bürkert
FLUID CONTROL SYSTEMS

Type 336x

Software description for electromotive control valves

Operating Instructions - Software

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Software description for electromotive control valves

About the table of contents.

Menus, which are adequately explained by the displayed help texts and do not require any additional description, are not listed in the table of contents.

The complete menu structure, organized according to configuration areas with a brief description of all menus, can be found in the chapter "Overview of the menus".

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1 ABOUT THESE INSTRUCTIONS

The instructions describe the software for the electromotive control valves of types 3360, 3361, 3363, 3364 and 3365.

Important safety information!

Safety instructions and information for using the devices can be found in the respective operating instructions.

▸ Carefully read instructions.

1.1 Symbols

DANGER!

Warns of an immediate danger!

▸ Failure to observe the warning will result in fatal or serious injuries.

WARNING!

Warns of a potentially dangerous situation!

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

CAUTION!

Warns of a potential danger!

▸ Failure to observe the warning may result in a moderate or minor injury.

NOTE!

Warns of damage!

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

Indicates important additional information, tips and recommendations.

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

▶ Designates an instruction which you must follow to prevent a hazard.

→ Designates a procedure which you must carry out.

✔ Indicates a result.

MENUE Representation of software interface text.

1.2 Definition of the term "device"

In these instructions the term "device" denotes the following device types: 3360, 3361, 3363, 3364, 3365.

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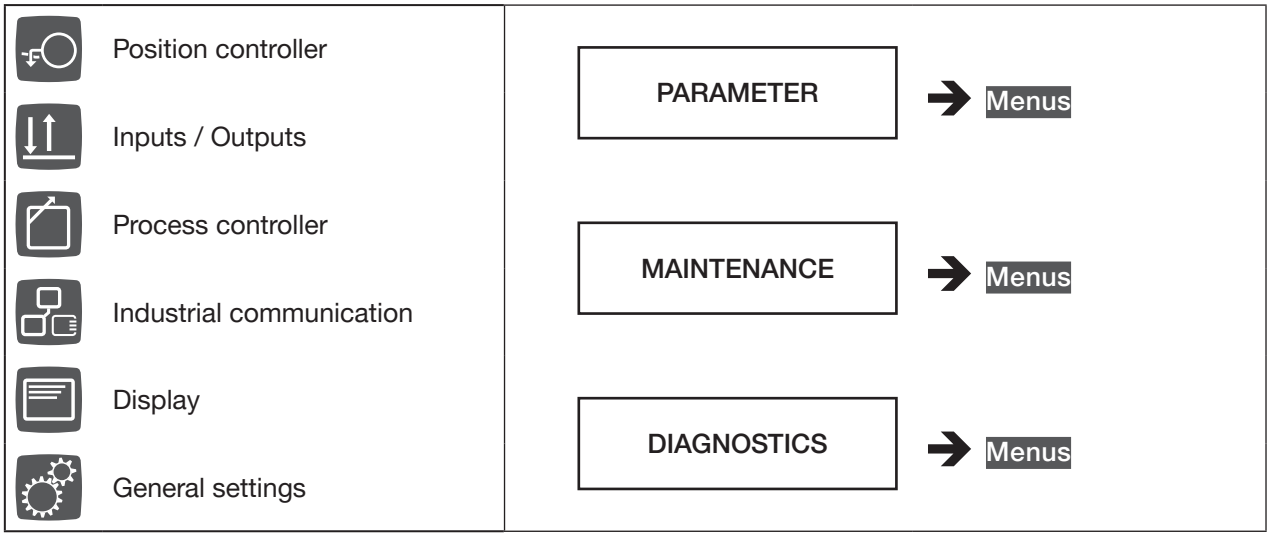
2 OVERVIEW OF THE MENUS

The software for the electromotive control valve is organized according to the functions in the following areas:

- **Configuration areas**
  The menus of the particular configuration area are assigned to the registers PARAMETER, MAINTENANCE and DIAGNOSTICS.



- **Context menu**
  The context menu can be accessed on the start screen, in the user-defined views and in the configuration areas.
  The type and number of available submenus depend on which area the context menu is accessed from.

2.1 Menus in the position controller configuration area

PARAMETERS for position controller	
Levels 1 and 2	**Description**
START-UP	Wizard for starting up the position control. Not available for devices with process controller function.
X.CONTROL	For description see chapter "3.1 X.CONTROL – Parameterization of the position control".
DBND	Set insensitivity range (dead band).
ACCELERATION	Set acceleration.
SAFEPOS	For description see chapter "3.2 SAFEPOS - Setting of the safety position and the energy pack".
FUNCTION	Select safety position.
Position	Set user-defined safety position.
ENERGY-PACK	Energy pack functions. See chapter "3.2.3 ENERGY-PACK - Energy pack functions", page 34.

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PARAMETERS for position controller	
Levels 1 and 2	**Description**
DIAPHRAGM	For description see chapter "3.3 DIAPHRAGM - Settings of the diaphragm valve", page 38. Only available for diaphragm control valves.
Cutoff force	Set sealing force.
Additional force	Set intensification of the sealing force.
Maximum force	Set maximum sealing force.
M.Q.0.TUNE	Set parameters for function M.Q0.TUNE.
M.CLEAN	Set duration of the cleaning function.
DIP.SWITCH	Displays the DIP switch configuration. Only available in PC software Bürkert-Communicator and for devices without a display module. References to the detailed description of the submenus can be found in the main menus of the same name which are listed below on Level 1.
DIR.CMD	Displays the DIP switch position: Effective direction between input signal and set-point position.
CHARACT	Displays the DIP switch position: Correction characteristic activated / deactivated.
CUTOFF	Displays the DIP switch position: Sealing function activated / deactivated.
MANUAL MODE	Displays the DIP switch position: MANUAL operating state activated / deactivated.
ADD.FUNCTION	For description see chapter "3.4 ADD.FUNCTION - Activation and deactivation of auxiliary functions". References to the detailed description of the submenus can be found in the main menus of the same name which are listed below on Level 1.
CHARACT	Activation and deactivation of the auxiliary function: Correction characteristic.
CUTOFF	Activation and deactivation of the auxiliary function: Sealing function.
DIR.CMD	Activation and deactivation of the auxiliary function: Change effective direction.
SPLTRNG	Activation and deactivation of the auxiliary function: Signal split range.
X.LIMIT	Activation and deactivation of the auxiliary function: Limit of the mechanical stroke range.
X.TIME	Activation and deactivation of the auxiliary function: Limit of the control speed.

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PARAMETERS for position controller	
Levels 1 and 2	**Description**
CHARACT	For description see chapter "3.5 CHARACT - Configuring correction characteristic".
TYPE	Select correction characteristic: linear, equal percentage or user-defined.
TABLE DATA	Program user-defined correction characteristic.
CUTOFF	For description see chapter "3.6 CUTOFF - Configuring sealing function".
CUTOFF.type	Select source of the sealing function input signal.
Lower Limit	Specify the lower limit for the sealing function.
Upper Limit	Specify the upper limit for the sealing function.
DIR.DMD	For description see chapter"3.7 DIR.CMD - Changing effective direction of the standard signal for the valve position".
SPLTRNG	For description see chapter "3.8 SPLTRNG - Signal split range".
X.LIMIT	For description see chapter "3.9 X.LIMIT - Mechanical stroke limit".
X.TIME	For description see chapter "3.10 X.TIME - Actuating time limit".

Table 1: Menus - PARAMETERS for position controller

MAINTENANCE for position controller	
Levels 1 and 2	**Description**
CALIBRATION	For description see chapter "3.11 MAINTENANCE - Start-up and maintenance of the position controller".
X.TUNE	Automatic adjustment of the position control for seat valves.
M.Q.0.TUNE	Adjustment of the position control for diaphragm valves.
M.CLEAN	Cleaning function for diaphragm valves.
M.SERVICE	Starting up the diaphragm armature.

Table 2: Menus - Maintenance for Position controller

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DIAGNOSTICS for position controller	
Levels 1, 2 and 3	**Description**
SYSTEM.VALUES	Overview of specific system values.
Operation time	Displays the entire operating duration of the device.
Travel accumulator	Displays the entire spindle distance covered.
Direction change	Displays the total number of changes of direction.
Device temperature	Displays the current device temperature.
Highest temperature	Displays the highest temperature which has been measured so far.
Lowest temperature	Displays the lowest temperature which has been measured so far.
HISTOGRAM.POS	Dwell time density histogram over the entire runtime of the device.
HISTOGRAM.SPAN	Movement range histogram over the entire runtime of the device.
HISTOGRAM.DTEMP	Device temperature histogram over the entire runtime of the device.
ENERGY-PACK	Energy pack diagnostics. For description see chapter "3.2.3.2. Setting in DIAGNOSTICS – ENERGY-PACK". The menu is not displayed until energy pack is activated.
State of health	Display for state of health (SOH, state of health) of the energy pack.
NAMUR-State	**Select device status for failure of the energy pack.** Can only be set if immediate start has been set for behavior of the actuator during a restart (setting in PARAMETER → SAFEPOS → ENERGY-PACK → FUNCTION → Immediate control).
Error	If the energy pack fails, the "Error" status message is output. The device moves into the safety position and cannot be operated again until the energy pack has been replaced.
Out of specification	If the energy pack fails, the "Out of specification" status message is output. The device can still be operated despite the energy pack failing.
USER.DIAGNOSIS	Configuration of the user-specific diagnostic functions.
MSG.CONFIG	Configuration of the messages for the user-specific diagnostic functions.
Acknowledge	Set confirmation for diagnostic messages: required or not required.
Logbook	Select diagnostic functions for which messages are entered in the logbook.

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DIAGNOSTICS for position controller	
Levels 1, 2 and 3	**Description**
NAMUR-Type	Specify Namur status for the diagnostic functions. In this menu the status signals, according to NAMUR NE 107, are set for the messages of the diagnostic functions. The status signals have different priorities. If several diagnostic messages are available with different status signals, the signal for the message with the highest priority is displayed. Priority of the status signals:

Priority	1	2	3	4
Signal color	red	orange	yellow	blue
Icon				
Meaning	Failure, error or fault	Function check	Outside the specification	Maintenance requirement

ADD.DIAGNOSE	Activating and deactivating diagnostic functions. The following diagnostic functions can be activated:	
	SERVCE.TIME	Maintenance interval: Operating duration.
	TRAVEL.ACCU	Maintenance interval: spindle distance covered.
	CYCLE.COUNTER	Maintenance interval: Number of changes in direction.
	POS.MONITOR	Monitoring of position controller position where set-point position is constant.
	PV.MONITOR	Monitoring of process actual value where set-point value is constant.
	HISTOGRAM.POS	Dwell time density histogram.
	HITSTOGRAM.SPAN	Movement range histogram.
	When activated, the diagnostic function is included as a menu option in the menu USER.DIAGNOSE and can be set there.	
SERVICE.TIME	Diagnostics and maintenance interval of the operating duration. Physical variable: Time[1]. The operating duration is the time during which the device is switched on. When the operating duration reaches the time limit of the specified interval, a message is generated.	
Operation time	Displays the entire operating duration of the device.	
Interval	Set maintenance interval[2].	
Next message	Displays the operating duration remaining until the next message.	

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DIAGNOSTICS for position controller	
Levels 1, 2 and 3	**Description**
TRAVEL.ACCU	Diagnostics and maintenance interval of the spindle distance covered. Physical variable: Length[1]. The spindle distance is the distance which the actuator spindle covers. The maintenance interval refers to the accumulated distance of the spindle. When the spindle has covered the specified distance, a message is generated.
Travel accumulator	Displays the entire spindle distance of the device covered.
Interval	Set maintenance interval[2].
Next message	Displays the spindle distance remaining until the next message.
CYCLE.COUNTER	Diagnostics and maintenance interval for the number of changes in direction. The change in direction refers to the actuator. When the number of changes in direction has reached the specified interval, a message is generated.
Direction Change	Displays the total number of changes in direction of the device.
Interval	Set maintenance interval[2].
Next message	Displays the changes in direction remaining until the next message.
POS.MONITOR	Monitoring of position controller position where set-point position is constant. For description see chapter "3.12.1 POS.MONITOR - Position monitoring of the position controller", page 51.
Tolerance band	Set tolerance band for permitted control deviation. Specification as percentage.
Compensation time	Set maximum time[1] until persistent state needs to be achieved, whereupon monitoring of the position controller position starts.
PV.MONITOR	**Only available for devices with process controller function.** **Menu for** monitoring of process actual value where set-point value is constant. Monitoring by PV.MONITOR is based on the same principle as described in the POS.MONITOR menu. The difference with the POS.MONITOR is that the actual value of the process control, and not the actual position, is monitored.

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DIAGNOSTICS for position controller	
Levels 1, 2 and 3	**Description**
Tolerance band	Set tolerance band for permitted control deviation. The displayed physical variable[1)] depends on the process variable to be controlled which is specified in the menu UNIT (configuration area Process controller → Parameter).
Compensation time	Set maximum time[1)] until persistent state needs to be achieved, whereupon monitoring of the process actual value starts.
HISTOGRAM	Configure menu for setting histograms.
Start | Stop	Start and end recording of histograms.
Clear	Reset histograms.
HISTOGRAM.POS	Displays the dwell time density histogram.
Operation time	Displays the runtime[1)] for the dwell time density histogram.
Travel accumulator	Displays the distance covered[1)] for the dwell time density histogram.
HISTOGRAM.SPAN	Displays the movement range histogram.
Operation time	Displays the runtime[1)] for the movement range histogram.
Direction change	Displays the number of changes in direction for the movement range histogram.

[1)] The displayed physical unit can be changed in the PC software Bürkert-Communicator:

To change the physical unit to the square symbol, click above the displayed value. Select the physical unit in the open dialog window.

[2)] When the interval has expired, the displayed device status changes and a message is output. The display of the message and the displayed device status can be configured in the menu MSG.CONFIG.

Table 3: Menus - Diagnostics for position controller

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2.2 Menus in the inputs / outputs configuration area

PARAMETERS for inputs / outputs	
Levels 1 and 2	**Description**
CMD	**Only available for devices with position controller function.** Parameterize position set-point value.
CMD.source	Select signal source of the set-point value default of the position controller: Analog, büS, Manual. For devices with the Gateway option, büS, Manual and Fieldbus can be selected as the signal source.
ANALOG.type	Select standard signal for the set-point value default of the position controller: 0-5 V, 0-10 V, 4-20 mA, 0-20 mA. The menu is only available when the signal source Analog has been selected in the menu CMD.source.
Signal loss detection	Activate signal loss detection for the set-point value of the position controller. Specifying the status message for signal loss: Outside the specification or fault. The menu is only available for the following parameterization: In the menu CMD.source Selection of the signal source Analog. In the menu CMD.type Selection of the standard signal 4-20 mA.
CMD.manual	Manual specification of the position set-point value. The menu is only available when the signal source Manual has been selected in the menu CMD.source.
CMD / SP	**Only available for devices with process controller function.** Parameterize process values.
SP.source	Select signal source of the set-point value default of the process controller: Analog, büS, Manual. For devices with the Gateway option, Manual and Fieldbus can be selected as the signal source.
CMD.source	Select signal source of the set-point value default of the position controller: Analog, büS, Manual. For devices with the Gateway option, Manual and Fieldbus can be selected as the signal source.
ANALOG.type	Select standard signal for the set-point value default: 0-5 V, 0-10 V, 4-20 mA, 0-20 mA. The menu is only available when the signal source Analog has been selected in the menu SP.source / CMD.source.
Signal loss detection	Activate signal loss detection for the set-point value of the process controller. Specifying the status message for signal loss: Outside the specification or fault. The menu is only available for the following parameterization: In the menu SP.source / CMD.source Selection of the signal source Analog. In the menu CMD.type Selection of the standard signal 4-20 mA.

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PARAMETERS for inputs / outputs	
Levels 1 and 2	**Description**
SP.scale	Scale process set-point value. During scaling the values for the lower and upper process set-point value are assigned to the particular current or voltage value of the standard signal.
SP.manual	Manually specify process set-point value. The menu is only available when the signal source Manual has been selected in the menu SP.source.
PV	**Only available for devices with process controller function.** See chapter "4.1 PV - Parameterization of the process actual value", page 52.
PV.source	Select signal source of the actual value default of the process controller: Analog, büS.
ANALOG.type	Select signal type of the process actual value: 4-20 mA, frequency, PT 100. The menu is only available when the signal source Analog has been selected in the menu PV.source.
K factor	Set K factor. The menu is only available for the following parameterization: In the menu PV.source Selection of the signal source Analog. In the menu ANALOG.type Selection of the signal type Frequency.
PV.scale	Scale process actual value. The menu is only available for the following parameterization: In the menu PV.source Selection of the signal source Analog. In the menu ANALOG.type Selection of the signal type 4-20 mA.
Signal loss detection	Activate signal loss detection for the process actual value. Specifying the status message for signal loss: Outside the specification or fault. The menu is only available for the following parameterization: In the menu PV.source Selection of the signal source Analog. In the menu ANALOG.type Selection of the standard signal 4-20 mA.

