 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 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.

*Table 59: Error messages **X.TUNE**, Type 8692*

49.2. Other malfunctions

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 60: Other Malfunctions, Typ 8692

50. ERROR MESSAGES AND MALFUNCTIONS TYPE 8693

50.1. Error messages on the display

50.1.1. General error messages

Display	Causes of error	Remedial action
	Minimum input value has been reached	Do not reduce value further
	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
PT 100 error	Signal error Actual value Pt 100	Check signal
EEPROM fault	EEPROM defective	not possible, device defective
MFI fault [80)]	Field bus board defective	
invalid code	Incorrect access code	Input correct access code

Table 61: General error messages, Type 8693

80) only field bus

50.1.2. Error 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 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.

Table 62: Error messages X.TUNE, Type 8693

50.1.3. Error messages while the *P.Q'LIN* function is running

Display	Causes of error	Remedial action
P.Q LIN ERROR 1	No compressed air connected No change to process variable	Connect compressed air 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* ▪ Autotune was not run.	Check compressed air supply Run *X.TUNE*

Table 63: Error messages P.Q'LIN, Type 8693

50.1.4. Error messages while the *P.TUNE* function is running

Display	Causes of error	Remedial action
P.TUNE ERROR 1	No compressed air connected	Connect compressed air
	No change to process variable	Check process and, if required, switch on pump or open the shut-off valve. Check process sensor.

Table 64: Error messages P.TUNE, Type 8693

50.1.5. 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 65: Error messages DeviceNet, Type 8693

On PROFIBUS-DP:

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 66: Error messages PROFIBUS-DP; Type 8693

50.2. Other malfunctions

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 67: Other malfunctions Type 8693

Demontage

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51. DISASSEMBLY

51.1. Safety instructions

DANGER!

Risk of injury from high pressure!

- Before dismounting pneumatic 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!

WARNING!

Risk of injury from improper disassembly!

- Disassembly 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 disassembly, ensure a controlled restart.

51.2. Disassembly the positioner

Procedure:

1. Pneumatic connection

DANGER!

Risk of injury from high pressure!

- Before dismounting pneumatic lines and valves, turn off the pressure and vent the lines.

→ Loosen the pneumatic connection.

→ Series 20xx:
Loosen the pneumatic connection between positioner and actuator.

2. Electrical connection

DANGER!

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!

Circular plug-in connector:

→ Loosen the circular plug-in connector.

Cable gland:

→ Unscrew the 4 screws on the cover and remove the cover.

→ Unscrew the screw terminals and pull out cables.

→ Close the positioner.

3. Mechanical connection

→ Loosen the fastening screws.

→ Remove the positioner upwards.

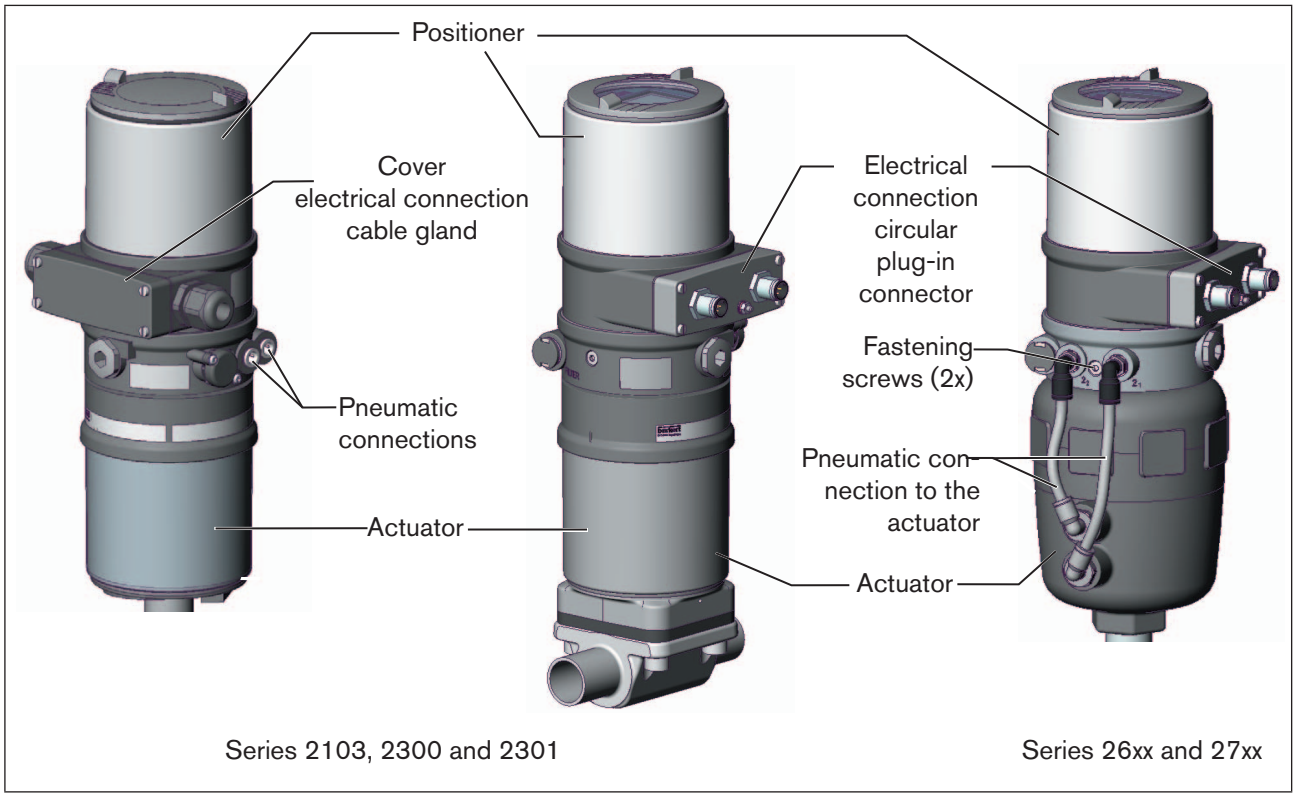

Figure 131: Disassembly the positioner

Packaging, storage and disposal

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52. 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 the effects of heat and cold which could result in temperatures above or below the permitted storage temperature.

53. STORAGE

NOTE!

Incorrect storage may damage the device.

- Store the device in a dry and dust-free location!
- Storage temperature -20 – +65°C.

54. 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 the relevant disposal and environmental protection regulations.

Note:

Observe national waste disposal regulations.

Accessories

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55. ACCESSORIES

Designation	Order no.
Connection cable M12 x 1, 8-pole, 2 m assembled cable	919 061
Connection cable M12 x1, 4-pole, 5 m assembled cable	918 038
Silencer G1/8	780 779
Silencer, push-in connector	902 662

Table 68: Accessories

General Rules (Appendix)

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56. 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 nominal width 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 Δp = 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 Q_{ma} 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 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 also be > 0.1 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.

