Automation System TROVIS 6400

Process Control Stations TROVIS 6412 and 6442

CE

Edition July 2007

Firmware C 1.3
Firmware Si 1.4

Mounting and Operating Instructions

EB 6412 EN

Contents

1. Notes on these mounting and operating instructions

1.1. Documentation

Two manuals constitute the documentation for the TROVIS 6412 and 6442 Process Control Stations: *Mounting and Operating Instructions EB 6412 EN* and *Configuration Manual KH 6412 EN*.

EB 6412 EN contains information about the installation, electrical connection and operation of the control stations. Also introduced is how to work with the COPA pen, the COPA adapter and the associated TROVIS 6482 Configuration and Parameterization Program. In addition, the function of the RS-485 interface is described.

Configuration Manual KH 6412 EN presents a detailed description of the optional control modes of the process control station, which can be defined by selecting the corresponding configuration blocks and parameters.

1.2. Abbreviations used in this manual

The parameter names and input and output abbreviations used in this manual are those appearing on the front-panel display of the TROVIS 6412 Process Control Station. These are not always the same as the ones defined in the relevant DIN standards or often used in other documents.

Caution!
Assembly, commissioning and operation of this process control station may only be performed by experienced personnel.

2. Description

2.1. Features

The TROVIS 6412 and 6442 Process Control Stations are microprocessor-controlled devices used to automate industrial and process engineering plants. They are suitable not only for constructing simple control loops, but for solving complex control problems as well. The TROVIS 6412 and TROVIS 6442 Process Control Stations only differ from each other in their design (see section 2.2.).

Function blocks which are permanently stored in memory allow the user to easily define pre-configured control systems and select various functions. The control mode selected determines which configuration blocks can be set, and these configuration blocks in turn determine the adjustable parameters.

The process control stations are available with various input boards with either three or four analog inputs. Furthermore, each control station has three binary inputs.

The analog inputs of the input boards are suitable for either standardized current and voltage signals, potentiometers, Pt 100 temperature sensors, thermocouples or transmitter supply. The input board 4 in the Technical data (page 8 and following) is no longer available. As a result, the use of thermocouples is restricted.

Standard outputs include: One continuous control output, one on-off/three-step output and one binary output for error messages.

The functional range of the process control stations can be optionally enhanced with the following: One additional continuous control output, one analog output, two limit switches and two binary outputs.

The process control stations can be operated, configured, and parameterized directly on the control panel via several keys. The functions associated with the respective keys can be disabled.

An optional program - TROVIS 6482 - allows configuration and parameterization of the process control station via a PC (see page 56). Apart from this, all configuration blocks and parameters can also be transferred to the process control stations, using a configuration and parameterization pen (COPA pen) (see page 58).

The process control stations can be equipped with a RS-485 serial interface for use in a higher level process control system.

2.2. Versions

TROVIS	64□2
Panel-mounting unit	**1**
Rack-mounting unit	**4**

2.3. The process control station (overview)

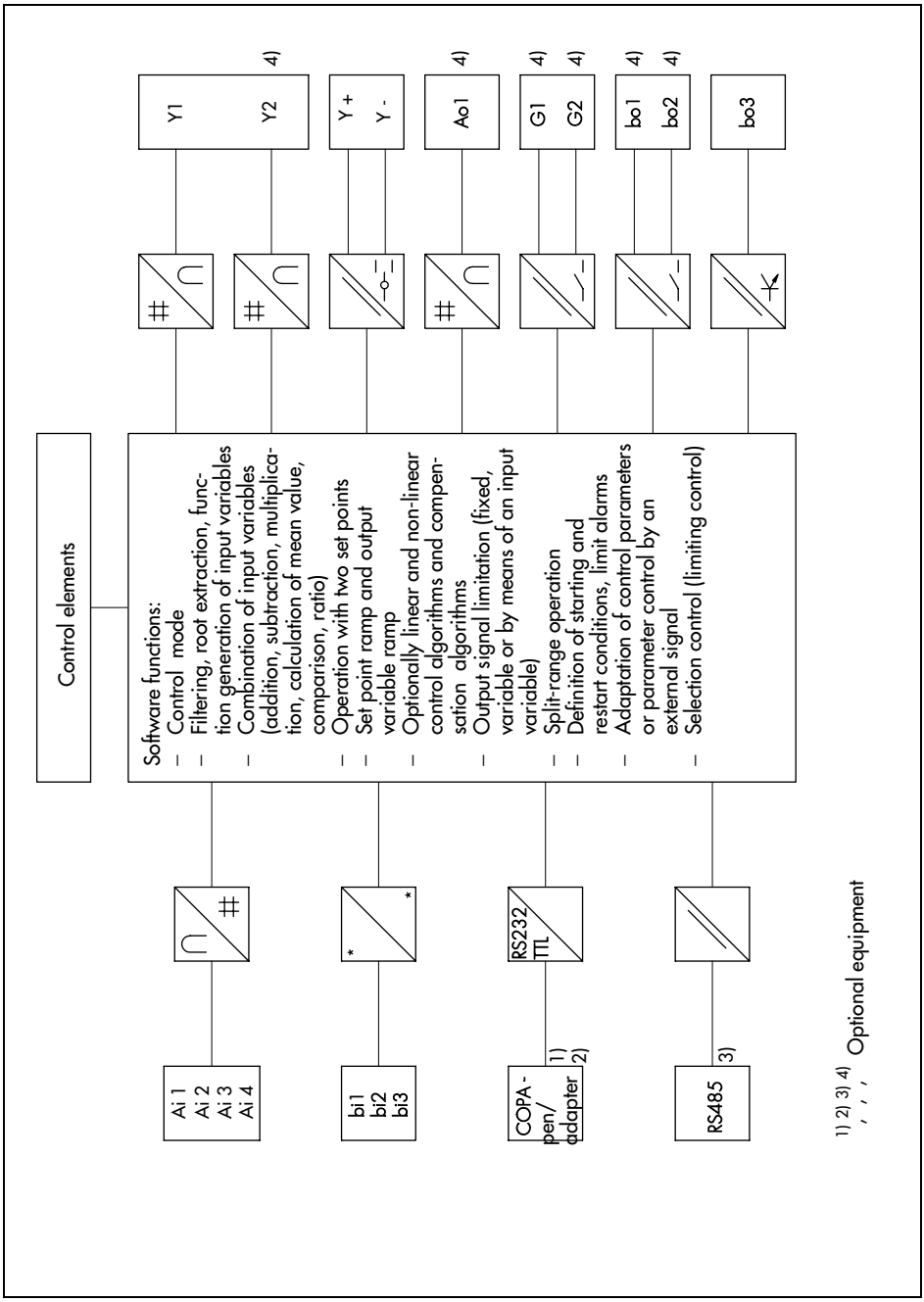


Fig. 1 · Block diagram of the process control station

2.4. Technical data

Inputs	Input board	1	2	3	4 [1]
Input 1		mA, V, potentiometer, transmitter supply	Pt 100 in 2/3 or 4-wire circuit		Thermocouple (int./ext. reference junction)
Input 2		mA, V input, transmitter supply		Pt 100 in 2/3 or 4-wire circuit	mA, V, transmitter supply
Input 3		mA or V input	mA, V, transm. supply	Omitted	Omitted
Input 4		mA, V or potentiometer		mA, V, potentiometer, transmitter supply	mA, V or potentiometer
mA or V input	Measuring ranges	4(0) to 20 mA or 2(0) to 10 V; 0.2(0) to 1 V; 1(0) to 5 V			
	Meas. range switch-over	Soldering jumpers			
	Max. permissible values	Current ± 50 mA, voltage ± 25 V			
	Internal resistance	Current R_i = 50 Ω; voltage R_i = 200 kΩ			
	Permissible DC voltage	0 to 10 V			
	Error	Zero point < 0.2 %, span < 0.2 %, linearity < 0.2 %			
	Temperature influence	Zero point < 0.1 %/10 K; span < 0.1 %/10 K			
Pt 100 temperature sensors	Measuring ranges [2]	–50 to 100 °C; 0 to 200 °C; 100 to 600 °C			
	Meas. range switch-over	Soldering jumpers and configuration			
	Line resistances	Two-wire $R_{L1} + R_{L2} < 10$ Ω, Three-wire $R_{L1} = R_{L2} = R_{L3} < 50$ Ω, Four-wire, each $R_L < 100$ Ω			
	Error	Zero point, gain, linearity < 0.2 %			
	Temperature influence	Zero point < 0.2 %/10 K; span < 0.2 %/10 K			
Potentiometer	Measuring range	0 to 1kΩ, ± 100 Ω, three-wire			
	Line resistance	R_L < 10 Ω each			
	Error	Zero point < 0.2 %, gain < 0.2 %			
	Temperature influence	Zero point < 0.1 %/10 K; gain < 0.2 %/10 K			
Thermocouple [1]		Specifications on request			
Transmitter supply		16 to 23 V, max. 50 mA, short-term short-circuit protected			
Binary inputs		3 binary inputs, switching contacts (load 36 V DC, approx. 3 mA) or external switching voltage (24 V DC, ± 30 %, maximum 6 mA), selection via soldering jumpers			

