Automation System TROVIS 6400
Compact Controller
TROVIS 6493

Mounting and operating instructions

EB 6493 EN

Firmware version 2.0 and 3.0

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TROVIS®
Electronics from SAMSON

Modifications of firmware version 2.0 and 3.0

The TROVIS 6493 Compact controller has been extended by the version 6493-02 (Firmware version 3.0). This version's hardware is different from version 6493-01 (Firmware version 2.0) as regards to the In2 input. The version 6493-02 has two mA inputs. The result is a change of function IN2 in the main group (IN), see chapter 3.2.2.

The software has also been extended for both version of the compact controller:
- 6493-01 Firmware version 2.0
- 6493-02 Firmware version 3.0.

A new main group, PAR, has been implemented. This group allows faster setting of Kp, Tn and Tvs parameters (see chapter 3.1).
The main group, AUX, has been supplemented with the function DP. This function allows the user to determine how many decimal places for the analog input variables are indicated in the display (see chapter 3.7.6).
In the main group, I-O, the serial number of the device is now indicated under S-No (see chapter 3.9.2).
Moreover, the factory settings of several parameters have been changed (see Table Appendix A).
In the parameter level, the selector key has been given a special function to allow even faster modifiation of the parameters: each time you press the key, the indicated value is multiplied by 10 until the end of the value range is reached for that parameter. When the key is pressed again, the display jumps to the start of value range of the same parameter.

Contents

1 Notes

The TROVIS 6493 Compact Controller is a microprocessor-based controller with a flexible software design for automating industrial process plants. It is suitable for single control loops as well as for complex control tasks. The flexible software design gives you the power to configure control circuits without changing the hardware. The fixed-programmed functions can be adapted to your specific plant configuration.
These Mounting and operating instructions (EB) describe the controller's powerful capabilities. To give you a good start, we make you familiar with the convenient operation. All the functions and parameters are described in chapter 3. Then some practical examples are given in chapter 4 to show you which settings are needed for which task. Chapters 6 and 7 explain the electrical connections and the installation. At the end, the index gives you direct reference in case you have specific questions or problems.

Caution!
Assembly, start-up and operation of the device may only be performed by trained and experienced personnel familiar with this product.

2 Operation

In this chapter, you learn how to operate the controller. First, open the folded back cover of this EB. You can see now the controller's front panel with its display and six keys.
Principally, there are two levels which provide different key functions and different displays: these are the operating level and the setup level. The functions of the controller are defined by configuration and parameterization procedures. A table containing all the details necessary for parameterization and configuration is provided in Appendix A. In addition, we will give you a suitable example in chapter 2.6 to show you how to use this table.

2.1 Display

Depending on the selected level, the display shows the following variables and operating statuses (see folded back cover):

Item	Operating level	Setup level
1	Controlled variable X	Designations, settings and values of functions, parameters; abbreviations are listed in Appendix A
2	Value assumed by W, W2, WE, Y or Xd	
3	Limit relay L2 active	Not displayed
4	Three-step output –	Not displayed
5	Limit relay L1 active	Not displayed
6	Three-step output + or two-step output	Not displayed
7	Alarm messages See chapter 3.2.3	Not displayed
8	Hand symbol appears when in manual mode No symbol when in automatic mode	Not displayed
9	Press the key to display W, W2, WE, Y or Xd% in sequence. The associated value appears in (2). W2 and WE only when they have been activated, see chapter3.3.1	$\underline{\vee}$ and $\overline{\wedge}$ are used for minimum and maximum values of different parameters.
10	Bar graph display of Xd in percent	Not displayed

2.2 Keys

You operate the compact controller via six keys whose functions depend on the selected level.

Key	Function in operating level	Function in setup level
Programming key (yellow)	Provides access to setup level. Activates a new reference variable, provided that its symbol (W, W2 or WE) is **blinking** on the display (9).	Activates functions and parameters to be changed (display is blinking). Acknowledges new setting of functions or parameters (display stops blinking).
Selector key	Changes the lower display section: W internal reference variable 1, W2* internal reference variable 2, WE* external reference variable, Y continuous output variable, Xd% error. * Only when selected, see p.22.	Provides access to parameter level. Jump within the value range in the parameter level.
Manual/auto transfer key	Changes from manual to automatic mode and vice versa. In manual mode, the symbol appears.	No function
Cursor keys	Change the value of W or W2 provided that they are displayed on the lower display section. Change the controller output when in manual mode and when Y is indicated on the lower display section.	Browse within the main groups, the functions, settings and parameters. Change function settings and parameter values.
Reset key	Displays the current reference variable.	Return to preceeding level up to the operating level.
No key pressed	After approx. 5 minutes, display changes to current reference variable. Exception: in manual mode and display of output variable	Changes to operating level after approx. 5 minutes.

2.3 Operating level

In the operating level, you can	Press		Note!
view different variables: W, W2, WE, Y, Xd.		selector key repeatedly until the desired variable appears on the display.	W2 and WE are only displayed when you have activated them in SETP, see chap. 3.3.1.
select another reference variable.		selector key repeatedly until the desired reference variable (W, W2 or WE) appears on the display. Finally, activate the programming key.	When the reference variables are inactive, W, W2 or WE are blinking. Whereas they are not blinking when active.
change the value of the internal reference variable W or W2.		selector key repeatedly until W or W2 appears, then change the value using the cursor keys.	New value is accepted at once. No acknowledgement required.
switch to manual mode.		manual/auto transfer key.	In manual mode, use the cursor keys to determine the output variable.
change the output variable.		manual/auto transfer key, to display Y. Change its value using the cursor keys.	
enter the setup level for configuration and parameterization.		programming key.	Do not use it when W, W2 or WE are blinking, otherwise you activate a new reference variable!

2.4 Setup level

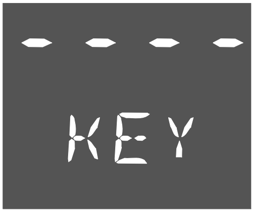
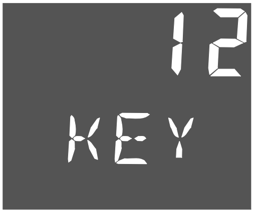
This level is the platform for configuration and parameterization. You can enter the setup level from the operating level by pressing the programming key once. Here, you can adapt preset functions to your specific needs (configure) and change parameters. The functions are part of nine so-called main groups:

- PAR (fast setting of Kp, Tn and Tv parameters)
- IN (input functions)
- SETP (reference variable)
- CNTR (control structure and functions)
- OUT (output functions)
- ALRM (alarm functions)
- AUX (additional functions)
- TUNE (start-up adaptation)
- I-O (view process data)

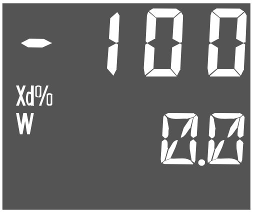
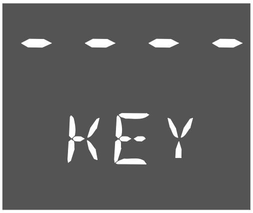
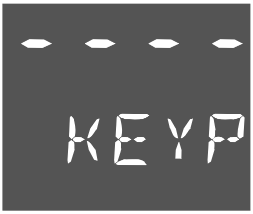
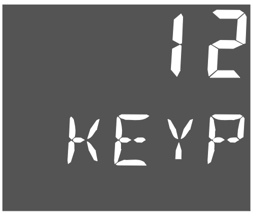
The parameters are always connected to the function they are assigned to. This means that pressing the selector key allows you to access only the parameters that are relevant for the particular function you have chosen.
Appendix A lists all the functions and parameters provided by the compact controller. The table includes the main groups and their functions with the setting options in the left column, and the associated parameters in the right column. This table will be a great help in learning how to operate the controller. You just have to keep in mind the following:
To move from the left to the right (in columns), use the programming key .
To move in the reverse direction (from the right to the left), use the reset key .
The key number (KEY) will be prompted in the setup level only for the first change of a function or parameter.
The right column of the table, i.e. the parameters, can be accessed by pressing the selector key . Then press again the programming key to move forward in columns.
To move in rows from top to bottom, press the cursor key .
Moving in the reverse direction is done by pressing the cursor key . Confirm the new setting or the new value by pressing the programming key .
How to configure and parameterize properly will show an example in chapter 2.6.
Note: The display changes from the setup level into the operating level after 5 minutes if no key is pressed!

2.5 Key number

You are prompted to enter the key number when you want to change the setting of functions or parameters.
The compact controller can be operated with or without a key number. Factory default is without key number. Each time you prepare to change a function or a parameter in the setup level for the first time, the key number is prompted. Then perform the following steps:

Press!	Display shows	Comment
		KEY is blinking. You must now enter the key number. Omit the following step for operation without key number. **Note:** With this display, the key number can always be changed, see following section.
△ or ▽		KEY is blinking. Enter the valid key number. In this example, it is 12.
	If you have entered the correct key number, the selected function is blinking on the display. If not, the key number is prompted once more and 1 appears in the upper display section, meaning the controller operates with key number. Enter the key number again or cancel by pressing the reset key .	

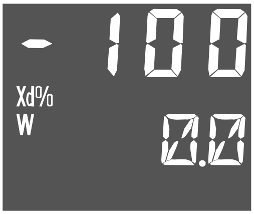
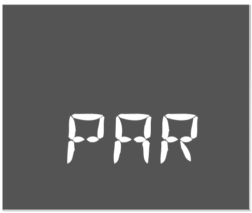
Changing the key number
You can define a new key number or set up the controller to operate without key number. When defining a new key number, you first need to know the service key number which you will find on page 95. To prevent any misuse, you should cut it out or make it unreadable.
Proceed as described on the next page to define a new key number:

Press!	Display shows	Comment
		You are in the operating level. The display looks like this.
□ 3 x		KEY is blinking. **Note:** When you see this display, the key number can always be changed.
△ or ▽		KEY is blinking. Enter the service key number. See page 95.
□		You have acknowledged the service key number. You now see KEYP which stands for key number programming. The upper display section shows the current key number. The four dashes stand for "no key number".
△ ▽		Enter the new key number (- - - - for "no key number"). We have chosen 12 in this example.

Press!	Display shows	Comment
		You have acknowledged the new key number and return to the selected function or parameter. In our example, we return to the Kp value.

2.6 Example for configuration and parameterization

We will use the "Function and parameter table" provided in Appendix A to learn configuration and parameterization procedures. The exercise consists of setting up the controller to be a PID controller and adjusting the controller parameters accordingly.
The biggest problem to solve is of course where to find the appropriate function and what to change in this function. There are two ways to proceed. You may search for the function in the table in Appendix A where you also find some reference to further details, or you may look it up in the index. With PID controller, you will find the function C.PID which is part of the main group CNTR. As you know now which main group to activate and which function to change, carry out the following steps:

Press!	Display shows	What happens!
		You are in the operating level.
		You have entered the setup level. The display shows the first main group IN. Main groups are always displayed in a single line. You are now in the first column of the table in Appendix A. **Note:** If you press the programming key again, you reach Kp, see page 12.

Press!	Display shows	What happens!
△ repeatedly until CNTR appears!	CNTR	You browse through the main groups [in the table in Appendix A you move from top to bottom] until you reach the main group CNTR. Here, you adjust the dynamic behavior of the controller output.
	-CO- C.PID	You have entered the main group CNTR [moved to the right in the table] and arrived at the functions. Functions are always marked with -CO- for configuration. The display shows the first function C.PID, "Dynamic behavior of controller output ", in our case the function we have been looking for.
	PI CP.YP	You have moved again one column to the right and see now the current setting of the function: PI action. This setting is to be changed to PID action.
KEY is blinking	---- KEY	Now you have to enter the key number (KEY). The prompt appears when you, upon entering of the setup level, change a function for the first time. You will not be prompted for the following changes. If you do not use a key number, leave out the next step.
△ or ▽	27 KEY	Use the cursor keys to enter the key number. In our example, this is 27.

Press!	Display shows	What happens!
	P I CP.YP	After having entered the correct key number, the display looks like this. If not, the prompt will be repeated. The upper section is blinking, meaning that you may change the setting of the function. In the table, you have moved another column to the right and reached "Setting options".
or	PId CP.YP	The upper section is blinking! Use the cursor keys to choose the desired setting, which is in our example PId standing for PID action of the controller output.
	PId CP.YP	You have acknowledged the new setting. The upper display section stops blinking. Bravo! The first part of the task is completed. Now change the control parameters KP, TN and TV. To do so, you need to enter the parameter level.
	-PA- C.PID	Press the selector key to open the parameter level. In the table, you have jumped to the first column on the right page. The lower display section shows C.PID and CP.YP in turn.
	1.0 KP	The first parameter Kp is displayed. **Note:** You can go directly from the PAR display to this display if you press the programming key (yellow key) once. You can just change the KP, TN and TV parameters.

Press!	Display shows	What happens!
▢	1.0 KP	KP is blinking, i.e. you can change this parameter.
△ or ▽	1.5 KP	Adjust a new value for KP. For our example, this would be 1.5. The upper section continues blinking.
▢	1.5 KP	You have acknowledged the new value for Kp. The upper section now stops blinking.
△	120.0 TN	The next parameter is displayed. To change this and other parameters, proceed in the same way as for KP, i.e. repeat the steps in the shadowed fields.
↵ repeatedly until the display looks like this!	- 100 Xd% Y --0.0	You are now back in the operating level! The symbol indicates that the compact controller is in manual mode.

3 Functions of the compact controller

This chapter describes each function of the setup level. We assume that you are familiar with the operation of this controller and know how to change functions and parameters.
The compact controller contains nine main groups: PAR, IN, SETP, CNTR, OUT, ALRM, AUX, TUNE and I-O. Each of the chapters 3.2 to 3.9 is dedicated to one of the main groups. The main groups have different functions that can be identified by - C O - displayed in the upper display section. The functions are explained in the subchapters (e.g. 3.2.1) where you can already derive the type of function from the headline. Almost every function provides different setting options from which you can choose one to adapt this function to your specific needs. The setting options of the functions are marked with a small grey square ■ in this EB.
If you need to additionally adjust parameters for your function, they will be specified and explained as necessary. The value range of the parameters and factory default can be found in Appendix A.

3.1 PAR Fast setting of Kp, Tn, Tv parameters

This main group fulfills a special purpose. In contrast to all other main groups, it does not include any functions. When you open this level, it immediately jumps to the parameter level where you can set the Kp, Tn and Tv control parameters.
This main group allows you to quickly set the control parameters. You can also carry out the same settings in the main group CNTR, function C.PID.

3.2 IN Input functions

This main group defines all the functions of the two analog inputs In1 and In2. You can specify the input signal range and assign the analog inputs to the controlled variable X or the external reference variable WE. In addition, you can determine the measuring range of both signals. You may also perform measuring range monitoring and filter as well as generate a function of the input signal.

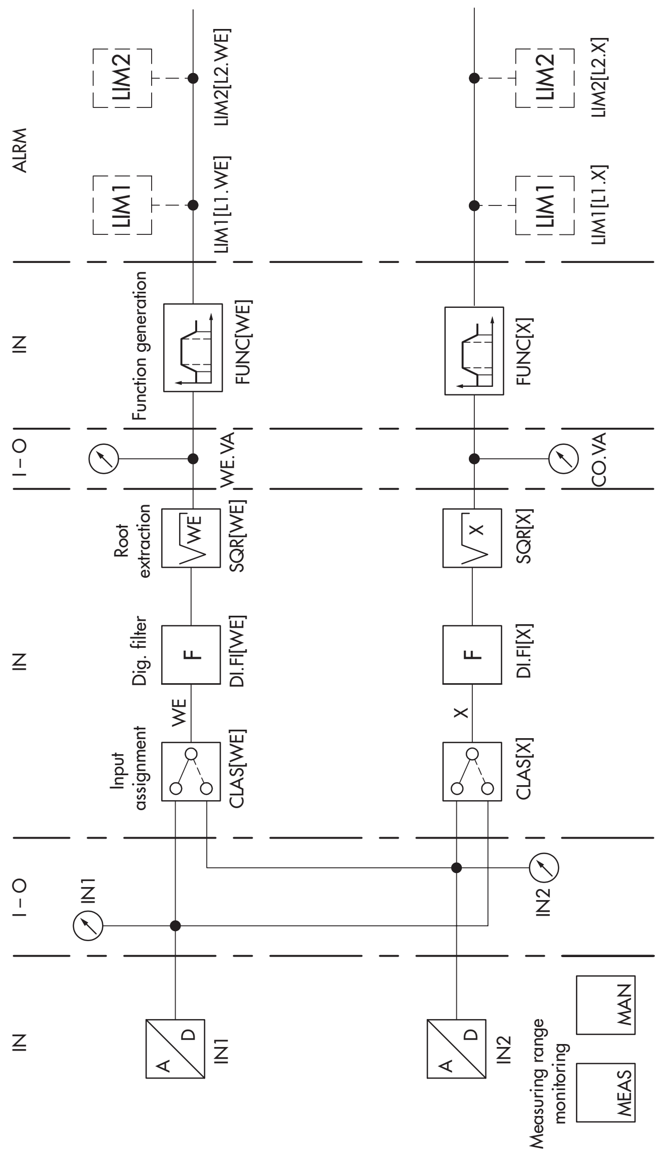


Fig. 1 : Main group IN

3.2.1 IN1 Input signal range IN1

This function enables you to define the input signal type and range for the analog input In1. The parameters lower and upper range value must be given in absolute values.
Choose between:

- 0-20 mA 0 to 20 mA input
- 4-20 mA 4 to 20 mA input
- 0-10 V 0 to 10 V input
- 2-10 V 2 to 10 V input

Parameters to be set

⊻ IN1 Lower range value as absolute value
⊼ IN1 Upper range value as absolute value

3.2.2 IN2 Input signal range IN2

Please note that there are two hardware versions for the analog input In2: controller version 6493-01 (model no. on the nameplate) has a temperature sensor or potentiometer input, whereas, controller version 6493-02 has a mA input.