57. PROPERTIES OF PID CONTROLLERS

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

57.1. P portion

Function:

$$T_v = 0{,}42 \cdot T_u$$

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

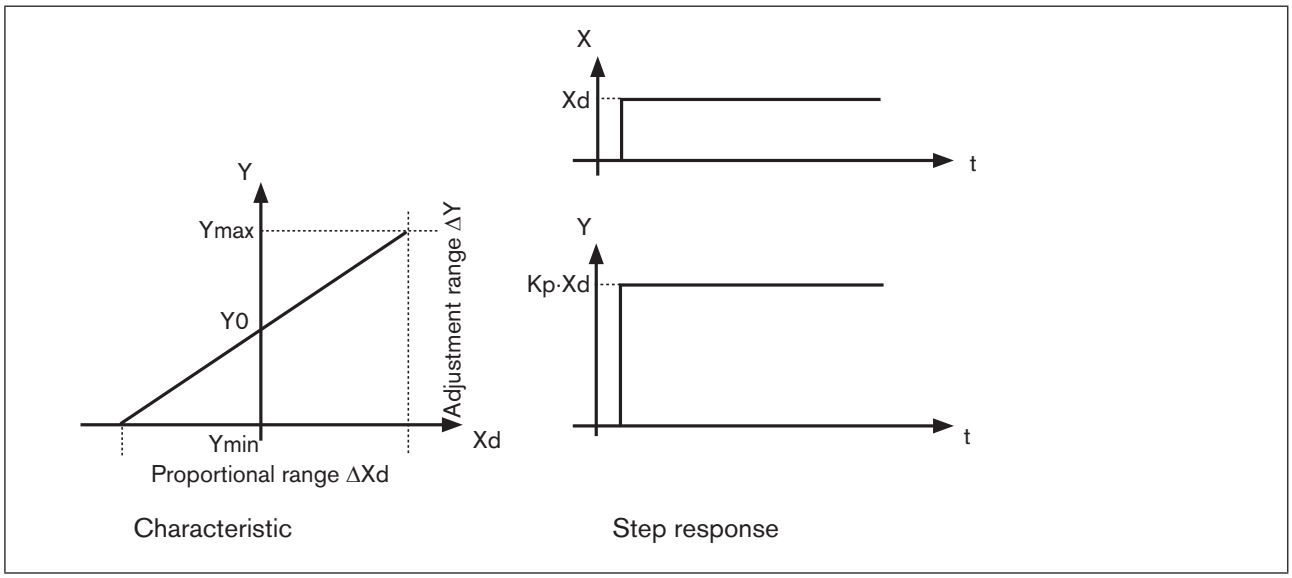

Figure 132: Characteristic and step response of the P portion of a PID controller

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.

57.2. I portion

Function:

$$Y = \frac{1}{Ti} \int X \, d \, dt \qquad (5)$$

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

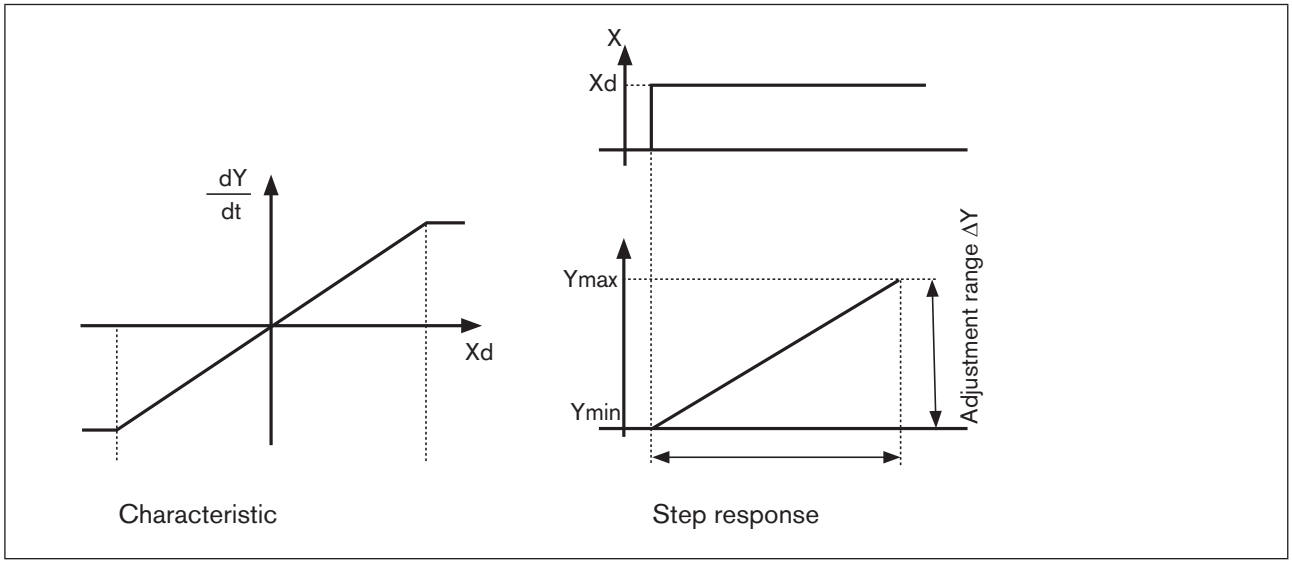

Figure 133: Characteristic and step response of the I portion of a PID controller

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.

57.3. D portion

Function:

$$Y = K_d \cdot \frac{dX_d}{dt} \qquad (6)$$

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

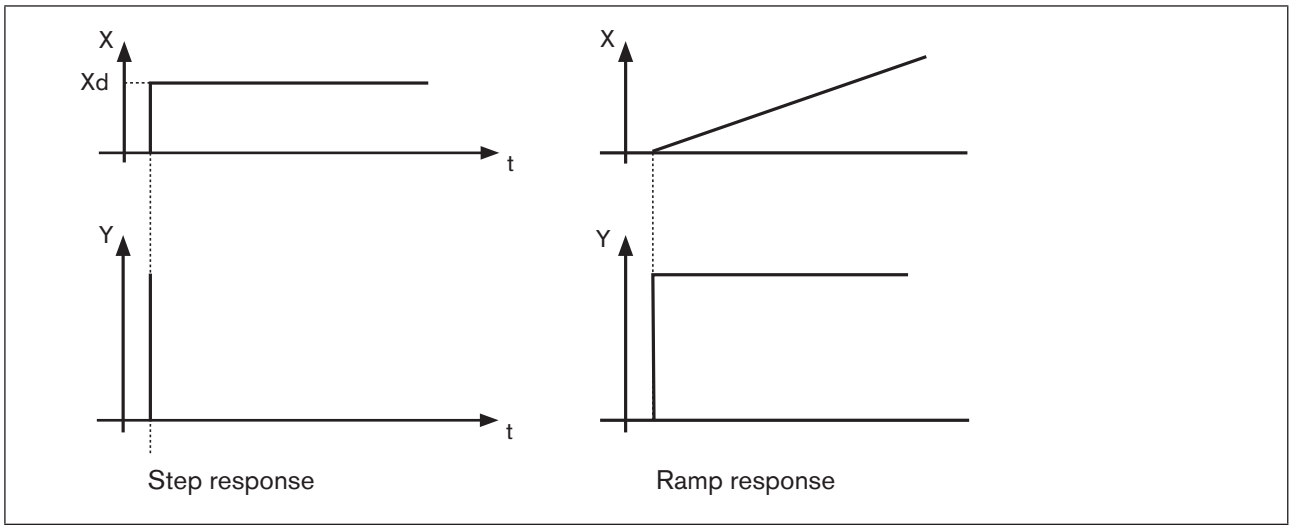

Figure 134: Characteristic and step response of the D portion of a PID controller

Properties

A controller with a D portion responds to changes in the control variable and may therefore reduce any control differences more quickly.