Outputs		
Continuous control output	Signal range	4(0) to 20(22) mA, permissible load < 750 Ω or 2(0) to 10 V, permissible load > 3 kΩ
	Output control range	–10 to 110 %
	Error	Zero point < 0.3 %, nominal end value < 0.3 %, linearity < 0.3 %
	Temperature influence	Zero point < 0.1 %/10 K; nominal end value < 0.1 %/10 K
Switching output		1 on-off or three-step output, 250 V AC (1A AC, cos φ = 1)
Binary output (BO 3)		Electrically isolated transistor output, U_{min} = 3 V DC, U_{max} = 42 V DC, I_{max} = 30 mA DC
Options	Control output	1 continuous control output for split-range operation; signal range, output control range, error and temperature influence same as first continuous control output (see above)
	Analog output	4(0) to 20 mA, permissible load < 750 Ω or 2(0) to 10 V or –10 to 10 V, permissible load > 3kΩ Error and temperature influence same as first continuous control output (see above)
	Limit relay	2 relays, floating contacts, maximum 250 V AC (1 A AC, cos φ = 1) or maximum 250 V DC (0.1 A DC)
	Binary outputs	2; floating contacts; maximum 42 V AC (0.1 A AC); 42 V DC (0.05 A DC)
Interfaces		
Serial interface on the front-panel		RS-232 in conjunction w. SAMSON cable no. 1170-1141
	Communications protocol	TROVIS 6482 SAMSON Protocol
	Number of stations	1
	Length of cable	< 2 m
	Transmittable data	Configuration, parameters, input and output signals for graphic display
COPA pen		Read/write pen for transmitting the CONFIGURATION and PARAMETER data to/from the process controls station via the front-panel serial interface
Serial interface RS-485 (optional)	Communications protocol	Modbus RTU 584
	Data transmission	Asynchronous, half duplex, 4-wire or 2-wire
	Character format	RTU (8 bit), 1 start bit, 8 data bits, 1(2) stop bit(s), optional parity bit
	Baud rate	300 to 19200 bit/s
	Number of addressable stations	246
	Number of stations	32 (can be extended with repeater)
	Length of cable and transmitting medium	< 1200 m, with repeater maximum 4800 m, 4-wire (2 wires twisted, stranded in pairs, with static screen)
	Transmittable data	Configuration, parameters, operating state, process variables, error messages

General specifications		
Displays	Read-off angle	Readable from all sides, high-contrast and lighted Liquid Crystal Display (LCD)
	Displays	$3\frac{1}{2}$-digit set point (reference variable) display and $3\frac{1}{2}$-digit controlled variable display; bar graph displays for deviation (i.e. error) and output variable; LED displays for range exceeding, alarm messages when limits are exceeded, manual operation, faults etc.; parameter display (only in the PARAMETER level)
Configuration		Permanently stored function blocks for fixed set point control, follow-up control with or without internal/external set point change-over, cascade control, synchro control, ratio control, SPC control, limiting control, DDC backup fixed set point control via binary contact
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), Option 24 V DC (19 to 34 V DC); 48 to 62 Hz
Power consumption		Approx. 18 VA
Temperature range		0 to 50 °C (operation), –20 to 70 °C (shipping and storage)
Degree of protection		Panel-mounting unit: Front IP 54, case IP 30, terminals IP 00; Rack-mounting unit: IP 00
Overvoltage category		II
Degree of contamination		2
Conformance to European standards		EN 61010, edition March 1994
Electrical connection	Functional earthing	Panel-mounting unit: On case w. Cu-flex. lead > 2.5 mm^2 Rack-mounting unit: Connector, Type F (DIN 41 612), Cu-flex. lead > 2.5 mm^2
	Power voltage and process signals	Panel-mounting unit: Screw terminals 1.5 mm^2; Rack-mounting unit: Two connectors, Type F (DIN 41 612), soldering or crimp types
Total delay time [3]		Approx. 100 ms
Resolution		Input and output, approximately 11 bits
Dimensions		See Fig. 3 and Fig. 4
Weight		Panel-mounting unit, approx. 1.9 kg; rack-mounting unit, 1 kg

[1] The input board 4 (thermocouple at input 1) is no longer available
[2] Specific measuring ranges on request
[3] Depending on how many functions are configured

3. Installing the process control stations

3.1. TROVIS 6412 (panel-mounting unit)

The TROVIS 6412 Process Control Station is designed for panel-mounting and has the front-frame dimensions 72 x 144 mm. Perform the following steps in order to mount the controller:

1. Make a panel cut-out with the dimensions $68^{+0.7}$ x $138^{+1.0}$ mm.
2. Push the process control station in the panel cut-out from the front side.
3. Install one supplied mounting bracket, both on the top and bottom of the control station following steps 1) and 2) shown in Fig. 2 .
4. Turn the threaded rods in the direction of the control panel, using a screwdriver so that the case is clamped against the panel ((step 3), Fig. 2).

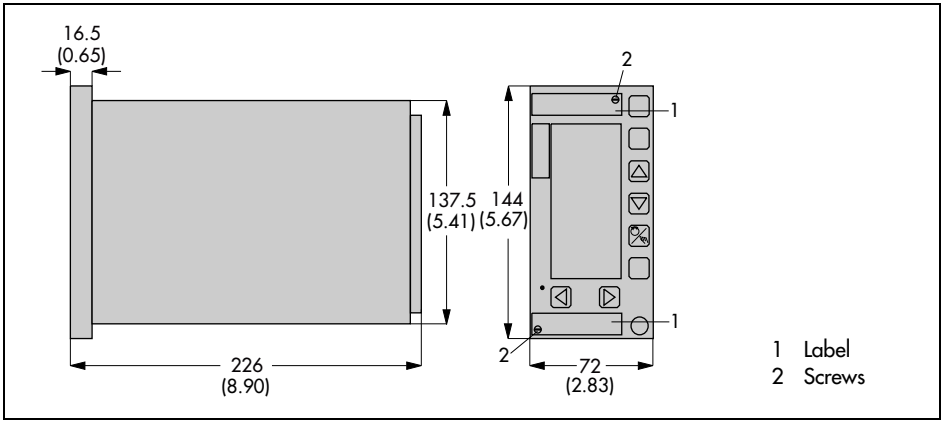


Fig. 3 · Dimensions (panel-mounting unit)

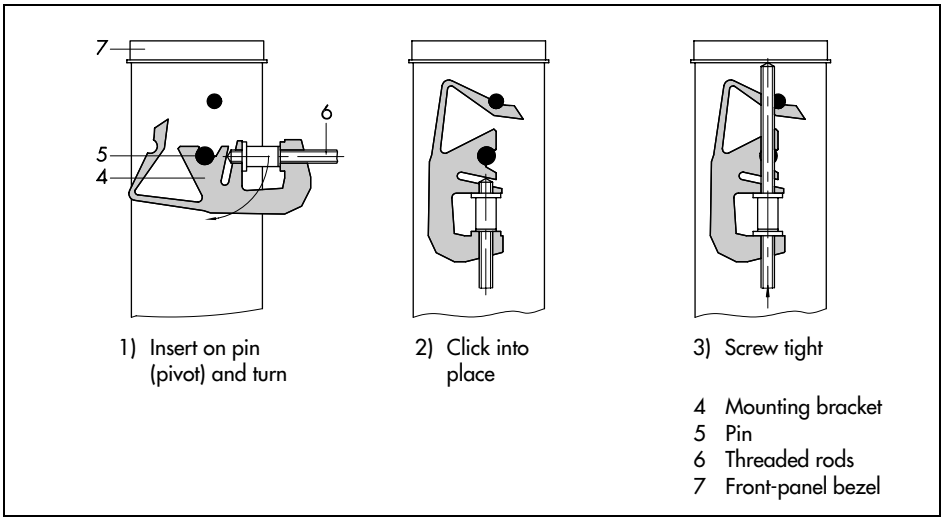


Fig. 2 · Installation (panel-mounting unit)

3.2. TROVIS 6442 (rack-mounting unit for 19inch racks)

The TROVIS 6442 Process Control Station is a rack-mounting unit designed for mounting in 19inch racks. It has to be installed as follows:

1. Push the control station along the guiding rails into the corresponding rack unit, making sure it does not become tilted. Push until the connectors connect.
2. Secure the process control station to the rack unit by fastening it from the front, using two screws (see 1, Fig. 4).
3 Press one protective nipple (enclosed in the delivery) into each bore made for the screws.