IN2 for controller version 6493-01
This function enables you to define the input signal type and range for the analog input In2. The measuring range must be specified with the parameters ⊻ IN2 and ⊼ IN2. Make sure that the span is not smaller than 100 °C.
Choose between:

- 100 PT Pt 100 resistance thermometer –100 to 500 °C
- 1000 PT Pt 1000 resistance thermometer –100 to 500 °C
- 100 NI Ni 100 resistance thermometer –100 to 500 °C
- 1000 NI Ni 1000 resistance thermometer –60 to 250 °C
- 0-1 KOHM 0 to 1000 Ω input

Parameters to be set

⊻ IN2 Lower range value as absolute value
⊼ IN2 Upper range value as absolute value

IN2 for controller version 6493-02
This function enables you to define the input signal type and range for the analog input In2. Enter the parameters lower range and upper values as absolute values of the size you require.

Choose between:
- 0-20 mA 0 to 20 mA input
- 4-20mA 4 to 20 mA input

Parameters to be set

⊻ IN2 Lower range value as absolute value

⊼ IN2 Upper range value as absolute value

3.2.3 MEAS Measuring range monitoring for analog input 1 and 2

This function enables you to define whether the measuring values of the analog inputs are to be monitored either for exceeding or falling below the measuring range.
Choose between :
- oFF ME.MO No measuring range monitoring
- In1 ME.MO Measuring range monitoring of analog input IN1
- In2 ME.MO Measuring range monitoring of analog input IN2
- ALL ME.MO Measuring range monitoring of both analog inputs IN1 and IN2

When values exceed or fall below the measuring range, this is signalized on the display by the alarm message symbol, and the binary output is set. In addition, "__o1" is blinking on the upper display section when values exceed the measuring range and "__u1" when values fall below the measuring range of the analog input 1, or analog inputs 1 and 2. When the analog input 2 exceeds or falls below the measuring range, " __o2" or "__u2" appears on the display. Whenever values exceed or fall below the measuring range, the compact controller can change over to manual mode, see chapter 3.2.4.

3.2.4 MAN Changeover to manual mode upon transmitter failure

This function enables you to define whether the controller switches manual mode and which output value is generated when the measuring range is exceeded or not reached. This function becomes effective only when measuring range monitoring has previously been activated in the function MEAS, see the preceeding chapter 3.2.3. Manual mode is easily recognized by the symbol on the display.
Choose between:
- oFF FAIL No changeover to manual mode upon transmitter failure
- F01 FAIL Changeover to manual mode with 2nd output variable Y1K1
- F02 FAIL Changeover to manual mode with last received output value

Parameter to be set

Y1K1 2nd output value

Note: When values exceed or fall below the measuring range, Y1K1 becomes effective only when the compact controller is in automatic mode.

The parameter Y1K1 can also be set in the main group OUT via the function SAFE as well as in the main group AUX via the function RE.CO, see chapters 3.5.1 and 3.7.1.

3.2.5 CLAS Assignment of X and WE

The compact controller operates internally with the analog input signals X and WE. The function CLAS is used to assign these signals to the analog inputs IN1 or IN2. Principally, X is assigned to the analog input IN2 and WE to the analog input IN1.

Assignment of X

- IN1 X X assigned to analog input IN1
- IN2 X X assigned to analog input IN2

Assignment of WE

- IN1 WE WE assigned to analog input IN1
- N2 WE WE assigned to analog input IN2

3.2.6 DI.FI Filtering of X and WE

This function enables you to determine whether X and/or WE are to be filtered.
The first-order filter (low-pass filter or Pt1 behavior) smoothes the selected signals and suppresses input signal interferences of higher frequency.
The time constant of the Pt1 element is defined by the parameter TS.X for the input signal X, and by TS.WE for the input signal WE. The time constant is given in seconds.

Filtering of input variable X

- oFF X Filtering of input variable X deactivated
- on X Filtering of input variable X activated

Filtering of input variable WE

- oFF WE Filtering of input variable WE deactivated
- on WE Filtering of input variable WE activated

Parameters to be set

TS.X Time constant X filter, in seconds
TS.WE Time constant WE filter, in seconds

3.2.7 SQR Root extraction

This function enables you to root-extract the signals X as well as WE. So you have the possibility to easily calculate, for example, the flow rate of the differential pressure.
Choose :

Root extraction X

- oFF X No root extraction of signal X
- on X Root extraction of X

Root extraction WE
- oFF WE No root extraction of signal WE
- on WE Root extraction of WE

3.2.8 FUNC Function generation of X and WE

You may apply function generation to the signal X as well as WE.
Choose between:
Function generation of X
- oFF X No function generation of signal X
- on X Function generation of X

Function generation of WE
- oFF WE No function generation of signal WE
- on WE Function generation of WE

Function generation means that a signal is re-evaluated to be further processed. This allows adapting auxiliary, reference or equivalent variables which are necessary for measuring and control to your specific control loop. For this purpose, you need to plot 7 points to characterize the relationship between the signal to be function-generated E (X or WE) and the desired new output signal E′ (X′or WE′). This relationship is known to you from physical laws, experience or calculated values, as it is the case for the relationship between steam pressure and temperature. We recommend that you either construct a table or create a curve in a Cartesian coordinate system. Choose the 7 points in such a way that a curve can be easily created by drawing straight lines between two adjacent points.

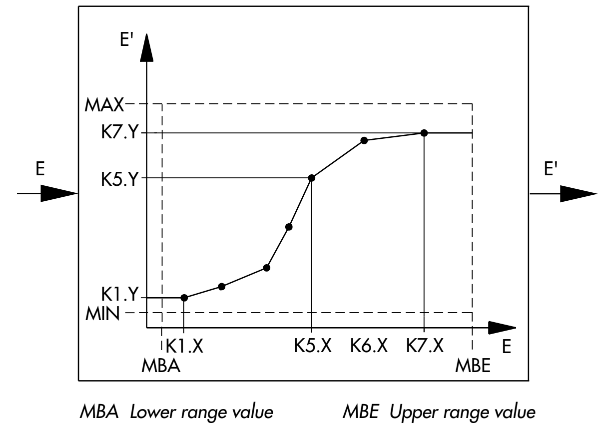


Fig. 2 : Example for function generation

The points for the input signal are entered via the parameters K1.X to K7.X, for the output signal, they are entered via the parameters K1.Y to K7.Y. The values are fixed as absolute values, i.e. in units of measurement comprehensible for the user (in °C, bar or %).

Even when the signal curve can be sufficiently characterized by less than 7 points, you always have to plot 7 points. As appropriate, you may define the seventh point to be located in the same position as the last point.
The parameters MIN and MAX are used to determine the measuring range of the output signal E'. It corresponds to that of the not function-generated signal E with reference to the output signal E'. By entering these two parameters you create the proper basis for the percentage calculation performed by the software.
If K1.Y or K7.Y do not agree with MIN and MAX, the output values for the function-generated signal which are below or above these limits are constantly set to K1. Y or K7.Y. The compact controller completes in this way the polygonal curve by generating straight lines (see Fig. 2).
If you have entered an output value greater than MAX or smaller than MIN, it will be set to the value of MAX or MIN.
You will find an application example of function generation in chapter 4.3.

Note:
The course of the polygonal curve is not limited by the software. Polygonal curves with more than one maximum or minimum are possible. However, make sure that you assign only one ordinate value to one abscissa value. Otherwise you risk to lose clear assignment of the input signal.

Parameters to be set

MIN	Lower range value of output signal
MAX	Upper range value of output signal
K1.X bis K7.X	Input values for points 1 to 7
K1.Y bis K7.Y	Output values for points 1 to 7

3.3 SETP Reference variable

This main group enables you to determine one or more reference variables and you can change from one to another as required. The compact controller has two internal reference variables W and W2 for fixed set point control, however, W2 must be activated by you. Standard setting of the controller is fixed set point control. To obtain follow-up control, you just have to activate the external reference variable WE. However, the input WE can also be used for fixed set point control, serving then as input for position transmission with a three-step output and external position feedback, or for feedforward control. If you want to activate one of these other control modes, you have to fix this here. Moreover, you can select a set point ramp with various starting conditions.

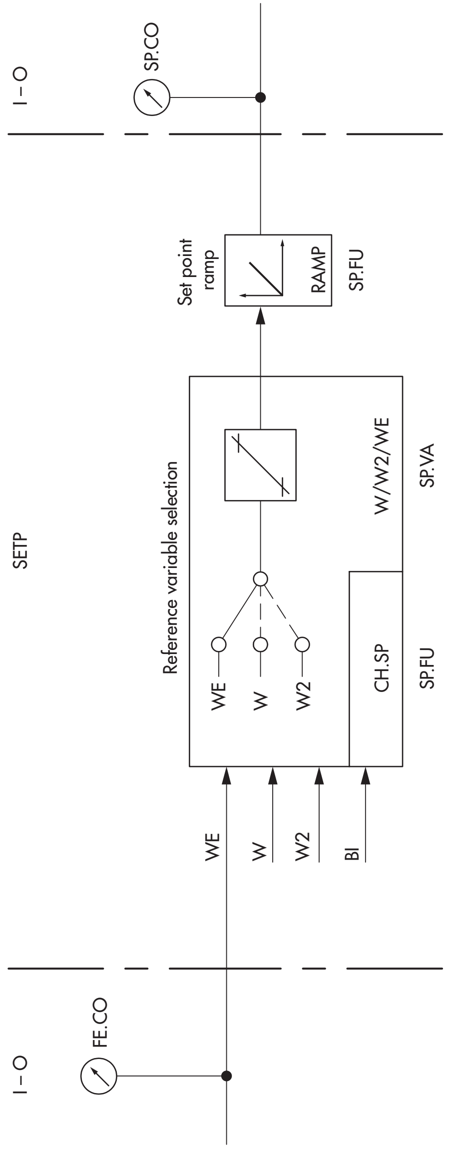


Fig. 3 : Main group SETP

3.3.1 SP.VA

This function enables you to define which reference variables are active: W, W2 or/and WE. When you activate WE, follow-up control will automatically be in effect, except that you use WE as input for position transmission with three-step output and external position feedback (F01 WE), or for feedforward control (F02 WE).
In the parameter level, you define the desired value of the reference variable (W, W2) and its measuring range ($\underline{\vee}$ WINT, $\overline{\wedge}$ WINT). You can limit this measuring range via the parameters $\underline{\vee}$ WRAN and $\overline{\wedge}$ WRAN. The value of the reference variable can only be chosen to be between $\underline{\vee}$ WRAN and $\overline{\wedge}$ WRAN, this also applies to the operating level.
Choose between:

Internal reference variable W

- on W — Internal reference variable W, always active

Parameters to be set

W	Internal reference variable W
$\underline{\vee}$ WINT	Lower range value for W, W2, WE
$\overline{\wedge}$ WINT	Upper range value for W, W2, WE
$\underline{\vee}$ WRAN	Limitation of W, W2, WE, lower limit
$\overline{\wedge}$ WRAN	Limitation of W, W2, WE, upper limit

Internal reference variable W2

- oFF W2 — Internal reference variable W2 not active
- on W2 — Internal reference variable W2 active

Parameter to be set

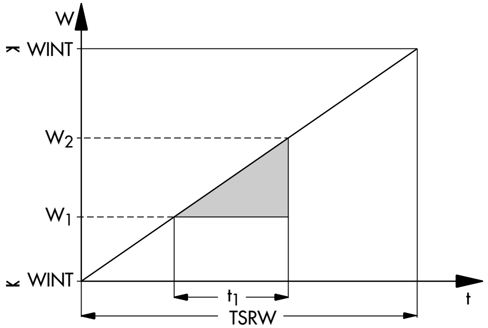
W2	Internal reference variable W2

External reference variable WE

- oFF WE — External reference variable not active
- on WE — External reference variable active
- F01 WE — WE as input for external position feedback with 3-step output
- F02 WE — WE as input for feedforward control (in this case, WE is not displayed in the operating level! It is only displayed in the I-O level, see chapter 3.9.3)

3.3.2 SP.FU

This function enables you to define a set point ramp and change between the different reference variables through the binary input.
The term set point ramp means that the reference variable changes at constant rate. When the reference variable is changed, the compact controller follows this change with a certain delay to prevent against oscillations. The transit time of the set point ramp is determined by the parameter TSRW. TSRW refers to the entire defined measuring range, so this would be ⊻ WINT and ⊼ WINT. When the reference variable changes from a value W_1 to a new value W_2, the actual transit time of the set point ramp is the time t_1 as shown in Fig. 4. You can start the set point ramp via the binary input and choose between two starting values (actual value or parameter WIRA). The set point ramp can also be active upon each change in the reference variable.



⊼ WINT	*Upper range value*	*W_1*	*Previous value of ref. variable*
⊻ WINT	*Lower range value*	*W_2*	*New value of ref. variable*
TSRW	*Transit time of set point ramp*	*t_1*	*Actual transit time of set point ramp*

Fig. 4 : Set point ramp

Choose between:

Set point ramp

- oFF RAMP   Set point ramp deactivated
- F01 RAMP   Set point ramp starts with BI1 and actual value
- F02 RAMP   Set point ramp starts with BI1 and WIRA
- F03 RAMP   Set point ramp activated, no starting conditions

Parameters to be set

TSRW   Transit time of set point ramp in seconds
WIRA   Starting value of reference variable in absolute values

You can use the binary input to change between the internal and external reference variable:

Changeover of W via BI1

- oFF CH.SP   No changeover between internal reference variable W (W2) and external WE
- F01 CH.SP   Changeover between active internal reference variable W (W2) and external reference variable WE via binary input BI1

- F02 CH.SP Changeover between internal reference variables W and W2 via binary input BI1. If W2 is active when setting the binary input, no function will be performed. The function -CO- SP.VA may not be set to "ON" for WE.

Note: The binary input can be assigned to several functions!

3.4 CNTR Controller structure and functions

This main group enables you to determine the functions for the controller algorithm. You can define the dynamic behavior of the controller output, the operating direction of error and the output variable, select the input variable for the D element and fix control mode changeover. If you use the input WE for feedforward control, you may link this signal with parameters. The binary input can also be used to influence the actual value.
Finally, you have the option of defining an operating point in manual mode, which is then added to the calculated operating point in automatic mode.