57.4. 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 · Ti = Tn and Kd/Kp = Tv the **function of the PID controller** is calculated according to the following equation:

$$Y = Kp \cdot \left(Xd + \frac{1}{Tn}\int Xd\,dt + Tv\frac{dXd}{dt}\right) \qquad (8)$$

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 with 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

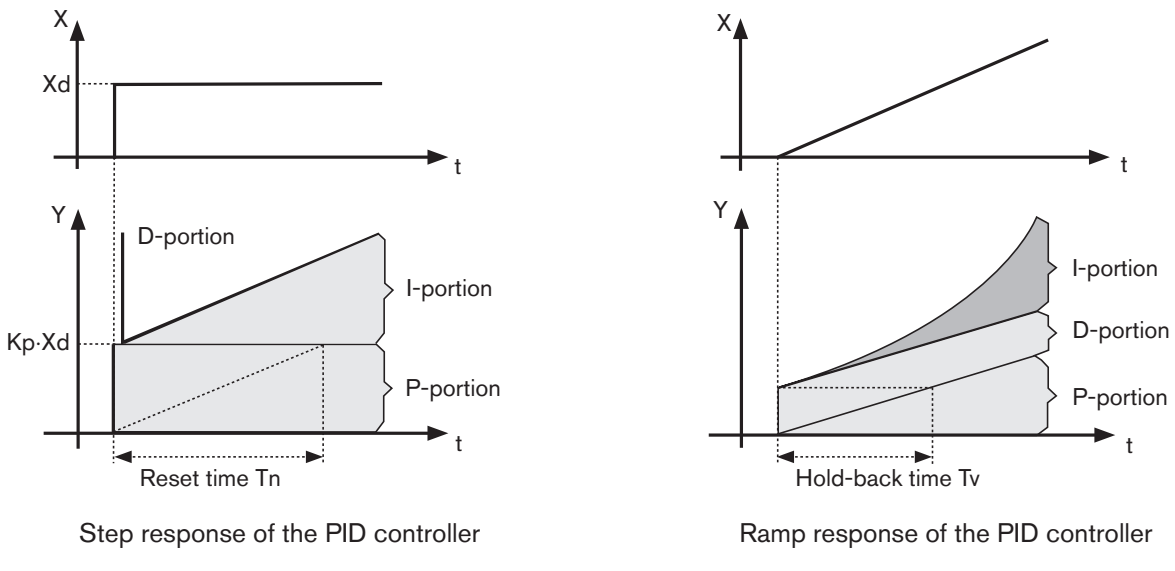

Figure 135: Characteristic of step response and ramp response of PID controller

57.5. Implemented PID controller

57.5.1. D portion with delay

In the process controller of the positioner the D portion is implemented with a delay T.

Function:

$$T \cdot \frac{d\,Y}{d\,t} + Y = K\,d \cdot \frac{d\,X\,d}{d\,t} \qquad (9)$$

Superposition of P, I and DT Portions

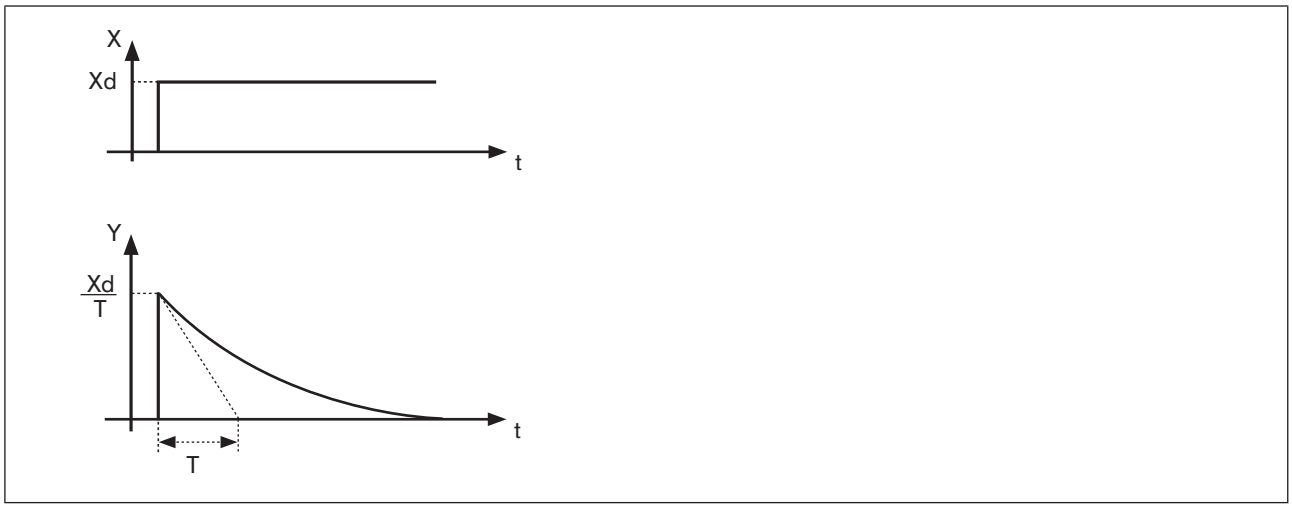

Figure 136: Characteristic of superposition of P, I and DT Portions

57.5.2. 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

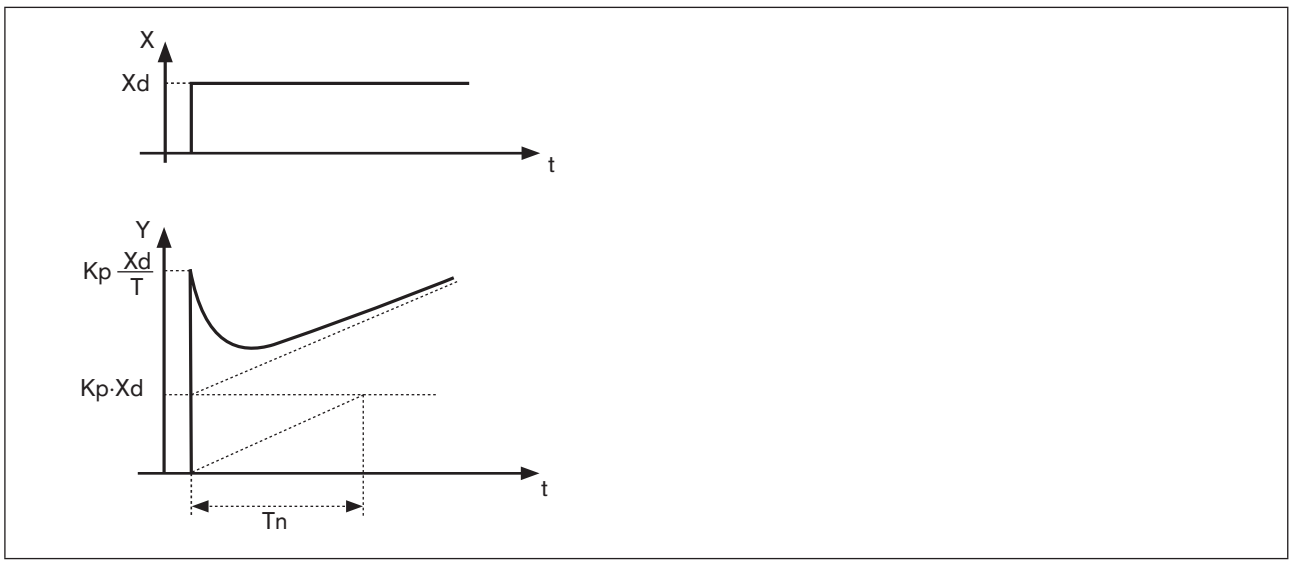

Figure 137: Characteristic of step response of the real PID controller

58. ADJUSTMENT RULES FOR PID CONTROLLERS

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, spielt dabei eine Rolle, whether a change in the disturbance variable or command variable is to be corrected.