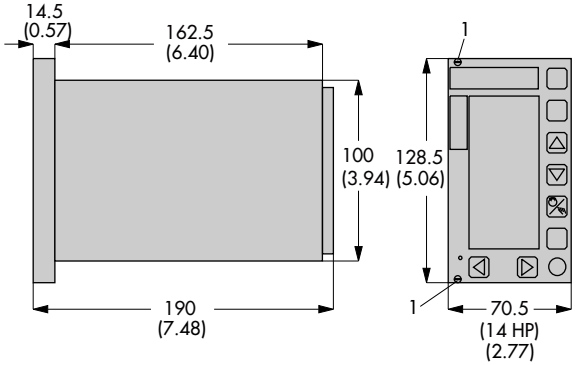


Fig. 4 · Dimensions of the 19inch rack-mounting unit

3.3. Opening the controller case

⚠ ATTENTION!

The case may only be opened by experienced personnel when the power to the process control station has been cut off!

Re-jumpering (see section 4.) or retrofitting the process control station with an interface board requires that the case be opened as follows:

1. With panel-mounting cases, remove small paper labels (see 1, Fig. 3) if necessary. With 19inch rack-mounting units, remove the two protective nipples. Unscrew the two screws located on the front-panel of the case (see Fig. 3 or Fig. 4 , depending on the type of case).
2. Withdraw controller section towards the front. Then, proceed as described for the respective PCB to be modified.

Modify **input** (5, Fig. 5) or/ and **interface board** (6, Fig. 5):

3. Unscrew the four screws (1, 2) and remove the two distance bolts (4).
4. Carefully withdraw the input and/or interface board from the case.
5. Modify the board as desired (see sections 4.1., 4.4.).
6. Carefully reinstall the interface or/and input board by plugging it/them into the associated connectors. Make sure the connections are made correctly! Terminals 1 and 21 of each connector are marked.
7. Reinstall the two distance bolts (3) and the four screws (1, 2).

Proceed as described under 8. to 10.

Modify the **logic board** (7, Fig. 5) as follows:

3. Unscrew the two screws (1).
4. Remove cover plate (3).
5. Modify the board as desired (s. sections 4.2. and 4.3.).
6. Reinstall cover plate, making sure that its curved part bends towards the outside.
7. Reinstall the two screws (1).

Proceed as described under 8. to 10.

8. Record any modifications made on the label located on the cover plate. With panel-mounting units, additionally mark modifications on the label on the outside case wall!
9. Insert controller section and fasten it with the two associated screws.
10. If necessary, reinsert small labels and protective nipple on the front-panel of the control station.

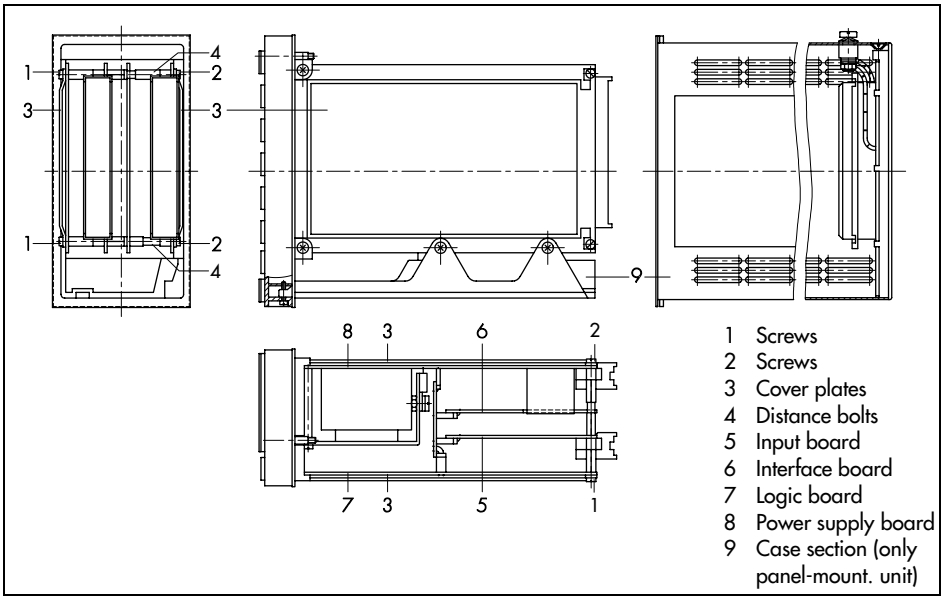


Fig. 5 · Location of the boards in the controller case

4. Soldering jumpers

> ⚠ **ATTENTION!**
> The soldering jumpers may only be modified by experienced personnel when the power to the process control station has been cut off!

Several functions of the process control station are determined by means of soldering jumpers. Open the case as described in section 3.3. to modify the jumpers. The soldering jumpers are marked on the soldering sides of the PCBs.

4.1. Determining the input signals

4.1.1. Input board 1 (IB1)

Note: Select the desired input signal and close the related soldering jumpers listed in line 3 or the following ones of the table below (depending on type of signal selected)! Open all remaining jumpers associated with the corresponding input (line 2)! See Fig. 5 for the location of the input board.

Input signal		**Input 1 (Ai 1)**	**Input 2 (Ai 2)**	**Input 3 (Ai 3)**	**Input 4 (Ai 4)**
		Jumpers: 10 to 19	Jumpers: 20 to 26	Jumpers: 31 to 34	Jumpers: 41 to 47
Current	0 to 20 mA	11	21	31	41, 45
	4 to 20 mA	11, 14	21, 24	31, 34	41, 44, 45
	–20 to 20 mA	11, 15, 16	21, 25, 26	–	–
Voltage	0 to 1 V	11	21	31	41
	0 to 5 V	12	22	32	42
	0 to 10 V	13	23	33	43
	0.2 to 1 V	11, 14	21, 24	31, 34	41, 44
	1 to 5 V	12, 14	22, 24	32, 34	42, 44
	2 to 10 V	13, 14	23, 24	33, 34	43, 44
Potentiometer	0 to 1kΩ	12, 17, 18	–	–	42, 46, 47
Transmitter supply		10, 11, 14, 19	20, 21, 24	–	–

Soldering jumpers associated with the binary inputs for all input boards:

	Binary input 1 (bi 1) Jumpers	**Binary input 2 (bi 2)** Jumpers	**Binary input 3 (bi 3)** Jumpers
Switching contact	50, 51	60, 61	70, 71
External switching voltage	Jumpers mentioned above are open		

4.1.2. Input board 2 (IB 2)

Note: Select the desired input signal and close the related soldering jumpers listed in line 3 or the following ones of the table below (depending on type of signal selected)! Open all remaining jumpers associated with the corresponding input (line 2)! See Fig. 5 for the location of the input board. The soldering jumpers associated with the binary inputs are described in section 4.1.1., page 14

Input signal		**Input 1 (Ai 1)**		**Input 2 (Ai 2)**	**Input 3 (Ai 3)**	**Input 4 (Ai 4)**
		Jumpers: 10 to 19		Jumpers: 20 to 26	Jumpers: 30 to 34	Jumpers: 41 to 47
Current	0 to 20 mA	–		21	31	41, 45
	4 to 20 mA			21, 24	31, 34	41, 44, 45
	–20 to 20 mA			21, 25, 26	–	–
Voltage	0 to 1 V			21	31	41
	0 to 5 V			22	32	42
	0 to 10 V			23	33	43
	0.2 to 1 V			21, 24	31, 34	41, 44
	1 to 5 V			22, 24	32, 34	42, 44
	2 to 10 V			23, 24	33, 34	43, 44
Potentiometer	0 to 1kΩ			–	–	42, 46, 47
Transmitter supply				20, 21, 24	30, 31, 34	–
Pt 100		2 /3-wire	4-wire	–		
		10, 12, 13, 15, X[2]	11, 14, 16, X[2]			
Measuring ranges[1]	–50 to 100 °C	19[1]				
	0 to 200 °C	18[1]				
	100 to 600 °C	17[1]				

[1] Select one measuring range and the corresponding soldering jumper. In the PA level, adjust the measuring range by means of the parameters $GWK_1 \leq$ and $GWK_1 \geq$.

[2] For specific measuring ranges (on request), soldering jumper X must be open and soldering jumper 17 must be closed.

4.1.3. Input board 3 (IB 3)

Note: Select the desired input signal and close the related soldering jumpers listed in line 3 or the following ones of the table below (depending on type of signal selected)! Open all remaining jumpers associated with the corresponding input (line 2)! See Fig. 5 for the location of the input board. The soldering jumpers associated with the binary inputs are described in section 4.1.1., page 14.