3.4.1 C.PID Dynamic behavior of controller output

This function enables you to define the dynamic behavior to be performed by the compact controller. Factory default is PI action. You can also define the control parameters in this function. For the error, you can define the dead band DZXD within which the control signal does not change. In addition, you can determine limit values for the error with the parameters ⊻ DZXD and ⊼ DZXD. Minimum or maximum values of error are then used for output signal calculation.
Choose between:

- P P controller
- PI PI controller
- PD PD controller
- PID PID controller
- PPI P^2I controller

Parameters to be set

KP	Proportional-action coefficient
TN	Reset time
TV	Derivative-action time
TVK1	Derivative-action gain
Y.PRE	Y rate action
DZXD	Dead band of error
⊻ DZXD	Min. limitation of error
⊼ DZXD	Max. limitation of error

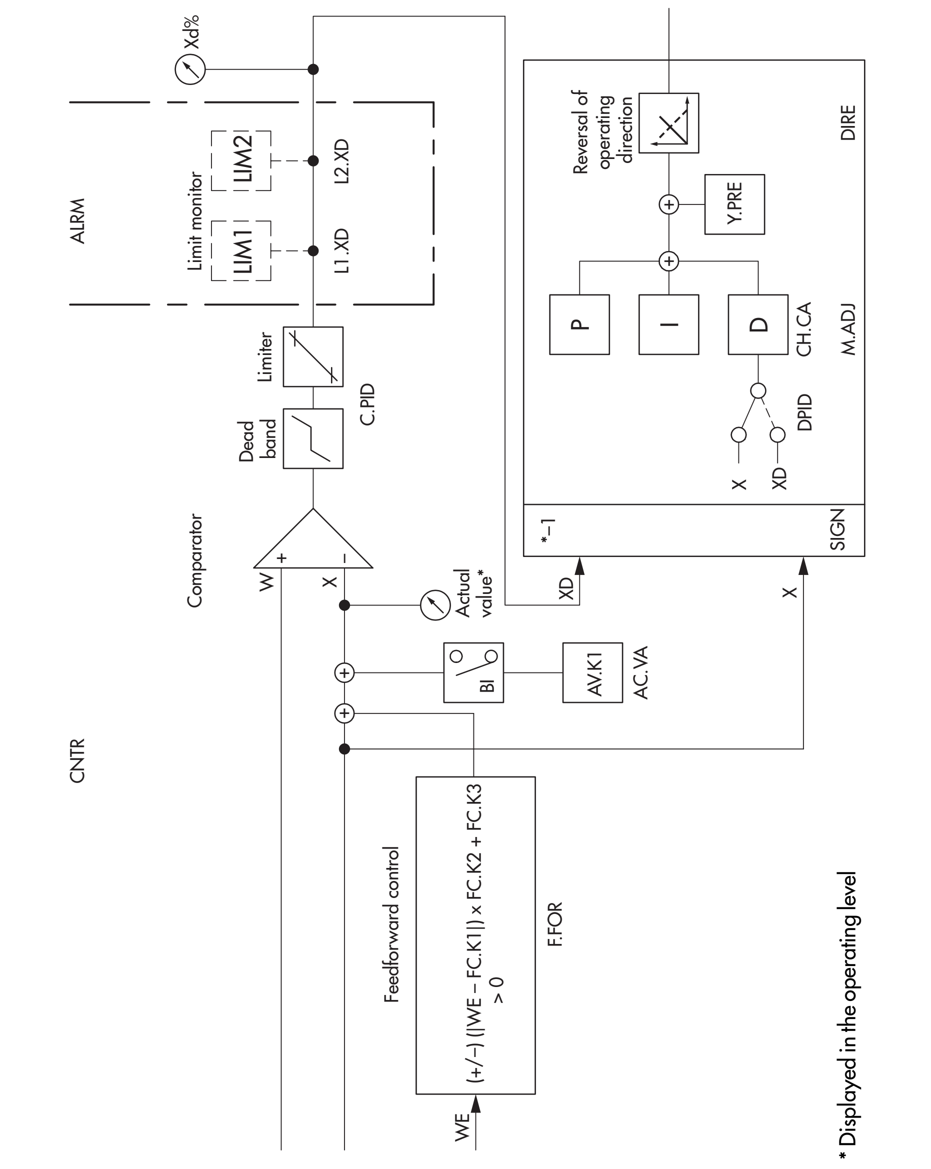


Fig. 5 : Main group CNTR

3.4.2 SIGN Inversion of error Xd

This function enables you to reverse the input operating direction. Multiplication by –1 convertes increasing error into a decreasing one or, the other way round, a decreasing error into an increasing one. This also inverts the operating direction of the output signal. Note the adjusted operating direction in the function DIRE (see chapter 3.4.6)! There you can change the operating direction of the output signals once more.
Choose between:

- dir.d No inversion of error
- in.d Inversion of error

3.4.3 D.PID Assignment of controller output D element

When dynamic behavior with D component has been selected (see chapter 3.4.1), you have the choice of defining different input variables for the D element: error or controlled variable. If you have selected error, the compact controller reacts to a fast change in the controlled variable, the reference variable or the disturbance variable by generating a D-step response. If you select the controlled variable, a fast change only in the controlled variable causes a D-step response in the output variable. The D component of the compact controller does not consider changes in the disturbance or the reference variable.
Choose between:

- F01 DP.YP Assignment of controller output D element to error
- F02 DP.YP Assignment of controller output D element to controlled variable

3.4.4 CH.CA Control mode changeover P(D)/PI(D)

Control mode changeover enables the compact controller to be operated under varying operating conditions with different dynamic behaviors as to the control algorithm. Selection of control mode changeover is principally only useful when control action with I component has been selected. (see chapter 3.4.1).

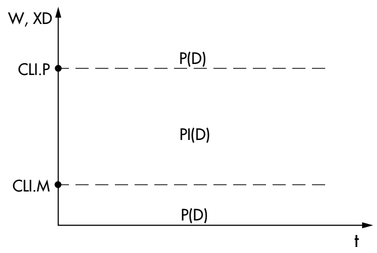


Fig. 6 : Control mode changeover

The function control mode changeover activates either P (or PD) or PI (or PID) control depending on the error or reference variable.
Beyond the definable range of the reference variable or error, the parameters for P or PD control are used to operate the controller. Within this defineable range, the D component is included. The reference variable or error or is defined by the parameters CLI.P and CLI.M.
Fig. 6 clearly illustrates this.
Choose between:

- oFF CC.P No control mode changeover
- F01 CC.P Control mode changeover activated by error
- F02 CC.P Control mode changeover activated by reference variable

Parameters to be set

CLI.P Maximum limit for range of PI(D) control
CLI.M Minimum limit for range of PI(D) control

3.4.5 M.ADJ Operating point adjustment in manual mode for Y_{PID}

This function enables you to activate operating point adjustment in manual mode. In factory default, this option is not available.
Proceed as follows to activate the operating point adjustment: Go to manual mode and adjust the output variable using the cursor keys to the desired value. When switching to automatic mode, the last received value is stored as operating point and added to the output variable calculated by the P or PD algorithm. The stored operating point remains effective until you either deactivate operating point adjustment in manual mode by selecting oFF MA.YP or you adjust a new operating point in manual mode.
If you deactivate operating point adjustment in manual mode, the output variable specified in manual mode will assume the calculated value within approx. 2 seconds.
Choose between:

- oFF MA.YP Operating point adjustment in manual mode for Y_{PID} deactivated
- on MA.YP Operating point adjustment in manual mode for Y_{PID} activated

3.4.6 DIRE Operating direction of output variable

The output variable may either act directly or inversely to the error. This operating direction is defined with the function DIRE. Note that the operating direction can also be inverted with the function SIGN, see chapter 3.4.2!
Choose between:

- dir.d DI.AC Direct operating direction of output variable (factory default)
- in.d DI.AC Inverted operating direction of output variable

3.4.7 F.FOR Feedforward control

You may use the input WE for feedforward control, see chapter 3.3.1. The disturbance signal can be multiplied and additively linked by means of parameters according to the formula: $\pm (|W_{EX} - FC.K1|)$ FC.K2 + FC.K3. Finally, the signal is connected with the controlled variable. FC.K1, FC.K2 and FC.K3 are constants you have to define in the parameter level. The mathematical sign of the formula stated above is determined in the function F.FOR.
Choose between:

- oFF FECO Feedforward control deactivated (factory default)
- POS FECO Feedforward control with positive sign
- nE6 FECO Feedforward control with negative sign

Parameters to be set

FC.K1	Constant for formula stated above
FC.K2	Constant for formula stated above
FC.K3	Constant for formula stated above

3.4.8 AC.VA Increase, decrease of actual value

This function enables you to increase or decrease the actual value.
Upon activation of the binary input, the input signal X is additively linked with the parameter AV.K1. The new actual value is now used for control. This is also indicated on the upper display section of the controlled variable. Upon deactivation of the binary input, the input signal X is used for control again.
The parameter AV.K1 is stated in the parameter level in percent ranging from –110 to 110 %. When you enter, for example, AV.K1 = 30 %, the current X value will be increased from 50 to 80 %.
Choose between:

- oFF IN.DE Increase, decrease of actual value deactivated
- bi1 IN.DE Increase, decrease of actual value via binary input BI1

Parameter to be set
AV.K1 Constant in %
Note: The binary input can be assigned to several functions!

3.5 OUT Output definition

This main group enables you to define the output functions of the compact controller. You can specify whether the compact controller operates with continuous or discontinuous output. You can limit the output signal and define ramps. You also have the option of issuing X, WE or XD at the continuous output and transfer them to a recorder. For the continuous output, you can make mathematical adaptations. The discontinuous outputs can also be used as binary outputs to signalize varying operating conditions. The following functions can be assigned to the binary input in this main group: locking of the output signal, manual/automatic transfer, start of an output ramp or initialization of a 2nd output variable Y1K1.

3.5.1 SAFE Initialization of 2nd output variable Y1K1 for Y_{PID}

This function enables you to generate a predefined value for the output variable at the controller output, provided that the binary input is activated. This output value is the parameter Y1K1. It is adjusted in the parameter level in percent.
- oFF SA.VA Deactivated
- bi1 SA.VA Initializing Y1K1 via binary input BI1

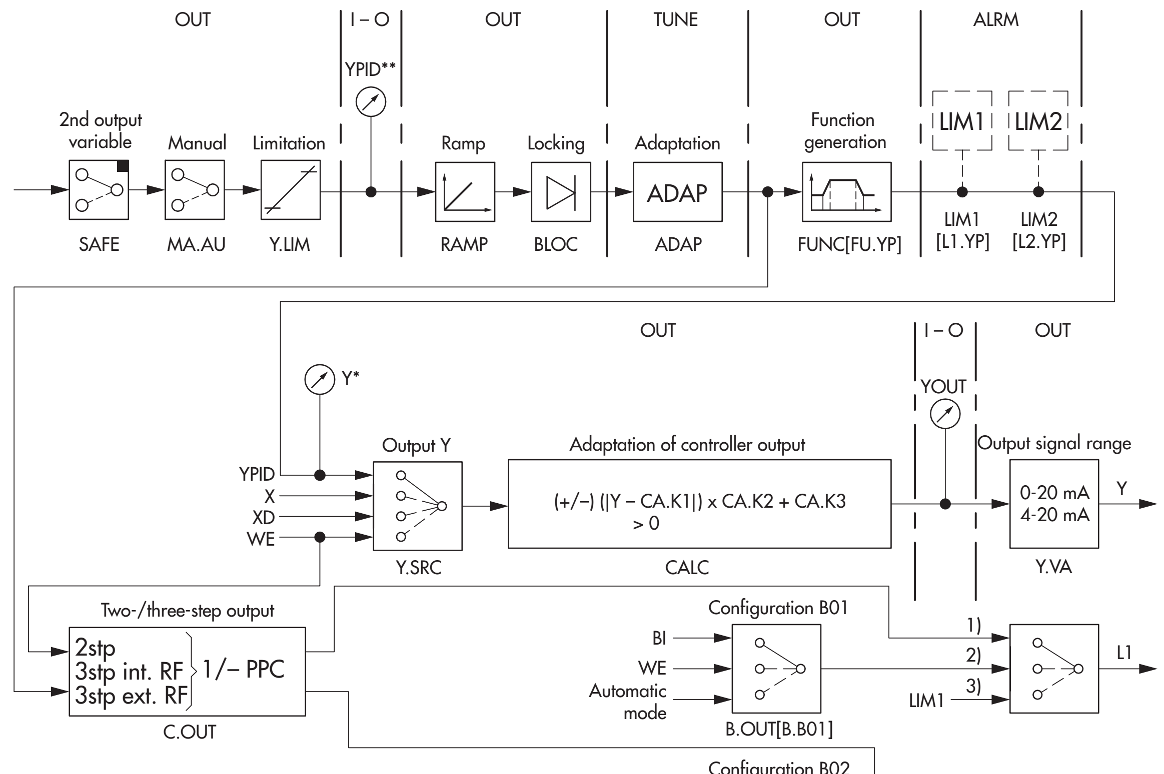
Parameter to be set
Y1K1 2nd output variable in %
Note: The binary input can be assigned to several functions!

3.5.2 MA.AU Manual/automatic transfer

When you choose the setting bi1 in this function, the controller switches to manual mode upon activation of the binary input and locks the manual/automatic transfer key at the same time. When the binary input is deactivated, the controller switches back to automatic mode. Exception: If the controller was already in manual mode upon activation of the binary input, it remains in manual mode. Manual mode is indicated by the symbol ☝ appearing on the display.
Choose between:
- oFF CH.MA Function deactivated
- bi1 CH.MA Transfer to manual mode via binary input BI1

Note: The binary input can be assigned to several functions!

Fig. 7 : Main group OUT



* y displayed in the operating level in automatic mode
** In manual mode: y displayed in the operating level
1) Assignment to two-step/three-step output
2) Assignment to binary output BO1, BO2
3) Assignment to limit relays L1, L2

3.5.3 Y.LIM Output signal limitation Y_{PID}

Output signal limitation is always active. When entering the parameter level, you can only set the parameters minimum and maximum output variable.

on LI.YP Output signal limitation Y_{PID} activated

Parameters to be set

$\underline{\vee}$ Y Minimum output variable

$\overline{\wedge}$ Y Maximum output variable

3.5.4 RAMP Output ramp or limitation of rate of output changes Y_{PID}

This function enables you to implement an output ramp or limit the rate of output changes. The latter is possible for an increasing and/or a decreasing output signal.

The term output ramp means that the output variable changes at constant speed. The parameter TSRA determines the transit time of the output ramp and, hence, the speed. This parameter refers to an output change by 100 %, see Fig. 8. The output ramp can be started by activating the binary input bi1. In doing this, you have the choice of starting the ramp with either – 10 % or the value of the parameter Y1RA. Manual mode and restart after power failure deactivate the output ramp.

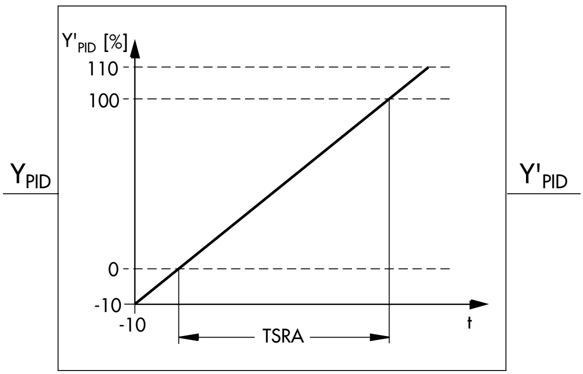


Fig. 8 : Output ramp

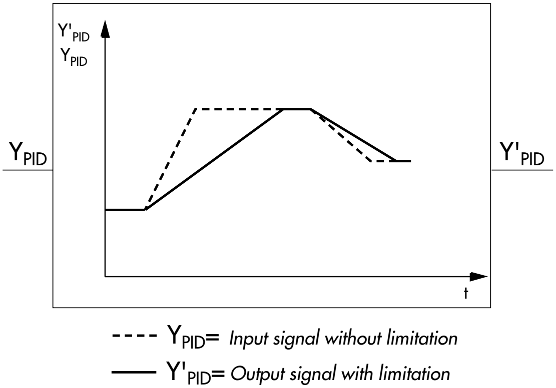


Fig. 9 : Limitation of rate of output changes

You can limit the rate of output changes for a decreasing and an increasing output variable (F03 RA.YP), but also only for an increasing (F04 RA.YP), or only for a decreasing (F05 RA.YP) output variable. The output variable then changes in the limited direction(s) only as fast as the parameter TSRA allows it. If the rate of output changes is slower than the defined rate of changes, the limitation will not be effective. Fig. 9 shows the effect of the described function.

The rate of changes for the output variable v_y calculates as follows:

$$v_y = \frac{100\ \%}{TSRA}$$

Choose between:

- oFF RA.YP Deactivated
- F01 RA.YP Ramp with activated BI1; starts with –10%,
- F02 RA.YP Ramp with activated BI1; starts with parameter Y1RA
- F03 RA.YP Limitation for decreasing and increasing output variable
- F04 RA.YP Limitation for increasing output variable
- F05 RA.YP Limitation for decreasing output variable

Parameters to be set

TSRA Transit time of output ramp
Y1RA Starting value for output ramp

Note: The binary input can be assigned to several functions!

3.5.5 BLOC Locking of output signal Y_{PID}

This function locks the output signal upon activation of the binary input BI1. As a result, the current value of the output variable at the controller output is not changed as long as the binary input is active. When it is deactivated again, the output signal locking will be cancelled and the controller continues by using the last calculated output value.
Choose between:

- oFF BL.YP No locking of output signal via binary input (factory default)
- bi1 BL.YP Locking of output signal via binary input BI1

Note: The binary input can be assigned to several functions!

3.5.6 FUNC Function generation of output variable

You can generate functions of the output variable as well as the input variables X and WE. We do not go into further details since function generation is thoroughly described in chapter 3.2.8. However, make sure that you enter the pairs of value in percent. The parameters MIN and MAX are preset and cannot be changed here.
Choose between:

- oFF FU.YP No function generation of output variable
- on FU.YP Function generation of output variable

Parameters to be set
K1.X bis K7.X Input values for points 1 to 7 in %
K1.Y bis K7.Y Output values for points 1 to 7 in %

3.5.7 Y.VA Output signal range

This function enables you to define the range of the continuous output:

- oFF Y No continous output
- 0-20 mA 0-20 mA output
- 4-20 mA 4-20 mA output

3.5.8 Y.SRC Assignment of continous output

This function enables you to determine whether the continuous output is used as controller output (PID output) or assigned to the inputs X or WE, or to error. Optionally, the signals can then be transferred to a recorder.