Table 4: Menus - PARAMETERS for inputs / outputs, main menus SP, CMD

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PARAMETERS for inputs / outputs	
Levels 1, 2 and 3	**Description**
ADDITIONAL IOs	Configuration of the signal inputs and signal outputs.
DIGITAL IN	Configuration of the digital input.
X.CO/P.CO.source	Specify signal source for switching between position control and process control.
EXT.ERROR.source	Specify signal source of external fault.
M.CLEAN.source	Specify signal source of the M.CLEAN cleaning function for diaphragm valves.
EXT-ERROR.para	Specify behavior of the control valve if an external fault occurs: SAFEPOS Actuator moves to the set safety position. Stop Actuator stops.
DIGITAL.type	Select the digital signal type. The switching functions Normally open (NO) and Normally closed (NC) can be selected for the signal. The menu is only available if a digital signal source was specified in the menu DIGITAL IN for one of the functions listed below: - external fault EXT-ERROR.source or - cleaning function M.CLEAN.source.
DIGITAL OUT 1 and DIGITAL OUT 2	For description see "4.2 DIGITAL OUT - Configuration of the digital outputs".
SOURCE	Signal source of the digital output: Select Intern or büS.
FUNCTION	Specify function for the digital output.
DIGITAL.type	Specify switching status for the digital output.
ANALOG OUT	**Only available for devices with the analog output option.** Configuration of the additional analog output.
SIGNAL	Select input signal for the analog input: - CMD position set-point value - POS position actual value - SP process set-point value - PV process actual value (SP and PV only for devices with process controller function) - büS input signal is specified by the büS network.
ANALOG.type	Select standard signal for the additional analog output: 0-5 V, 0-10 V, 4-20 mA, 0-20 mA.
SCALE	Scale input signal of the additional analog output.

Table 5: Menus - PARAMETERS for inputs / outputs, main menu ADDITIONAL IOs

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MAINTENANCE for inputs / outputs	
Levels 1 and 2	**Description**
CALIBRATION	Menu for calibration of the signal for the set-point value and actual value, the optional additional analog output and for the analog inputs 1 and 2.
CMD	Calibration of the position set-point value for devices with position controller function. The menu is only available if the analog input was selected as the source of the input signal. This depends on the following setting: Configuration area Inputs / Outputs → CMD.source → Analog. For the calibration the signal type is displayed which was specified as the standard signal for the input signal. This depends on the following setting: Configuration area Inputs / Outputs → CMD → ANALOG.type.
SP I CMD	**Only available for devices with process controller function.** Calibration of the process set-point value (SP) or position set-point value (CMD). The menu is only available if the analog input was selected as the source of the input signal. This depends on the following setting: Configuration area Inputs / Outputs → SP.source or CMD.source → Analog. For the calibration the signal type is displayed which was specified as the standard signal for the input signal. This depends on the following setting: Configuration area Inputs / Outputs → SP I CMD → ANALOG.type.
PV	**Only available for devices with process controller function.** Calibration of the process actual value (PV). The menu is only available if the analog input was selected as the source of the input signal. This depends on the following setting: Configuration area Inputs / Outputs → PV.source → Analog. For the calibration the signal type is displayed which was specified as the standard signal for the input signal. This depends on the following setting: Configuration area Inputs / Outputs → PV → ANALOG.type.
ANALOG OUT	**Only available for devices with the analog output option.** Calibration of the analog output. For the calibration the signal type is displayed which was specified as the standard signal for the analog output. This depends on the following setting: Configuration area Inputs / Outputs → ANALOG OUT → ANALOG.type.
CALIBRATION RESET	Reset calibration values to factory setting.

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Table 6: Menus - MAINTENANCE for inputs / outputs

2.3 Menus in the process controller configuration area

The process controller configuration area is only available for devices with process controller function.

PARAMETERS for process controller	
Levels 1 and 2	**Description**
START-UP	Wizard for starting up the process control.
PID.PARAMETER	For description see chapter "5.1 PID-PARAMETER - Parameterization of the process controller", page 56.
DBND	Set insensitivity range (dead band) of the process controller.
KP	Set proportional component (P-component of the PID controller).
TN	Set reset time (I-component of the PID controller).
TV	Set hold-back time (D-component of the PID controller).
XO	Set operating point.
UNIT	Select the physical variable for the process variable. The physical variables which are available depend on the signal type and the signal source which were assigned to the process actual value. The menus for parameterization of the process actual value are located in the configuration area → Inputs / Outputs→ PV.
P.CO Unit PLC	Select physical unit of the process control for the PLC.
SP.SLOPE	For description see chapter "5.2 SP.SLOPE - Setting growth rate per unit of time", page 58.
SP.SLOPE on/off	Activate or deactivate menu for adjustment of the growth rate.
Rise	Set growth rate for upwards movement.
Fall	Set growth rate for downwards movement.
SP.Filter	Select filter for the process set-point value. The stages from 0 to 9 can be selected for filtering the process set-point value. Stage 0: lowest / no effect on filtering. Stage 9: highest effect on filtering.
PV.Filter	Select filter for the process actual value. The stages from 0 to 9 can be selected for filtering the process actual value. Stage 0: lowest / no effect on filtering. Stage 9: highest effect on filtering.

Table 7: Menus - PARAMETERS for process controller

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MAINTENANCE for process controller	
Levels 1 and 2	**Description**
CALIBRATION	Menu for calibrating the process control.
P.TUNE	Automatic parameterization of the PID controller. When the function is running, the parameters for the P, I and D-components of the PID controller are automatically determined and transferred to the corresponding menus (KP, TN, TV). The menus KP, TN, TV are located in the **configuration area** Process controller → PARAMETER → PID.PARAMETER and can be re-adjusted there if required. **Explanation of the PID controller:** The control valves with process controller function have an integrated PID process controller. Any process variable, such as flow rate, temperature, pressure, etc., can be controlled by connecting an appropriate sensor. To obtain good control performance, the PID controller must be adjusted to the properties of the process (controlled system). This task requires control experience as well as measuring instruments and is time-consuming. The P.TUNE function can be used to automatically parameterize the PID controller integrated in the process controller.
P.LIN	Automatic linearization of the process characteristics. The linearization of the process characteristic is only required if the process characteristic deviates greatly from the linearity. Linearization with the P.LIN function takes a longer time for slow processes. **Note:** The characteristic is entered in the table Date of Charact.

Table 8: Menus - MAINTENANCE for process controller

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2.4 Menus in the industrial communication configuration area

The industrial communication configuration area is only available for devices with the Gateway option.

PARAMETERS for industrial communication	
Levels 1 and 2	**Description**
Protocol	Select protocol for communication. The following can be selected: PROFINET, EtherNet/IP, Modbus TCP.
DNS compatible name	Set DNS compatible name. The menu is available on PROFINET only.
MAC address	Displays the MAC address.
Static IP address	Set the IP address.
Network mask	Set network mask.
Default gateway	Set standard gateway.
Temporary IP address	Set temporary IP address.
Unit conversion	Set physical units:
Advanced settings	Menu for advanced settings.
IP settings	Settings for EtherNet/IP. The menu is available on EtherNet/IP only.
Internal cycle time	Set internal cycle time.
Communication Timeout	Setting: - Time limit (time span before a process is terminated due to a fault). - Timeout (time span until the fault itself is actuated in the event of an incorrect process).
Control Mode	Set start conditions.
Control Word	Set actions for the runtime.
Edit hide objects	Process values to be hidden.
Reset hide objects	Reset values to be hidden.
Protocol firmware update	Displays the protocol for the firmware update.
Reset device	Reset devices. The following can be selected: Restart Hardware reset of industrial communication Restore XML data

Table 9: Menus - PARAMETERS for industrial communication

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MAINTENANCE for industrial communication	
Levels 1 and 2	**Description**
Version numbers	Display for the communications stack. The following are displayed:
	Stack Name
	Stack Version
	Stack Build
	Stack Revision
	Stack Date
	ICom Version

Table 10: Menus - MAINTENANCE for industrial communication

DIAGNOSTICS for industrial communication	
Levels 1 and 2	**Description**
Protocol	Displays the protocol.
Connections to PLC	Set connection to the PLC.
Communications status	Displays the communication status.
Advanced	Other displays.
Last status code	Displays the last status code.

Table 11: Menus - DIAGNOSTICS for industrial communication

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2.5 Menus in the configuration area display

The configuration area display is only available for devices with display (option).

PARAMETERS for display	
Levels 1 and 2	**Description**
Brightness	Set brightness for the device display.
Contrast	Set contrast for the device display.
Screen saver	Set screen saver for the device display.
Waite time	Set waiting time between operating and activation of the screen saver for device display. Factory setting: 1 minute.
Brightness	Set brightness of the screen saver for the device display.

Table 12: Menus - PARAMETERS for display

DIAGNOSTICS for display	
Levels 1 and 2	**Description**
Temperature	
Device temperature	Displays the temperature of the temperature sensor which is located inside the display.

Table 13: Menus - DIAGNOSTICS for display

MAINTENANCE for display	
Levels 1 and 2	**Description**
Version numbers	Displays the version numbers of the device display.
Software version	Displays the software version of the device display.
Hardware version	Displays the hardware version of the device display.
Ident. number	Displays the ident. number for the device display.
Software ident. number	Displays the software ident. number for the device display.
Serial number	Displays the serial number for the device display.

Table 14: Menus - MAINTENANCE for display

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2.6 Menus in the general settings configuration area

PARAMETERS for general settings	
Levels 1, 2 and 3	**Description**
Status LED	For description see chapter "6.1 Status LED - adjustment of the LED for indicating device statuses", page 59.
Mode	Set LED mode for displaying the device statuses. The following LED modes can be selected: • NAMUR mode • Valve mode • Valve mode + warnings • LED off.
Valve open	Select color of the LED for displaying the device status "Valve open". Yellow and green can be selected. The menu is only available if the Valve mode or Valve mode + warnings was selected.
Valve closed	Select color of the LED for displaying the device status "Valve open". Yellow and green can be selected. The menu is only available if the Valve mode or Valve mode + warnings was selected.
büS	Parameterization of the device as a büS user.
Displayed name	Assign name under which the device is displayed.
Location	Name the location which is displayed for the device.
Description	The input window can be used for the description of the device or for additional information on the device. No input required.
Advanced	Other settings for the device as the user of a network.
Unique device name	Assign communication ID for communication in the network. When changing the communication ID, the assigned partnership is lost to another user.
Baud rate	Set data transmission rate for the device as büS user or CANopen user.
büS address	Assign address under which the device is controlled as büS user or CANopen user.
Bus mode	Select communication protocol CANopen or büS.

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PARAMETERS for general settings	
Levels 1, 2 and 3	**Description**
CANopen status	Specify communication status for the device: Pre-operational: It is possible to communicate with the user via SDOs. PDO communication is not possible. Operational: The user can independently send and receive process data. The menu is available only for selection of the communication protocol CANopen.
Deallocation delay	Time from loss of a partner to deletion of his configuration.
Alarm limits	Displays and adjusts the limit values; if the limit values are exceeded or fall below the minimum, the device outputs an error message or warning. The limit values for outputting an error message can only be read and not adjusted.
Supply voltage	Displays and adjusts the limit values for the supply voltage.
Error high	Displays the limit value for the supply voltage; if the limit value is exceeded, the device outputs an error message. Consider hysteresis!
Error low	Displays the limit value for the supply voltage; if the limit value falls below the minimum, the device outputs an error message. Consider hysteresis!
Warning high	Adjust limit value for the supply voltage; if the limit value is exceeded, the device outputs a warning. Consider hysteresis!
Warning low	Displays the limit value for the supply voltage; if the limit value falls below the minimum, the device outputs a warning. Consider hysteresis!
Hysteresis	Adjust hysteresis for the limit values of the supply voltage. The hysteresis is centrally assigned to the limit value. Example: Warning high 26 V Hysteresis 0.4 V The warning is output at a supply voltage > 26.2 V and is canceled again at a supply voltage < 25.8 V.
Device temperature	Displays and adjusts the limit values for the device temperature.
Error high	Displays the limit value for the device temperature; if the limit value is exceeded, the device outputs an error message. Consider hysteresis!
Error low	Displays the limit value for the device temperature; if the limit value falls below the minimum, the device outputs an error message. Consider hysteresis!
Warning high	Adjust limit value for the device temperature; if the limit value is exceeded, the device outputs a warning. Consider hysteresis!
Warning low	Displays the limit value for the device temperature; if the limit value falls below the minimum, the device outputs a warning. Consider hysteresis!

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PARAMETERS for general settings	
Levels 1, 2 and 3	**Description**
Hysteresis	Adjust hysteresis for the limit values of the device temperature. The hysteresis is centrally assigned to the limit value. Example: Warnung über 80 °C Hysteresis 4 °C The warning is output at a device temperature > 82 °C and is canceled again at a device temperature < 78 °C.
Quick start	Menu for initial start-up of the display, for setting the language and the system of units. The menu is automatically selected when the display is started up for the first time. The setting which was made is identified by a tick. This menu is not available in the PC software Bürkert-Communicator.
Display	Set display for initial start-up. Select language: English, German, French. Select the system of units: Metric, Imperial, Anglo-American (U.S.).
Diagnostics	Menu for activation and deactivation of the diagnostic function.
Active	Diagnostic function activated: • Device status and valve positions are displayed depending on the set LED mode on the LED illuminated ring. • Error messages are entered in the logbook. LED mode setting: see chapter "6.1 Status LED - adjustment of the LED for indicating device statuses", page 59
Inactive	Diagnostic function deactivated: • Device status not displayed on the LED illuminated ring and error messages not entered in the logbook. • The valve positions are displayed on the LED illuminated ring even when the diagnostic function is deactivated, depending on the set LED mode. LED mode setting: see chapter "6.1 Status LED - adjustment of the LED for indicating device statuses", page 59. • The safety position is approached by the actuator even when the diagnostic function is deactivated, depending on the menu setting, in the event of an internal or external error, signal loss or failure of the supply voltage. Setting safety position, see chapter "3.2 SAFEPOS - Setting of the safety position and the energy pack", page 33.
Language	Set language for the menu texts. English, German, French.

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PARAMETERS for general settings	
Levels 1, 2 and 3	**Description**
Passwords	For description see chapter "6.2 Passwords - Activating and deactivating password protection", page 62. With the PC software Bürkert-Communicator the setting is made on the menu bar Options → Password manager.
Physical units	Specify the physical units in which the values of the physical variables are displayed. With the PC software Bürkert-Communicator the setting is made on the menu bar View → System of units.

Table 15: Menus - PARAMETERS for general settings

DIAGNOSTICS for general settings	
Levels 1 and 2	**Description**
Device status	Information on the device status.
Operating duration	Displays the operating duration over the entire life cycle of the device.
Device temperature	Displays the device temperature.
Supply voltage	Displays the supply voltage.
Min./Max. values	Displays the minimum and maximum measured values for device temperature and supply voltage.
Transverable memory status	Displays whether SIM card available.
büS status	Information on the büs network.
Receive errors	Display for current receive errors.
Receive errors max.	Displays all recent and current receive errors.
Transmit errors	Display for current send errors.
Transmit errors max.	Displays all recent and current send errors.
CANopen status	Information on the communication status of the device as a user in the büS network. Pre-operational or operational.
Logbook	Menu for displaying and managing the logbook entries.

Table 16: Menus - DIAGNOSTICS for general settings

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MAINTENANCE for general settings	
Levels 1 and 2	**Description**
Device information	Displays device-specific data.
Displayed name	Displays the name which was entered for the device. The name is entered in the configuration area General settings → PARAMETER in the menu büS → Displayed name.
Ident. number	Displays the device ident. number.
Serial number	Displays the device serial number.
Software ident. number	Displays the ident. number for the software which is used in the device.
Software version	Displays the software version which is used in the device.
büS version	Displays the device büS version.
Hardware version	Displays the device hardware version.
Product typ number	Displays the type designation for the device.
Manufacture date	Displays the date on which the device was manufactured.
eds version	Displays the eds version.
Device driver	Information on the device driver. This menu is available only in the PC software Bürkert-Communicator.
Reset device	Menu for resetting and restarting the device.
Restart	Restart device. When the device is restarted, the voltage is reset. The configuration and parameterization settings made on the device are retained after the restart.
Reset to factory settings	Reset device to factory settings. When resetting to factory settings, the corresponding settings, which were made on the device, are overwritten with the default values.
Simulation	For description see chapter "6.3 Simulation - Simulating device functions", page 63.
SIGNAL GENERATOR	Menu for simulation of the set-point value.
PROCESS SIMULATION	Menu for simulation of the process and process valve.
AUTO / MANU	Switch between AUTOMATIC and MANUAL operating state.
Manual mode	Displays the current valve position and process values. The menu is only available on devices with display module and when the Manual mode operating state has been selected in the AUTO / MANU menu.

Table 17: Menus - MAINTENANCE for general settings

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2.7 Context menu for operation on the display

The context menu is available in the shown operating structure on the device display only.

Opening the context menu:

Press the menu key  for a long time

Type and scope of the context menu depend on whether the menu is opened in the Views area or in the Configuration area.

In the PC software Bürkert-Communicator the partially identical menus are integrated differently in the operating structure.

A detailed description of the PC software Bürkert-Communicator can be found in the associated operating instructions.

Context menu in the Views area (only available when operating on the device display)	
Levels 1 and 2	**Description**
Messages overview	Displays available messages. To display all the text of a message, select the message with the arrow key and open it with the menu key.
Add new view	Create new views.
Delete this view	Delete existing view.
Change layout	Adjust or change layout for the views. 6 different layouts can be selected.
1 Value	Layout for displaying 1 process value.
2 Values	Layout for displaying 2 process values.
4 Values	Layout for displaying 4 process values.
Trend	Layout for displaying the process sequence graphically as a curve.
Trend with 2 Values	Layout for displaying 2 process values and with the process sequence graphically as a curve.
MANU / AUTO	**Factory preset layout for the start screen.** This layout shows the position of the valve as a value and graphically by a symbol for the position indicator. In addition, the symbols for changing the operating state to AUTOMATIC and MANUAL as well as for closing and opening the valve are shown.
Change title	Change the Views title. The title is displayed on the information bar above the view.
Change value	Set the process values which are displayed in the Views. The view of the process values cannot be changed in MANU / AUTO layout.