Input signal		**Input 1 (Ai 1)**		**Input 2 (Ai 2)**		**Input 4 (Ai 4)**
		Jumpers: 10 to 19		Jumpers: 20 to 29		Jumpers: 41 to 47
Current	0 to 20 mA	–		–		41, 45
	4 to 20 mA					41, 44, 45
	–20 to 20 mA					–
Voltage	0 to 1 V					41
	0 to 5 V					42
	0 to 10 V					43
	0.2 to 1 V					41, 44
	1 to 5 V					42, 44
	2 to 10 V					43, 44
Potentiometer	0 to 1kΩ					42, 46, 47
Transmitter supply						40, 41, 44, 45, 48
Pt 100		2 /3-wire	4-wire	2 /3-wire	4-wire	–
		10, 12, 13, 15, X[3]	11, 14, 16, X[3]	20, 22, 23, 25, XX[4]	21,24, 26, XX[4]	
Measuring ranges	–50 to 100 °C	19[1]		29[2]		
	0 to 200 °C	18[1]		28[2]		
	100 to 600 °C	17[1]		27[2]		

1) Select one measuring range and the corresponding soldering jumper. In the Pa level, adjust the measuring range by means of the parameters $GWK_1 \leq$ and $GWK_1 \geq$.
2) Select one measuring range and the corresponding soldering jumper. In the PA level, adjust the measuring range by means of the parameters $GWK_2 \leq$ and $GWK_2 \geq$.
3) For specific measuring ranges (on request), soldering jumper X must be open and soldering jumper 17 must be closed.
4) For specific measuring ranges (on request), soldering jumper XX must be open and soldering jumper 27 must be closed.

4.1.4. Input board 4 (IB 4)

Input board 4 is no longer available.
Note: Select the desired input signal and close the related soldering jumpers listed in line 3 or the following ones of the table below (depending on type of signal selected)! Open all remaining jumpers associated with the corresponding input (line 2). See Fig. 5 for the location of the input board. The soldering jumpers associated with the binary inputs are described in section 4.1.1., page 14.

Input signal		**Input 1 (Ai 1)**	**Input 2 (Ai 2)**	**Input 3/4 (Ai 3/4)**
		Jumpers: 10 to 19	Jumpers: 20 to 26	Jumpers: 41 to 47
Current	0 to 20 mA		21	41, 45
	4 to 20 mA		21, 24	41, 44, 45
	–20 to 20 mA		21, 25, 26	–
Voltage	0 to 1 V	–	21	41
	0 to 5 V		22	42
	0 to 10 V		23	43
	0.2 to 1 V		21, 24	41, 44
	1 to 5 V		22, 24	42, 44
	2 to 10 V		23, 24	43, 44
	0 to 50 mV	17	–	–
	0 to 100 mV	16		
	–50 to 50 mV	15		
	–100 to 100 mV	14		
Potentiometer	0 to 1kΩ	–	–	42, 46, 47
Transmitter supply		–	20, 21, 24, 29	40, 41, 44, 45, 49
Thermocouples				
Type U	0 to 200 °C	17	–	–
	150 to 400 °C	16		
	300 to 600 °C	15		
	0 to 600 °C	14		
Type R	0 to 700 °C	17		
	500 to 1200 °C	16		
	1000 to 1700 °C	15		
	0 to 1700 °C	14		
Type T	0 to 150 °C	17		
	100 to 250 °C	16		
	200 to 400 °C	15		
	0 to 400 °C	14		

Input signal		**Input 1 (Ai 1)**	**Input 2 (Ai 2)**	**Input 3/4 (Ai 3/4)**
		Jumpers: 10 to 19	Jumpers: 20 to 26	Jumpers: 41 to 47
Type S	0 to 700 °C	17		
	500 to 1200 °C	16		
	1000 to 1700 °C	15		
	0 to 1700 °C	14		
Type L	0 to 350 °C	17		
	250 to 600 °C	16		
	500 to 900 °C	15		
	0 to 900 °C	14		
Type B	200 to 1200 °C	17		
	1000 to 1500 °C	16		
	1300 to 1800 °C	15		
	200 to 1800 °C	14		
Type J	0 to 400 °C	17	–	–
	350 to 800 °C	16		
	700 to 1200 °C	15		
	0 to 1200 °C	14		
Type E	0 to 400 °C	17		
	300 to 700 °C	16		
	600 to 1000 °C	15		
	0 to 1000 °C	14		
Type K	0 to 500 °C	17		
	400 to 900 °C	16		
	800 to 1300 °C	15		
	0 to 1300 °C	14		
Reference junction temperature for external reference junction	0 °C	11		
	20 °C	12		
	50 °C	13		

4.2. Soldering jumpers on the logic board

See Fig. 5 for the location of the logic board

		Soldering jumper: X closed, 0 open											
		11	13	21	23	31	33	37	38	SZ	LB 1	LB 2	LB 3
Continuous control output Y1	0(4) to 20 mA	X	0										
	0(2) to 10 V	0	X										
Continuous control output Y2	0(4) to 20 mA			X	0								
	0(2) to 10 V			0	X								
Analog output Ao1	0(4) to 20 mA					X	0	X	0				
	–10 to 10 V					0	X	0	X				
	0(2) to 10 V					0	X	X	0				
Operation with code number										X			
Operation with interface											X	X	X

4.3. Soldering jumper for implementing the code number

The CONFIGURATION level and the PARAMETER level can be protected against unauthorized use by means of code numbers. To activate this function, the soldering jumper SZ located on the logic board must be closed (see table in section 4.2.). This jumper SZ is open when the controller is delivered, meaning that the configuration and parameter data of the process control station can be modified without having to enter a corresponding code number.
Refer to section 6.10 and 6.11 on how to define the code numbers for CONFIGURATION level and the PARAMETER level.

4.4. Soldering jumpers on the interface board

See. Fig. 5 for the location of the interface board and Fig. 6 for the location of the soldering jumpers.

Important! In the interface mode, the soldering jumpers LB1, LB2 and LB3 on the logic board must also be closed (see section 4.2., page 19). This must be observed when retrofitting the process control station with the interface board.

	Soldering jumper (LB)	Default setting: X closed, 0 open
Enable parity bit	PARITAET	0
Parity odd	UNGERADE	0
2 stop bits	RES	0
Baud rate Modbus	Select a soldering jumper	
300 bit/s	300	0
600 bit/s	600	0
1200 bit/s	1200	0
2400 bit/s	2400	0
4800 bit/s	4800	0
9600 bit/s	9600	X
19200 bit/s	19200	0
Termination	BUSABSCHLUSS (4 LBs)	0
Two-wire mode	2LEITER (2 LBs)	0
Four-wire mode	4LEITER (2 LBs)	X