- on Y.PID Assignment to PID output
- on Y.X ~ to X input
- on Y.WE ~ to WE input for feedforward control
- on Y.XD ~ to error Xd

3.5.9 CALC Mathematical adaptation of continuous output Y

This function enables you to mathematically modify the continuous output to adapt it, for example, to the requirements of a recorder. The following formula applies:

$$y' = \pm(|Y - CA.K1|)\ CA.K2 + CA.K3$$

- oFF CA.Y Mathematical adaptation deactivated (**note:** no output signal!)
- POS CA.Y Mathematical adaptation with positive sign
- nE6 CA.Y Mathematical adaptation with negative sign
- on CA.Y Mathematical adaptation without conditions

Parameters to be set

CA.K1 Constant for above formula in %
CA.K2 Constant for above formula (for continuous output, adjust > 0!)
CA.K3 Constant for above formula in %

3.5.10 C.OUT Configuration of two-step or three-step output

This function enables you to select a two-step or three-step output. The active two-step output is easily recognized by the symbol ⊞. For the three-step output, the symbol ⊞ indicates an active Y+ output, whereas the symbol ⊟ indicates an active Y- output.
Note! The selection of one of these settings has priority over the settings in the functions B.OUT (see chapter 3.5.11), LIM1 and LIM2 (see chapter 3.6). When you configure a three-step output, the functions of the binary outputs or limit relays can therefore not be used! When you configure a two-step output, you are able to use the functions of the binary output BO2 or the limit relay L2.
Choose between:

- oFF 2/3S. No two-step or three-step output
- on 2.STP Two-step output
- i.Fb 3.STP Three-step output with internal position feedback
- E.Fb 3.STP Three-step output with external position feedback
- PP 2.STP Two-step output with pulse-pause modulation (PPM)
- i.PP 3.STP Three-step output with internal position feedback and PPM
- E.PP 3.STP Three-step output with external position feedback and PPM

When accessing the parameter level, all the possible parameters for output definition are displayed. The following pages will show you which parameters are relevant for which output.

Two-step output

The two-step output can only assume two states, which is on (1) or off (0). This controller output is used for applications, such as electric radiators with thermostat behavior.

The parameters dead band TZ and XSDY determine the switch-on and switch-off point of the two-step output. The parameter XSDY represents the differential gap and is used to prevent the two-step output from constantly switching on and off upon small system deviations.

Parameters to be set

XSDY	Differential gap
TZ	Dead band

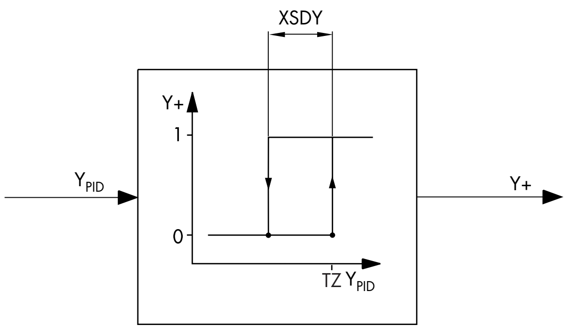


Fig. 10 : Two-step output

Three-step output with internal position feedback
The three-step output with internal position feedback determines the position of a valve by means of the transit time of the connected actuator. This transit time can be specified by the parameter TY.
The output variable of the three-step output can assume three values: –100 %, 0 and 100 %. This controller output is used, e.g. for electric actuators where the three output variables correspond to "counterclockwise rotation", "motor switched off" or "clockwise rotation". A definable dead band lies between both switching points. The dead band is the parameter TZ, see Fig. 11. In addition, you have to specify the parameter XSDY representing the differential gap. The differential gap applies to both switching points. Note that the differential gap must always be smaller than $\frac{TZ}{2}$.
A comparator produces the difference between the Y_{PID} signal and the feedback signal Y_R. This difference constitutes the output value for the three-step output. The following applies:
When the difference is larger than $\frac{TZ}{2}$ and larger than 0, the Y+ output is active.
When it is larger than $\frac{TZ}{2}$ and smaller than 0, the Y– output is active.
When the difference is smaller than $\frac{TZ}{2}$ – XSDY, the three-step output is deactivated.
When the YPID value exceeds 105 % or falls below –5 %, a permanent signal is issued at the controller output.

Parameters to be set

XSDY	Differential gap
TZ	Dead band for three-step output
TY	Transit time of actuator

Three-step output with external position feedback
This type of three-step output feeds back the position of a connected actuator externally via the WE input using, for example, a potentiometer.
Apart from that, this three-step output is similar to the three-step output with internal position feedback.
When a potentiometer is used for external position feedback, you have to calibrate it as described in chapter 3.9.5.

Parameters to be set

XSDY	Differential gap of two-step/three-step output
TZ	Dead band of three-step output

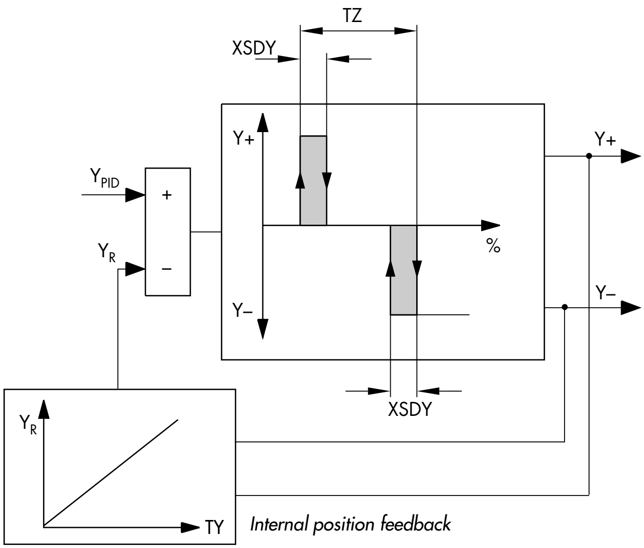


Fig. 11 : Three-step output with internal position feedback

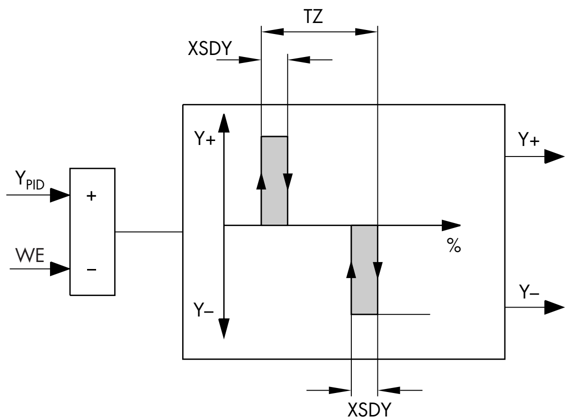


Fig. 12 : Three-step output with external position feedback

Two-step output with pulse-pause modulation (PPM)
The two-step output with pulse-pause modulation (PPM) converts the continuous Y_{PID} signal into a pulse sequence whose pulse-pause ratio varies depending on the Y_{PID} value, see Fig. 13. The on-time T_E of the two-step signal Y_+ results from:

$$T_E = \frac{(Y\,[\%] - TZ[\%]) \cdot KPL1}{100\,[\%]} \cdot TYL1\ [s].$$

The parameter TYL1 is the duty cycle and at the same time the maximum on-time. KPL1 is a gain factor.
You also have to set the parameter ⊻ TYL1. It specifies the minimum on-time in percent of the duty cycle. The minimum on-time in seconds $T_{E_{min}}$ is calculated by:

$$T_{E_{min}} = \frac{TYL1\ [s]}{100\ \%} \cdot \veebar\, TYL1\ [\%]$$

Due to the hardware, $T_{E_{min}}$ lasts 0.3 s minimum.
When choosing the parameters TYL1, KPL1 and ⊻ TYL1 suitably, the two-step output with PPM provides a good compromise between small fluctuations in the controlled variable (high switching frequency) and high service life of the final control element (low switching frequency).

Parameters to be set

KPL1	Gain Y+
TYL1	Duty cycle, maximum on-time in seconds
⊻ TYL1	Minimum on-time of BO1 in % of TYL1
TZ	Dead band of three-step output in %

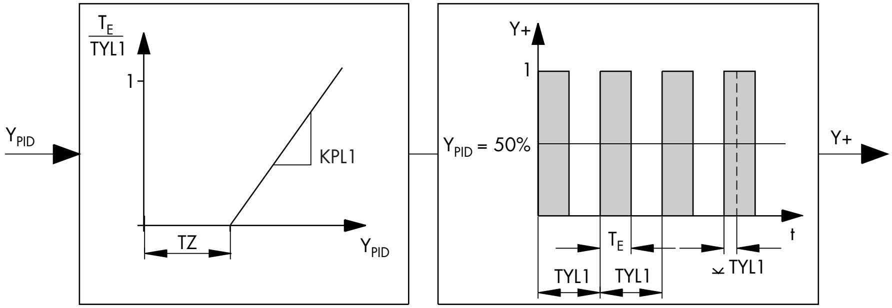


Fig. 13 : Two-step output with PPM

Three-step output with internal position feedback and PPM

The three-step output with internal position feedback and pulse-pause modulation converts the three-step signal into a pulse sequence.

The characteristic of this output is shown in Fig. 14. The position of the control valve is determined by the transit time of the connected actuator. You can specify the transit time via the parameter TY. The difference created from the Y_{PID} signal and the feedback signal Y_R is converted into a pulse sequence depending on the defined duty cycle. The duty cycle can be defined individually for the Y_+ as well as the Y_- signal. The parameter TYL1 determines the duty cycle for the Y_+ signal, and the parameter TYL2 for the Y_- signal. In addition, you have to specify the minimum on-time in percent of the duty cycle via the parameter $\veebar$ TYL1 for the Y_+ signal, and via $\veebar$ TYL2 for the Y_- signal. The minimum on-time in seconds calculates as follows:

$$T_{E_{min}} = \veebar\,\mathrm{TYL1}\ [\%] \cdot \frac{\mathrm{TYL1}\,[\mathrm{s}]}{100\ \%} \text{ for } Y_+ \text{ signal, or } T_{E_{min}} = \veebar\,\mathrm{TYL2}\ [\%] \cdot \frac{\mathrm{TYL2}\,[\mathrm{s}]}{100\ \%} \text{ for } Y_- \text{ signal.}$$

You also have to define the dead band for this output using the parameter TZ. The dead band must be specified in percent referred to the difference Y_{PID} - WE. As required you can also change the parameters KPL1 and KPL2 which provide a certain gain. You can use them together with the parameters TYL1 and TYL2 to adapt the connected actuator to different opening and closing times.

Parameters to be set

KPL1	Gain Y+
KPL2	Gain Y–
TYL1	Duty cycle Y+ in s
TYL2	Duty cycle Y– in s
$\veebar$ TYL1	Minimum on-time Y+ in % referred to TYL1
$\veebar$ TYL2	Minimum on-time Y– in % referred to TYL2
TZ	Dead band of three-step output
TY	Transit time of actuator

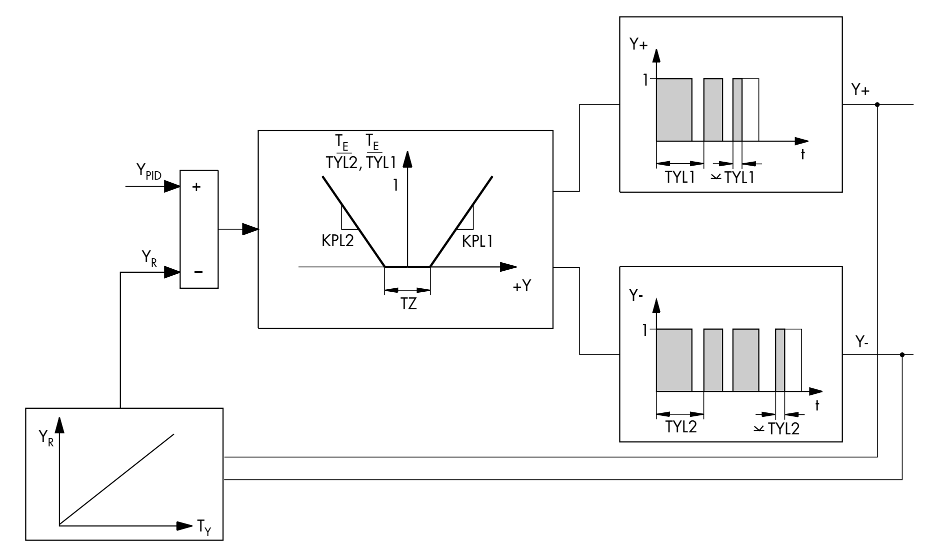


Fig. 14 : Three-step output with internal position feedback and PPM

Three-step output with external position feedback and PPM

This type of three-step output is similar to the three-step output with internal position feedback and pulse-pause modulation (PPM). The only difference is that the position of a connected actuator is fed back externally via the WE input, for example using a potentiometer. The parameter TY is omitted. If a potentiometer is used for external position feedback, it must be calibrated as described in chapter 3.9.5.

Parameters to be set

KPL1	Gain Y+
KPL2	Gain Y–
TYL1	Duty cycle Y+ in s
TYL2	Duty cycle Y– in s
⊻ TYL1	Minimum on-time Y+ in % referred to TYL1
⊻ TYL2	Minimum on-time Y– in % referred to TYL2
TZ	Dead band of three-step output

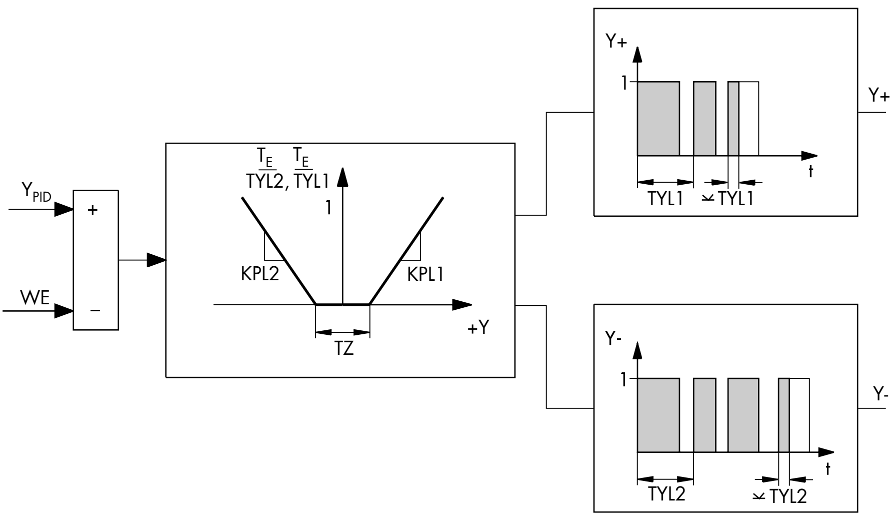


Fig. 15 : Three-step output with external position feedback and PPM

3.5.11 B.OUT Configuration of binary outputs BO1 and BO2

This function enables you to specify which operating conditions are to be indicated by the binary outputs BO1 and BO2. You can display the states of the binary outputs in the I-O level with the function BIN, see chapter 3.9.4.

Note! When you have selected a three-step output (see chapter 3.5.10), you are not able to use the functions of the binary outputs. Having selected a two-step output, you can use the functions of the binary output BO2. All the settings of B.OUT have priority over the settings made with the functions LIM1 and LIM2, see chapter 3.6.1.

Choose between:

Configuration of binary output BO1

- oFF B.BO1 Binary output BO1 deactivated
- F01 B.BO1 Active when binary input active
- F02 B.BO1 Active when external reference variable selected
- F03 B.BO1 Active in automatic mode

Configuration of binary output BO2

- oFF B.BO2 Binary output BO1 deactivated
- F01 B.BO2 Active when binary input active
- F02 B.BO2 Active when external reference variable selected
- F03 B.BO2 Active in automatic mode

3.6 ALRM Alarm functions

This main group enables you to determine the functions of the limit relays L1 and L2.
The limit relays monitor variables as to whether they exceed or fall below a limit value. The limit relay can assume two switching states. When the switching condition is fulfilled, the limit relay is closed, if not, it is open.
The functions LIM1and LIM2 determine which variable will be monitored by the limit relay L1 or L2, and also whether the limit relay becomes active when limit values are exceeded or not reached.
The limit value of the selected variable is defined in the parameter level via LI.X, LI.WE, LI.YPID or LI.XD. In addition, you have to set the parameter L.HYS to define a differential gap (hysteresis). The differential gap is the distance to be set between the points where the limit relay switches on and off. It is given in percent referred to the measuring range.
Fig. 16 shows an example to illustrate the function of the limit relay and the parameters to be set for this purpose. Here, the controlled variable X is monitored.

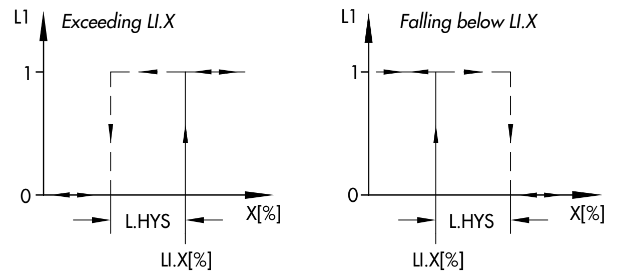


Fig. 16 : Function of the limit relays L1 and L2

First case: The limit relay monitors the controlled variable for exceeding a preset limit value. The limit relay is activated when the controlled variable X increases and reaches the preset limit value LI.X. When the controlled variable decreases again to finally reach the preset limit value minus a hysteresis L.HYS, the limit relay is deactivated.
Note that LI.X and LI.WE are stated in absolute values, however, in Fig. 16, LI.X is represented in percent!
Second case: The limit relay monitors the controlled variable X for falling below a preset limit value. The limit relay is activated when the controlled variable decreases and reaches the preset limit value LI.X. When the controlled variable increases again to finally reach the limit value LI.X plus a hysteresis L.HYS, the limit relay is deactivated.