58.1. 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

→ Set controller as P-controller (i.e. Tn = 999, Tv = 0), first select a low value for Kp

→ Set required set-point value

→ 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

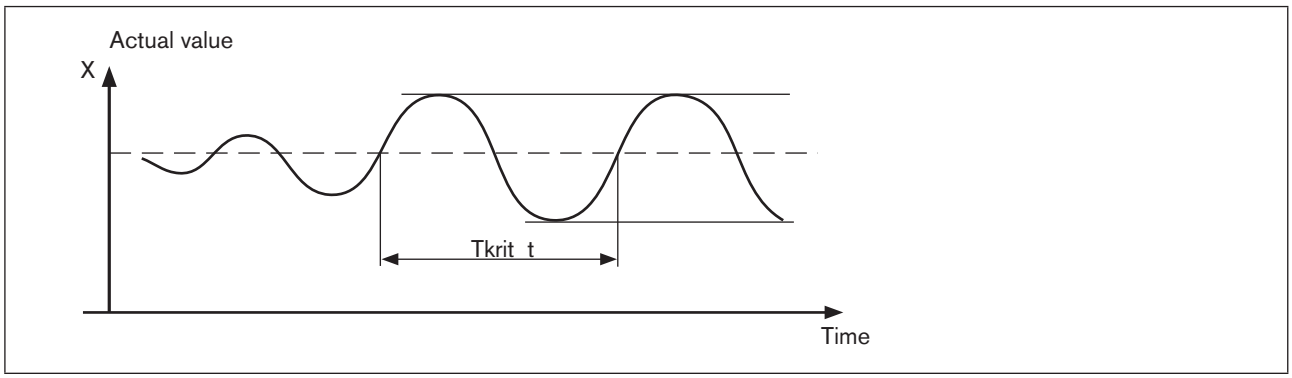

Figure 138: Progress of the control variable PID

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 69: 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.

58.2. 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

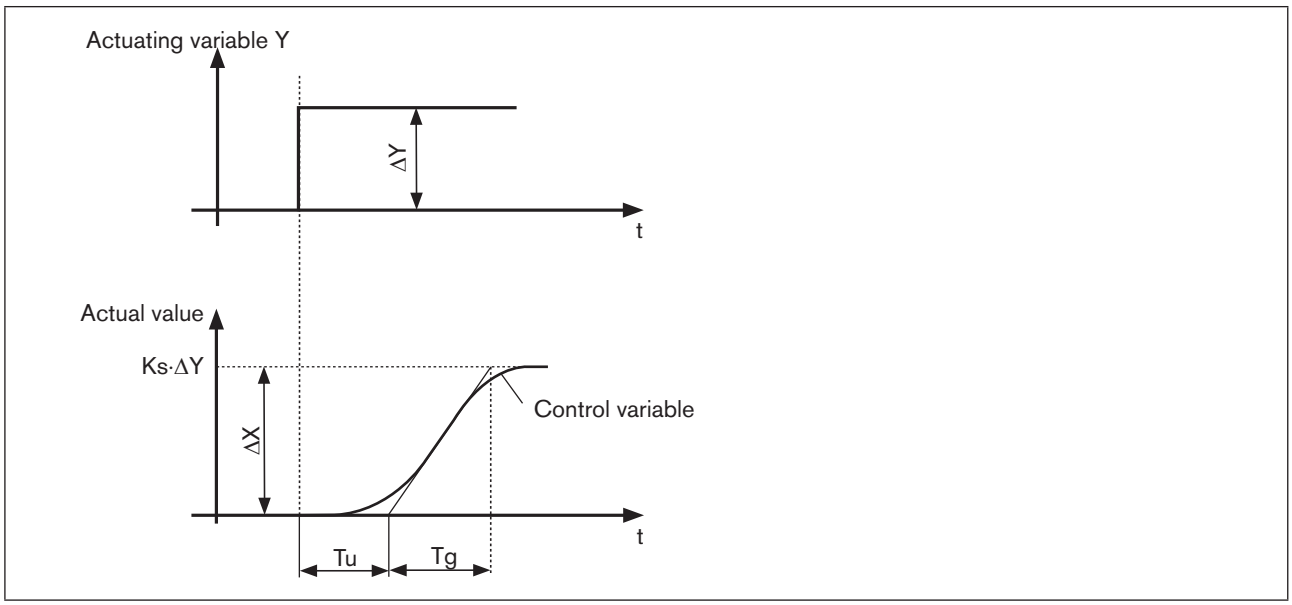

Figure 139: Progress of the control variable, actuating variable jump

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 70: " 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)		Adjustment of the parameters for control process with 20 % overshoot	
	Reference	Malfunction	Reference	Malfunction
P controller	$Kp = 0{,}7 \cdot \frac{Tg}{Tu \cdot Ks}$	$Kp = 0{,}7 \cdot \frac{Tg}{Tu \cdot Ks}$	$Kp = 0{,}7 \cdot \frac{Tg}{Tu \cdot Ks}$	$Kp = 0{,}7 \cdot \frac{Tg}{Tu \cdot Ks}$
PI controller	$Kp = 1{,}2 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tv = 0{,}42 \cdot Tu$	$Kp = 1{,}2 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tn = 2 \cdot Tu$	$Kp = 1{,}2 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tn = Tg$	$Kp = 0{,}7 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tv = 0{,}42 \cdot Tu$
PID controller	$Kp = 1{,}2 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tn = Tg$ $Tv = 0{,}42 \cdot Tu$	$Kp = 1{,}2 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tv = 0{,}42 \cdot Tu$ $Tv = 0{,}42 \cdot Tu$	$Kp = 1{,}2 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tv = 0{,}42 \cdot Tu$ $Tv = 0{,}42 \cdot Tu$	$Kp = 1{,}2 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tn = 2 \cdot Tu$ $Tv = 0{,}42 \cdot Tu$

Table 70: Adjustment of the parameters according to Chien, Hrones and Reswick

The proportionality factor Ks of the controlled system is calculated as follows:

$$Ks = \frac{\Delta X}{\Delta Y} \qquad (11)$$

Operating structure of the positioner (Appendix)