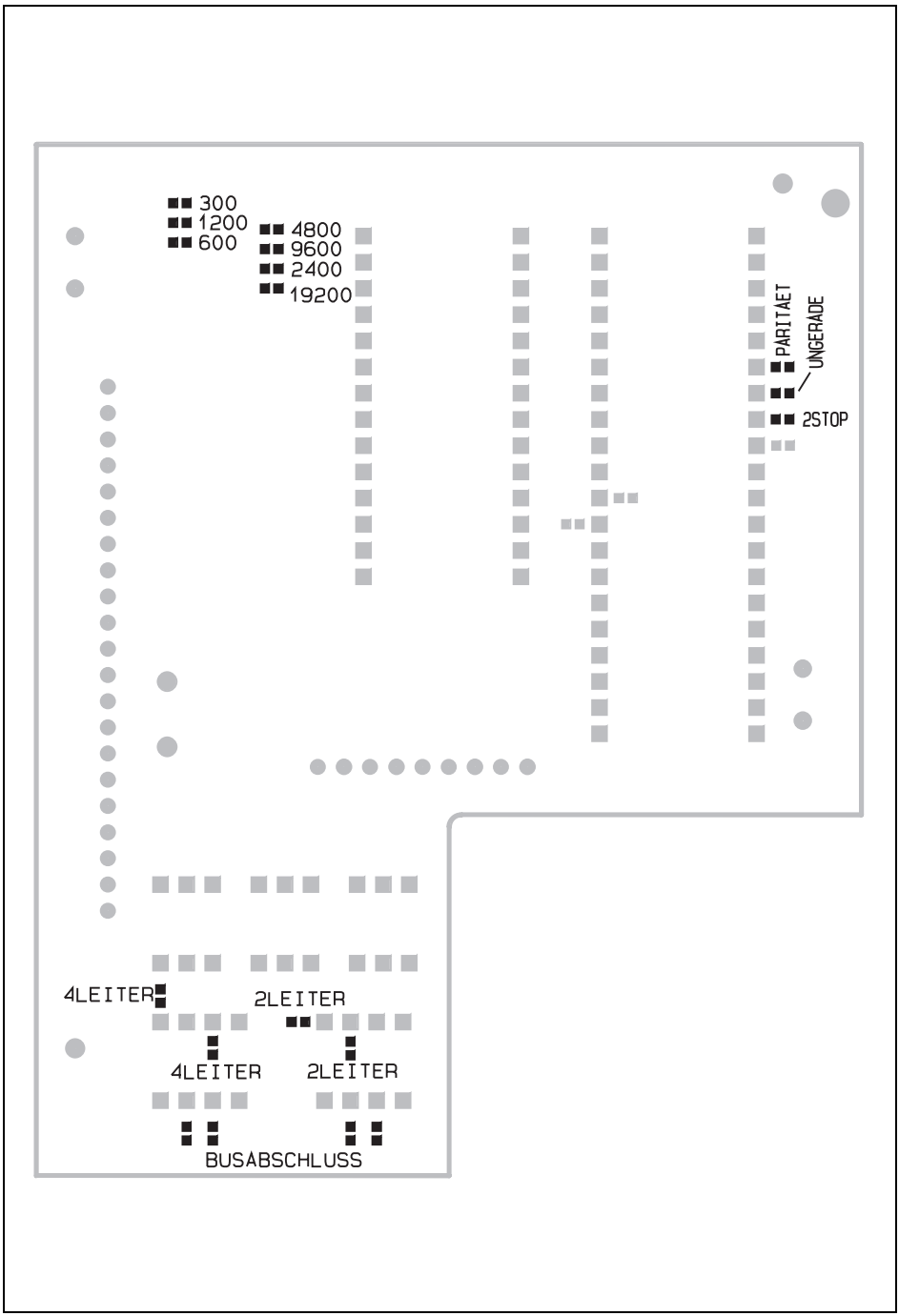


Fig. 6 · Location of the soldering jumpers on the interface board

5. Electrical connections

When making the electrical connections, note the VDE 0100 regulations and the regulations valid in the country where the control station is intended to be installed.

Use shielded cables for the signal lines of the analog and binary inputs, which are installed outside the control cabinets, in order to avoid measuring errors or other interferences. Inside the control cabinets, these lines have to be installed separately from the control and power supply lines.

The shieldings of the lines are to be grounded on one side at the neutral point of the measuring and control system.

5.1. TROVIS 6412 (panel-mounting unit)

The device has plug-in terminals for wires with cross-sections of 0.5 to 1.5 mm^2 (DIN 45 140).

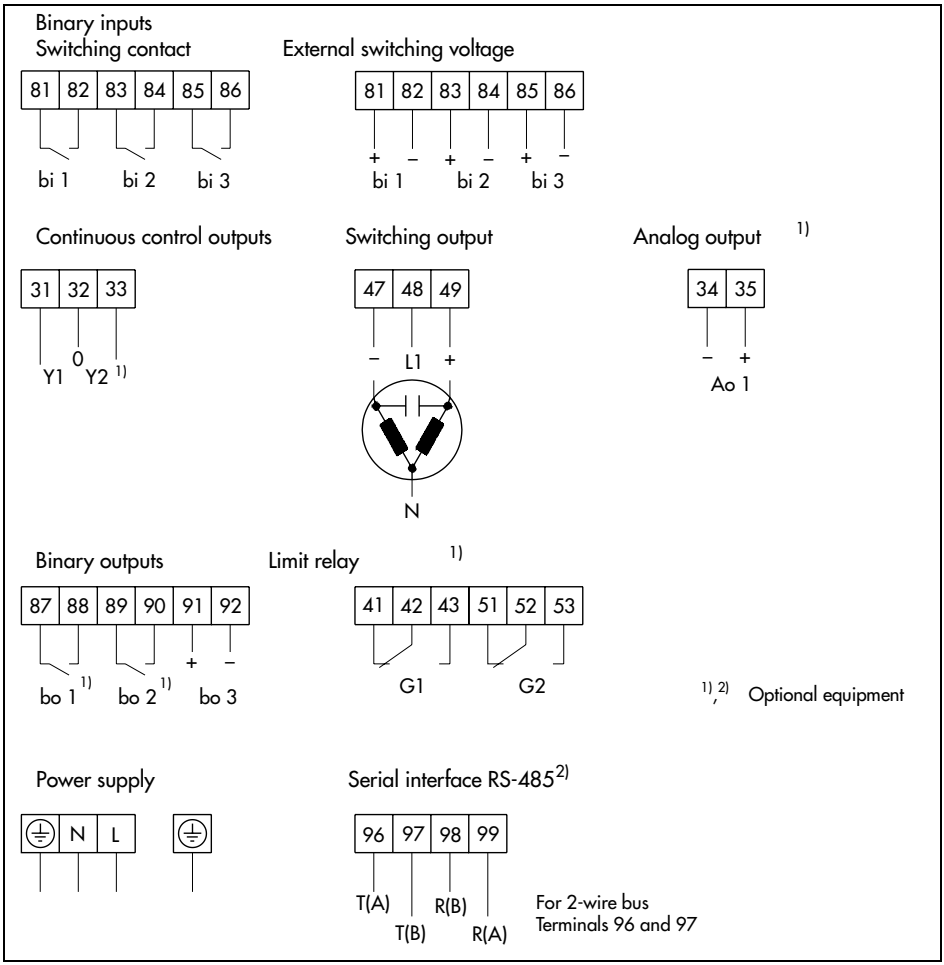


Fig. 7 · Terminal assignment of TROVIS 6412

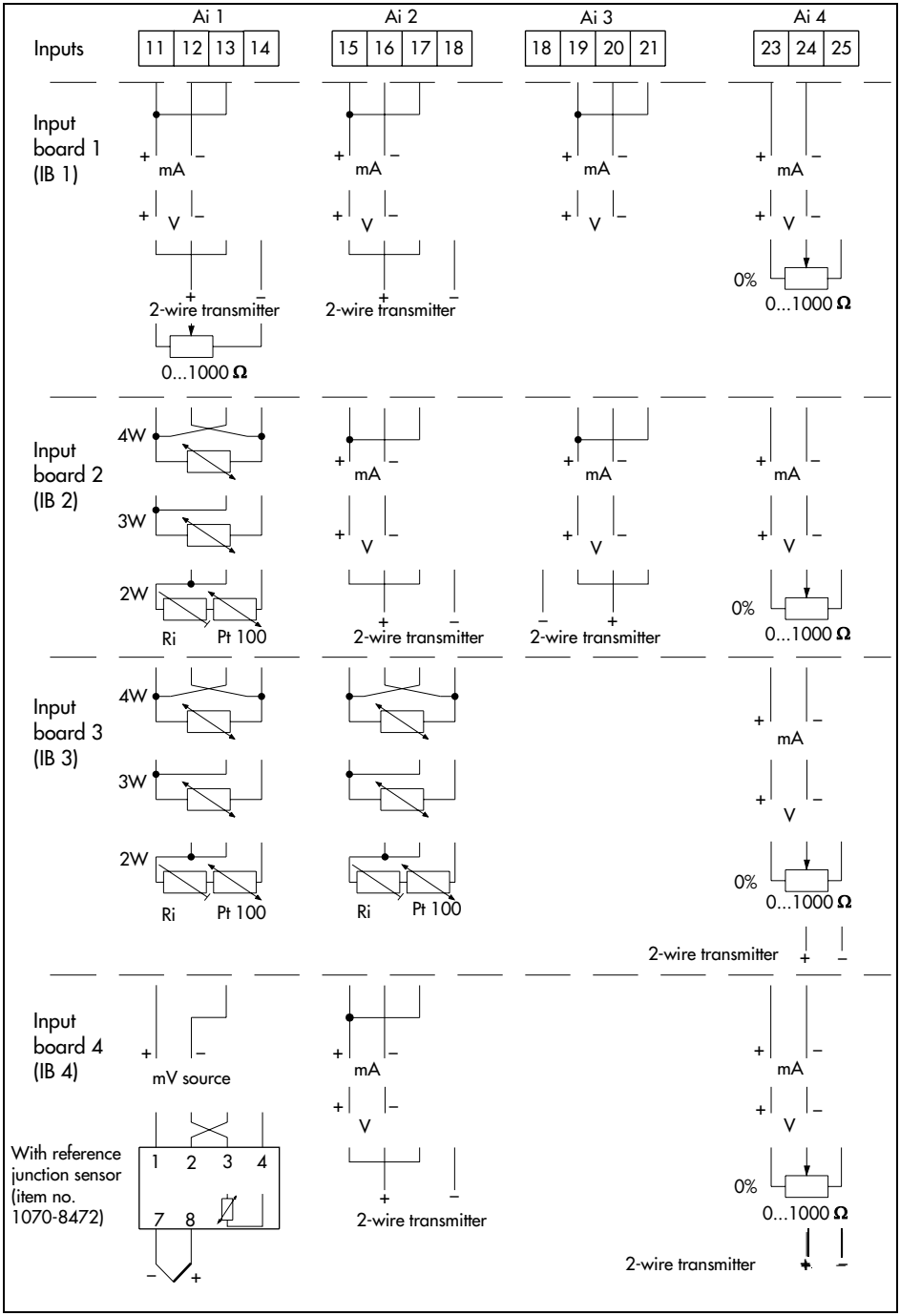


Fig. 8 · Terminal assignment of TROVIS 6412 (continued)

5.2. TROVIS 6442 (rack-mounting unit for 19inch racks)

The device has two plug connectors, style F (DIN 41612). The signal lines are assigned to one of these two connectors, whereas the power supply lines are assigned to the other one, meaning these lines are installed separately (see Fig. 9 and Fig. 10).