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Context menu in the Views area (only available when operating on the device display)	
Levels 1 and 2	**Description**
Change unit	Set the physical units in which the process values are displayed in the views. The physical unit, in which the process values are displayed, cannot be changed in MANU / AUTO layout.
Fractional digits	Set decimal places for displaying the process values. This setting is possible only for the layouts 1 Value, 2 Values and 4 Values.
Change user level	Menu for changing the user level. There are 3 user levels, which are password-protected, for assigning user rights. The 3 user levels are:
	Advanced user: Rights: Read values, limited right to change values. Factory setting: Password protection not activated.
	Installer: Rights: Read values, extended right to change values. Factory setting: Password protection not activated.
	Bürkert: Only for Bürkert employees. Factory setting: Password protection activated.
	See also chapter "6.2 Passwords - Activating and deactivating password protection", page 62.

Table 18: Menus - Context menu in the Views area

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Context menu in the Configuration area (only available when operating on the device display)	
Levels 1 and 2	**Description**
Messages overview	Displays available messages. To display all the text of a message, select the message with the arrow key and open it with the menu key.
Help	Displays context-related help texts. Help is only available for the configuration areas Position controller, Process controller and Inputs / Outputs.
Add Shortcut	Create shortcut to a menu. When a shortcut has been created for a menu, the menu can be opened directly in the Context menu. Creating the shortcut. Using the arrow keys and the menu key on the displayed character pad, enter a name and confirm with OK. For the shortcut the menu is listed as the last menu option in the Context menu under the name which was entered for it.
Where am I?	The path, where the menu is located in the operating structure, is displayed.
Change user level	Menu for changing the user level. There are 3 user levels, which are password-protected, for assigning user rights. The 3 user levels are: **Advanced user**: Rights: Read values, limited right to change values. Factory setting: Password protection not activated. **Installer**: Rights: Read values, extended right to change values. Factory setting: Password protection not activated. **Bürkert**: Only for Bürkert employees. Factory setting: Password protection activated. See also chapter "6.2 Passwords - Activating and deactivating password protection", page 62

Table 19: Menus - Context menu in the configuration area

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3 MENUS POSITION CONTROLLER

Menus of the configuration area Position controller are described in this chapter.

3.1 X.CONTROL – Parameterization of the position control

The parameters for the position control can be re-adjusted in this menu. Do not re-adjust them unless required for the application.

3.1.1 DBND - Insensitivity range of the position control

Configuration area: Position controller → **Menu:** X.CONTROL

Required user rights for settings in the menu: Advanced user

Factory setting: 0.5 %

Functional dependencies:

Menu	Function
X.LIMIT	Limit of the mechanical stroke range

This function causes the control valve to respond only from a specific control difference; as a result the valve body and the actuator are protected.

The insensitivity range (dead band) is specified as a % and refers to the scaled stroke range which can be limited in the menu X.LIMIT.
(see chapter "X.LIMIT – Limiting the mechanical stroke range").

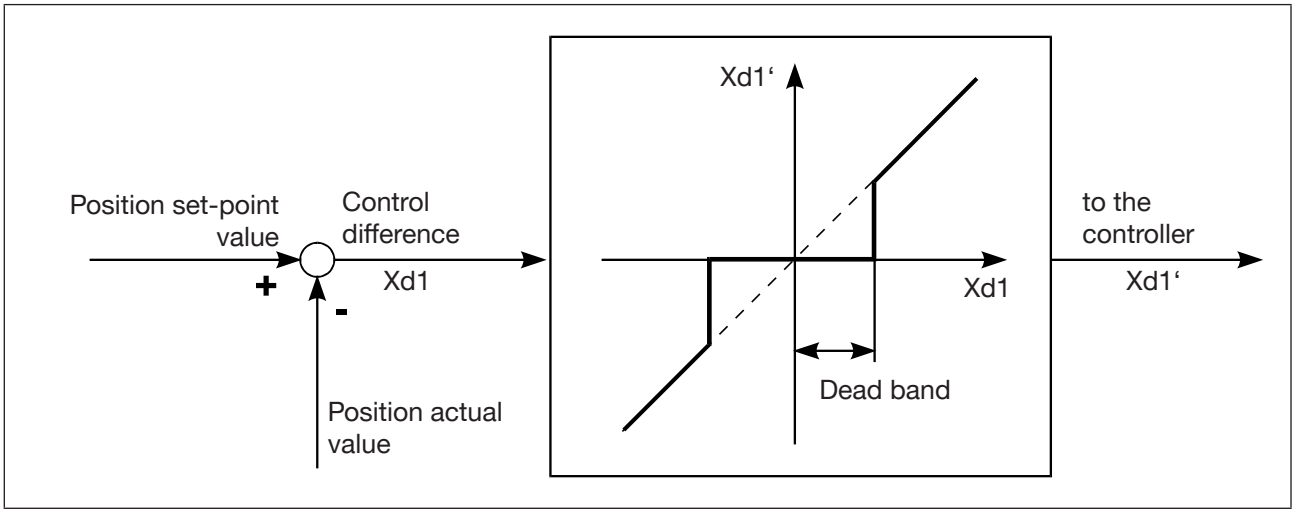

Figure 1: Diagram, insensitivity range

3.1.2 ACCELERATION - Acceleration of the control speed

Configuration area: Position controller → **Menu:** X.CONTROL

Required user rights for settings in the menu: Advanced user

Factory setting: Medium

Three stages can be selected for acceleration when starting up and braking the actuator: Slow, Medium, Fast.

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A slow acceleration protects the actuator train; as a result, the actuating time is longer.

Slow: For gently starting up and braking the actuator during which the actuator train is mechanically and electrically protected.

Medium: Good compromise between actuating duration and protective start-up and braking.

Fast: Shortest actuating time.

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3.2 SAFEPOS - Setting of the safety position and the energy pack

In this menu the safety position is set for the valve and the energy pack is activated or deactivated.

3.2.1 FUNCTION - Selecting safety position

Configuration area: Position controller → **Menu:** SAFEPOS

Required user rights for settings in the menu: Advanced user

Factory setting: Close

Functional dependencies:

Menu	Function
SP / CMD / PV Signal loss detection	Setting the device behavior when there is a signal loss
DIGITAL IN	Parameterization of the digital input
-	Option: SAFEPOS energy-pack

In this menu the safety position is selected which the valve occupies in the following cases:

- Internal error
- Signal loss if parameterized accordingly.
  Setting in Inputs / Outputs → SP / CMD / PV → Signal loss detection
- External error (digital input) if parameterized accordingly.
  Setting in Inputs / Outputs → ADDITIONAL IOs → DIGITAL IN
- Failure of the supply voltage (optional). This function is available only on devices which have the optionally available SAFEPOS energy-pack.

The following safety positions can be selected:

Selection	Effect on the safety position
Close	Valve closed
Open	Valve open
User-Defined	Freely defined, safety position input by a percentage value (0 % = closed, 100 % = open).
Inactive	Valve stops in an undefined position if the supply voltage fails.

Table 20: Selection of the safety position

The safety position is approached in AUTOMATIC operating state only.

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3.2.2 Position - Setting user-specific safety position

Configuration area: Position controller → **Menu:** SAFEPOS

Required user rights for settings in the menu: Advanced user

Functional dependencies:

Menu	Function
FUNCTION	Selection User-Defined

In this submenu the user-specific safety position is set as a percentage (0 % = closed, 100 % = open).

The submenu Position is only available if the safety position User-Defined has been selected in the FUNCTION menu.

3.2.3 ENERGY-PACK - Energy pack functions

Configuration area: Position controller

Required user rights for settings in the menu: Advanced user

Factory setting: Function Immediate control, Self-diagnostics Error

Dependencies: Only available for devices with the SAFEPOS energy pack option.

In this menu the function of the energy pack is set.

The energy pack is used as an emergency power supply to move the valve into the selected safety position in the event of a power failure. The energy pack is designed in such a way that the actuator can move from any position into the selected safety position at nominal load. Operation with the energy pack is indicated by a symbol on the display.

Settings and information on the energy pack: Configuration area: Position controller →

Description of the function	Path to the menu	
	Register card →	Menu
Activating deactivating the energy pack.	PARAMETER →	SAFEPOS → ENERGY-PACK → Function On | Off
Behavior of the actuator during a restart.[3]	PARAMETER →	SAFEPOS → ENERGY-PACK → FUNCTION
Information on the state of health (SOH) of the energy pack.[3]	PARAMETER →	SAFEPOS → ENERGY-PACK → State of health
	DIAGNOSTICS →	ENERGY-PACK → State of health
If an immediate start has been set for the behavior of the actuator during a restart, select the device status for the failure of the energy pack (SOH 0%).[4]	DIAGNOSTICS →	ENERGY-PACK → NAMUR-State

[3] The menu is not displayed until energy pack is activated.

[4] The menu is not displayed until energy pack is activated and if selected in PARAMETER → SAFEPOS → ENERGY-PACK → FUNCTION → Immediate control.

Table 21: Settings and information on the energy pack

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3.2.3.1. Setting in PARAMETER – SAFEPOS – ENERGY-PACK

Function On | Off - Activation and deactivation of the energy save function

In this menu the function of the energy pack is activated or deactivated.

- On The function of the energy pack is activated. Messages are output depending on the state of the energy pack and the device status (see "Table 23: Status messages for the energy pack", page 37). When the Error status message occurs, the actuator moves into the safety position.
- Off The function of the energy pack is deactivated. No messages are output on the state of the energy pack. The actuator does not move into the safety position if the energy pack fails (SOH 0 %).

WARNING!

Danger due to an uncontrolled process when the function of the energy pack is deactivated.

If the function of the energy pack is deactivated, there is no guarantee that the safety position will be approached in the event of a power failure.

▸ If the valve position is relevant with regards to safety, do not deactivate the function of the energy pack.

FUNCTION - Set behavior of the actuator during a restart.

In this menu the behavior is set during a restart for devices with energy pack.

- Immediate control: During a restart the device immediately starts in AUTOMATIC operating state. If the power supply is interrupted shortly thereafter, there is no guarantee that the safety position will be approached.
- Control if ready: During a restart the device starts in AUTOMATIC operating state only if the energy pack is ready to move the actuator reliably into its safety position.

State of health - Information on the state of health (SOH) of the energy pack

The state of health (SOH) of the energy pack is displayed in this menu.
The State of health describes the aging condition of the battery. One criterion for this is the amount of charge which the cells absorb. The absorption capacity is reduced as the battery age increases.

SOH 100 %: corresponds to new condition

SOH 0 %: the amount of charge is too low to move the actuator into the safety position.

SOH <30 %: the state of health is less than 30 %. The energy pack must be replaced promptly.

The FUNCTION and State of health menus are only displayed when the energy pack is activated.

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3.2.3.2. Setting in DIAGNOSTICS – ENERGY-PACK

The menu is not displayed until energy pack is activated.

State of health - Information on the state of health (SOH) of the energy pack.

The state of health (SOH) of the energy pack is displayed in this menu.
The State of health describes the aging condition of the battery. One criterion for this is the amount of charge which the cells absorb. The absorption capacity is reduced as the battery age increases.

NAMUR-State - Select device status for failure of the energy pack.

In this menu the behavior of the device is set, depending on the status message, when the energy pack fails (SOH 0 %).

The following device status can be selected:

Status message	Effect on the behavior of the device
Error	If the amount of charge of the energy pack is too low (SOH 0 %), the actuator moves into the safety position. The device cannot be operated again until the energy pack has been replaced.
Out of specification	If the amount of charge of the energy pack is too low (SOH 0 %), the status "outside the specification" is displayed. A message is output. The device can still be operated despite the energy pack failing.

Table 22: Selection of the device status for self-diagnostics of the energy pack

If the self-diagnostics of the energy pack were changed over, the device must be restarted.

Possible status messages for the energy pack when the diagnostic function is activated:

Status messages according to NAMUR	Dependencies	
	States of the energy pack	Setting in the menu
Error	State of health: SOH 0 % Amount of charge too low. The device moves into the safety position and cannot be operated again until the energy pack has been replaced.	PARAMETER → SAFEPOS → ENERGY-PACK → FUNCTION → Control if ready
		DIAGNOSTICS → ENERGY-PACK → NAMUR-State → Error
Out of specification	State of health: SOH 0 % Amount of charge too low. The device can still be operated despite the energy pack failing.	PARAMETER → SAFEPOS → ENERGY-PACK → FUNCTION → Immediate control
		DIAGNOSTICS → ENERGY-PACK → NAMUR-State → Out of specification

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Status messages according to NAMUR	Dependencies	
	States of the energy pack	Setting in the menu
Maintenance	State of health: SOH <30 % Amount of charge reduced. The energy pack must be replaced soon.	-
Function check	This status is displayed when the device has been restarted. The energy pack is still not ready. The device starts operating when the emergency power supply is ensured by the energy pack.	PARAMETER → SAFEPOS → ENERGY-PACK → FUNCTION → Control if ready

Table 23: Status messages for the energy pack

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3.3 DIAPHRAGM - Settings of the diaphragm valve

In this menu the sealing force of the diaphragm armature is set as well as the parameters for the M.Q0.TUNE function for devices with process control.

The sealing force is automatically determined by running the M.Q0.TUNE function. Manual setting is only required if the valve does not close tightly.

3.3.1 Cutoff force - Sealing force

Configuration area: Position controller → **Menu:** DIAPHRAGM

Required user rights for settings in the menu: Installer

Dependencies: Only available for diaphragm control valves

In this menu the force is specified which is required in AUTOMATIC operating state to close the valve tightly. The required force depends on the operating conditions such as temperature, medium pressure, etc.

The sealing force can be automatically determined with the M.Q0.TUNE function (see "3.3.4 M.Q0.TUNE - Parameters for the M.Q0.TUNE function").

3.3.2 Additional force - Increasing the sealing force

Configuration area: Position controller → **Menu:** DIAPHRAGM

Required user rights for settings in the menu: Installer

Factory setting: 300 N

Dependencies: Only available for diaphragm control valves

If the valve is not adequately sealed, the set sealing force (cutoff force) can be increased in the Additional force menu.

NOTE!

Damage to or premature wear of the diaphragm due to high sealing force.

- The increased sealing force (Cutoff force + Additional force) must not be greater than the maximum sealing force (Maximum force).

3.3.3 Maximum force - Maximum sealing force

Configuration area: Position controller → **Menu:** DIAPHRAGM

Required user rights for settings in the menu: Installer

Dependencies: Only available for diaphragm control valves

In this menu the maximum force is specified which may act on the diaphragm when the valve closes. The maximum sealing force is relevant when the valve closes in MANUAL operating state and when the M.Q0. TUNE function runs.

The maximum sealing force is automatically determined by running the M.Q0.TUNE function.

Manually set the maximum sealing force in the following cases only:
- Termination of the M.Q0.TUNE
- Valve no longer closes tightly due to wear.

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3.3.4 M.Q0.TUNE - Parameters for the M.Q0.TUNE function

Configuration area: Position controller → Menu: DIAPHRAGM

Required user rights for settings in the menu: Installer

Dependencies: Only available for diaphragm control valve and devices with process controller function.

In this menu the parameters for running the M.Q0.TUNE function can be changed. With the M.Q0.TUNE function, the position control is adjusted to the physical stroke of the actuator used and the required sealing force is determined.

The calculation of the sealing force is based on the sealing point which is manually approached when M.Q0. TUNE is running. Alternatively, the sealing point can be determined via the process actual value for devices with process controller function (submenu PV-Limit). An algorithm is used to calculate the optimum sealing force.

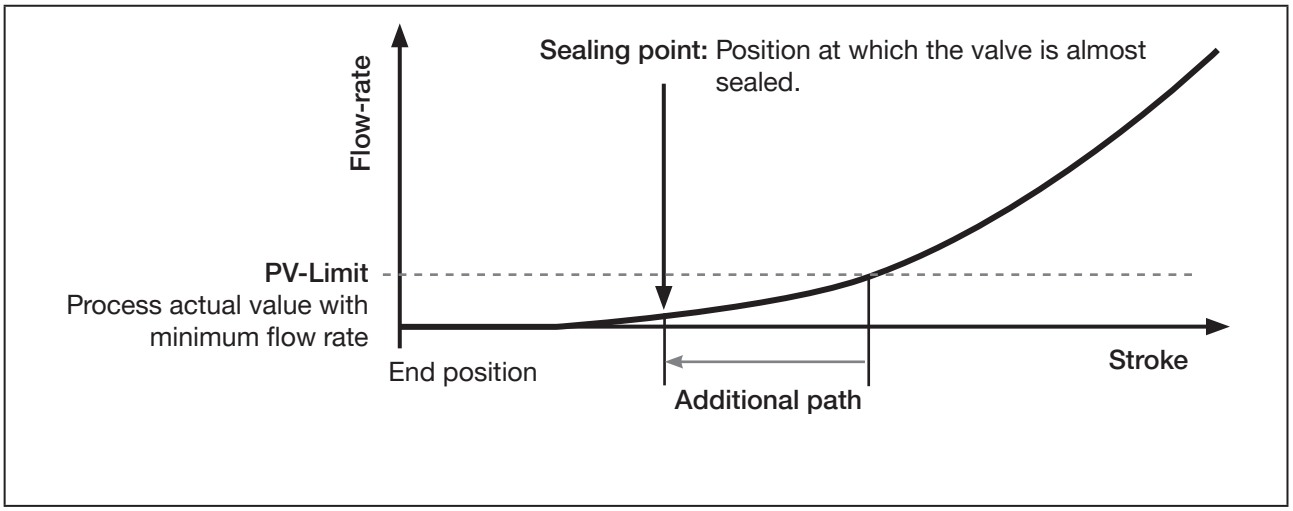

Table 24: Parameters for sealing function

Additional path - Setting additional path for sealing point:

Factory setting: depending on the size of the diaphragm/valve orifice

PV-Limit - Set process actual value with minimum flow rate:

Factory setting: 1 %

PV-Time - Set time constant for the process

Factory setting: 0.5 s

3.3.5 M.CLEAN - Setting duration of the cleaning function

Configuration area: Position controller → Menu: DIAPHRAGM

Required user rights for settings in the menu: Bürkert Service

Factory setting: 5 s

Dependencies: Only available for diaphragm control valves

The duration for the cleaning function is set in this menu. While the cleaning function is running, the valve changes continuously between the 80 % and 100 % open positions. As a result, all parts which come into contact with media are accessible for cleaning during the flushing process.