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59. OPERATING STRUCTURE

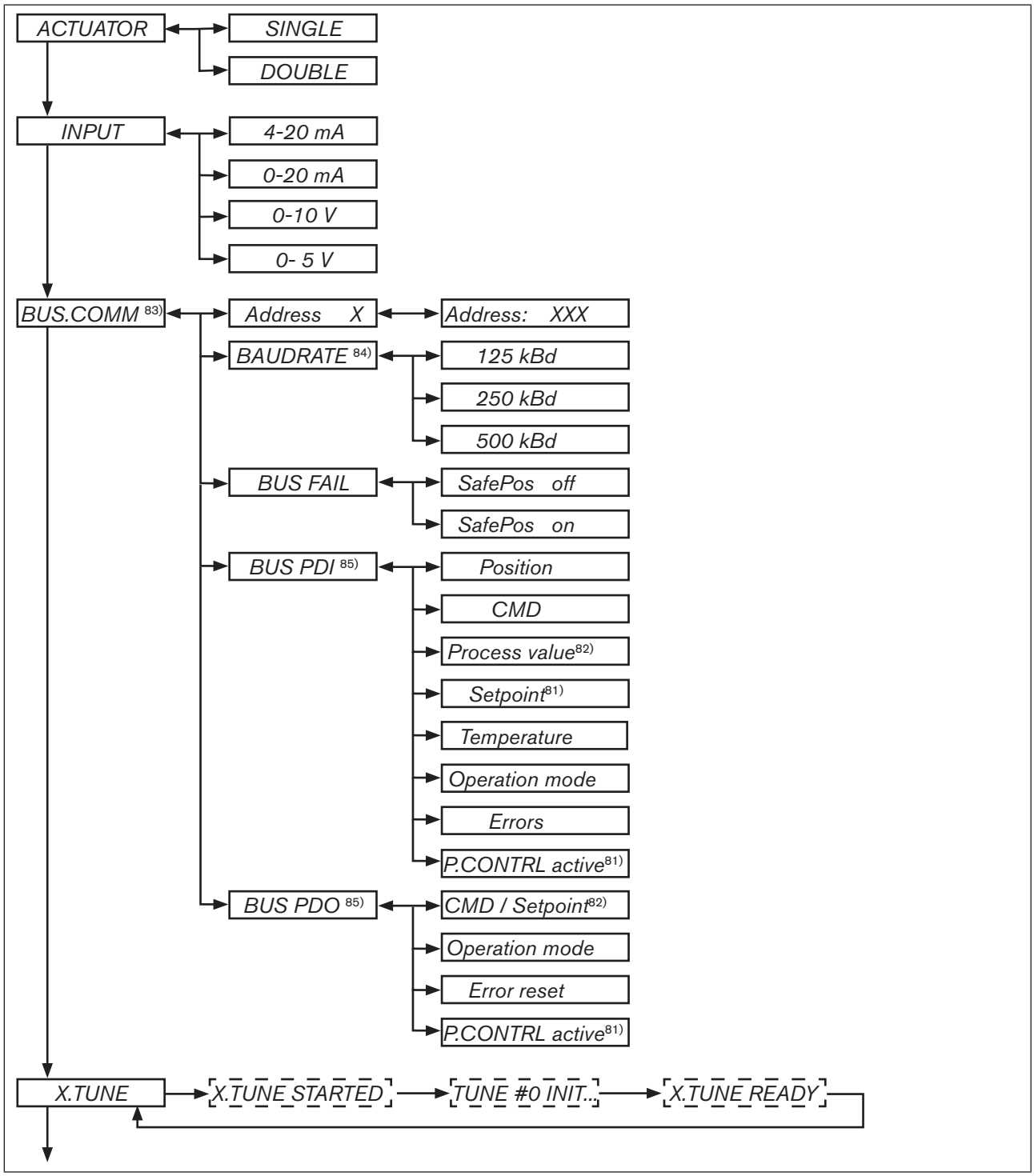

Figure 140: Operating structure - 1

81) *only process controller 8693*
82) *only process controller 8693 and activated process controller*
83) *only field bus*
84) *only DeviceNet*
85) *only Profibus DP*