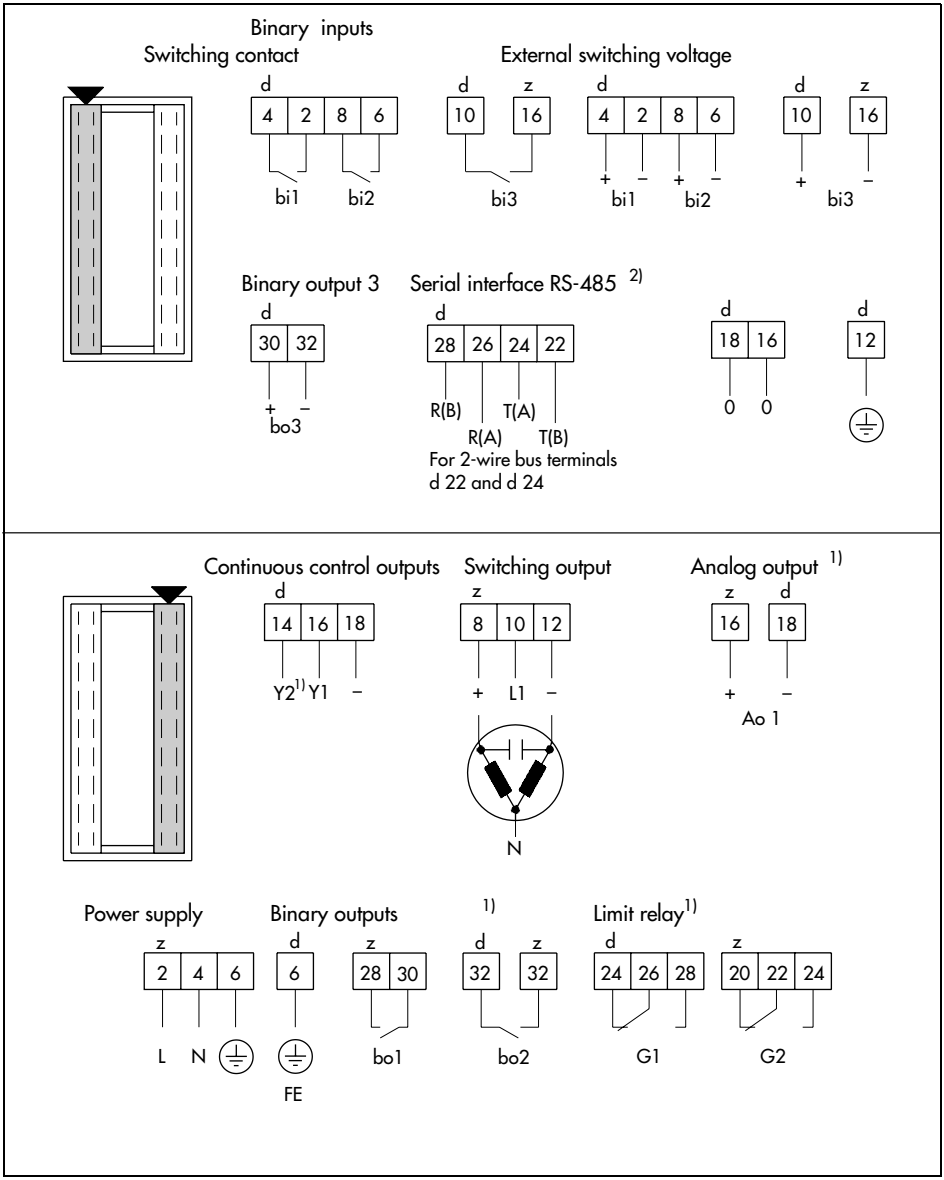


Fig. 9 · Terminal assignment of TROVIS 6442

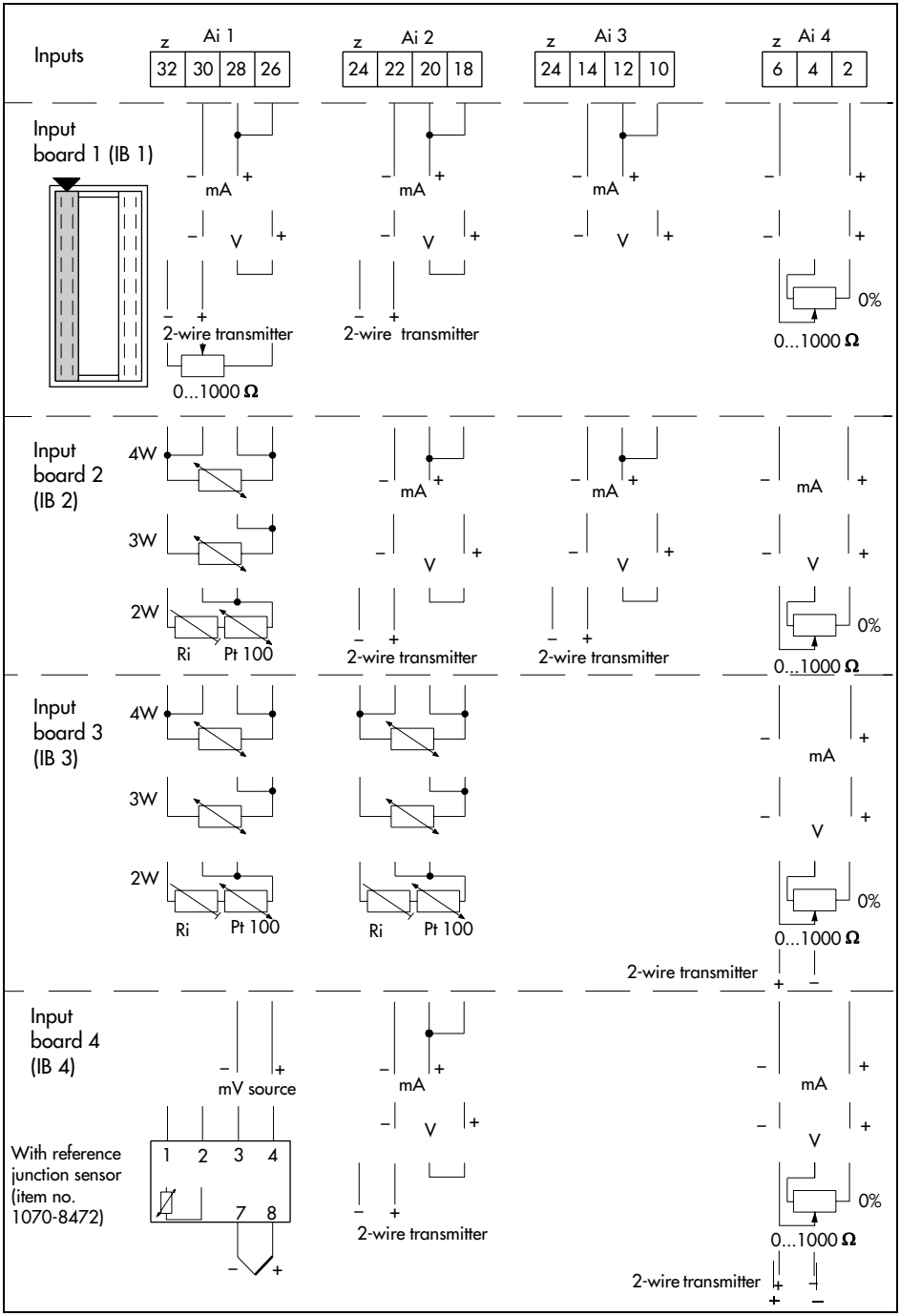


Fig. 10 · Terminal assignment of TROVIS 6442 (continued)

5.3. Balancing the line resistance for the connection of Pt 100 sensors

When Pt 100 sensors are connected to the control station in a **two-wire circuit**, the line resistance is to be balanced to 10 Ω at the external resistor R_j in order to avoid measuring errors:

1. Short-circuit the line at the Pt 100 sensor or potentiometer.
2. Switch the resistor R_j in the line.
3. Measure the resistance in the total circuit, using a suitable ohmmeter.
4. Adjust the resistor R_j until the line resistance is 10 Ω.

In **three-wire circuits**, the line resistance must not be balanced. Zero and span, however, should be checked and re-adjusted if necessary.

In **four-wire circuits**, balancing the line resistance is also not necessary.

5.4. Wiring technique with regard to electromagnetic compatibility

All input, output and data lines have to be run in shielded cables for reasons of electromagnetic compatibility (EMC).

The power supply lines, as well as the protective conductors and the functional earthing line (FE) are to be connected separately from each controller to the corresponding multi-terminal bus bar.