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3.4 ADD.FUNCTION - Activation and deactivation of auxiliary functions

Configuration area: Position controller

Required user rights for settings in the menu: Installer

Factory setting: No auxiliary functions activated

The device has auxiliary functions for demanding control tasks. The auxiliary functions can be activated and deactivated in the menu ADD.FUNCTION.

Auxiliary functions which are not activated are hidden on the 1st level of the parameter configuration area. Activated auxiliary functions are shown on the 1st level of the parameter configuration area where they can be configured.

Deactivation makes the auxiliary function ineffective. The settings made previously under this auxiliary function are retained even after deactivation.

Activation of the auxiliary functions in the position controller configuration area:

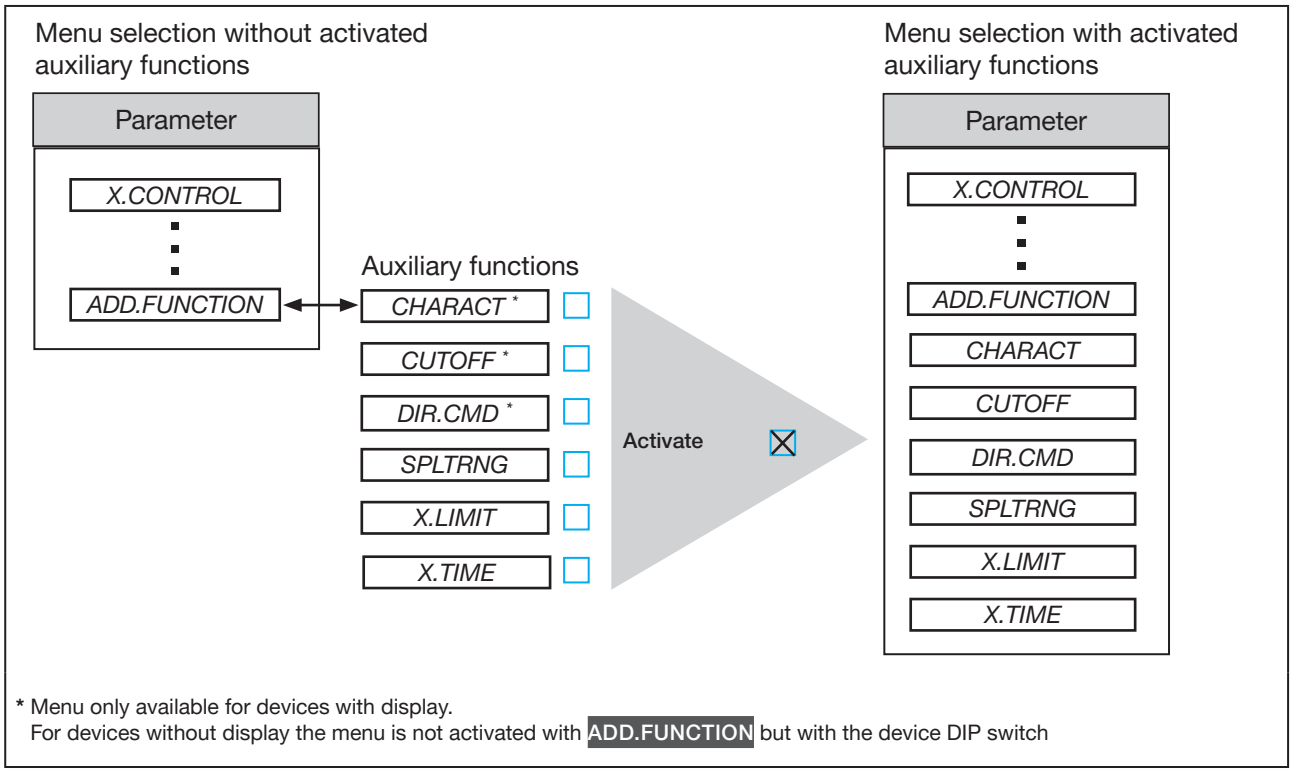

Figure 2: Activating the auxiliary functions

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3.5 CHARACT - Configuring correction characteristic

Configuration area: Position controller

Factory setting: Correction characteristic deactivated.

In this menu the correction characteristic is configured which is used to correct the flow characteristic and operating characteristic with regard to the set-point position (CMD) and the valve stroke (POS).

When the correction characteristic is activated, the flow characteristic or operating characteristic is corrected with regard to the set-point position value (CMD) and the valve stroke (POS).

Flow characteristic:
The flow characteristic $k_V = f(s)$ indicates the flow-rate of a valve, expressed by the k_V value as a function of the stroke s of the actuator spindle. The flow characteristic is determined by the design of the valve body, the valve cone and the diaphragm. In general 2 types of flow characteristics are implemented, the linear and the equal percentage.

In the case of linear characteristics, equal k_V value changes dk_V are assigned to equal stroke changes ds.

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

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

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

Operating characteristic:
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. The operating characteristic therefore exhibits a form which differs from the flow 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. The control valve therefore has a transfer element which implements different characteristics. These characteristics are used to correct the operating characteristic.

Equal percentage characteristics 1:25, 1:33, 1:50, 25:1, 33:1, and 50:1 as well as a linear characteristic can be set. Moreover, it is possible to program a user-defined characteristic by inputting nodes.

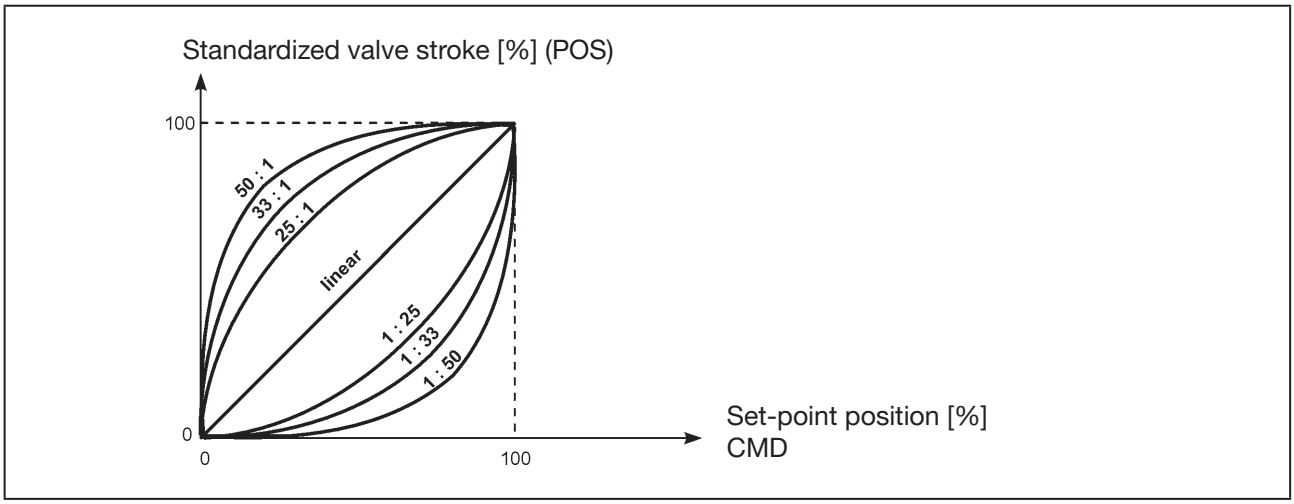

Figure 3: Characteristics

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3.5.1 TYPE - Selection of the correction characteristic

Configuration area: Position controller → Menu: CHARACT

Required user rights for settings in the menu: Advanced user

Factory setting: linear

Functional dependencies:

Menu	Function
ADD.FUNCTION	Activating the CHARACT auxiliary function
	For devices without a display: Activation of the CHARACT auxiliary function using the device DIP switch.

In this menu the correction characteristic is selected which is used to correct the flow characteristic and operating characteristic with regard to the set-point position (CMD) and the valve stroke (POS).

For devices without a display the correction characteristic is selected in the PC software Bürkert-Communicator.

Correction characteristics which can be selected:

Menu designation	Description of the characteristic
Linear	Linear correction characteristic
GP 1:25	Equal percentage correction characteristics
GP 1:33	
GP 1:50	
GP 25:1	
GP 33:1	
GP 50:1	
User-Defined	User-defined correction characteristic, freely programmable via nodes

Table 25: Selection of the correction characteristic

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3.5.2 TABLE DATA - Programming user-defined correction characteristic

Configuration area: Position controller → **Menu:** CHARACT

Required user rights for settings in the menu: Advanced user

Functional dependencies:

Menu	Function
ADD.FUNCTION	Activating the CHARACT auxiliary function.
	For devices without a display: Activation of the CHARACT auxiliary function using the device DIP switch.
CHARACT	In the TYPE submenu selection of the correction characteristic User-Defined.

In this menu the correction characteristic is programmed specific to the user and is used to correct the flow characteristic and operating characteristic with regard to the set-point position (CMD) and the valve stroke (POS).

For devices without a display the correction characteristic is corrected in the PC software Bürkert-Communicator.

Programming: During programming a set-point position is assigned, via the standard signal (CMD), to the nodes which divide the valve stroke into 5 percentage steps. The programmed correction characteristic is indicated as a graphic on the display or in the PC software Bürkert-Communicator.

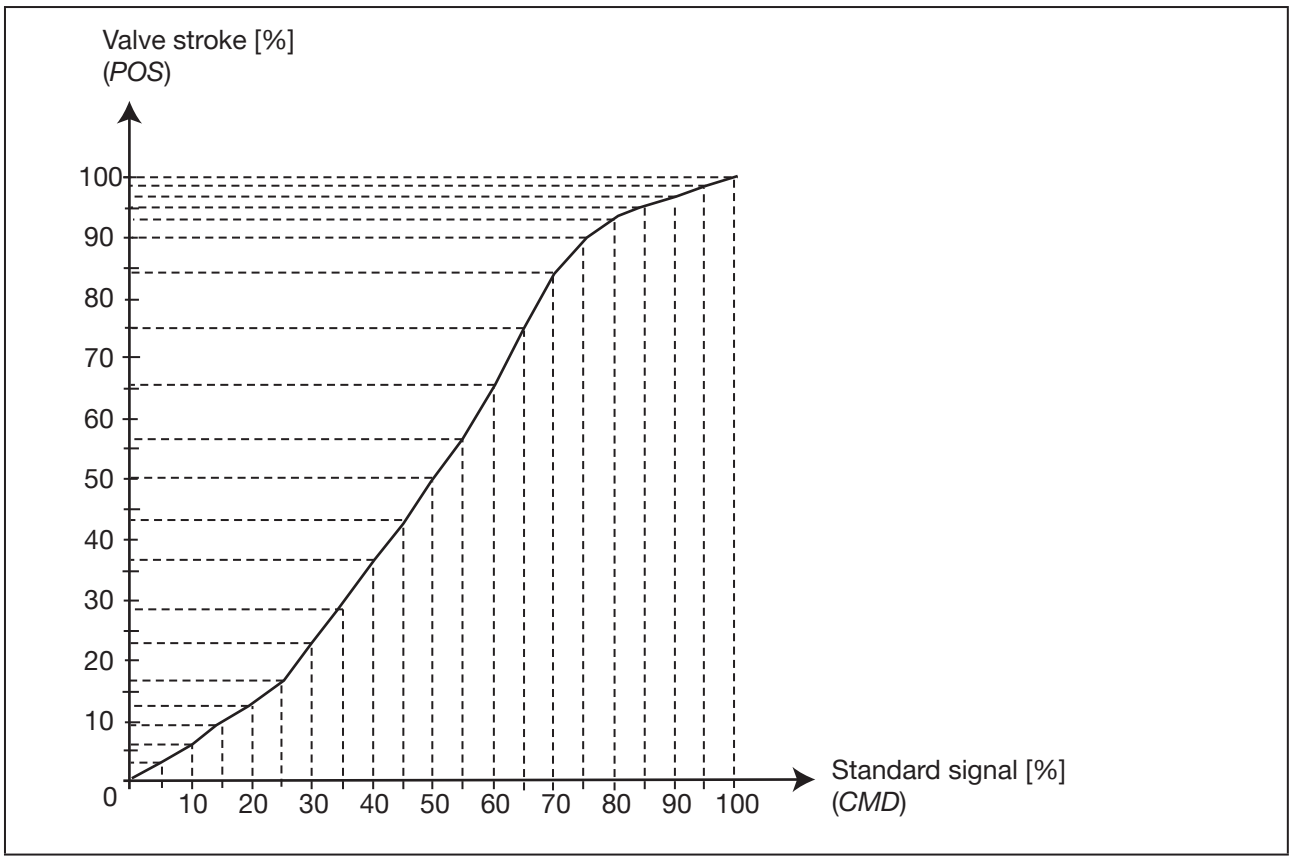

Figure 4: Example of a programmed correction characteristic

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3.6 CUTOFF - Configuring sealing function

Configuration area: Position controller

Required user rights for settings in the menu: Advanced user

Factory setting: Sealing function deactivated.

Functional dependencies:

Menu	Function
ADD.FUNCTION	Activating the CUTOFF auxiliary function
	For devices without a display: Activating the CUTOFF auxiliary function using the device DIP switch.

The sealing function is configured in this menu. This function causes the valve to be sealed or completely opened in the set area.

To do this, the limit values for sealing or opening the valve (CMD) are input as a percentage. The transition from sealing or opening to control mode occurs at a hysteresis of 1 %.

For devices with process controller function you can select whether the sealing function is to refer to the process set-point value or the position set-point value.

3.6.1 CUTOFF.type - Selecting source of the sealing function input signal

Configuration area: Position controller → Menu: CUTOFF

Required user rights for settings in the menu: Advanced user

Factory setting: X.CO, position set-point value

Functional dependencies: Only available for devices with process controller function.

The source of the sealing function input signal is specified in this menu.

The limit values of the sealing function for the scaling range of the process set-point value are entered as a percentage.

Lower limit - Entry of the lower limit value for the sealing function

Factory setting: 1 %

Upper limit - Entry of the upper limit value for the sealing function

Factory setting: 100 %

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3.7 DIR.CMD - Changing effective direction of the standard signal for the valve position

Configuration area: Position controller

Required user rights for settings in the menu: Advanced user

Factory setting: Rise**, positive effective direction**

Functional dependencies:

Menu	Function
ADD.FUNCTION	Activating the DIR.CMD auxiliary function
	For devices without a display: Activating the DIR.CMD auxiliary function using the device DIP switch.

In this menu the effective direction of the standard signal is changed with regard to the valve position.

Meaning of the setting:

Rise: The position 0 % (valve closed) is controlled with the standard signal 0 V, 0 mA or 4 mA.

Fall: The position 0 % (valve closed) is controlled with the standard signal 5 V, 10 V or 20 mA.

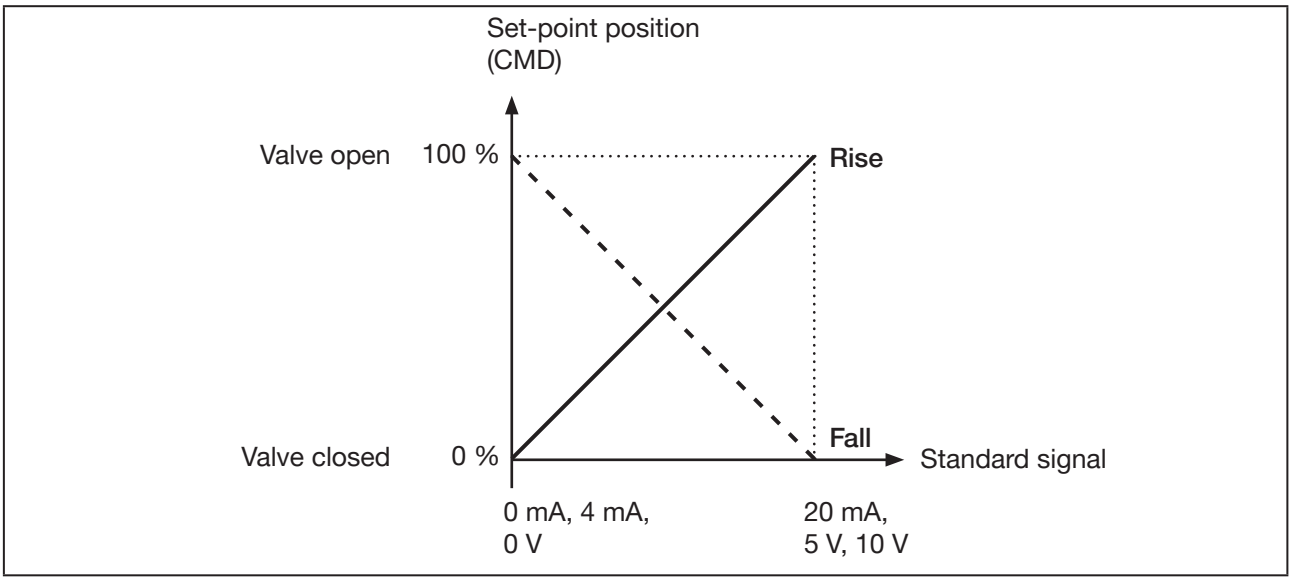

Figure 5: Diagram of effective direction

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3.8 SPLTRNG - Signal split range

Configuration area: Position controller

Required user rights for settings in the menu: Advanced user

Factory setting: Minimum 0 %, maximum 100 % (no signal split range)

Functional dependencies:

Menu	Function
ADD.FUNCTION	Activating the SPLTRNG auxiliary function.