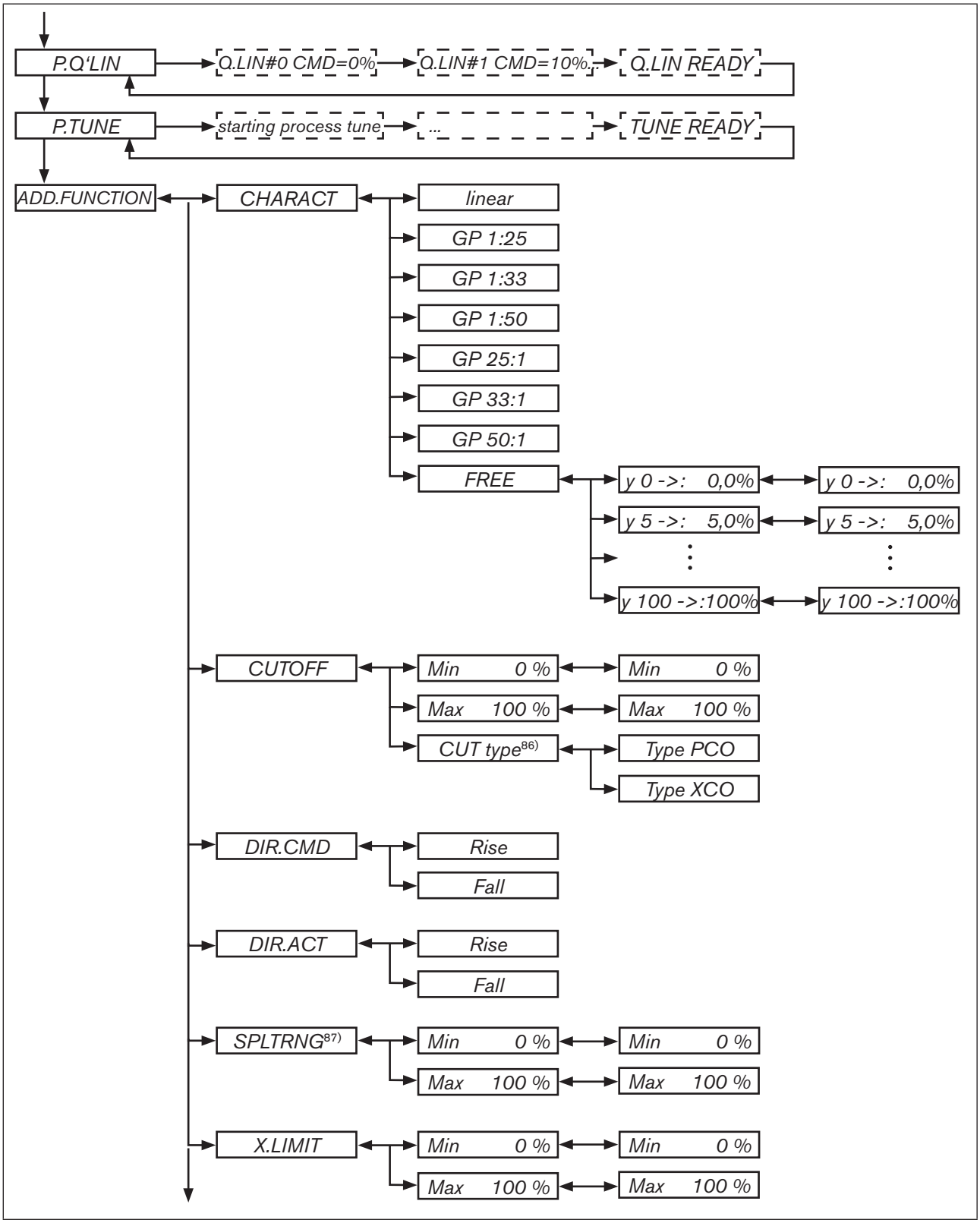

Figure 141: Operating structure - 2

86) only process controller 8693
87) only position controller 8692

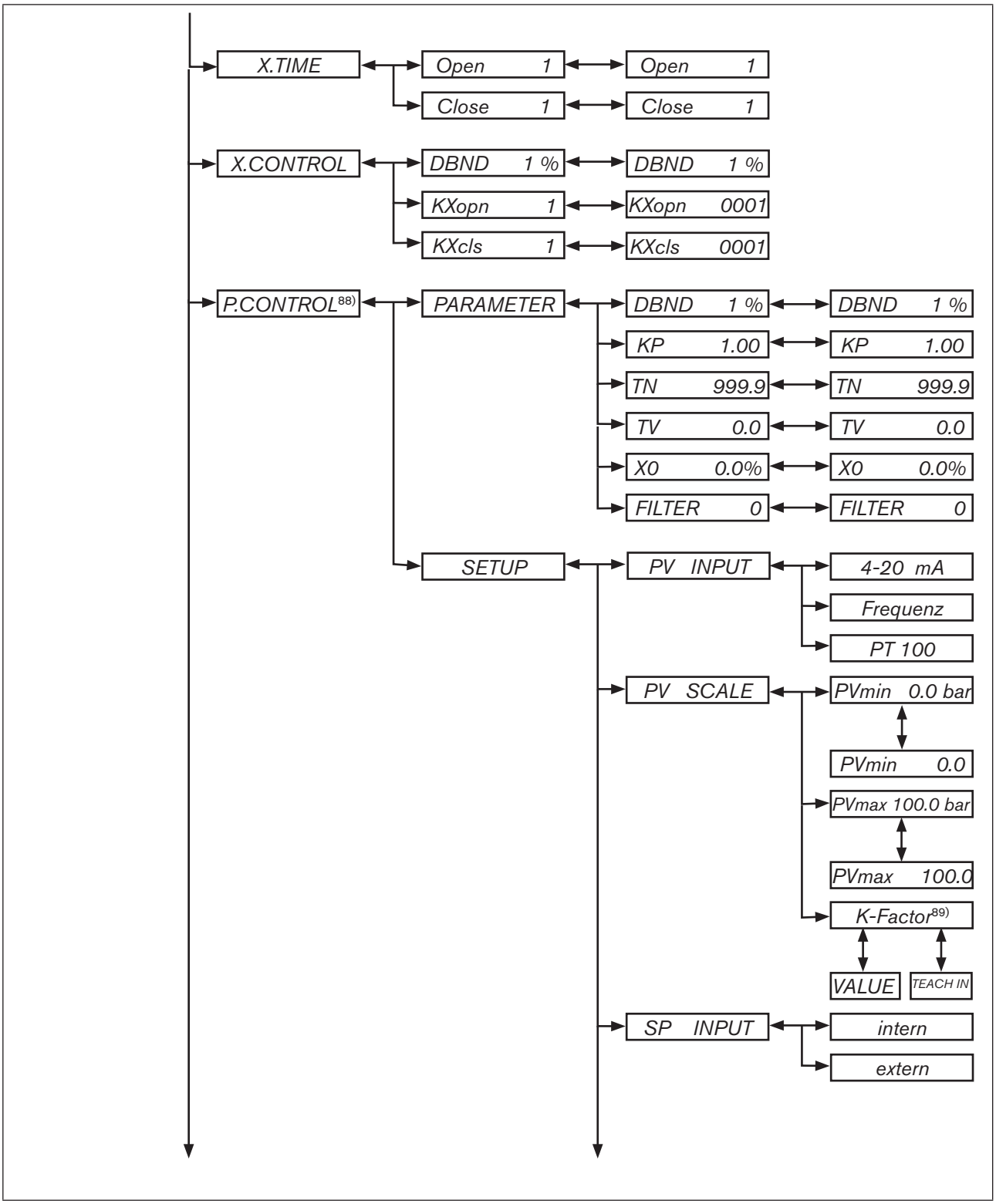

Figure 142: Operating structure - 3

88) *only process controller 8693*
89) *only for frequency signal type (PV INPUT / frequency)*