With 19inch racks, a conductive connection between the functional earthing line and the rack has to be made.

The shielded cables are to be grounded at one end (see Fig. 11 and Fig. 12).

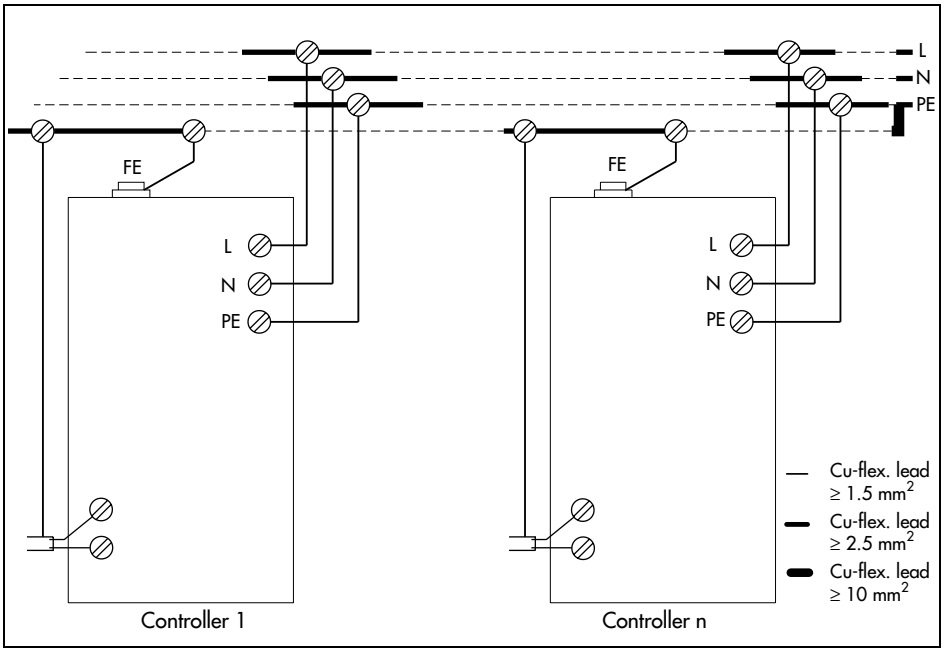


Fig. 11 · Electrical connections for panel-mounting units

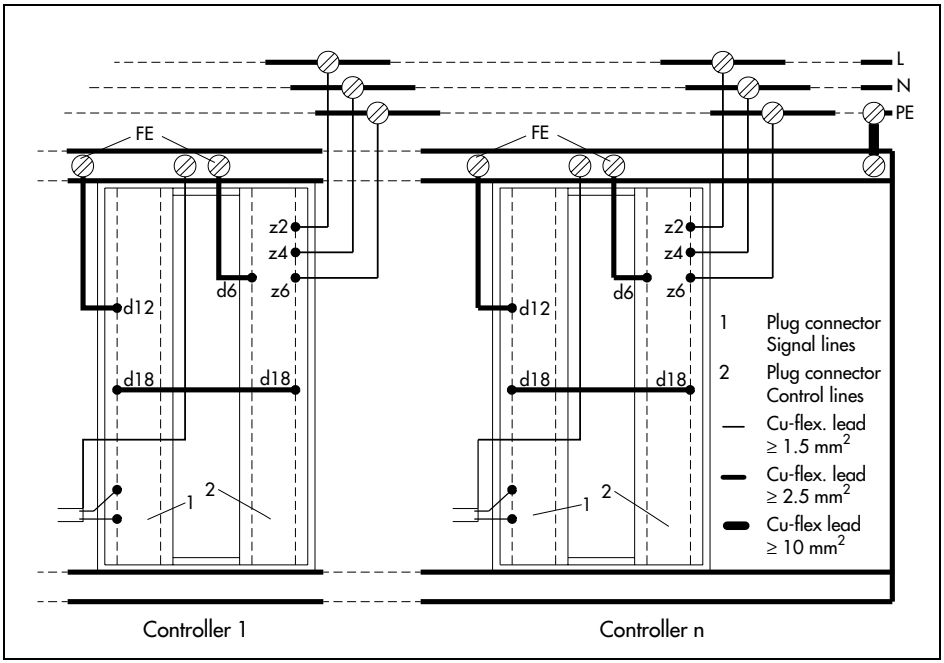


Fig. 12 · Electrical connections for 19inch rack-mounting units

6. Operation

This section describes how to operate the process control stations directly on the control panel. Unfold the last page of this manual to obtain a better understanding of this description!

The process control stations are designed according to a three-level, logic operating structure: 1) OPERATING level, 2) PARAMETER level and 3) CONFIGURATION level. These levels are described in sections 6.2. to 6.13. Depending on the selected level (mode), the visual displays on the LCD panel and the keys assume different functions.

6.1. Process display and control panel elements

The process control station is operated via eight front-panel keys. The front panel also contains a clear display field, which shows different variables and symbols, depending on the selected operating level. Note that some parameters available in the PARAMETER and ADAPTATION PARAMETER level can be a combination of several variables and symbols.

All process display and control panel elements are listed and explained on the last two pages of this manual. Optional error messages are described in Appendix B .

6.2. OPERATING level

This is the standard operating level of the process control station (control mode). In this level, the control station operates according to the pre-set control mode and the defined parameters.

The values of the set point (reference variable) (3) and the controlled variable (8) are numerically indicated on the display panel. The control deviation (error) (7) and the output variable (14) are represented as a percentage by means of bar graphs. In addition, a LED (19) indicates whether the control station is in the AUTOMATIC or MANUAL mode. If the F key is pressed, the numerical value of the output variable appears in the upper line of the display field (3).

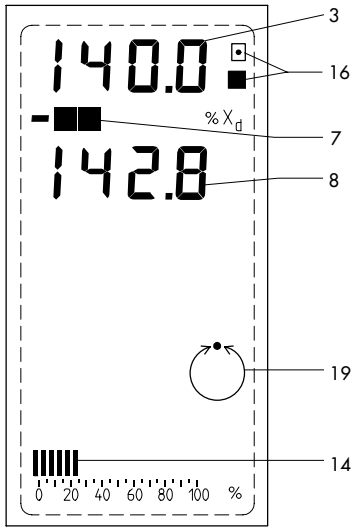
The OPERATING level allows the operator to modify the value of the internal set point (reference variable), abort the restart condition option after a start-up procedure or a power supply failure has occurred, or open the cascade when the controller is in the follow-up control mode. The output variable can be modified manually when having changed over the process control station to the MANUAL mode. These functions are described in the following sections.
All other levels can be accessed from the OPERATING level.

6.2.1. Modifying the internal set point (reference variable)

In the OPERATING level, the internal set point W_{IN} can be modified by pressing the C or D key, provided that these keys have not been disabled in the CONFIGURATION level (C59-2 or C59-4). Pressing the respective key briefly modifies the last digit of the indicated number by one. The key must be held down to further advance the number. In this case, the displayed value changes more quickly. While this modification is made, W_{IN} is additionally indicated on the display. W_{IN} disappears after approximately 3 s. Note that the digital display field (3) can also be configured to display other values than W_{IN} (see configuration block C4).

Pressing the C key increases the set point (reference variable).

Pressing the D key decreases the set point (reference variable).



3 Set point (reference variable)
7 Control deviation (error)
8 Controlled variable
14 Manipulated variable display
16 Indicator "internal set point valid"
19 AUTOMATIC mode

Fig. 13 · Display of the set point (reference variable) in the OPERATING level

6.2.2. Power supply failure

Configuration block C 43 (restart condition) defines the behaviour of the process control station after switching on the power supply in the start-up phase or after detecting a power supply failure (> approx. 1 s). This restart condition determines the operating mode, the set point (reference variable) and the output variable for output Y1 or Y2.

If one of the restart conditions C43-1 to C43-6 is set, it is necessary to confirm the setting by pressing the F key in order to return to the normal control mode. In both cases, the digital displays for the set point and the controlled variable flash until the F key is pressed. The settings C43-5 and C43-6 cause the process control station to remain in the MANUAL mode, even when the F key is pressed. This is indicated by the ☜ symbol in (19).

The settings C43-7 to C43-12 must not be confirmed in order to return to the normal control mode. The process control station automatically operates in the control mode according to the restart conditions implemented with configuration block C 43.

The following table is a short summary of the optional restart conditions.

C43	Set point	Output variable	Oper. mode	Press F-key	Comment
-1, -2	Last active	Y_1K_1, Y_2K_1	Automatic	Yes	
-3, -4	W_S	Y_1K_1, Y_2K_1	Automatic	Yes	WS overwrites W_{IN}
-5, -6	Last active	Y_1K_1, Y_2K_1	Manual	Yes	After pressing F, still MANUAL mode
-7, -8	Last active	Y_1K_1, Y_2K_1	Automatic	No	
-9, -10	Internal	Y_1K_1, Y_2K_1	Automatic	No	
-11, -12	External	Y_1K_1, Y_2K_1	Automatic	No	

6.2.3. Manual adjustment of the output variable

In MANUAL mode, the connected control valve can be manually moved to the desired position, using the G and H keys, provided that these keys have not been disabled in the configuration mode (C59-2 or C59-4). The corresponding key must be pressed until the desired output variable is adjusted. The bar graph (13) indicates the change in the output variable. If the F key is pressed, the numerical value of the output variable is also displayed in the digital display field (2).