When the limit relay 1 is activated, the symbol L1 appears on the display. The symbol L2 appears when the limit relay 2 is activated.

3.6.1 LIM1 Limit relay L1

The function of the limit relays has been described in detail in the previous chapter 3.6.
Note! Functions of the two-step or three-step output C.OUT (see chapter 3.5.10) and functions of the binary outputs B.OUT (see chapter 3.5.11) have priority over the settings of the functions LIM1 and LIM2.
Choose between:
Limit relay L1

- oFF L1 Limit relay L1 deactivated
- Lo L1.X ~ L1 is activated when LI.X is not reached
- Hi L1.X ~ L1 is activated when LI.X is exceeded
- Lo L1.WE ~ L1 is activated when LI.WE is not reached
- Hi L1.WE ~ L1 is activated when LI.WE is exceeded
- Lo L1.YP ~ L1 is activated when LI.YP is not reached
- Hi L1.YP ~ L1 is activated when LI.YP is exceeded
- Lo L1.XD ~ L1 is activated when LI.XD is not reached
- Hi L1.XD ~ L1 is activated when LI.XD is exceeded
- AbS L1.XD ~ L1 is activated when the sum of LI.XD is exceeded

Parameters to be set

LI.X	Limit value for X, as absolute value
LI.WE	Limit value for WE, as absolute value
LI.YP	Limit value for Y_{PID} in %
LI.XD	Limit value for XD in %
L.HYS	Differential gap in % referred to the measuring range

3.6.2 LIM2 Limit relay L2

This function enables you to define the limit relay L2 which is described in detail in chapter 3.6.
Note! Functions of the two-step or three-step output C.OUT (see chapter 3.5.10) and functions of the binary outputs B.OUT (see chapter 3.5.11) have priority over the settings of the functions LIM1 and LIM2.
Choose between:
Limit relay L2

- oFF L2 Limit relay L2 deactivated
- Lo L2.X ~ L2 is activated when X is not reached
- Hi L2.X ~ L2 is activated when X is exceeded
- Lo L2.WE ~ L2 is activated when WE is not reached
- Hi L2.WE ~ L2 is activated when WE is exceeded
- Lo L2.YP ~ L2 is activated when Y_{PID} is not reached
- Hi L2.YP ~ L2 is activated when Y_{PID} is exceeded

- Lo L2.XD ~ L2 is activated when XD is not reached
- Hi L2.XD ~ L2 is activated when XD is exceeded
- AbS L2.XD ~ L2 is activated when the sum of XD is exceeded

Parameters to be set

LI.X	Limit value for X, as absolute value
LI.WE	Limit value for WE, as absolute value
LI.YP	Limit value Y_{PID} in %
LI.XD	Limit value for X, in %
L.HYS	Differential gap in % referred to the measuring range

3.7 AUX Additional functions

This main group enables you to determine restart conditions after power failure has occurred. You have several options, such as resetting functions, parameters and calibrating values to factory default and locking operator keys. Finally, you can modify the contrast setting of the display.

3.7.1 RE.CO Restart conditions upon power failure

This function enables you to define the output variable and operating mode after power failure has occurred. When selecting F03, acknowledgement is necessary to return to normal control operation. In this case, the display sections for reference variable and controlled variable are blinking until you press the reset key.
Choose between:

- F01 MODE Manual mode with 2nd output variable Y1K1
- F02 MODE Automatic mode with last received value of reference variable and Y1K1, without acknowledgement
- F03 MODE Automatic mode with last received value of reference variable and Y1K1, restart with acknowledgement via reset key

3.7.2 ST.IN Resetting to factory default

This function enables you to reset all the settings of parameters, functions and calibrating values together or each individually:

- FrEE INIT Resetting deactivated/completed
- All INIT Resetting of all the functions, parameters and the key number
- FUnC INIT Resetting of all the functions
- PArA INIT Resetting of all the parameters and the key number
- AdJ INIT Basic initialization of the calibrating values for In1, In2 and Y1

To reset to factory default, proceed as follows:
You are in the main group AUX and have selected ST.IN.

1. Press the programming key. FrEE INIT appears on the display.
2. Use the cursor keys to choose from the settings listed above (All, FUnC,PArA or AdJ).
3. Press the programming key. The selected settings are reset to factory default. When the resetting procedure is completed, FrEE INIT appears again.

3.7.3 KEYL Operator keys

This function enables you to turn the function of the six keys via the binary input on and off, or to disable the following keys: selector key, manual/automatic transfer key and the cursor keys.

- oFF LOCK Operator keys enabled
- bi1 LOCK Enabling/disabling all the keys via the binary input BI1
- on noH.W Selector, manual/automatic transfer and cursor keys disabled. The compact controller remains in the operating mode that was in effect before you have activated this function

Note: The binary input can be assigned to several functions!

3.7.4 VIEW Setting of display contrast

This function enables you to modify the display contrast from grade 1 to 10. This allows optimum display illumination at the site of installation. 1 is especially suitable for installation on high places, whereas 10 suits low places of installation.
Choose between:

- 1 VIEW Contrast setting 1
  . .
- . .
  . .
- 10 VIEW Contrast setting 10

3.7.5 FREQ Power frequency

This function enables you to set the power frequency of the system to either 50 or 60 Hz.
Choose between:

- on 50Hz Power frequency set to 50 Hz
- on 60Hz Power frequency set to 60 Hz

3.7.6 DP Decimal point setting

This function enables you to determine the number of decimal places for all variables which directly apply to the analog inputs In1 and In2.
Choose between:

- on DP0 No decimal place
- on DP1 One decimal place (factory default)
- on DP2 Two decimal places

3.8 TUNE Start-up adaptation

This main group enables you to initiate a start-up adaptation. It works according to the inflectional tangent principle which means that one unit step response is used to determine the inflectional point, the inflectional tangent as well as different characteristics. The controller calculates then the parameters K_P, T_N and T_V.
For start-up adaptation, observe the following:

- The controlled system must be stable. Eliminate disturbance variables (e.g. drifting).
- The controlled system must be settled when you begin start-up adaptation.
- You can only adapt controlled systems with self-regulation.
- Adaptation must be completed after 5 hours.

3.8.1 ADAP Start-up adaptation

The start-up adaptation is initiated if you select run ADP.S. Before you start this procedure, define the parameter Y.JMP. Its value is added to the output variable to subsequently determine the step response of the controlled system. The step response can take place in both directions. It should be as large as possible and located around the operating point, however, without leaving the defined controlled variable range. If the latter happens during adaptation, the adaptation procedure is interrupted and Err 32 appears on the display.
When the start-up adaptation is successfully completed, the determined parameters become instantaneously effective. The compact controller is in manual mode. Now, switch to automatic mode.
The function ADAP includes the following settings:

- oFF ADP.S No adaptation
- run ADP.S Initiating start-up adaptation

Parameter to be set
Y.JMP Value of step response in %

Carry out the following steps to initiate start-up adaptation:
The compact controller is in the operating level.

Press!	Display shows	Comment
	IN	You have accessed the setup level.
▽ 2x	TUNE	You have reached the main group TUNE.
	-CO- ADAP	You have reached the function for start-up adaptation.
	oFF ADP.S	Start-up adaptation is not yet activated.
	PA ADAP (blinking)	First, enter the parameter level so that you can define the value for the step response.
	1.0 (factory default) KP	KP, TN, TV are the same as in C.PID.
▽	20.0 (factory default) Y.JMP	Parameter of value for step response.
	- - - - KEY	Key number optionally prompted. If so, proceed as described on p. 8.
△ or ▽	(blinking display)	Adjust the value for the step response.
		You have acknowledged the value for the step response and the display stops blinking.
	oFF ADP.S	You leave the parameter level.
	oFF (blinking) ADP.S	
△	run (blinking) ADP.S	
	20 ADP.S (blinking)	Adaptation is initiated. In sequence, status messages indicating the running procedure are displayed on the upper section.

Press!	Display shows	Comment
	End ADP.S	You have successfully completed start-up adaptation.

Cancelling start-up adaptation

Press!	Display shows	Comment
	StoP ADP.S	You can cancel the adaptation procedure at any time to modify the parameters. Pressing again on the programming key restarts adaptation.

Errors during start-up adaptation
The following errors appear in the display and, in addition, the binary output for messages is set.

Display shows	Type of error	Comment
30 ERR	Timeout > 5h	Termination of adaptation procedure after 5 hours.
31 ERR	Parameter determination impossible	The adaptation procedure cannot determine parameters.
32 ERR	X input < 0% or > 100%	Modify Y.JMP.
33 ERR	Interferences too strong	Increase Y.JMP and check interferences
34 ERR	Selected PID setting does not allow adaptation.	Set P, PI or PID control in the function C.PID (main group CNTR) .
35 ERR	Output signal limited	Modify Y.JMP.

3.9 I-O View process data

This main group enables you to view different variables and information. In addition, you can adjust zero and span for the analog inputs IN1 and IN2 as well as the analog output Y.

3.9.1 CIN Firmware

This function shows you the version of your firmware (software version).

- FIR View firmware version

3.9.2 S-No Serial number

This function shows you the serial number of the controller. All controllers are given a serial number by the manufacturer.

- View serial number

3.9.3 ANA View values of analog inputs

This function enables you to view the values of analog variables. Please also note Fig. 1 on page 15 , Fig. 3 on page 21, Fig. 5 on page 25, and Fig. 7 on page 31. There you will find the displayed variables illustrated.

- IN1 Analog input 1 (absolute value)
- IN2 Analog input 2 (absolute value)
- CO.VA Controlled variable before function generation has been performed
- WE.VA Reference variable after function generation has been performed
- FE.CO WE prior to applying feedforward control (when using WE for feedforward control, i.e. parameter SP.VA set to F02 WE in the main group SETP, WE is not displayed in the operating level).
- SP.CO Reference variable at the comparator
- YPID Y_{PID} after the limitation
- YOUT Controller output after mathematical adaptation Y_{OUT}

3.9.4 BIN Status of binary input and outputs

This function enables you to view the respective status of the binary input and outputs.

- BI1 Status of binary input BI1 on/oFF
- BO1 Status of binary output BO1 on/oFF
- BO2 Status of binary output BO2 on/oFF

3.9.5 ADJ Adjusting the analog inputs and output

This function enables you to adjust zero and span for the analog inputs and the analog output.
To do this, proceed as described below:
You are in the main group I-O and you have selected ADJ.

1. Press the programming key. ADJ IN1 appears on the display.
2. Choose the respective input or output using the cursor keys:
   AdJ IN1 Adjusting the analog input IN1
   AdJ IN2 Adjusting the analog input IN2
   AdJ Y1 Adjusting the analog output Y
3. Press the programming key.
4. You are prompted to enter the key number. Enter the key number via the cursor keys!
5. Acknowledge with the programming key!
6. Adjust the desired signal to the lower range value using a high-precision meter. The display section indicating adjustment range shows ZERO and IN1 (IN2 or Y1) in turn.
7. Press the programming key! Now, zero adjustment is completed. The display shows 0.0 and ZERO.
8. Adjust the desired signal to the upper range value using a high-precision meter. The display section indicating adjustment range shows SPAN and IN1 (IN2 or Y1) in turn.
9. Press the programming key! Span adjustment is completed. The display stops blinking and shows 100.0 and SPAN.
10. Press the reset key once ! Continue with step 2 when you want to adjust other inputs or the output. Now, the key number prompt is omitted (step 3 and 4).

4 Practical examples

In this chapter, we will show you how to configure your TROVIS 6493 Compact Controller so that you can implement fixed set point control, follow-up control and follow-up control with function generation. We assume you know how to operate this controller. If not, please read chapter 2. Note that there are two controller versions due to the different inputs In2!

4.1 Fixed set point control

For this example, we have chosen a simple temperature control loop as shown in Fig. 17. The controlled variable X is the flow temperature which is measured at the input IN2 via a Pt 100 sensor. The flow temperature is to follow a fixed reference variable value. The TROVIS 6493-01 Compact Controller issues a continuous 4 to 20 mA signal as output variable Y. To perform this control task, you just have to define the reference variable and the control parameters. The reference variable can be directly set in the operating level using the cursor keys. Whereas, the control parameters must be defined in the setup level in the main group CNTR. All the other settings required are standard configured in the compact controller. The table below lists the settings you require:

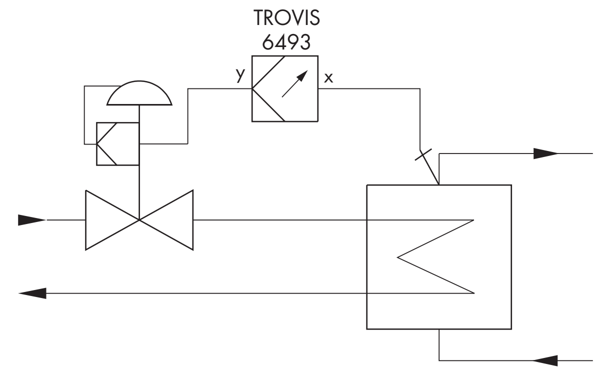


Fig. 17 : Single temperature control loop

Setup level

Main group	Function -CO-	Setting	Parameter -PA-	Value	Comment
CNTR	-CO- C.PID	PI (factory default	KP TN	0.8 16.0	Define control parameter.
	-CO- DIRE	dir.d	-		Change oper. dir., if needed.

Operating level

Use selector key to display W. Use cursor keys to enter new value.	Determine new value for reference variable.

4.2 Follow-up control

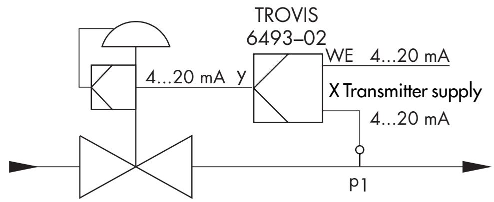


Fig. 18 : Pressure control

A follow-up control loop is illustrated in Fig. 18. In this example, a pressure between 0 to 10 bar is controlled and measured via a two-wire transmitter. The two-wire transmitter could be, e.g. the SAMSOMATIC 994-0050 Transmitter. The external reference variable is provided by a 4 to 20 mA signal. We also want to be able to switch to a fixed value for the internal reference variable. The control valve with positioner is controlled by a continuous output variable Y ranging from 4 to 20 mA. The controller version TROVIS 6493-02 with two mA inputs is used in this example. Now, proceed as described below:

- The controlled variable X is the pressure p_1 which is measured via a two-wire transmitter and is connected to the input In2. This input is designed for 4 to 20 mA as standard, i.e. it does not need to be changed. However, you have to set the measuring range for this input to 1 to 10 bar. To do this, select for this in the main group IN the function -CO- IN2 and define the measuring range in the parameter level.
- The external reference variable WE is applied to the input In1 as 4 to 20 mA signal. The input In1 is originally set up for 4 to 20 mA, therefore it must not be changed. However, you must determine the measuring range for the reference variable in the parameter level with 0 to 10 bar. To do this, open the parameter level in the main group IN in the function -CO-IN1.
  WE is principally not activated. To activate WE, enter the function -CO- SP.VA in the main group SETP and select WE. Set WE to "on". Additionally, set the measuring range of W (internal reference variable) to 0 to 10 bar. In the operating level, you can now choose W or WE as reference variable. When you define WE as active reference variable, you automatically obtain follow-up control. When you define W to be active, you have a set up fixed set point control. For this control action, you can enter the value of the reference variable in the operating level via the cursor keys.
- Control action must be PID, not PI as specified in factory default. Go to the main group CNTR and change the setting of the function -CO- C.PID to PId and also change KP, TN, and TV in the parameter level.

- The output variable Y is principally set up for a continuous signal ranging from 4 to 20 mA. Therefore, the output variable must not be modified in this example.

The following table lists the required settings in short together with the parameter definitions:

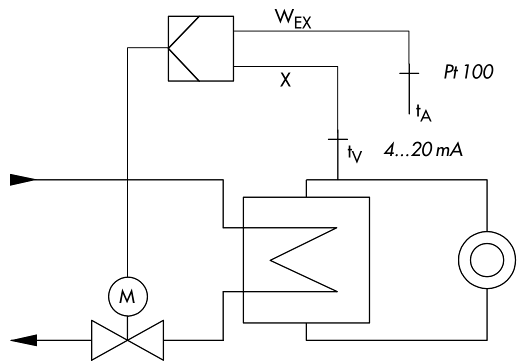
Setup level

Main group	Function -CO-		Setting	Parameter -PA-	Value	Comment
IN	-CO- IN1		4 -20 mA (factory default)	⊻ IN1 ⊼ IN1	0 [bar] 10 [bar]	Define measuring range for input 1, WE assigned (factory default)
	-CO- IN2		4-20 mA	⊻ IN2 ⊼ IN2	0 [bar] 10 [bar]	Define measuring range for input 2, X assigned (factory default)
	-CO- CLAS	X	In2 (factory default)			Assign the controlled variable X to input In2
		WE	In1 (factory default)			Assign the external reference variable to input In1
SETP	-CO- SP.VA	WE	on			Activate WE and, hence, follow-up control
		W	on (factory default)	W ⊻ WINT ⊼ WINT	5.2 [bar] 0 [bar] 10 [bar]	Value for internal W Measuring range for W
CNTR	-CO- C.PID		PId	KP TN TV TVK1	0.8 16.0 6.0 1.0	Select PID action and specify control parameters
	-CO- DIRE		dir.d	-		Change oper. dir., if needed

Operating level

Press selector key to view WE. Press programming key.	Define WE as active reference variable

4.3 Follow-up control with function generation



t_V Flow temperature *t_A Outdoor temperature*

Fig. 19 : Temperature control with function generation

We will show you how to use function generation by means of a weather-sensitive flow temperature control loop as illustrated in Fig. 19. The controlled variable is the flow temperature. The outdoor temperature is measured by a Pt 100 sensor and subsequently converted into a flow temperature through function generation. The relationship between outdoor temperature and required flow temperature is represented in the table below. The resulting characteristic serves as external reference variable. The compact controller controls the valve via a three-step signal with internal position feedback.