In this menu it is possible to split the standard signal range between several devices. In doing so, the standard signal for the position set-point value is restricted by a minimum and maximum value.

The minimum value and maximum value which restrict the standard signal range, are specified as a percentage.

The restricted standard signal range includes the entire stroke range which the valve runs through.

The signal split range can occur without or with overlapping for the standard signal ranges 0...20 mA, 4...20 mA, 0...5 V or 0...10 V.

The signal split range allows several valves to be used alternately or, in the case of overlapping set-point value ranges, simultaneously as actuators.

Adjustment range for the minimum values and maximum values:

Minimum 0...75 %

Maximum 25...100 %

There must be a difference of at least 10 % between minimum and maximum.

Example: Splitting a standard signal range into two set-point value ranges

Example

Standard signal range: 4...20 mA

Setting the set-point value range Device 1:
Minimum 0 %, maximum 37.5 %

Setting the set-point value range Device 2 minimum: 37.5 %, maximum 100 %

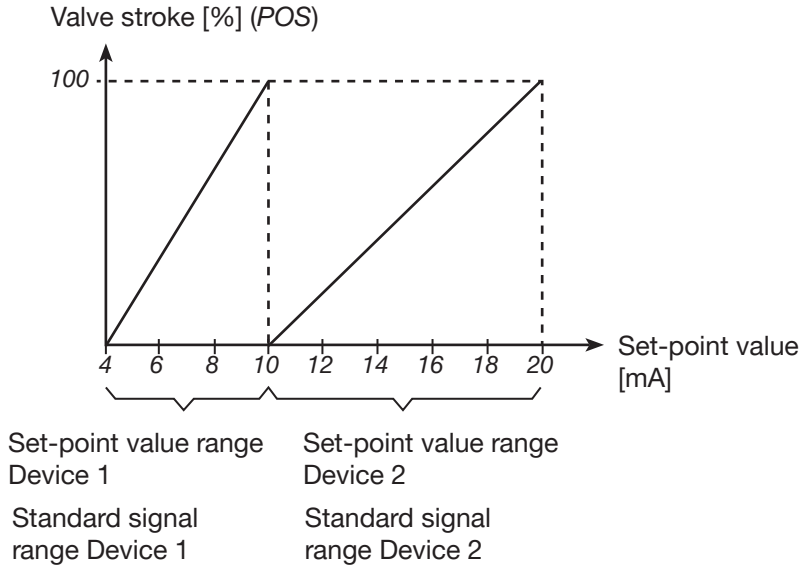

Figure 6: Diagram, signal split range

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3.9 X.LIMIT - Mechanical stroke limit

Configuration area: Position controller

Required user rights for settings in the menu: Advanced user

Factory setting: Minimum 0 %, maximum 100 % (no stroke limit)

Functional dependencies:

Menu	Function
ADD.FUNCTION	Activating the X.LIMIT auxiliary function.

In this menu the physical stroke range of the valve can be limited and is specified by the mechanical end positions.

To limit the valve stroke, a percentage value for the start position and the end position is entered with regard to the physical stroke range. In doing so, the stroke range of the limited stroke is set equal to 100 %.

Adjustment range for the start position and end position:

Minimum 0...90 %

Maximum 10...100 %

There must be at least a 10 % difference between the start position and end position. This means that the minimum valve stroke is 10 % of the physical stroke range.

In the MANUAL operating state the stroke limit is not effective. The valve can be manually moved into positions which are outside the limited stroke range.

Valve positions, which are outside the limited stroke range, are displayed as negative or positive values > 100 %.

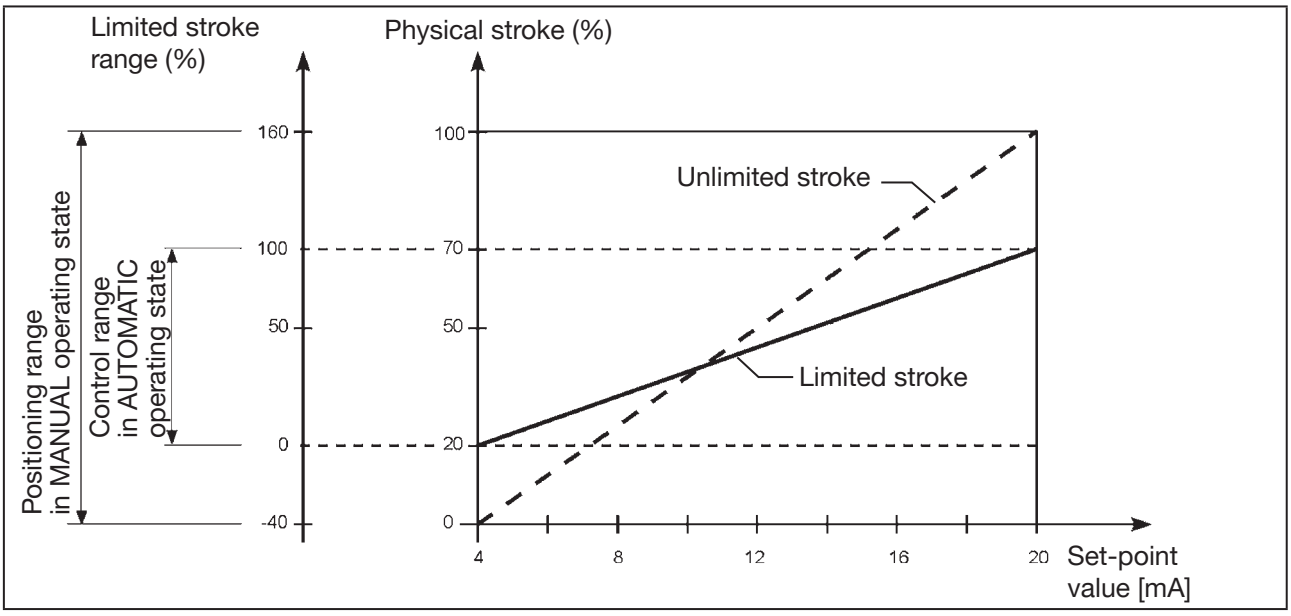

Figure 7: Diagram, mechanical stroke limit

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3.10 X.TIME - Actuating time limit

Configuration area: Position controller

Required user rights for settings in the menu: Advanced user

Factory setting: Maximum speed which was determined by the X.TUNE function.

Functional dependencies:

Menu	Function
ADD.FUNCTION	Activating the X.TIME auxiliary function.

In this menu the opening time and closing times of the valve can be extended for the entire stroke, thereby limiting the control speeds.

During start-up the X.TUNE function automatically determines the minimum opening time and closing time for the entire stroke and transfers it into the X.TIME menu. As a result, the valve is opened and closed at maximum speed.

To limit the control speed, the time span is entered during which the valve opens and closes with regard to the entire stroke range.

Adjustment range for the opening and closing time:

Opening time 1*...60 s

Closing time 1*...60 s

* *Theoretical value. The lowest closing time, depending on the device, is determined using the X.TUNE function.*

Effect of limiting the opening speed when there is a jump in the set-point value

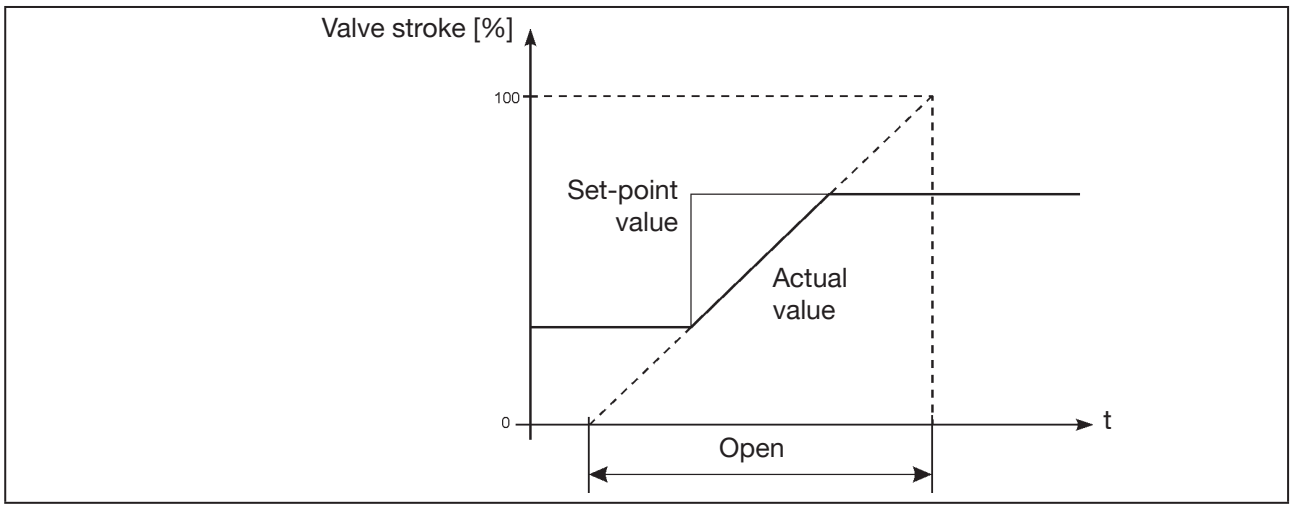

Figure 8: Diagram, limited opening speed

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3.11 MAINTENANCE - Start-up and maintenance of the position controller

Configuration area: Position controller / MAINTENANCE

This menu contains the functions for starting up the position control and the diaphragm armature as well as a function which supports the cleaning of the diaphragm control valves.

3.11.1 X.TUNE - Automatic adjustment of the position control for seat valves

Configuration area: Position controller / MAINTENANCE

Required user rights for settings in the menu: Installer

Functional dependencies: Not available for diaphragm control valves
For devices without display the X.TUNE function is run with the OPEN key and CLOSE key of the device.

The X.TUNE function is used to adjust the position control to the physical conditions of the device. In doing so, the sensor signal is adjusted to the (physical) stroke of the actuator used.

3.11.2 M.Q0.TUNE - Adjustment of the position control for diaphragm valves

Configuration area: Position controller / MAINTENANCE

Required user rights for settings in the menu: Installer

Functional dependencies: Only available for diaphragm control valves
For devices without display the M.Q0.TUNE function is run with the OPEN key and CLOSE key of the device.

The M.Q0.TUNE function is used to adjust the position control to the physical conditions of the device.

The following parameters are automatically determined and adjusted when running the M.Q0.TUNE:

- Adjustment of the sensor signal to the (physical) stroke of the actuator used.
- Determination of the optimum sealing force. The optimum sealing force considers the sealing of the valve and the long service life of the diaphragm due to low wear.

Menus for running the M.Q0.TUNE

Depending on the device model, 1 menu or 2 menus are available for adjusting the position control for diaphragm valves. The difference between the two menus is the determination of the sealing point.

- M.Q0.TUNE-MANU is available for all diaphragm control valves.

  The sealing point is determined by manually and cautiously approaching it.

- M.Q0.TUNE-AUTO is available only for diaphragm control valves with process controller function.

  The sealing point is automatically determined via the process set-point value. To do this, the process values and the process control must be scaled before the M.Q0.TUNE-AUTO is run.

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3.11.3 M.CLEAN - Cleaning function for diaphragm control valve

Configuration area: Position controller / MAINTENANCE

Required user rights for settings in the menu: Installer

Functional dependencies:

Menu	Function
-	Only available for diaphragm control valves.
M.CLEAN.source	Actuating the function via the digital input.

The menu is used to start and end the cleaning function for the diaphragm control valves.

While the M.CLEAN is running, the valve changes continuously between the 80 % and 100 % open positions. As a result, all parts, which come into contact with media, are accessible for cleaning during the rinsing process and all residue can be removed from the diaphragm armature.

Actuating the cleaning function via the digital input:

Alternatively, for actuation in the menu the cleaning function can be actuated via the digital input. To do this, the source Digital must be selected in the configuration area Inputs / Outputs.

Path: ADDITIONAL IOs → DIGITAL IN → M.CLEAN.source

3.11.4 M.SERVICE - Starting up the diaphragm armature

Configuration area: Position controller / MAINTENANCE

Required user rights for settings in the menu: Installer

Functional dependencies:

Menu	Function
-	Only available for diaphragm control valves.
-	For devices without a display: Actuating the M.SERVICE with the OPEN key and CLOSE key.

The menu is used to actuate the function for starting up the diaphragm armature.

The M.SERVICE function is run during installation, before the diaphragm base is screwed firmly to the valve body, and is an important aid for installation of the diaphragm.

The M.SERVICE function prevents the diaphragm from being damaged or deformed during installation. If the diaphragm is deformed during installation, it will have a shorter service life.

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3.12 DIAGNOSTICS - Diagnostics of the position controller

Configuration area: Position controller / DIAGNOSE

In this menu the diagnostic functions are configured and the values of the different diagnostics are displayed.

3.12.1 POS.MONITOR - Position monitoring of the position controller

Configuration area: Position controller / DIAGNOSE

Required user rights for settings in the menu: Advanced user

The POS.MONITOR function is used to monitor the current position of the actuator.

The tolerance band for the position set-point value is specified (as a percentage) in the Tolerance band submenu. The tolerance band specifies the permitted deviation between actual position and position set-point value in the persistent state (following elapsed compensation time). A message is output if the permitted deviation is exceeded.

A time span for alignment of the actual value with the position set-point value is specified in the Compensation time submenu.
This time span is designated as compensation time and starts as soon as the position set-point value is constant. When the compensation time has elapsed, monitoring starts.

During monitoring if the control deviation of the actual position with respect to the position set-point value is greater than that specified in the tolerance band, a message is output.

Schematic representation

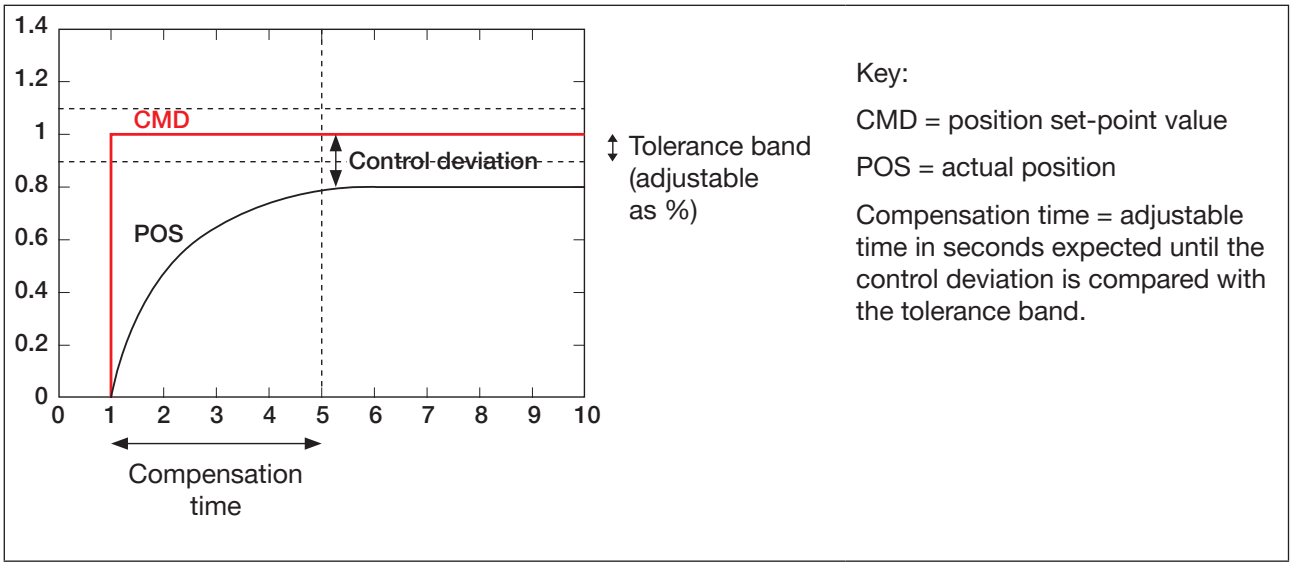

Figure 9: POS.MONITOR; schematic representation of position monitor

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4 MENUS INPUTS / OUTPUTS

4.1 PV - Parameterization of the process actual value

Configuration area: Inputs / Outputs

Required user rights for settings in the menu: Installer

Functional dependencies: Only available for devices with process controller function.

In this menu the signal source is selected for the process actual value and the analog signal source is parameterized depending on the selection.

In the PV.source submenu the signal sources büS and Analog can be selected.

Analog: For all analog sensors (4-20 mA, PT100, frequency).

büS: Sensor signals via büS. (büS sensors or analog sensors which are coupled to the büS network with the IO module).

If the signal source Analog was selected, the following options are available for parameterization of the process actual value:

- Selection of the signal type for the process actual value in the ANALOG.type menu. The following can be selected: 4-20 mA, frequency, PT 100.
  Factory setting: 4-20 mA

The physical unit is set in the process controller configuration area in the UNIT menu.

4.1.1 Settings for selection of the signal type 4-20 mA

- Scaling of the process actual value in the PV.scale menu.
  Factory setting: Minimum 0 %, maximum 100 %
- Activate signal loss detection for the process actual value in the Signal loss detection menu.
  The activation also specifies the device status for outputting the message.

  Out of specification and Error can be selected.
  If Error was selected, the actuator moves into the safety position when there is a signal loss.

4.1.2 Settings for selection of the frequency signal type

Setting of the K factor for calibration of the flow sensor in the K factor menu.

Description of the K factor:

The K factor (pulse/liter) is the proportionality factor for the conversion between sensor signal (pulses/unit of time) and process actual value PV (quantity/unit of time).