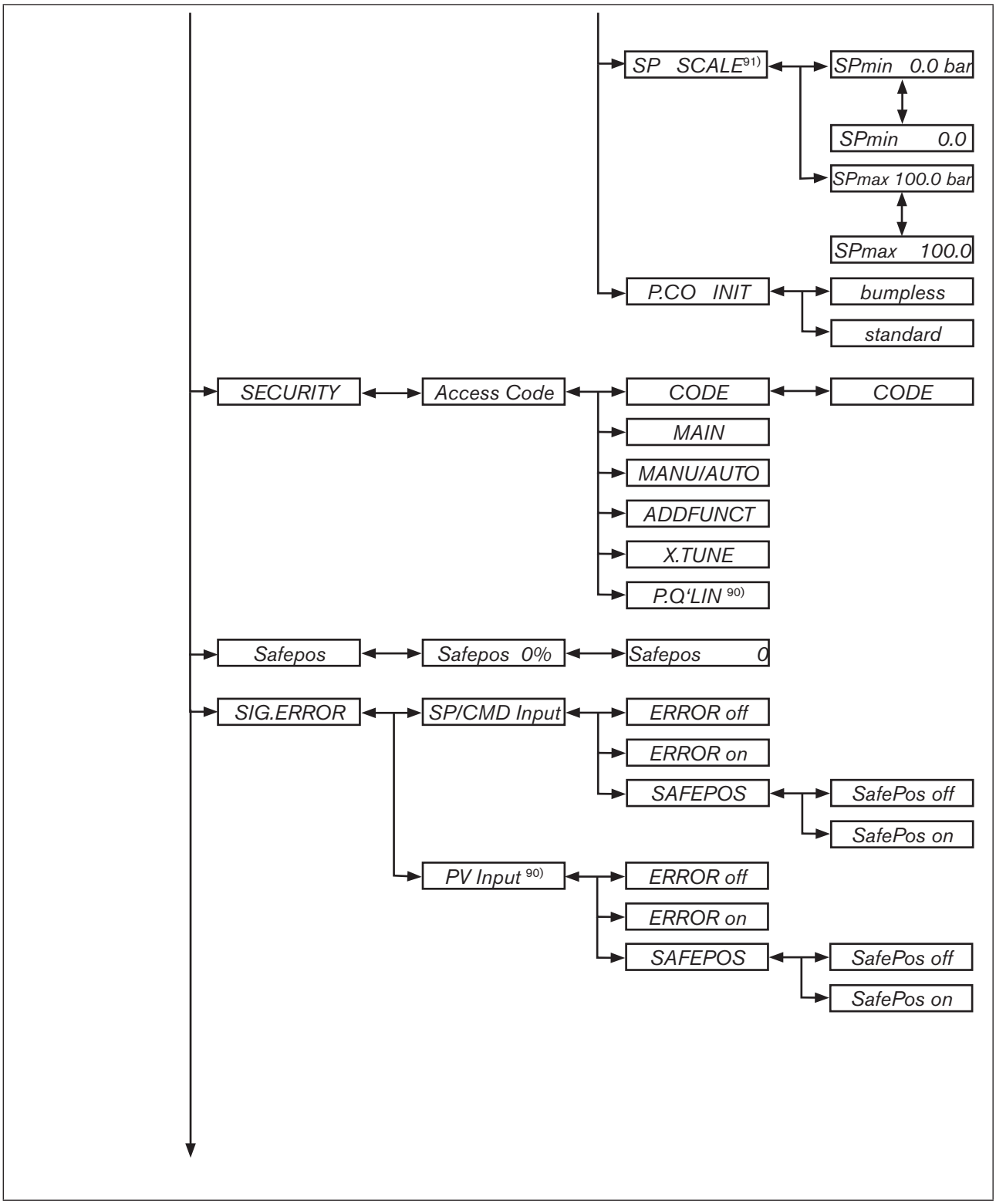

Figure 143: Operating structure - 4

90) only process controller 8693
91) only for external set-point value default (SP INPUT / external)