Carry out the following steps:

- The controlled variable X is the flow temperature which is measured by a two-wire transmitter. Two-wire transmitters can only be connected in controller version 6493-01 to the input In1. This input is adjusted to 4 to 20 mA as factory default, i.e. it does not need to be changed. However, you have to specify the measuring range for this input as to range from 0 to 150 °C. Additionally, you must assign the controlled variable X to the input In1.
- The outdoor temperature is the external reference variable WE and is applied to the input In2. This input is already set up for Pt 100 sensors. The measuring range is also fixed. Now, you have to assign WE to the input In2. WE is principally inactive. Set the measuring range for the internal reference variable W to 0 to 150 °C. In the operating level, you can choose between W and WE. When you select WE as to be the active reference variable, you automatically obtain follow-up control.
- Define the relationship between outdoor temperature and flow temperature in the main group IN with the function FUNC and WE in the parameter level.

t_A in °C (K1.X … K7.X)	–20.0	–10.0	0.0	10.0	20.0	30.0	40.0
t_V in °C (K1.Y … K7.Y)	100.0	90.0	85.0	75.0	60.0	55.0	50.0

- For the output, select a three-step signal with internal position feedback.

The following table lists the required settings in short:

Setup level

Main group	Function -CO-		Setting	Parameter -PA-	Value	Comment
IN	-CO- IN1		4 -20 mA (fact.def.)	⊻ IN1 ⊼ IN1	0.0 [°C] 150.0 [°C]	Define measuring range for input 1 (tv).
	-CO- CLAS	X	In1			Assign the controlled variable X (tv) to input In1.
		WE	In2			Assign the external reference variable WE (tA) to input In2.
	-CO- FUNC	WE	on	MIN MAX K1.X K1.Y K2.X K2.Y K3.X K3.Y K4.X K4.Y K5.X K5.Y K6.X K6.Y K7.X K7.Y	0.0 [°C] 150.0 [°C] -20.0 [°C] 100.0 [°C] -10.0 [°C] 90.0 [°C] 0.0 [°C] 85.0 [°C] 10.0 [°C] 75.0 [°C] 20.0 [°C] 60.0 [°C] 30.0 [°C] 55.0 [°C] 40.0 [°C] 50.0 [°C]	Activate function generation for WE. Define measuring range for the output signal tv obtained by function generation. Indicate 7 pairs of value which determine the relationship between outdoor and flow temperature.
SETP	-CO- SP.VA	WE	on			Activate WE and, hence, follow-up control.
		W	on (factory default)	W ⊻ WINT ⊼ WINT	25 [°C] 0 [°C] 150 [°C]	Define value for internal reference variable W and measuring range of W.
CNTR	-CO- C.PID		PI (factory default)	KP TN TV	0.8 16.0 6.0	Specify control parameters.
OUT	-CO- C.OUT		3.STP i.FB	XSDY TZ TY	0.8 [%] 2.0 [%] 90.0 [s]	Define three-step output with internal position feedback and appropriate parameters.

Operating level

Press selector key to view WE. Press programming key.	Define WE as active reference variable.

5 Start-up

When all the inputs and outputs and the power supply are connected, the compact controller must be set up according to the desired control task. This means that you have to configure and parmeterize the controller. Appendix C contains a checklist form where the settings can be filled in.
The compact controller must be adapted to the dynamic behavior of the controlled system via the parameters KP, TN and TV. So the system deviations caused by disturbances can be eliminated or largely suppressed. There are two ways to adjust these parameters, either via start-up adaptation (see chapter 3.8.1) or via manual optimization. The latter will be described in the following chapters, however, we can give you but general instructions. If appropriate setting values have not yet been determined for your controlled system, you should proceed as follows:
Note: Before you start manual optimization, close the connected control valve!

1. Press the manual/automatic transfer (13) key to switch to manual mode. The symbol appears on the display.
2. Use the cursor keys to change the output variable to a value at which the control valve slowly opens.
3. Choose the required control action and continue as described below.

5.1 P controller

- Enter KP = 0.1.
- Adjust the reference variable in the operating level to the desired value.
- Use the cursor keys to change the output variable to a value at which the control valve slowly opens and error X_d assumes approximately zero.
- Switch to automatic mode.
- Increase the KP value until the controlled system tends to oscillate.
- Slowly decrease the KP value until the oscillations disappear.
- You can eliminate the remaining system deviation as follows: Switch to manual mode! Change the output variable to obtain error Xd = 0. Now, read the value produced for the output variable and set the parameter Y.PRE (CNTR, C.PID) to this value.
  Important: Each change in the reference variable also changes the operating point!

5.2 PI controller

- Enter KP = 0.1 and TN = 1999.
- Adjust the reference variable in the operating level to the desired value.
- Use the cursor keys to change the output variable to a value at which the control valve slowly opens and error X_d approximately assumes zero.
- Switch to automatic mode.

- Increase the KP value until the controlled system tends to oscillate.
- Slightly decrease the KP value until the oscillations are eliminated.
- Decrease the TN value until the controlled system tends to oscillate.
- Slightly increase the TN value until the oscillations are eliminated.

5.3 PD controller

- Enter KP = 0.1, TV = 1 and derivative-action gain TVK1 = 1.
- Adjust the reference variable in the operating level to the desired value.
- Use the cursor keys to change the output variable to a value at which the control valve slowly opens and error X_d approximately assumes zero.
- Switch to automatic mode.
- Increase the KP value until the controlled system tends to oscillate.
- Increase the TV value until the oscillations are eliminated.
- Increase the KP value until the oscillations appear again.
- Increase the TV value further until the oscillations are eliminated.
- Repeat this procedure several times until the oscillations can no longer be suppressed.
- Slightly decrease the KP and TV value to calm down the controlled system.
- The remaining system deviation can be eliminated as follows: Switch to manual mode! Change the output variable until error Xd = 0. Read the value produced for the output variable and set the parameter Y.PRE (CNTR, C.PID) to this value.
  Important: Each change in the reference variable also changes the operating point!

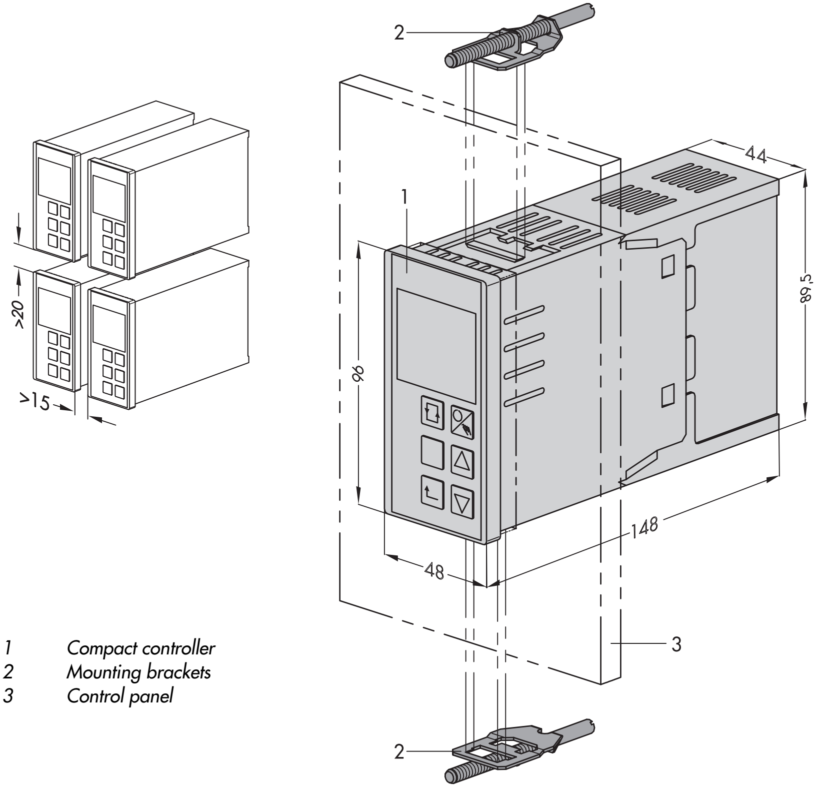
5.4 PID controller

- Enter KP = 0.1, TN = 1999 and TV = 1.
- Adjust the reference variable to the desired value.
- Use the cursor keys to change the output variable to a value at which the control valve slowly opens and error Xd approximately assumes zero.
- Switch to automatic mode.
- Increase the KP value until the controlled system tends to oscillate.
- Increase the TV, value until the oscillations are eliminated.
- Increase the KP value until the oscillations appear again.
- Increase the TV value until the oscillations are eliminated.
- Repeat this procedure several times until the oscillation can no longer be suppressed.
- Slightly decrease the KP and TV value to calm down the controlled system.
- Decrease the TN value until the controlled system tends to oscillate again and slightly increase, once again, so that the oscillations disappear.

6 Installation

The TROVIS 6493 Compact Controller is a panel-mounting unit with the front dimensions 48 x 96 mm. To mount the controller, carry out the following steps:

1. Make a panel cut-out with the dimensions $45^{+0.6}$ x $92^{+0.8}$ mm.
2. Push the controller into the panel cut-out so that its front panel goes through first.
3. Insert the provided mounting brackets (2) into the remaining slots between the upper and lower edge of the controller front and the panel cut-out, see Fig. 20.
4. Screw the threaded rods towards the control panel using a screwdriver to clamp the housing against the panel cut-out.

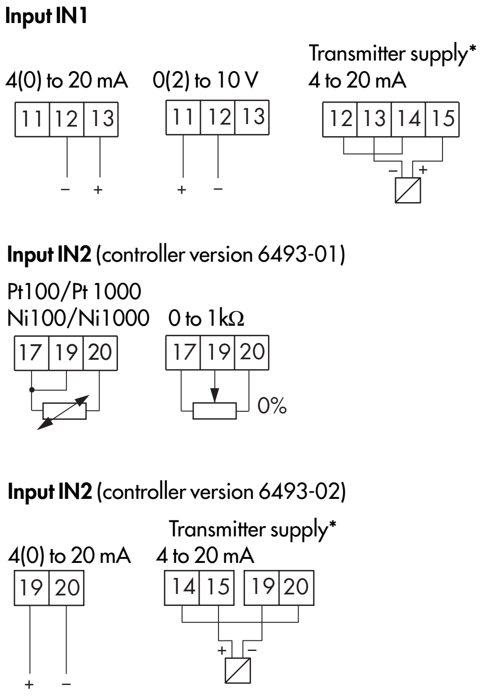


1 Compact controller
2 Mounting brackets
3 Control panel

Fig. 20 : Mounting the controller

7 Electrical connections

The compact controller has screw terminals suitable for lines up to 1.5 mm².
For electrical installation, you are required to observe the VDE 0100 regulation and the regulations relevant in your country.
To avoid measurement errors or other faults, use screened cables for the signal lines of the analog and binary inputs running outside the switching cabinets. Within the cabinets, these signal lines have to be installed separately from the control and network lines with sufficient space between them.
Ground the cable screenings on one side in the neutral point of the measuring and control system.



* *Note! The transmitter supply can only be used for one two-wire transmitter (at IN1* ***or*** *at IN2)* ***or*** *for the supply of the binary input BI!*

Fig. 21 : Electrical connections

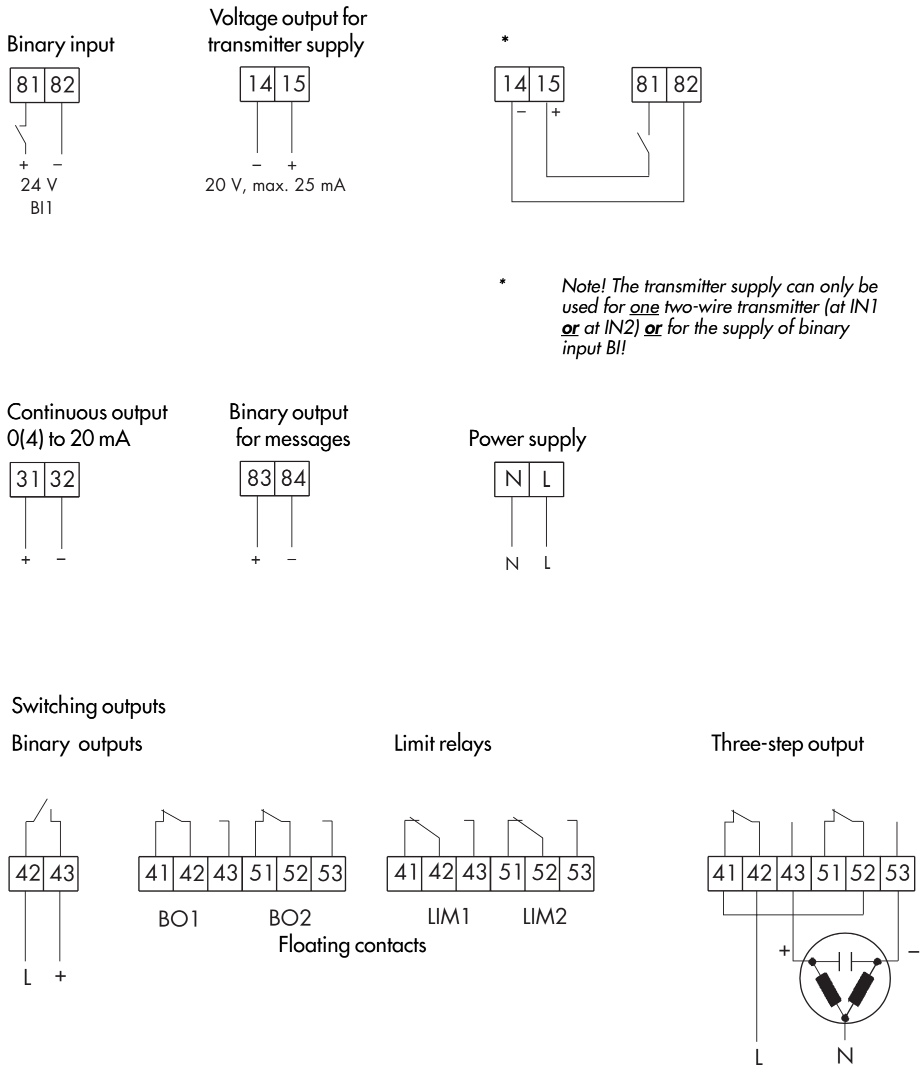


Fig. 22 : Electrical connections (continued)

8 Technical data

Inputs		Two analog inputs, optionally for the controlled variable X or the reference variable W
Analog input 1		0(4) to 20 mA or 0(2) to 10 V, or two-wire transmitter (see below)
Analog input 2 (two controller versions)		Version 1 (6493-01): Temperature sensor or potentiometer (see below) Version 2 (6493-02): 0(4) to 20 mA or two-wire transmitter (see below)
mA or V input	Measuring ranges	0(4) to 20 mA, or 0(2) to 10 V
	Meas. range changeover	Done by software
	Max. perm. values	Current ± 50 mA, voltage ± 25 V
	Internal resistance	Current R_i = 50 Ω, voltage R_i = 20 kΩ
	Permissible common mode voltage	0 to 5 V
	Error	Zero < 0.2 %, span < 0.2 %, linearity < 0.2 %
	Temperature influence	Zero < 0.1 %/10 K, span < 0.1 %/10 K
Transmitter supply		According to DIN IEC 381 (NAMUR NE06) 20 V, max. 25 mA, resistant to short-circuit
Temperature sensor	Measuring range	Pt 100, Pt 1000: –100 to 500 °C Ni 100, Ni 1000: –60 to 250 °C
	Line resistances	Three-wire $R_{L1} = R_{L2} = R_{L3} < 15\ \Omega$
	Error Pt 100, Pt 1000 in the range –40 to 150 °C	Zero < 0.2 %, gain < 0.2 %, linearity < 0.2 % Zero < 0.1 %, gain < 0.1 %, linearity < 0.1 %
	Temperature influence	Zero < 0.2 %/10 K, span < 0.2 %/10 K
Potentiometer	Measuring range	0 to 1kΩ, three-wire
	Line resistances	$R_L < 15\ \Omega$ each
	Error	Zero < 0.2 %, gain < 0.2 %
	Temperature influence	Zero < 0.1 %/10 K, gain < 0.2 %/10 K
Binary input		External switching voltage 24 V DC, ±30 %; 3 mA