Calculation:

$$\textit{Sensor pulses} \cdot \frac{1}{\textit{K factor}} = \textit{flow rate}$$

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Example:

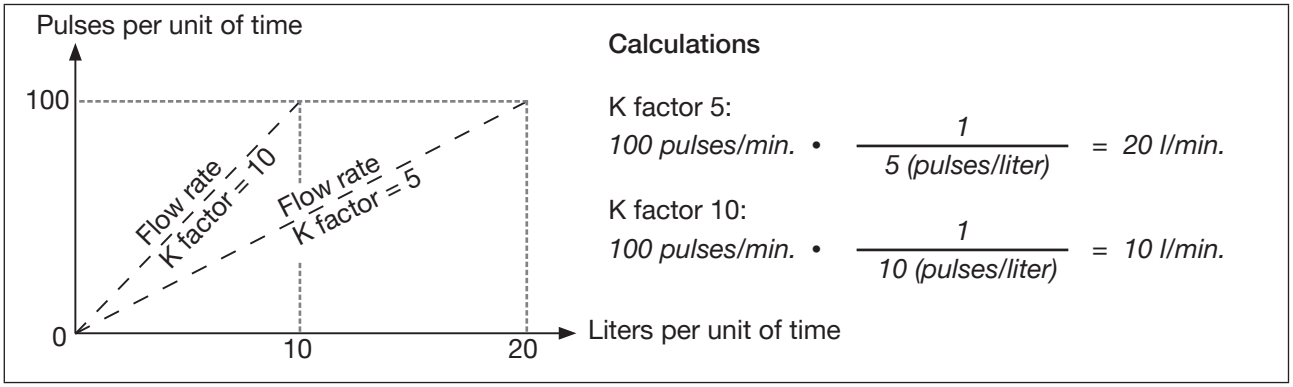

Figure 10: Example: K factor for sensor calibration for frequency signal type

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4.2 DIGITAL OUT - Configuration of the digital outputs

Configuration area: Inputs / Outputs → ADDITIONAL IOs

Required user rights for settings in the menu: Installer

Functional dependencies: Only available for devices with process controller function.

The description applies to the menus DIGITAL OUT 1 and DIGITAL OUT 2. The Configuration menu is identical for both digital outputs.

The additional digital output is configured in the DIGITAL OUT 1 menu.

4.2.1 Selection of the signal source for the digital output

In the SOURCE submenu the signal sources Internal and büS can be selected.

Factory setting: Internal

Internal is selected if the signal is to be used for an internal task/function.

büS is used if a büS signal is to be output via the digital output!

4.2.2 Specifying function of the digital output

The FUNCTION submenu specifies for which event the digital output is to output the switching signal 0 or 1.

Factory setting: Position limit

Position limit	Monitoring the valve position. Exceeding or dropping below a specified limit position. When this function is selected, the Input menu of the same name appears one level higher from which percentage value a control deviation is to be displayed.
Device state	Messages on the device status available, yes or no When this function is selected, the menu of the same name specifying the device status, for which the output is to be implemented, appears one level higher. **Factory setting: Error** The following device statuses can be selected: Maintenance Maintenance requirement Out of specification Outside the specification Function check Function check Error Failure, error or fault
Manual mode	AUTOMATIC or MANU operating state
Control deviation	Exceeding the permitted control deviation When this function is selected, the Input menu of the same name appears one level higher from which percentage value a control deviation is to be displayed.
Safepos	Actuator in safety position

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Output options and associated switching signals for the digital outputs 1 and 2:

Menu	Switching signal	Description
Position limit	0	Actual position is above the limit position
	1	Actual position is below the limit position
Device state	0	Message for the selected device status available
	1	Message not available for the selected device status
Manual mode	0	Device is in AUTOMATIC operating state
	1	Device is in MANUAL operating state
Control deviation	0	Control deviation is within the set limit
	1	Control deviation is outside the set limit
Safepos	0	Actuator is not in the safety position
	1	Actuator is in the safety position

The output signal depends on the set switching status NO or NC.

Switching signal	Switching statuses	
	NO normally open	NC normally closed
0	0 V	24 V
1	24 V	0 V

4.2.3 Specifying switching status for the digital output

In the DIGITAL.type submenu the switching status is specified for the digital output.

Factory setting: Normally open

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5 POSITION CONTROLLER MENUS

5.1 PID-PARAMETER - Parameterization of the process controller

Configuration area: Process controller

Required user rights for settings in the menu: Advanced user

Functional dependencies: Only available for devices with process controller function.

The following control parameters of the process controller are manually set in this menu.

DBND	Insensitivity range (dead band) of the process controller
KP	Proportional component (P-component of the PID controller)
TN	Reset time (I-component of the PID controller)
TV	Hold-back time (D-component of the PID controller)
XO	Operating point

Basic information for setting the process controller can be found in chapters "7 Properties of PID controllers", page 67 and "8 Adjustment rules for PID controllers", page 72.

5.1.1 DBND – Setting the insensitivity range (dead band)

This function causes the process controller to respond from a specific control difference only. This protects the electric actuator.

Factory setting: **1.0 %** with reference to the range of the scaled process actual value (setting in the configuration area Inputs / Outputs → PV → PV.scale).

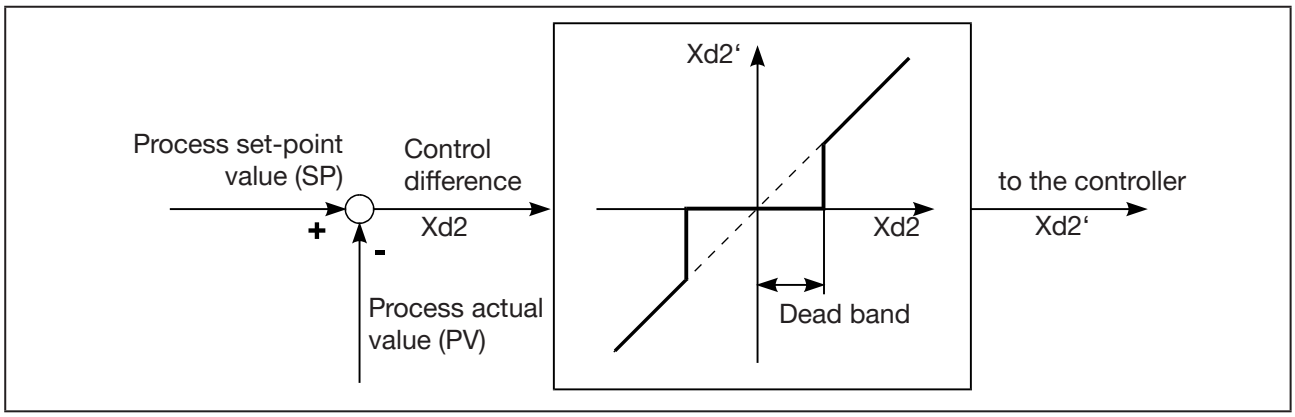

Figure 11: Diagram DBND; insensitivity range for process control

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5.1.2 Setting the PID controller parameters

For appliances with process controller function a PID controller for the process control is implemented in addition to the actual position control.

The PID controller can be automatically parameterized with the aid of the P.TUNE function.

The menu for actuating the P.TUNE function is located in the configuration area → Process controller → MAINTENANCE → CALIBRATION.

The menu options for parameterization of the PID controller:

KP **Proportional component (amplification factor)**

The proportional component specifies the P component of the PID controller.

Factory setting: 1

Setting the proportional component in the submenus:

Value **Set value.**

Unit **Set physical unit.**
The selection depends on the physical variable which has been set in the configuration area Process controller in the menu Parameter → UNIT.

TN **Reset time**

The reset time specifies the I component of the PID controller.

Factory setting: 999 s

TV **Hold-back time**

The hold-back time specifies the D component of the PID controller

Factory setting: 0 s

5.1.3 Setting the XO operating point

The operating point corresponds to an actuating variable as a percentage which is added to the PID actuating variable of the process controller as an offset which is independent of the control deviation. The PID actuating variable of the process controller depends on the control deviation.

The operating point is used primarily for process controllers which have a P structure. In this case the operating point has the effect that the control difference of 0 can be reached in a stationary state at a certain operating point of the process.

Factory setting: 0.0 %

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5.2 SP.SLOPE - Setting growth rate per unit of time

Configuration area: Process controller

Required user rights for settings in the menu: Advanced user

Factory setting: 1.000

In the SP.SLOPE menu the speed, at which the process set-point value is changed, can be limited.

The Rise and Fall parameters specify to what extent the process set-point value may be changed within 1 second.

Setting in the menu.

To make the setting, a value for the physical unit is entered based on 1 second.

RISE Setting for the upward movement.

Fall Setting for the downward movement.

Effect of limiting the speed when there is a jump in the set-point value

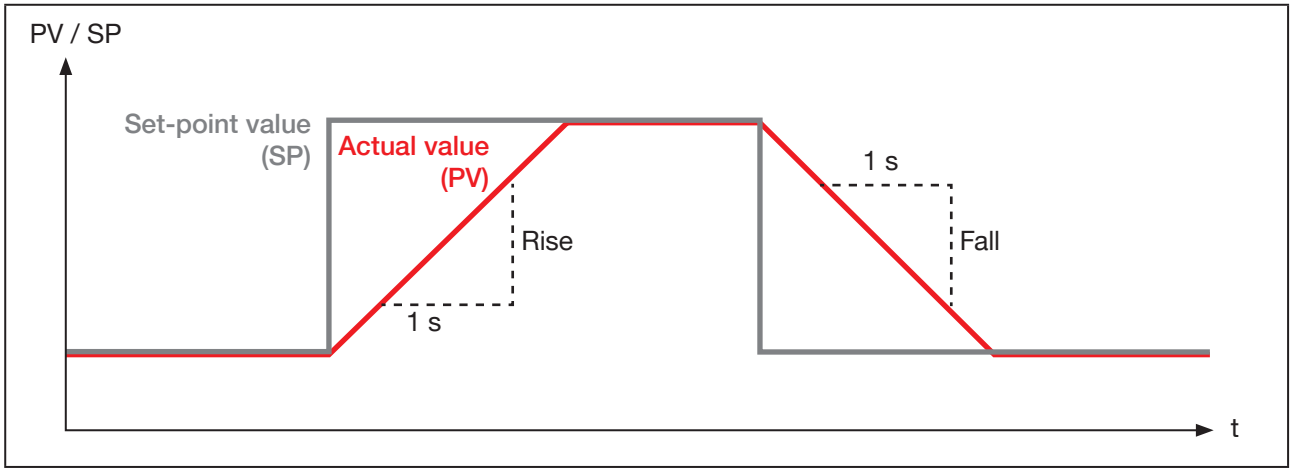

Figure 12: SP.SLOPE, effect of limit when there is a jump in the set-point value

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6 GENERAL SETTINGS MENUS

6.1 Status LED - adjustment of the LED for indicating device statuses

Configuration area: General settings

Required user rights for settings in the menu: Installer

Factory setting: Valve mode + warnings

The Status LED menu is used to set which device statuses are indicated on the LED illuminated ring.

The following LED modes can be selected:

- NAMUR mode
- Valve mode
- Valve mode + warnings
- LED off

The color for indicating the device status "Valve open" and "Valve closed" can be set for Valve mode and Valve mode + warnings.

6.1.1 Description of valve mode

The valve position and the device status "Error" are indicated in valve mode.

Messages on device status "Out of specification", "Maintenance" and "Function check" are not displayed in valve mode.

Displays in valve mode:

When device status "Normal": Permanently lit in the color of the valve position.
When device status "Failure": Flashes alternately red and in the color of the valve position.

Valve position	Color for valve position	Color for device status "Failure"
Open	yellow	red
Half-way	white	
Closed	green	

Table 26: Display of device status in valve mode

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6.1.2 Description of valve mode + warnings

The valve position as well as the device status "Error", "Out of specification", "Maintenance required", and "Function check" are displayed in this mode.

If several device statuses exist simultaneously, the device status with the highest priority is displayed. The priority is determined by the severity of the deviation from standard operation (red = failure = highest priority).

Displays in valve mode + warnings:
When device status "Normal": Permanently lit in the color of the valve position.
If device status deviates from "Normal": The colors for valve position and device status flash alternately.

Valve position	Color for valve position (factory setting)	Color for device status			
		Outage, error or malfunction	Function check	Out of specification	Maintenance required
Open	yellow	red	orange	yellow	blue
Half-way	white				
Closed	green				

Table 27: Display of device status in valve mode + warnings

6.1.3 Setting the colors for indicating the valve position

Configuration area: General settings → Status LED

Required user rights for settings in the menu: Installer

Functional dependencies: Setting possible only for Valve mode and Valve mode + warnings.

Factory setting: yellow for valve open, green for valve closed.

For the display on the LED illuminated ring the yellow and green colors can be assigned to the open and closed valve positions.

If the Valve mode or Valve mode + warnings was selected in the menu Status LED → Mode, the following submenus are available for setting:

- Valve open In this menu the color of the LED illuminated ring is selected for indicating the "Valve open" device status. Yellow and green can be selected.
- Valve closed In this menu the color of the LED illuminated ring is selected for indicating the "Valve closed" device status. Yellow and green can be selected.

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6.1.4 Description of NAMUR mode

In NAMUR mode, the LED illuminated ring lights up according to NAMUR NE 107, in the color specified for the device status.

If several device statuses exist simultaneously, the device status with the highest priority is displayed. The priority is determined by the severity of the deviation from standard operation (red = failure = highest priority).

Displays in NAMUR mode:

Status display in accordance with NE 107, edition 2006-06-12			
Color	**Color code**	**Description**	**Meaning**
red	5	Failure, error or fault	Control mode is not possible due to malfunctioning in the device or at its peripheral equipment.
orange	4	Function check	Work is being carried out at the device; control mode is therefore not currently possible.
yellow	3	Outside the specification	Ambient conditions or process conditions for the device are outside the specified area. Internal device diagnostics point to problems in the device or the process properties.
blue	2	Maintenance required	The device is in controlled operation, although a function is briefly restricted. → Service device.
green	1	Diagnostics active	Device is operating perfectly. Status changes are indicated in different colors. Messages are transmitted via a fieldbus if connected.
white	0	Diagnostics inactive	Device is switched on. Status changes are not displayed. Messages are not transmitted via a fieldbus if connected.

Table 28: Display of device status in NAMUR mode

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6.2 Passwords - Activating and deactivating password protection

Configuration area: General settings → Passwords

Required user rights for settings in the menu: Installer (when password protection set)

Factory setting: Password protection not activated

Password protection is not activated in as-delivered state. Settings in the software can be made at any time and without entering a password.

A password has to be entered for settings which only Bürkert employees are allowed to make.

Following activation of the password protection, settings in the software are possible only with the required user rights and by entering a code.

There are 3 user levels for assignment of user rights.

User level	Icon	Description
Advanced user		PIN required: Code 005678 assigned at the factory Rights: Read values, limited right to change values.
Installer		PIN required. Code 001946 assigned at the factory Rights: Read values, extended right to change values.
Bürkert		PIN required. Only for Bürkert employees

Table 29: User levels

The factory assigned code (password) can be changed for the user levels Advanced user and Installer.

Note! Document passwords and give access to authorized persons.

As soon as the screen saver is active, settings, which require a specific user level, are possible only by entering the password.

When password protection is activated, the Installer user level is required to change the password protection.

The user level is changed in the Context menu.

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6.3 Simulation - Simulating device functions

This function can be used to simulate set-point value, process and process valve independently of each other.

Restarting the device deactivates the simulation.
The settings in the Simulation menu are reset to the factory settings.

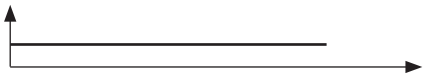
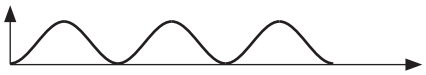
6.3.1 SIGNAL GENERATOR - Simulation of the set-point value

Configuration area: General settings → MAINTENANCE → Simulation

Required user rights for settings in the menu: Installer

Factory setting: SIGNAL GENERATOR switched off, waveform constant

The settings for simulation of the set-point value are made in this menu.
The waveform for simulation of the set-point value is specified in the SIGNAL.form submenu.

Constant	Constant signal	
Sine	Sine wave	
Square	Square wave	
Triangle	Triangle wave	
Mixed	Cycle of an alternating waveform.	

The following parameters can be set for the selected waveform.

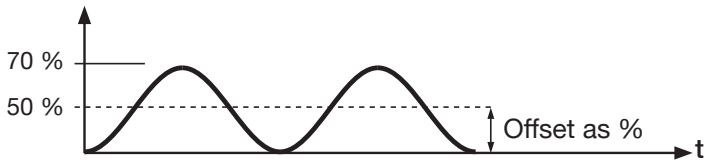
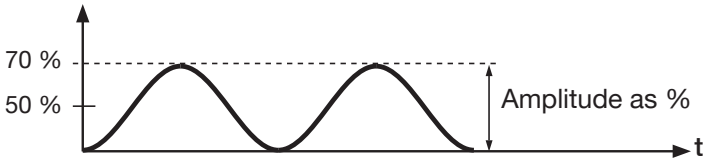
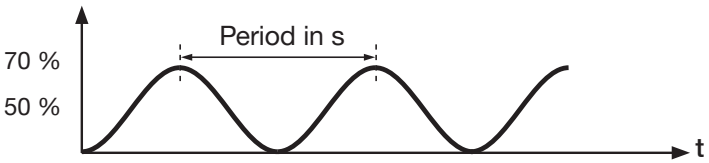
Menu option	Parameter setting	Schematic representation of the parameters as an example of a sine wave
Offset	(Zero offset as %)	
Amplitude	(Amplitude as %)	
Period	(Cycle duration in s)	

Table 30: Parameter settings of the waveforms for the set-point value simulation

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6.3.2 PROCESS SIMULATION - Simulation of the process and process valve

Configuration area: General settings → MAINTENANCE → Simulation

Required user rights for settings in the menu: Installer

Functional dependencies: Only available for devices with process controller function.