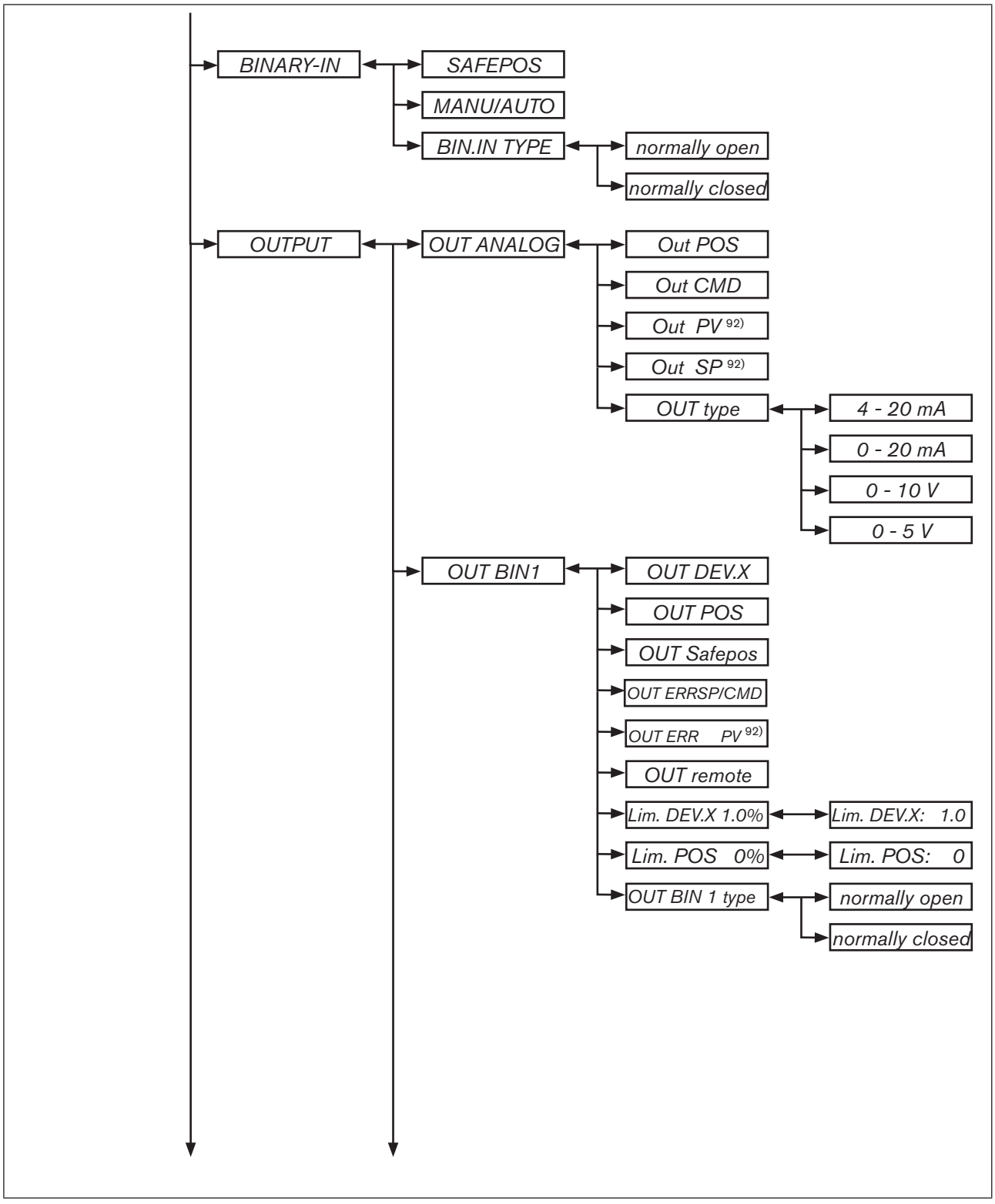

Figure 144: Operating structure - 5

92) only process controller

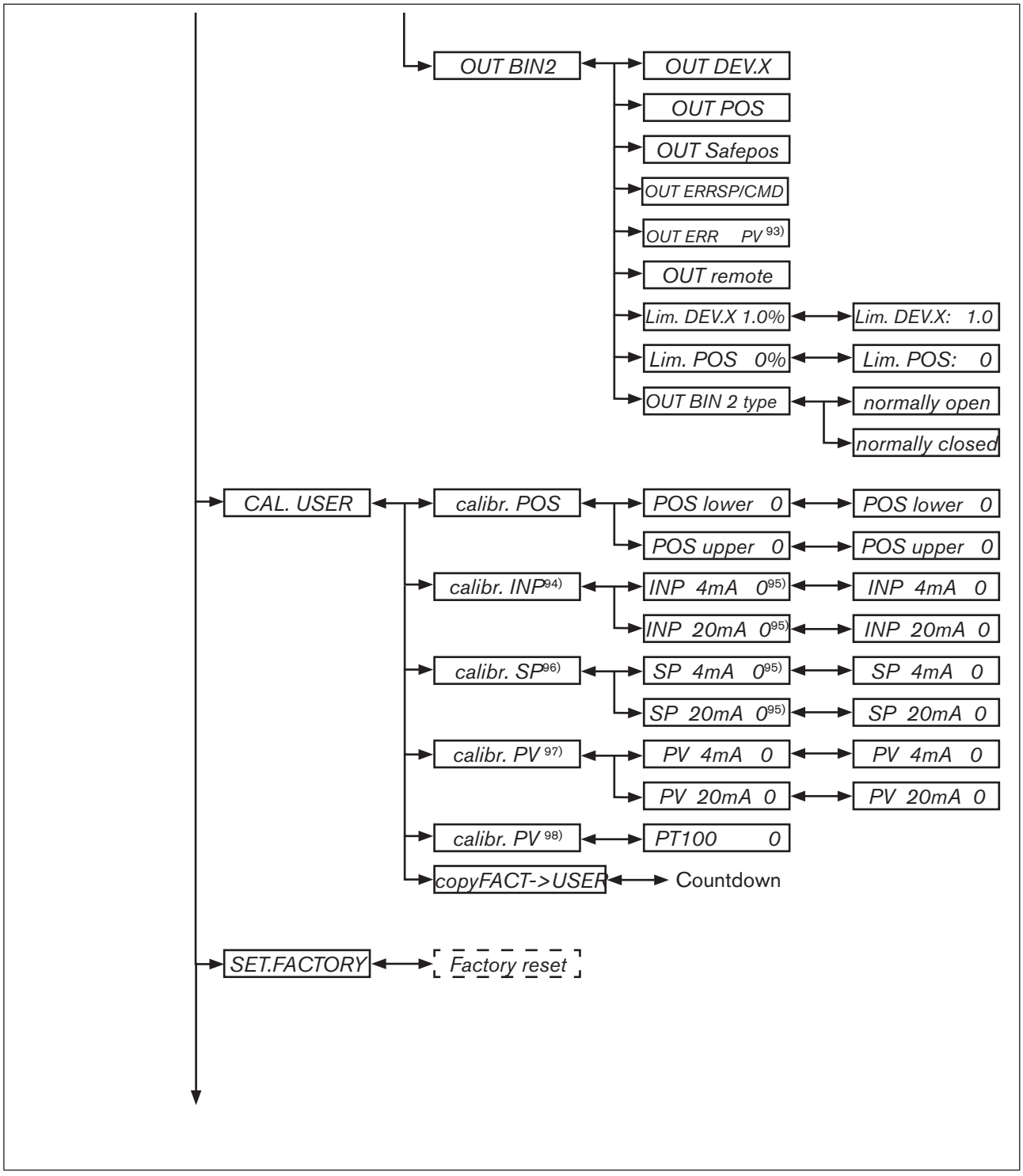

Figure 145: Operating structure - 6

93) *only process controller 8693*
94) *only position controller 8692*
95) *The signal type is displayed which is selected in the INPUT menu*
96) *only 8693, only for external set-point value default (P.CONTROL / SETUP / SP-INPUT / external)*
97) *only 8693, only for signal type 4 – 20 mA*
98) *only 8693, only for circuit with PT 100*

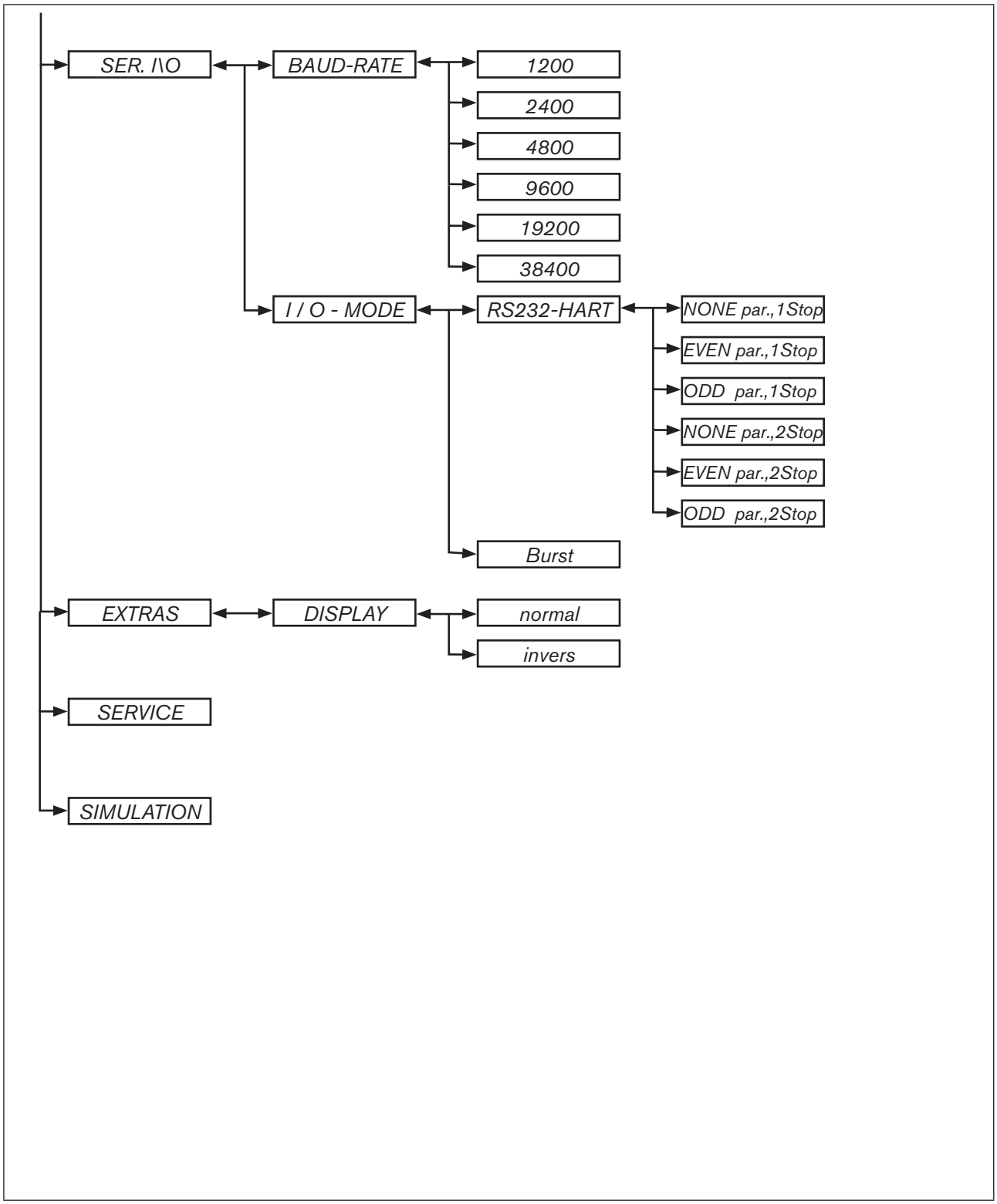

Figure 146: Operating structure - 7

Tables for customer-specific settings (appendix)

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60. SETTINGS OF THE FREELY PROGRAMMABLE CHARACTERISTIC TYPE 8692 AND TYPE 8693

Node (position set-point value as %)	Valve stroke [%]			
	Datum:	Datum:	Datum:	Datum:
0				
5				
10				
15				
20				
25				
30				
35				
40				
45				
50				
55				
60				
65				
70				
75				
80				
85				
90				
95				
100				

Table 71: Settings of the freely programmable characteristic

61. SET PARAMETERS OF THE PROCESS CONTROLLER TYPE 8693

	Datum:	Datum:	Datum:	Datum:
KP				
TN				
TV				
X0				
DBND				
DP				
PVmin				
PVmax				
SPmin				
SPmax				
UNIT				
K-Factor				
FILTER				
INP				

Table 72: Set parameters of the process controller Type 8693

Mastercode (Appendix)

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62. MASTERCODE

Mastercode
3108