Outputs		Continuous, two-step or three-step output
Continuous controller output	Signal range	0(4) to 20 mA, load < 740 Ω
	Control range	0 to 22 mA (0 to 110 %)
	Error	Zero < 0.2 %, gain < 0.1 %
	Temperature influence	Zero < 0.1 %/10 K, span < 0.1 %/10 K
Discontinuous output		2 relays with floating contact, max. 250V AC, max. 250 V DC, max. 1 A AC, max. 0.1 A DC, cos θ = 1
	Spark extinguisher	C= 2.2 nF and varistor U= 275 V
Binary output		Electrically isolated transistor output, max. 50 V DC and 30 mA, min. 3 V DC
General specifications		
Display		Four-digit liquid crystal display
Configuration		Fixed-programmed function blocks for fixed set point control and follow-up control
Power supply		230 V AC (200 to 250 V AC), 120 V AC (102 to 132 V AC), 24 V AC (21.5 to 26.5 V AC); 48 to 62 Hz
Power consumption		Approx. 6 VA
Temperature range		0 to 50 °C (operation); –20 to 70 °C (transport and storage)
Degree of protection		Front panel IP 65, housing IP 30, terminals IP 00
Device safety		Design and inspection acc. to EN 61010, edition 3.94
Class of protection		II
Overvoltage category		II
Degree of contamination		2
Noise emission		EN 50081 Part 1
Noise immunity		EN 50081 Part 2
Electrical connection		Screw terminals 1.5 mm^2
Sampling time		≤100 ms
Resolution		Input: 0.1 °C, 0.1%
Weight		Approx. 0.5 kg

Appendix A Function and parameter table

Main group	Function -CO-	Displayed setting	KEY 1)	Setting options	Description of function	Details see page	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit of meas.]	Factory default
Fast setting Kp, Tn, Tv											
PAR	(Press the programming key only once to go to Kp!)					p. 14		KP TN TV	Proportional-action coefficient Reset time Derivative-action time	0.1…100.0 [1] 1…9999 [s] 1…9999 [s]	1.0 120 10
Input functions											
IN	-CO- IN1	4 -20 mA	1)	4-20 mA 0-10 V 2-10 V 0-20 mA	**Input signal range IN1** 4-20 mA ~ 0-10 mA ~ 2-10 V ~ 0-20 mA	*p. 16*	-PA- IN1/mA -PA- IN1/mA -PA- IN1/V -PA- IN1/V	⊻ IN1 ⊼ IN1	Lower range value Upper range value	–999… ⊼ IN1 ⊻ IN1…9999 [absolute]3)	0.0 100.0
	-CO- IN2 6493-01	100 PT	1)	100 PT 1000 P T 100 NI 1000 NI 0-1 KOHM	**Input signal range IN2** Pt 100 (–100…500 °C) ~ Pt 1000 (–100…500 °C) ~ Ni 100 (–60…250 °C) ~ Ni 1000(–60…250 °C) ~ 0 to 1000 Ω	*p. 16*	-PA- IN2/PT -PA- IN2/PT -PA- IN2/NI -PA- IN2/NI -PA- IN2/KOHM	⊻ IN2 ⊼ IN2	Lower range value Upper range value	–999… ⊼ IN2 ⊻ IN2…9999 [absolute]3)	–100 500
	-CO- IN2 6493-02	4 -20 mA		4-20 mA 0-20 mA	**Input signal range IN2** 4-20 mA ~ 0-20 mA	p. 17	-PA- IN1/mA -PA- IN1/mA	⊻ IN2 ⊼ IN2	Lower range value Upper range value	–999… ⊼ IN2 ⊻ IN2…9999 [absolute]3)	0.0 100.0
	-CO- MEAS	oFF ME.MO	1)	oFF ME.MO IN1 ME.MO IN2 ME.MO ALL ME.MO	**Measuring range monitoring** analog inputs off ~ analog input 1 ~ analog input 2 ~ analog inputs 1 and 2	p. 17	noPA MEAS/ME.MO		No parameter		
	-CO- MAN	FAIL oFF	1)	oFF FAIL F01 FAIL F02 FAIL	**Transfer to manual mode upon transmitter failure** off ~ with 2nd output variable Y1K1 ~ with last received output value	*p. 17*	-PA- MAN/FAIL	Y1K1	2nd output variable	-10.0…110.0 [%]	-10.0
	-CO- CLAS	IN2 X	1)	IN2 X IN1 X	**Assignment of X** to analog input IN2 ~ to analog input IN1		noPA CLAS/X		No parameter		
		IN1 WE	1)	IN1 WE IN2 WE	**Assignment of WE** to analog input IN1 ~ to analog input IN2	*p. 18*	noPA CLAS/WE		No parameter		

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2) Range of values equals that of the assigned input.

3) Decimal place depends on the function DP (main group AUX)

4) The parameter values in brackets are only valid for controller version 6493-02.

Main group	Function -CO-	Displayed setting	KEY 1)	Setting options	Description of function	Details see page	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit of meas.]	Factory default
IN (conti- nued)	-CO- DI.FI	oFF X	1)	oFF X on X	**Filtering of input variable X** off ~ on		-PA- DI.FI/X	TS.X	Time constant of X filter	0.1… 100.0 [s]	1.0
		oFF WE	1)	oFF WE on WE	**Filtering of input variable WE** off ~ on	*p. 18*	-PA- DI.FI/WE	TS.WE	Time constant of WE filter	0.1… 100.0 [s]	1.0
	-CO- SQR	oFF X	1)	oFF X on X	**Root extraction of input variable X** off ~ on		no PA SQR/X				
		oFF WE	1)	oFF WE on WE	**Root extraction of input variable WE** off ~ on	*p. 18*	no PA SQR/WE				
	-CO- FUNC	oFF X	1)	oFF X on X	**Function generation of X** off ~ on	*p. 19*	-PA- FUNC/X	MIN	Output signal lower range value	-999… 9999	0.0
								MAX	Output signal upper range value	[absolute]3)	100.0
								K1.X	Input value point 1		–100.0
								K1.Y	Output value point 1	X values (e.g. K1.X):	0.0
								K2.X	Input value point 2	$\underline{\vee}$ IN1… $\overline{\wedge}$ IN1	–100.0
								K2.Y	Output value point 2	or 2)	0.0
								K3.X	Input value point 3	$\underline{\vee}$ IN2… $\overline{\wedge}$ IN2	–100.0
								K3.Y	Output value point 3		0.0
								K4.X	Input value point 4	Y values (e.g. K1.Y):	–100.0
								K4.Y	Output value point 4	MIN…MAX	0.0
								K5.X	Input value point 5		–100.0
								K5.Y	Output value point 5		0.0
								K6.X	Input value point 6		–100.0
								K6.Y	Output value point 6		0.0
								K7.X	Input value point 7		–100.0
								K7.Y	Output value point 7		0.0

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Appendix A

Main group	Function -CO-	Displayed setting	KEY 1)	Setting options	Description of function	*Details see page*	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit of meas.]	Factory default
IN		oFF WE	1)	oFF WE	**Function generation of WE** off		-PA- FUNC/WE	MIN	Output signal lower range value	-999… 9999	0.0
				on WE	~ on	*p. 19*		MAX	Output signal upper range value	[absolute]3)	100.0
(continu								K1.X	Input value point 1		0.0
ed)								K1.Y	Output value point 1	X values (e.g. K1.X):	0.0
								K2.X	Input value point 2	⊻ IN1… ⊼ IN1	0.0
								K2.Y	Output value point 2	or 2)	0.0
								K3.X	Input value point 3	⊻ IN2… ⊼ IN2	0.0
								K3.Y	Output value point 3		0.0
								K4.X	Input value point 4		0.0
								K4.Y	Output value point 4	Y values (e.g. K1.Y):	0.0
								K5.X	Input value point 5	MIN…MAX	0.0
								K5.Y	Output value point 5		0.0
								K6.X	Input value point 6		0.0
								K6.Y	Output value point 6		0.0
								K7.X	Input value point 7		0.0
								K7.Y	Output value point 7		0.0

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3) Decimal place depends on the function DP (main group AUX)

4) The parameter values in brackets are only valid for controller version 6493-02.

Main group	Function -CO-	Displayed setting	KEY	Setting options	Description of function	Details see page	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit of meas.]	Factory default
Reference variable											
SETP	-CO- SP.VA	on W	1)		**Internal reference variable W** (always active)		-PA- SP.VA/W	W	Internal reference variable 1	⊻ WRAN… ⊼ WRAN [1]	-100.0 (0.0)[4]
								⊻ WINT	Lower range value for W, W2, WE	–999… ⊼ WINT [1]	–100.0 (0.0)[4]
								⊼ WINT	Upper range value for W, W2, WE	⊻ WINT… 9999 [1]	500.0 (100.0)[4]
								⊻ WRAN	Limitation of lower range value	⊻ WINT… ⊼ WRAN [%]	–100.0 (0.0)[4]
								⊼ WRAN	Limitation of upper range value	⊻ WRAN… ⊼ WINT [absolute][3]	500.0 (100.0)[4]
		oFF W2	1)	oFF W2 onW2	**Internal reference variable W2** off ~ on		-PA- SP.VA/W2	W2	Internal reference variable W2	⊻ WRAN… ⊼ WRAN [absolute][3]	–100.0 0.0
		oFF WE	1)	oFF WE on WE F01 WE F02 WE	**External reference variable WE** off ~ on ~ input for ext. pos. feedback with 3-step output ~ input for feedforward control	*p. 22*	noPA SP.VA/WE		No parameter		
	-CO- SP.FU	oFF RAMP	1)	oFF RAMP F01 RAMP F02 RAMP F03 RAMP	**Set point ramp** off ~ starts with BI and meas. value ~ starts with BI and WIRA ~ without starting condition		-PA- SP.FU/RAMP	TSRW WIRA	Time parameter Starting value for reference variable	1.0… 9999 [s] ⊻ WINT… ⊼ WINT [absolute][3]	10 –100.0 (0.0)[4]
		oFF CH.SP	1)	oFF CH.SP F01 CH.SP F02 CH.SP	**Changeover W(W2)/WE via BI** off ~ W(W2)/WE via BI ~ W/W2 via BI	*p.23*	noPASP.VA/CH.SP		No parameter		

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3) Decimal place depends on the function DP (main group AUX)

4) The parameter values in brackets are only valid for controller version 6493-02.

Main group	Function -CO-	Displayed setting	KEY	Setting options	Description of function	Details see page	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit of meas.]	Factory default
Control structure and functions											
CNTR	-CO- C.PID	PI CP.YP	1)	PI CP.YP Pd CP.YP PId CP.YP PPI CP.YP P CP.YP	**Dynamic behavior of controller output** PI ~ PD ~ PID ~ P^2I ~ P	p.24	-PA- C.PID/CP.YP	KP TN TV TVK1 Y.PRE DZXD ⊻ DZXD ⊼ DZXD	Proportional-action coefficient Reset time Derivative-action time Derivative-action gain Y rate action Dead band of error XD Limitation of XD min. Limitation of XD max.	0.1… 100.0 [1] 1…9999 [s] 1…9999 [s] 0.1…10.0 [1] -10.0… 110.0 [%] 0.0… 110.0 [%] -110… ⊼ DZXD [%] ⊻ DZXD…110 [%]	1.0 120 10 1.0 0.0 0.0 -110.0 110.0
	-CO- SIGN	dir.d XD	1)	dir.d XD in.d XD	**Inversion of error Xd** no yes	p.26	noPA SIGN/XD		No parameter		
	-CO- D.PID	F01 DP.YP	1)	 F01 DP.YP F02 DP.YP	**Assignment of controller output D element** ~ to error ~ to controlled variable	p.26	noPA D.PID/DP.YP		No parameter		
	-CO- CH.CA	oFF CC.P/	1)	oFF CC.P/ F01 CC.P/ F02 CC.P/	**Control mode changeover P(D)/PI(D)** off ~ via error ~ via reference variable	p.27	-PA- CH.CA/CC.P/	CLI.P CLI.M	Maximum limit Minimum limit for PI(D) control	0.0… 110.0 [%] -110… 0.0 [%]	110.0 -110
	-CO- M.ADJ	oFF MA.YP	1)	 oFF MA.YP on MA.YP	**Operating point adjustment in manual mode for Y_{PID}** ~ off ~ on	p.28	noPA M.ADJ/MA.YP		No parameter		
	-CO- DIRE	dir.d DI.AC	1)	dir.d DI.AC in.d DI.AC	**Operating direction of output variable** direct ~ inverted	p. 28	noPA DIRE/DI.AC		No parameter		
	-CO- F.FOR	oFF FECO	1)	oFF FECO P05 FECO nE6 FECO	**Feedforward control** off ~ with positive sign ~ with negative sign	p.28	-PA- F.FOR/FECO	 FC.K1 FC.K2 FC.K3	$\pm (\lvert W_{EX} - FC.K1 \rvert)\ FC.K2 + FC.K3$ Constant Constant Constant	 0.0… 110.0 [%] 0.0… 10.0 [1] -10.0 …110.0 [%]	 0.0 1.0 0.0
	-CO- AC.VA	oFF IN.DE	1)	oFF IN.DE bi1 IN.DE	**Increase, decrease of actual value** off ~ via binary input BI	p.29	-PA- AC.VA/IN.DE	AV.K1	Constant	-110 …110.0 [%]	0.0

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4) The parameter values in brackets are only valid for controller version 6493-02.

Main group	Function -CO-	Displayed setting	KEY	Setting options	Description of function	Details see page	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit of meas.]	Factory default
Output functions											
OUT	-CO- SAFE	oFF SA.VA	1)	oFF SA.VA bi1 SA.VA	**Initialization of 2nd output variable Y1K1 for Y_{PID}** off ~ via binary input BI	p.30	-PA- SAFE/SA.VA	Y1K1	2nd output variable	-10.0...110 [%]	-10.0
	-CO- MA.AU	oFF CH.MA	1)	oFF CH.MA bi1 CH.MA	**Manual/automatic transfer** off ~ via binary input BI	p.30	noPA MA.AU/CH.MA		No parameter		
	-CO- Y.LIM	on LI.YP	1)	on LI.YP	**Output signal limitation Y_{PID}** on	p.32	-PA- Y.LIM/ LI.YP	⊻ Y ⊼ Y	Min. output variable Max. output variable	-10.0...110 [%]	-10.0 110.0
	-CO- RAMP	oFF RA.YP	1)	oFF RA.YP F01 RA.YP F02 RA.YP F03 RA.YP F04 RA.YP F05 RA.YP	**Output ramp or limitation of rate of output changes Y_{PID}** off Increasing ramp, starts with -10% via BI Decreasing ramp, starts with Y1RA via BI Limitation for decreasing and increasing output variable Limitation for increasing output variable Limitation for decreasing output variable	p.32	-PA- RAMP/RA.YP	TSRA Y1RA	Transit time of ramp Starting value for ramp	1.0... 9999 [s] -10.0... 110.0 [%]	1.0 -10.0
	-CO- BLOC	oFF BL.YP	1)	oFF BL.YP bi1 BL.YP	**Locking of output signal Y_{PID}** off ~ via binary input BI		noPA BLOC/BL.YP		No parameter		
	-CO- FUNC	oFF FU.YP	1)	oFF FU.YP on FU.YP	**Function generation of controller output** off ~ on	p.34	-PA- FUNC/FU.YP	K1.X K1.Y K2.X K2.Y K3.X K3.Y K4.X K4.Y K5.X K5.Y K6.X K6.Y K7.X K7.Y	Input value point 1 Output value point 1 Input value point 2 Output value point 2 Input value point 3 Output value point 3 Input value point 4 Output value point 4 Input value point 5 Output value point 5 Input value point 6 Outpout value point 6 Input value point 7 Output value point 7	X values (K1.X...): -10.0... 110.0 [%] Y values (K1.Y...): -10.0... 110.0 [%]	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
	-CO- Y.VA	4-20 mA	1)	0-20 mA 4-20 mA oFF Y	**Output signal range** 0 to 20 mA ~ 4 to 20 mA No continuous output	p.34	no PA Y.VA/Y no PA Y.VA/mA no PA Y.VA/mA		No parameter		