Factory setting: Process simulation deactivated

The process simulation can be used to simulate a controlled system which can be modeled from different transfer functions. It is therefore possible to test the behavior of the device under process conditions and to preset the process controller by running the P.TUNE function.

Description of the menu for simulation of a process:

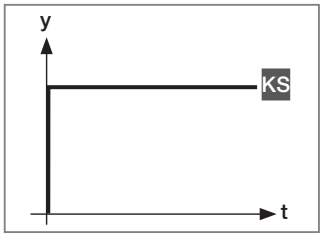
In the PROCESS.form menu different transfer functions can be selected for modeling the controlled system. These are switched in succession during the simulation.

Structure of the process simulation model

Transfer functions						
P element	Dead time element	Non-lin-earity of the characteristic	PT1 element no. 1	PT1 element no. 2	PT2-element	I-element
→ KS →	→	→ linear →	→	→	→	→
Always available. Amplification factor. Setting in the KS menu.	Setting in the Dead time menu.	Setting in the NON-LIN-EARITY menu. User-specific characteristic see chapter CHARACT	Select transfer elements in the Process.form menu. Setting the transfer elements in the menus: 1.PT1 2.PT1 PT2t, PT2d			

Table 31: Structure of the process simulation

Description of the transfer functions

Transfer function	Representation of the transfer behavior
P element	Input variable u →  → Output variable y

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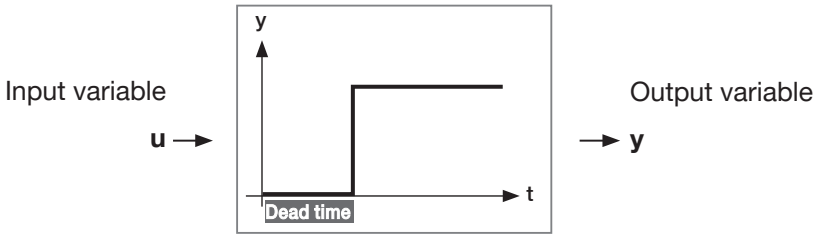
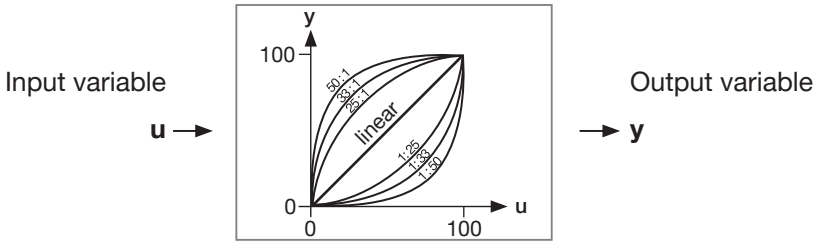
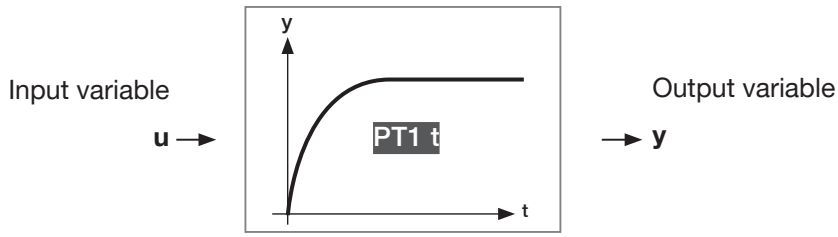
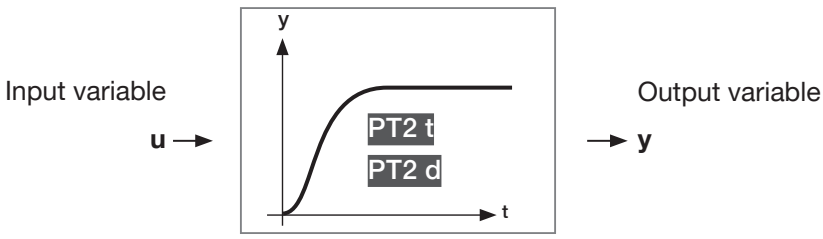
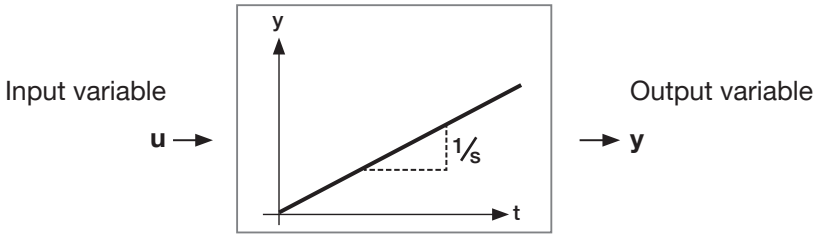
Transfer function	Representation of the transfer behavior
Dead time element	
Non-linearity	
PT1 element	
PT2 element	
I-element	

Table 32: Description of the transfer functions

In the KS menu the amplification factor can be entered for the process controlled system.

In the Dead time menu a dead time can be entered for the process controlled system.

In the NON-LINEARITY menu a linear or non-linear process can be selected.

In the menus 1.PT1 t, 2.PT1 t and PT2 t the time constant for the respective transfer element can be entered for simulation of the process.

In the PT2 d menu the degree of damping for the PT2 transfer element can be entered for simulation of the process.

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Example of a modeled process controlled system PT_1 - T_t:

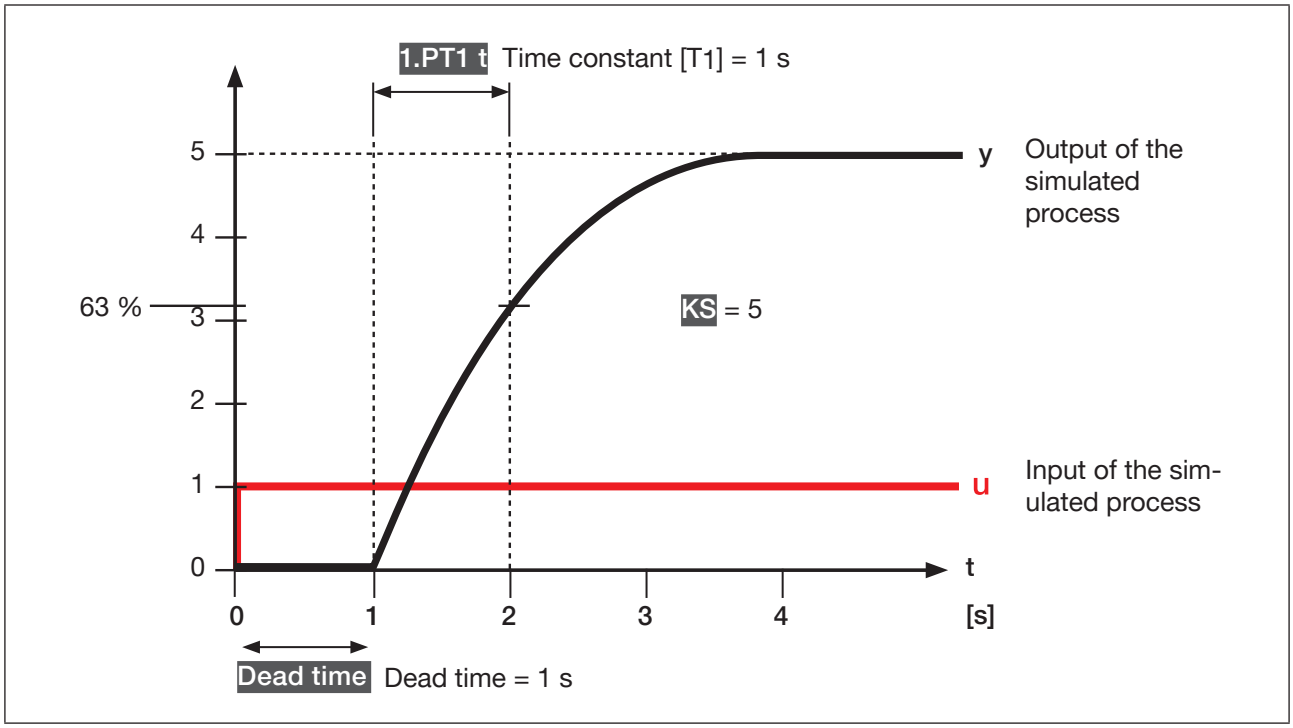

Figure 13: Example of a modeled process controlled system PT_1 - T_1

Example of a modeled process controlled system PT_2:

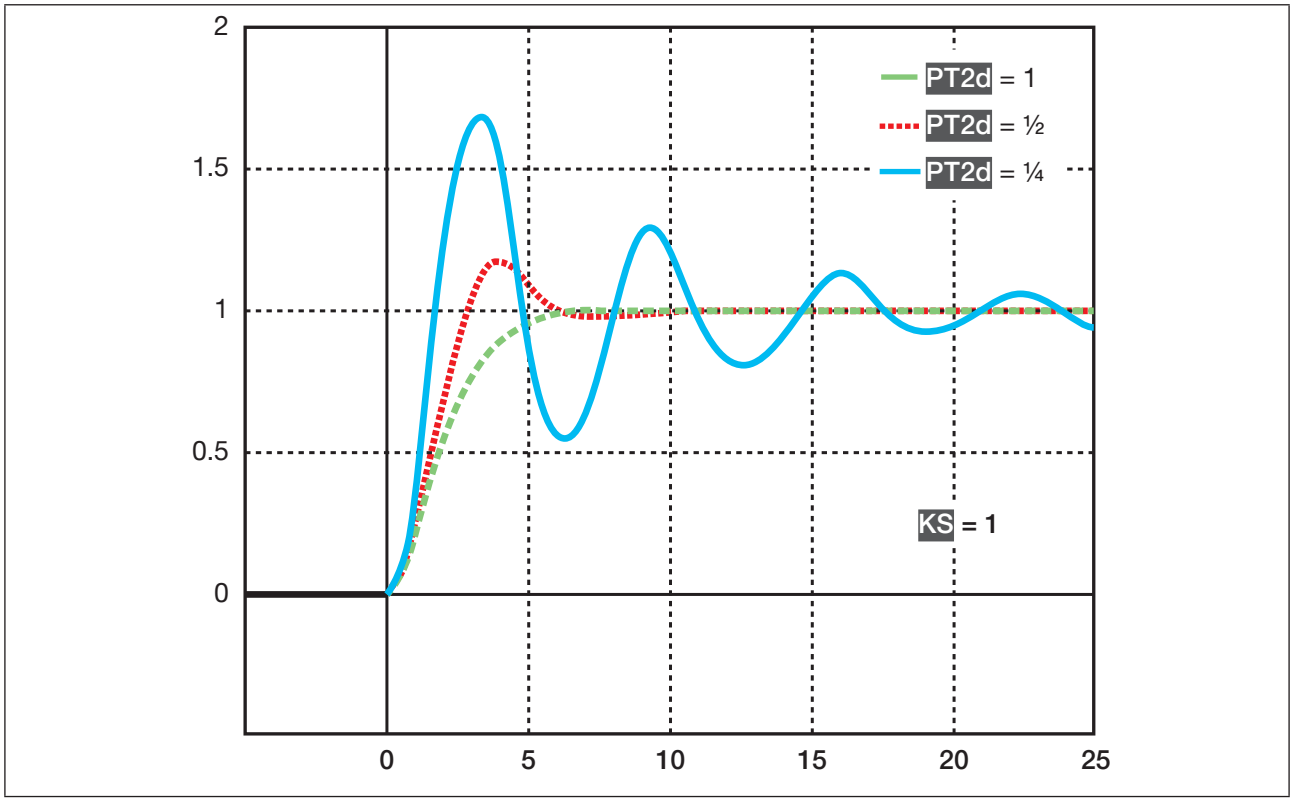

Figure 14: Example of different attenuations for a modeled process controlled system PT_2

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7 PROPERTIES OF PID CONTROLLERS

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

7.1 P component

Function:

$$Y = Kp \cdot Xd$$

Kp is the proportional coefficient (amplification factor). It is the ratio of the positioning range ΔY to the proportional component ΔXd.

Characteristic and step response of the P portion of a PID controller

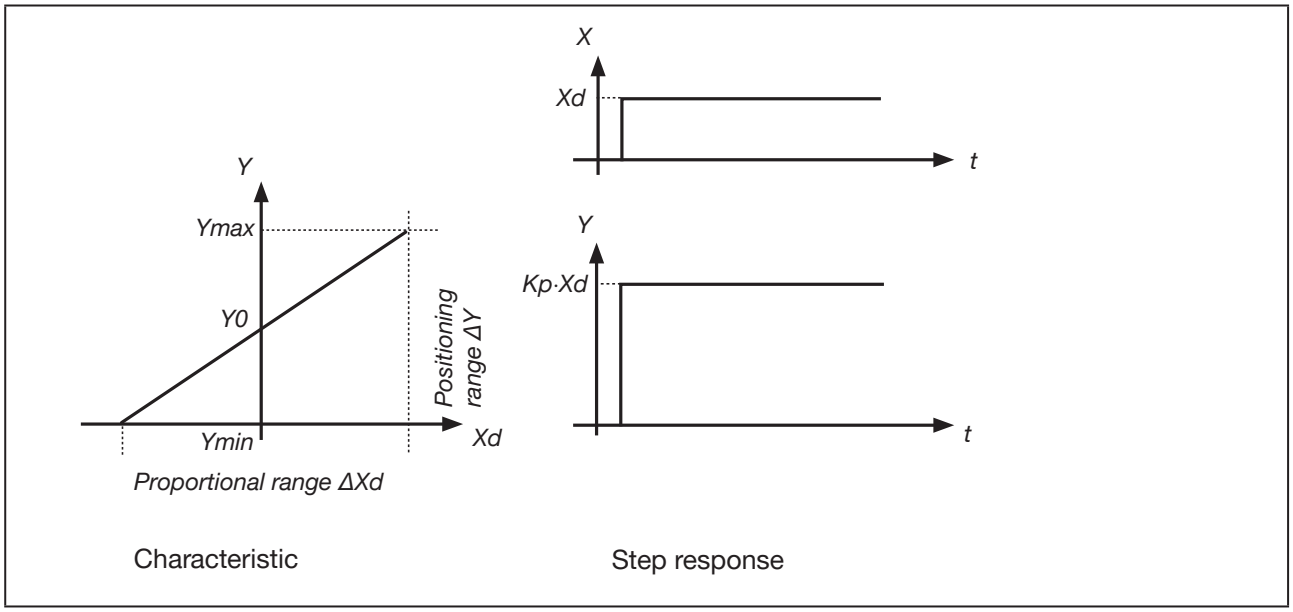

Figure 15: Characteristic and step response P component PID controller

Properties

In theory a pure P-controller functions instantaneously, i.e. it is quick and therefore dynamically favorable. It has a constant control difference, i.e. it does not fully correct the effects of malfunctions and is therefore statically relatively unfavorable.

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7.2 I component

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 positioning range.

Characteristic and step response of the I portion of a PID controller

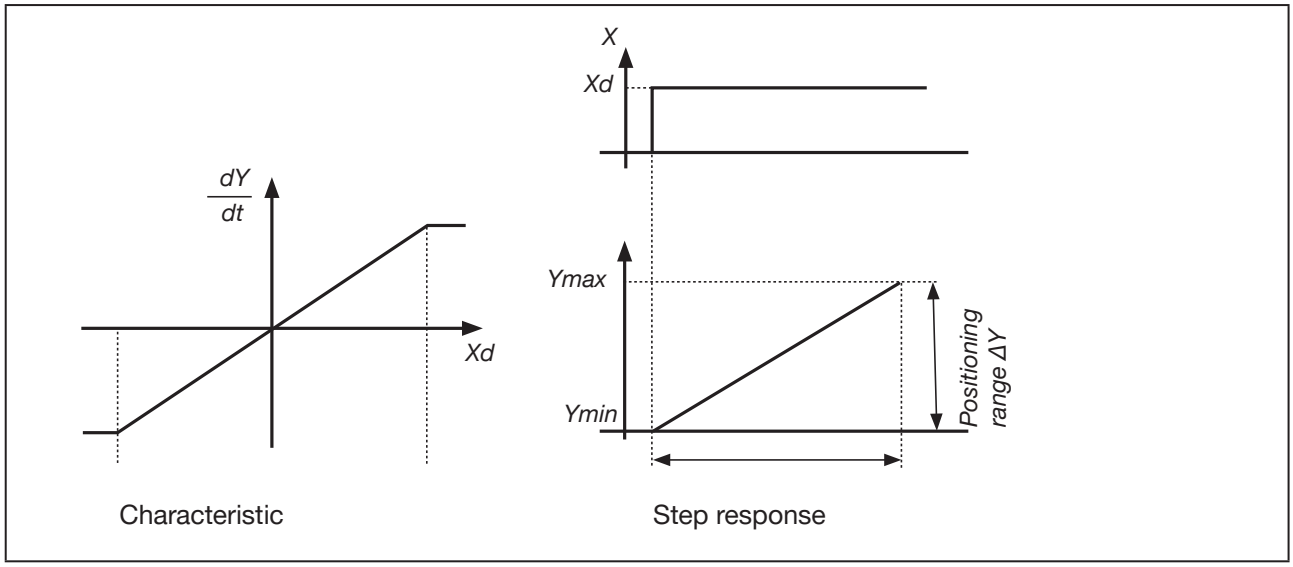

Figure 16: Characteristic and step response I component PID controller

Properties

A pure I-controller completely eliminates the effects of any malfunctions which occur. It therefore has a favorable static behavior. 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 unfavorable.