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Main group	Function -CO-	Displayed setting	KEY	Setting options	Description of function	Details see page	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit of meas.]	Factory default
OUT	-CO-	on Y.PID	1)		**Assignment of continuous output**		no PA Y.SRC/Y.PID		No parameter		
	Y.SRC			on Y.PID	~ to PID output		no PA Y.SRC/Y.X				
(continued)				on Y.X	~ to X input		no PA Y.SRC/ Y.WE				
				on Y.WE	~ to WE input (feedforward control)		no PA Y.SRC/ Y.XD				
				on Y.XD	~ to error Xd	*p.35*					
	-CO-	on CA.Y	1)		**Mathematical adaptation of controller output Y**		-PA- CALC/CA.Y		$Y_2 = \pm (\lvert Y_1 - CA.K1 \rvert)\ CA.K2 + CA.K3$		
	CALC			on CA.Y	~ without condition			CA.K1	Constant	0.0… 100.0 [%]	0.0
				oFF CA.Y	~ off (no output signal!)			CA.K2	Constant	0.0… 10.0 [1]	1.0
				POS CA.Y	~ with positive sign			CA.K3	Constant	–10.0…110.0 [%]	0.0
				nE6 CA.Y	~ with negative sign	*p.35*					
	-CO-	oFF 2/3.S	1)	oFF 2/3.S	**Configuration of two-step or three-step output** off		-PA- C.OUT/2/3.S	KPL1	Gain for BO1	0.1… 100.0 [1]	1.0
	C.OUT			on 2.STP	Two-step output		-PA- C.OUT/2.STP	KPL2	Gain for BO2	0.1… 100.0 [1]	1.0
				i.Fb 3.STP	Three-step output with internal position feedback		-PA- C.OUT/3.STP	TYL1	Duty cycle of BO1	0.1… 9999 [s]	10.0
				E.Fb 3.STP	Three-step output with external position feedback		-PA- C.OUT/3.STP	TYL2	Duty cycle of BO2	0.1… 9999 [s]	10.0
				PP 2.STP	Two-step output with pulse-pause modulation (PPM)		-PA- C.OUT/2.STP	⊻ TYL1	Min. on-time of BO1	0.1… TYL1 [%]	1.0
				i.PP 3.STP	Three-step output with internal position feedback + PPM		-PA- C.OUT/3.STP	⊻ TYL2	Min. on-time of BO2	0.1… TYL2 [%]	1.0
				E.PP 3.STP	Three-step output with external position feedback + PPM		-PA- C.OUT/3.STP	XSDY	Diff. gap of 2-stp/3-stp output	0.10… TZ [%]	0.50
						p.36		TZ	Dead band of 3-step output	XSDY… 100.0 [%]	2.00
								TY	Transit time	1… 9999 [s]	60
	-CO-	oFF B.BO1	1)	oFF B.BO1	**Configuration of binary output BO1** off		noPA OUT1/B.BO1		No parameter		
	B.OUT			F01 B.BO1	Active when binary input active						
				F02 B.BO1	Active when WE activated						
				F03 B.BO1	Active in automatic mode						
		oFF B.BO2	1)	oFF B.BO2	**Configuration of binary output BO2** off		noPA OUT1/B.BO2		No parameter		
				F01 B.BO2	Active when binary input active						
				F02 B.BO2	Active when WE activated						
				F03 B.BO2	Active in automatic mode	p.45					

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 Appendix A

Main group	Function -CO-	Displayed setting	KEY	Setting options	Description of function	Details see page	Parameters -PA-	Parameter selection	Parameter designation		Range of values [unit of meas.]	Factory default
Alarm functions												
ALRM	-CO- LIM1	oFF L1	1)	oFF L1	**Limit relay L1** off							
				Lo L1.X	L1 is activated when X is not reached		-PA- LIM1/L1.X	LI.X	Limit value for X		⊻ IN1… ⊼ IN1	500.0
				Hi L1.X	L1 is activated when X is exceeded					or	⊻ IN2… ⊼ IN2 2),3)	(100.0)4)
				Lo L1.WE	L1 is activated when WE is not reached		-PA- LIM1/L1.WE	LI.WE	Limit value for WE		⊻ IN1… ⊼ IN1	100.0
				Hi L1.WE	L1 is activated when WE is exceeded					or	⊻ IN2… ⊼ IN2 2),3)	
				Lo L1.YP	L1 is activated when Y_{PID} is not reached		-PA- LIM1/L1.YP	LI.YP	Limit value for YPID		⊻ Y … ⊼ Y [%]	110.0
				Hi L1.YP	L1 is activated when Y_{PID} is exceeded							
				Lo L1.XD	L1 is activated when + XD is not reached		-PA- LIM1/L1.XD	LI.XD	Limit value for XD		-110… 110.0 [%]	0.0
				Hi L1.XD	L1 is activated when – XD is exceeded							
				Ab S L1.XD	L1 is activated when the sum of XD is exceeded	*p.47*		L.HYS	Differential gap		0.10…100.0 [%]	0.50
	-CO- LIM2	oFF L2	1)	oFF L2	**Limit relay L2** off							
				Lo L2.X	L2 is activated when X is not reached		-PA- LIM2/L2.X	LI.X	Limit value for X		⊻ IN1… ⊼ IN1	500.0
				Hi L2.X	L2 is activated when X is exceeded					or	⊻ IN2… ⊼ IN2 2),3)	(100.0)4)
				Lo L2.WE	L2 is activated when WE is not reached		-PA- LIM2/L2.WE	LI.WE	Limit value for WE		⊻ IN1… ⊼ IN1	100.0
				Hi L2.WE	L2 is activated when WE is exceeded					or	⊻ IN2… ⊼ IN2 2),3)	
				Lo L2.YP	L2 is activated when Y_{PID} is not reached		-PA- LIM2/L2.YP	LI.YP	Limit value for Y_{PID}		⊻ Y … ⊼ Y [%]	110.0
				Hi L2.YP	L2 is activated when Y_{PID} is exceeded							
				Lo L2.XD	L2 is activated when + XD is not reached		-PA- LIM2/L2.XD	LI.XD	Limit value for XD		-110… 110.0 [%]	0.0
				Hi L2.XD	L2 is activated when – XD is exceeded							
				Ab S L2.XD	L2 is activated when the sum of XD is exceeded	*p.47*		L.HYS	Differential gap		0.1…100.0 [%]	0.50

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Main group	Function -CO-	Displayed setting	KEY	Setting options	Description of function	Details see page	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit of meas.]	Factory default
Additional functions											
AUX	-CO- RE.CO	F01 MODE	1)		**Restart conditions upon power failure**		-PA- RE.CO/MODE	Y1K1	2nd output variable	-10.0…110 [%]	-10.0
				F01 MODE	Manual mode with 2nd output variable Y1K1						
				F02 MODE	Automatic mode with last received value of reference variable and Y1K1, no acknowledgement						
				F03 MODE	Automatic mode with last received value of reference variable and Y1K1, acknowledgement needed	*p.48*					
	-CO- ST.IN	FrEE INIT	1)	FrEE INIT	**Resetting to factory default** off/completed		noPA ST.IN/INIT		No parameter		
				All INIT	~ of all the functions, parameters and the key number						
				FUnC INIT	~ of all the functions						
				PArA INIT	~ of all the parameters						
				AdJ INIT	Basic initialization of calibrating values for IN1, IN2, Y	*p.48*					
	-CO- KEYL	oFF LOCK	1)	oFF LOCK	**Operator keys** enabled		noPA KEYL/LOCK		No parameter		
				bi1 LOCK	~ enabling /disabling via BI						
				on noH.W	Selector, manual/automatic transfer and cursor keys disabled	*p.49*					
	-CO- VIEW	04 VIEW	1)	04 VIEW	**Display contrast** grade 4		noPA		No parameter		
				05 VIEW	Grade 5						
				06 VIEW	Grade 6						
				07 VIEW	Grade 7						
				08 VIEW	Grade 8						
				09 VIEW	Grade 9						
				10 VIEW	Grade 10						
				01 VIEW	Grade 1						
				02 VIEW	Grade 2						
				03 VIEW	Grade 3	*p.49*					
	-CO- FREQ	on 50HZ	1)	on 50Hz	**Power frequency** 50 Hz		noPA FREQ/50Hz		No parameter		
				on 60Hz	60 Hz	*p. 49*					
	-CO- DP	on DP1	1)	on DP1	One decimal place		noPA DP1		No parameter		
				on DP2	Two decimal places						
				on DP0	No decimal place	p. 50					

1) Functions and parameters can be read without key number. Only when changing functions or parameters for the first time, you are prompted to enter the key code.

2) Range of values equals that of the assigned input.

3) Decimal place depends on the function DP (main group AUX)

4) The parameter values in brackets are only valid for controller version 6493-02.

Main group	Function -CO-	Displayed setting	KEY	Setting options	Description of function	Details see page	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit of meas.]	Factory default
Start-up adaptation											
TUNE	-CO- ADAP	oFF ADP.S	1)	oFF ADP.S run ADP.S	Adaptation on Initiate adaptation	p.50	-PA- ADAP/ADP.S	KP TN TV Y.JMP	Proportional-action coefficient Reset time Derivative-action time Value of step response	0.1…100.0 [1] 1.0…9999 [s] 1.0…9999 [s] -100…100.0 [%]	1.0 120.0 1.0 20.0
View process data											
I-O	CIN	FIR	1)		View software version	p.53					
	S-No		1)		View serial number	p. 53					
	ANA	IN1 IN2 CO.VA WE.VA FE.CO SP.CO YPID YOUT	3) 3) 3) 3) 3) 3)		View values of analog input 1 View values of analog input 2 View value of controlled variable after root extraction View value of reference variable after root extraction View value of WE before applying feedforward control View value of reference variable at the comparator View value of Y_{PID} after limitation View value of controller output after mathematical adaptation Y_{OUT}	p.53				-999…9999 [1] –10.0…110.0 [%]	
	BIN	BI1 BO1 BO2	1)		Status of binary input BI1 Status of binary output BO1 Status of binary output BO2	p.53					
	ADJ	AdJ IN1 AdJ IN2 AdJ YOUT	1)		Adjusting analog input IN1 Adjusting analog input IN2 Adjusting analog output Y	p.54				–10.0…110.0 [%]	

1) Functions and parameters can be read without key number. Only when changing functions or parameters for the first time, you are prompted to enter the key code.

2) Range of values equals that of the assigned input.

3) Decimal place depends on the function DP (main group AUX)

4) The parameter values in brackets are only valid for controller version 6493-02.

Appendix B Error messages

Display is blinking	What does it mean?	What you need to do
1 ERR	No access to EEPROM	Ship the device to the manufacturer!
2 ERR	EEPROM cannot be programmed	Ship the device to the manufacturer!
3 ERR	Factory default is lost	Ship the device to the manufacturer!
4 ERR	Functions are changed without user intervention	Check the setting of the functions!
5 ERR	Parameters are changed without user intervention	Check the setting of the parameters!
6 ERR	Unknown whether internal or external reference variable is to be used	Specify either internal or external reference variable!
7 ERR	Data of adjustment procedure are changed without user intervention	Re-adjust the analog inputs and /or the analog output!
31 ERR to 35 ERR	Error during adaptation procedure	More details are given on p. 52.

The binary output for messages (fault indication output) is set when any error message occurs, likewise when the CPU fails.

Appendix C Checklist

TROVIS 6493 Compact Controller

Controller no.: Firmware version:

Date of configuration: Signature:

Main group	Function -CO-	Setting	Parameters
IN	IN1		⊻ IN1 ⊼ IN1
	IN2		⊻ IN2 ⊼ IN2
	MEAS		
	MAN		Y1K1
	CLAS	X	
		WE	
	DI.FI	X	TS.X
		WE	TS.WE
	SQR	X	
		WE	
	FUNC	X	MIN MAX

	1	2	3	4	5	6	7
K .X							
K .Y							

Main group	Function -CO-	Setting	Parameters
		WE	MIN MAX

	1	2	3	4	5	6	7
K .X							
K .Y							

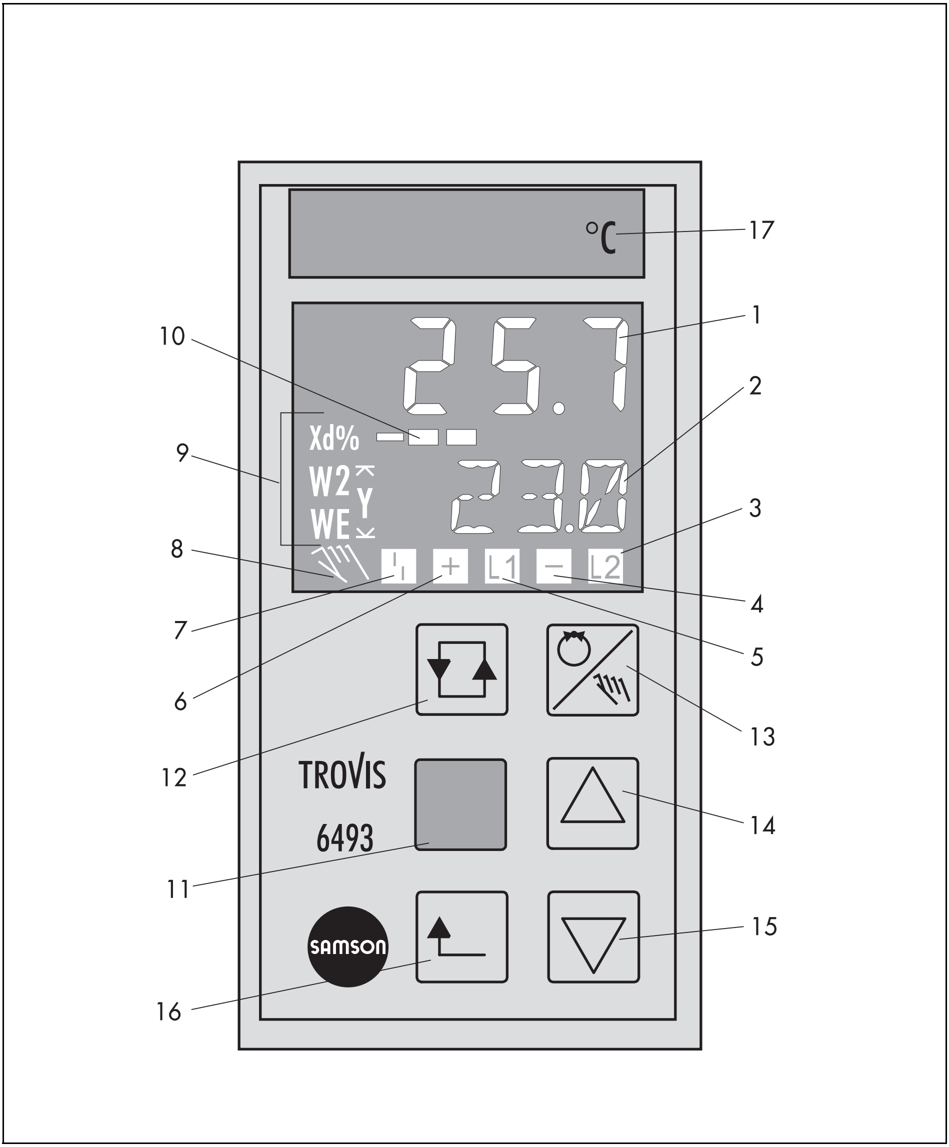
Main group	Function -CO-	Setting	Parameters
SETP	SP.VA	W	W ⊻ WINT ⊼ WINT ⊻ WRAN ⊼ WRAN
		W2	W2
		WE	
	SP.FU	RAMP	TSRW WIRA
		CH.SP	
CNTR	C.PID		KP TN TV TVK1 Y.PRE DZXD ⊻ DZXD ⊼ DZXD
	SIGN		
	D.PID		
	CH.CA		CLI.P CLI.M
	M.ADJ		
	DIRE		
	F.FOR		FC.K1 FC.K2 FC.K3

<table>
<tr><th>Main group</th><th>Function -CO-</th><th>Setting</th><th>Parameters</th></tr>
<tr><td></td><td>AC.VA</td><td></td><td>AV.K1</td></tr>
<tr><td>OUT</td><td>SAFE</td><td></td><td>Y1K1</td></tr>
<tr><td></td><td>MA.AU</td><td></td><td></td></tr>
<tr><td></td><td>Y.LIM</td><td></td><td>$\underline{\vee}$ Y
$\overline{\wedge}$ Y</td></tr>
<tr><td></td><td>RAMP</td><td></td><td>TSRA
Y1RA</td></tr>
<tr><td></td><td>BLOC</td><td></td><td></td></tr>
<tr><td></td><td>FUNC</td><td></td><td>MIN
MAX
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr>
<tr><td>K .X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>K .Y</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td></td><td>Y.VA</td><td></td><td></td></tr>
<tr><td></td><td>Y.SRC</td><td></td><td></td></tr>
<tr><td></td><td>CALC</td><td></td><td>CA.K1
CA.K2
CA.K3</td></tr>
<tr><td></td><td>C.OUT</td><td></td><td>KPL1
KPL2
TYL1
TYL2
MinTYL1
MinTYL2
XSDY
TZ
TY</td></tr>
<tr><td></td><td>B.OUT</td><td></td><td></td></tr>
</table>

Main group	Function -CO-	Setting	Parameters
ALRM	LIM1		LI.X LI.WE LI.YP LI.XD L.HYS
	LIM2		LI.X LI.WE LI.YP LI.XD L.HYS
AUX	RE.CO		Y1K1
	KEYL		
	VIEW		
	FREQ		

Index

Service key number 1732



1 *Controlled variable X*
2 *Value assumed by W, W2, WE, Y or Xd*
3 *Limit relay L2 active*
4 *Three-step output –*
5 *Limit relay L1 active*
6 *Three-step output +*
7 *Alarm message*
8 *Hand symbol*
9 *When pressing the selector key, W, W2, WE, Y or Xd appear with their associated values in 2*
10 *Bar graph display of Xd in %*
11 *Programming key*
12 *Selector key*
13 *Manual/automatic transfer key*
14 *Cursor key (increase, forward)*
15 *Cursor key (decrease, back)*
16 *Reset key*
17 *Exchangeable label*

SAMSON AG · MESS- UND REGELTECHNIK
Weismüllerstraße 3 · D-60314 Frankfurt am Main
Phone (0 69) 4 00 90 · Fax (0 69) 4 00 95 07
Internet: http://www.samson.de

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