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7.3 D component

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 D component of a PID controller

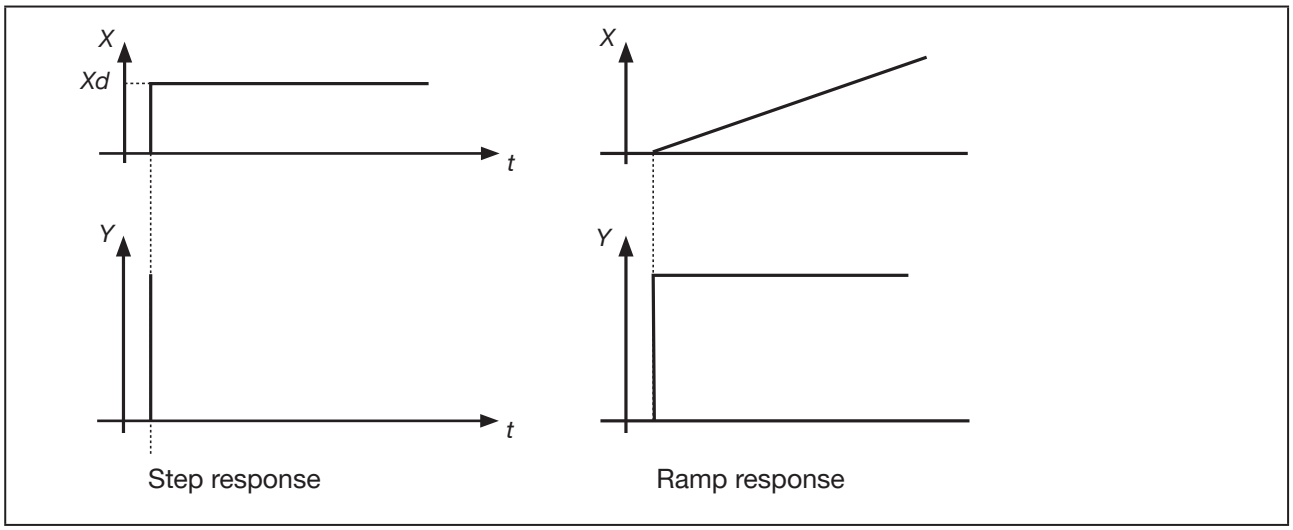

Figure 17: Characteristic and step response D component PID controller

Properties

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

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7.4 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 component / amplification factor
Tn	Reset time (Time which is required to obtain an equally large change in the actuating variable by the I component, as occurs due to the P component)
Tv	Hold-back time (Time by which a certain actuating variable is reached earlier on account of the D component than with a pure P-controller)

Step response and ramp response of the PID controller

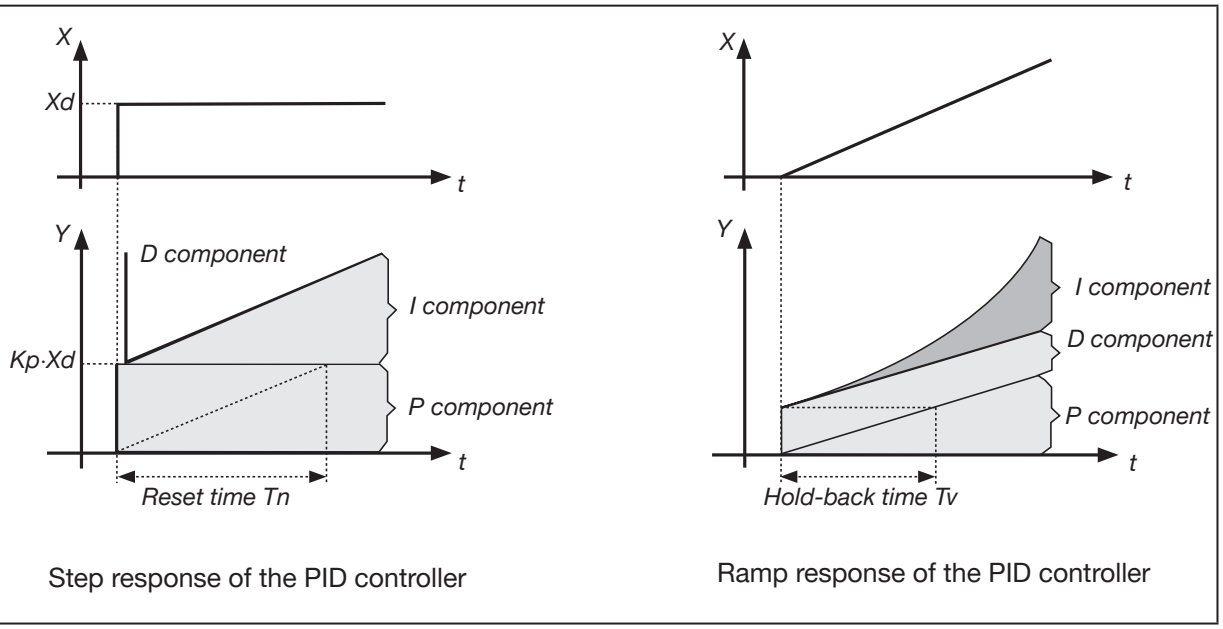

Figure 18: Characteristic of step response and ramp response of PID controller

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7.5 Implemented PID controller

7.5.1 D portion with delay

In the process controller Type 8693 the D component is implemented with a delay T.

Function:

$$T \cdot \frac{dY}{dt} + Y = Kd \cdot \frac{dXd}{dt} \qquad (9)$$

Superposition of P, I and DT Portions

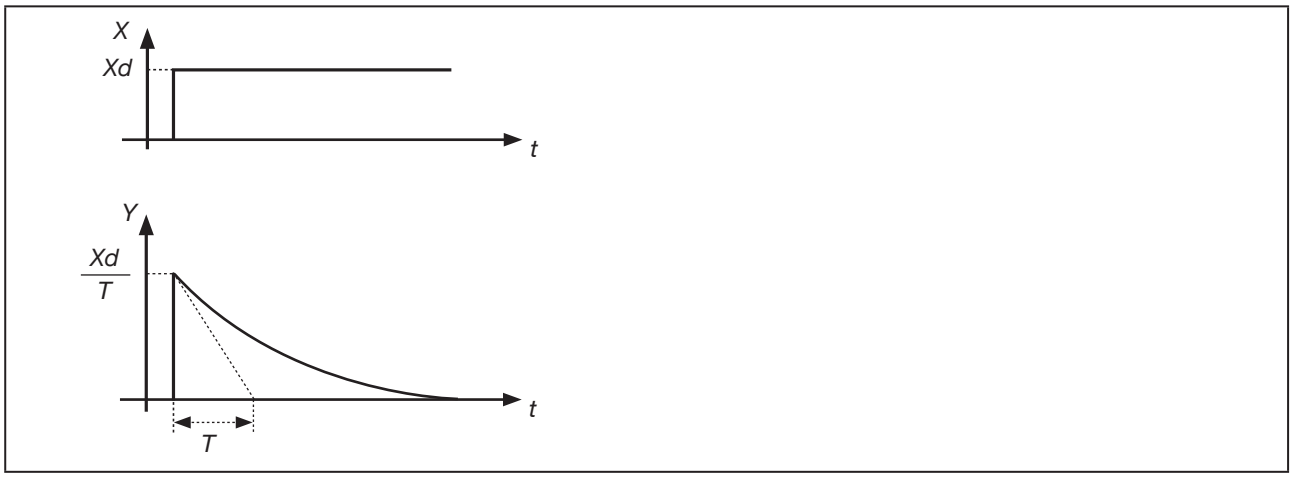

Figure 19: Characteristic of superposition of P, I and DT components

7.5.2 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

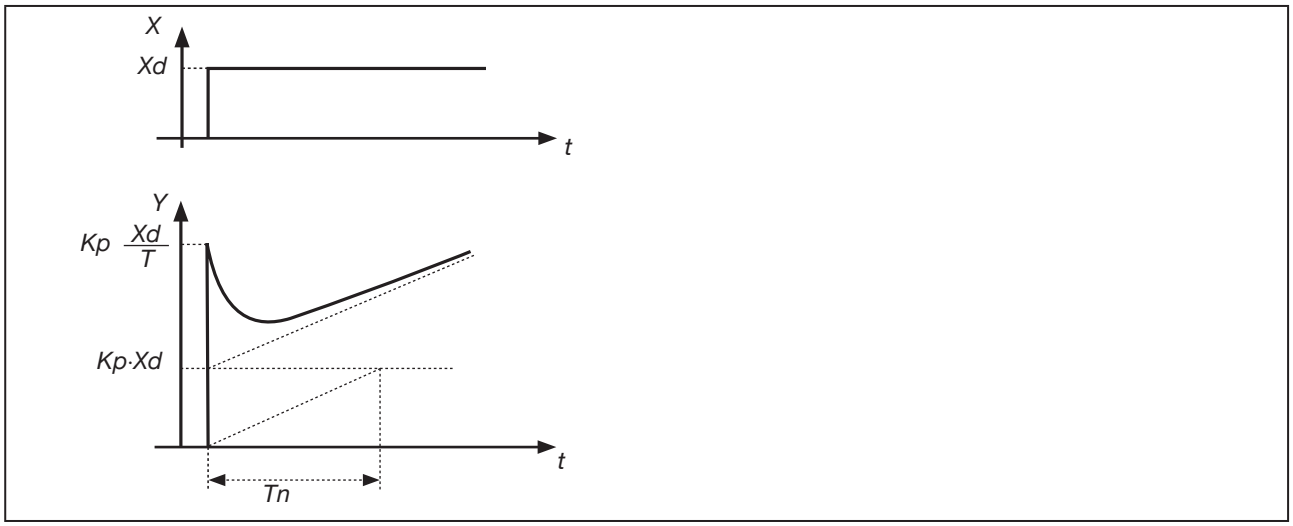

Figure 20: Characteristic of step response of the real PID controller

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8 ADJUSTMENT RULES FOR PID CONTROLLERS

The control system Type 8693 features a self-optimization function for the structure and parameters of the integrated process controller. The determined PID parameters can be viewed via the operating menu and empirically optimized as required.

The regulatory literature includes a series of adjustment rules which can be used in experimental ways to determine a favorable 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 controlled system and the controller itself, the aspect whether a change in the disturbance variable or command variable is to be corrected plays a role.

8.1 Adjustment rules according to Ziegler and Nichols (Oscillation Method)

With this method the controller parameters are adjusted on the basis of the behavior 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 favorable adjustment of the controller parameters. A prerequisite for the application of this method of course is that the control circuit may be 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_{crit}. The resulting oscillation duration is designated as T_{crit}.

Progress of the control variable at the stability limit

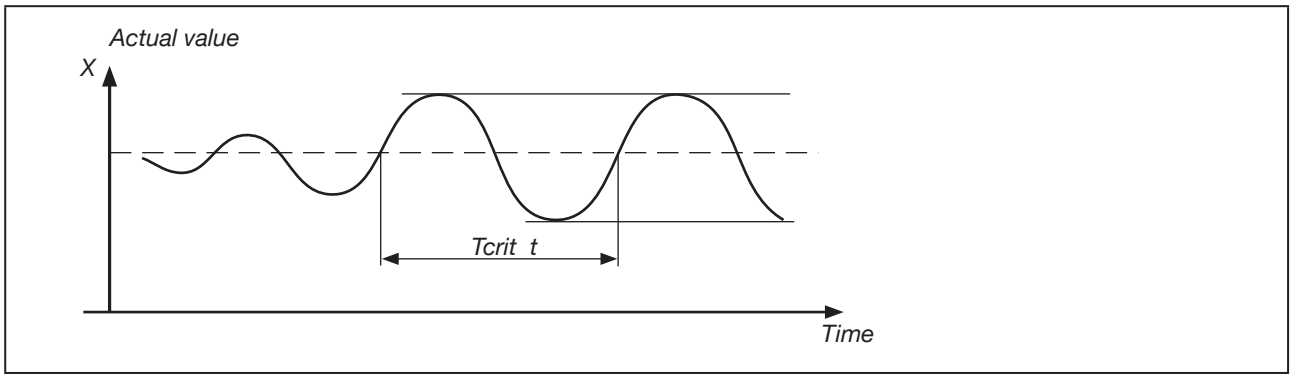

Figure 21: Progress of the control variable PID

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The controller parameters can then be calculated from K_{crit} and T_{crit} according to the following table.

Setting the parameters according to Ziegler and Nichols

Controller type	Setting the parameters		
P controller	Kp = 0.5 K_{crit}	-	-
PI controller	Kp = 0.45 K_{crit}	Tn = 0.85 T_{crit}	-
PID controller	Kp = 0.6 K_{crit}	Tn = 0.5 T_{crit}	Tv = 0.12 T_{crit}

Table 33: Setting 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.

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8.2 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 behavior 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

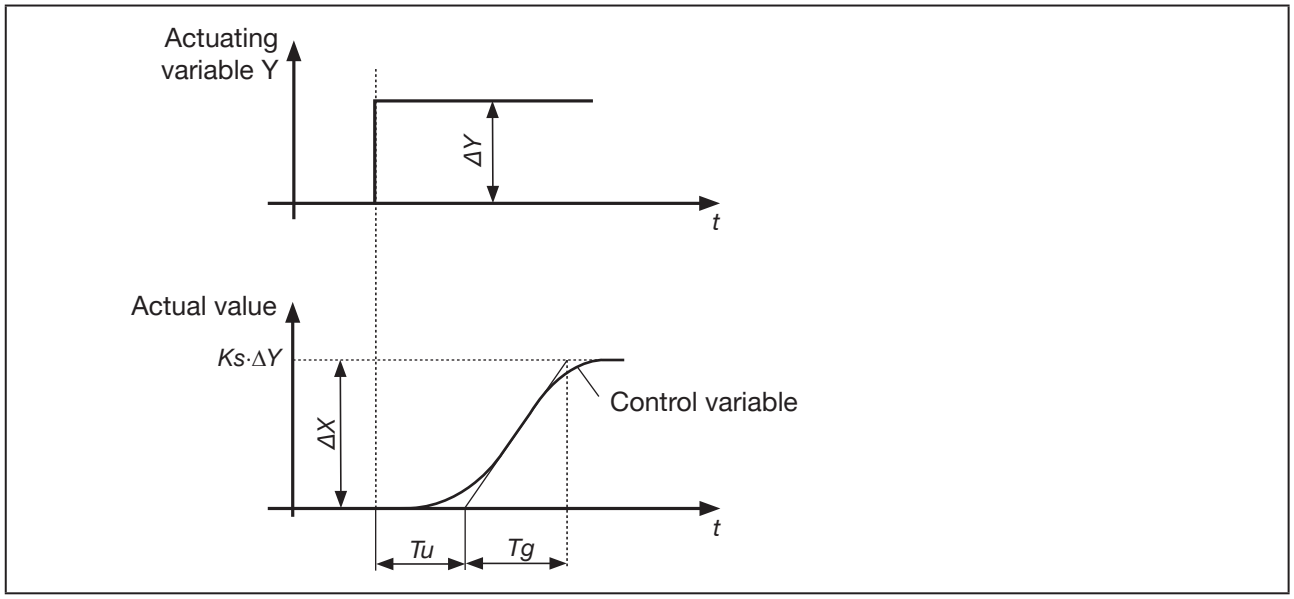

Figure 22: Progress of the control variable, actuating variable jump

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 34" 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 behavior, with dead time and with a delay of the first order.

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Setting the parameters according to Chien, Hrones and Reswick

Controller type	Setting the parameters for aperiodic control process (0 % overshoot)		Setting the parameters for control process with 20 % overshoot	
	Reference	Malfunction	Reference	Malfunction
P controller	$Kp = 0.3 \cdot \frac{Tg}{Tu \cdot Ks}$	$Kp = 0.3 \cdot \frac{Tg}{Tu \cdot Ks}$	$Kp = 0.7 \cdot \frac{Tg}{Tu \cdot Ks}$	$Kp = 0.7 \cdot \frac{Tg}{Tu \cdot Ks}$
PI controller	$Kp = 0.35 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tn = 1.2 \cdot Tg$	$Kp = 0.6 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tn = 4 \cdot Tu$	$Kp = 0.6 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tn = Tg$	$Kp = 0.7 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tn = 2.3 \cdot Tu$
PID controller	$Kp = 0.6 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tn = Tg$ $T v = 0.5 \cdot Tu$	$Kp = 0.95 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tn = 2.4 \cdot Tu$ $T v = 0.42 \cdot Tu$	$Kp = 0.95 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tn = 1.35 \cdot Tg$ $T v = 0.47 \cdot Tu$	$Kp = 1.2 \cdot \frac{Tg}{Tu \cdot Ks}$ $Tn = 2 \cdot Tu$ $T v = 0.42 \cdot Tu$

Table 34: Setting the parameters according to Chien, Hrones and Reswick

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

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

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9 GLOSSARY

Autotune	Adjustment of the position control position sensor to the physical stroke of the actuator. Below is the menu designation for running the Autotune. For globe and angle seat control valves: X.TUNE For diaphragm control valves: M.Q.0.TUNE
Views area	Device software subarea which is used to display values. In the Views area the process values are displayed in one or more views.
SAFEPOS energy pack	Proper name for the energy pack which is used for Bürkert devices.
Configuration area	Device software subarea in which the configuration and parameterization of the device are implemented. The software of the electromotive control valve is organized into the following configuration areas: • Position controller • Inputs / Outputs • Process controller (only available for devices with process controller function) • Industrial communication • Display • General settings
Context menu	Menu, which is available only on the device display and can be selected at any location in the menu structure. Apart from indicating context-sensitive information, the Context menu is used to adjust the display and to change user rights.
NAMUR	Abbreviation and proper name for the User Association of Automation Technology in Process Industries
NAMUR NE 107	Recommendation for the "Self-monitoring and diagnostics of field devices".
Register card	Device software subarea. The device software is subdivided into configuration areas, the menus of which are assigned to the register cards PARAMETER, MAINTENANCE and DIAGNOSTICS, depending on function.

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