Bumpless change-over from MANUAL to AUTOMATIC mode and vice versa is carried out via the MANUAL/AUTOMATIC key (E).

Pressing the G key increases the output variable.
Pressing the H key decreases the output variable.

6.3. PARAMETER level

The control parameters can be displayed and modified in the PARAMETER level. When the control station operates with a code number (code number mode) (see 4.3.), the parameters can only be modified after having entered the valid code number.

Only parameters that are supported by the controller's configuration can be displayed and modified. All dynamic parameters (e.g.. X, W_{EX}, Z, X_D, Y_1, Y_2), however, cannot be modified.

6.3.1. Operating the PARAMETER level

See last page of this manual for the designations of the keys and displays! The process control station is in the OPERATING level. Fig. 14 is a simplified representation of how to set a parameter.

Accessing the PARAMETER level and displaying the parameter values

1. Press A key. I-O appears on the display.
2. Press C key. PA appears on the display.
3. Press A key. Now, the control station is in the parameter mode. The LCD panel additionally shows the value of the currently selected parameter in the digital display field (3), the control deviation (error) bar graph (7), the parameter table (21), and the bar graph representing the output variable (14). The selected parameter flashes. When accessing the PARAMETER level for the first time, the flashing parameter is always the one which was selected last during a former modification process.
4. All parameters can be displayed by pressing the C or D key. Attention: the parameters can be combinations of several symbols, e.g. Y_1K_1.

Modifying parameter values

1. Follow steps 1 to 3 listed under "Accessing the PARAMETER level and displaying the parameter values".
2. Select the parameter to be modified by pressing the C or D key.
3. Press A key when the selected parameter flashes in the parameter table.

   What comes up on the display now depends on whether the process control station operates either with or without a code number.

   If no code number was entered, PA flashes on the display. Hold down the A key for approx. 3 s. Continue as described under 4.

   If a code number was entered, PA and ⊸○ flash on the display. Use the C and D keys to set the code number in the upper line of the display (3). Then, press A key. Now the parameter table should reappear on the display. If not, the wrong code number was entered. Re-enter the code number, using the C and D keys or cancel by pressing the F key.
4. The selected parameter and PA flash on the display. Now a new parameter value can be set by pressing the C and D keys. Then, press A key to accept.
5. Select next parameter with the C and D keys. Press A key, and modify them as described under 4.

Exiting the PARAMETER level

1. Press F key.
   The process control station returns to the OPERATING level.

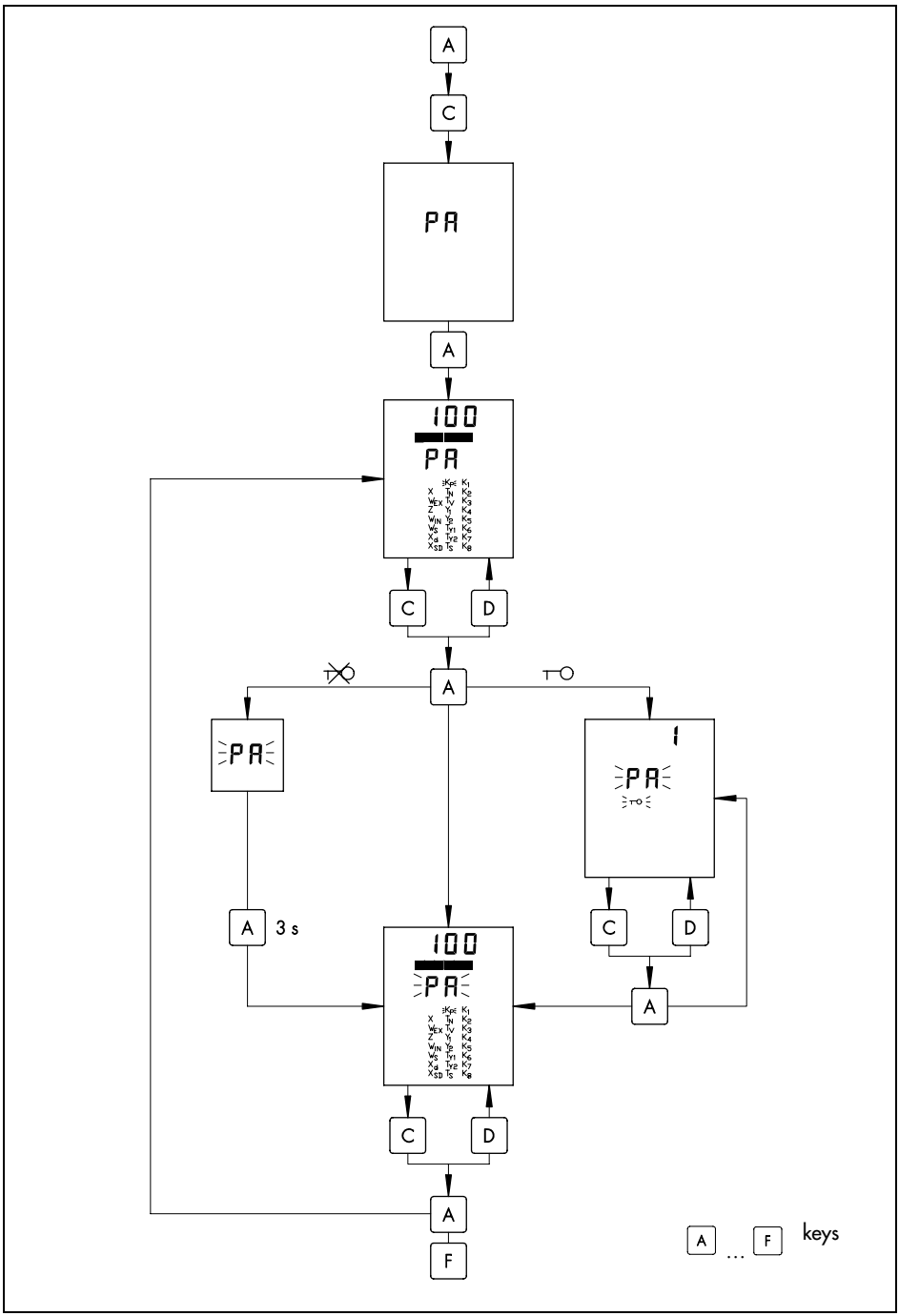


Fig. 14 · Simplified parameter setting diagram

6.3.2. Example how to modify a parameter

This section describes how to modify a parameter, using K_P as an example. All other parameters have to be modified accordingly.

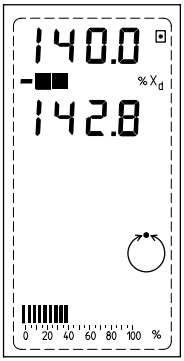


Fig. 15

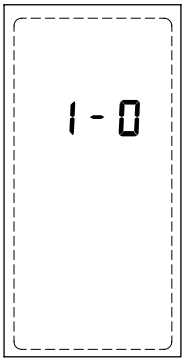


Fig. 16

Fig. 15
The process control station is in the standard operating mode and the display is, for example as shown in Fig. 15 .

Fig. 16
Press A key. I-O comes up on the display.

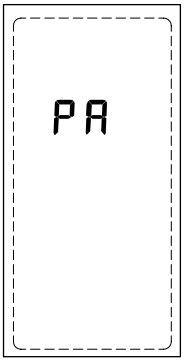


Fig. 17

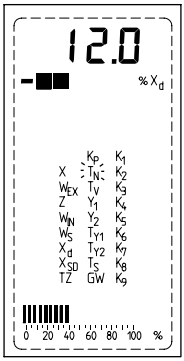


Fig. 18

Fig. 17
Press C key. PA appears on the display.

Fig. 18
Press A key. The LCD panel shows, for example this display. The parameter which was changed last (here T_N) flashes.

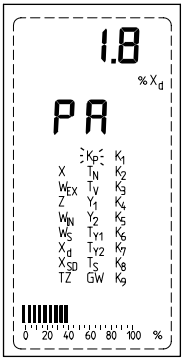


Fig. 19

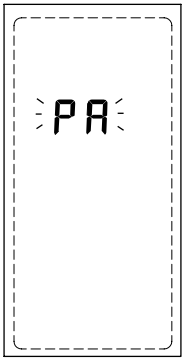


Fig. 20

Fig. 19
Press C or D key several times until K_P flashes (only K_P!). The valid K_P value, here 1.8, is displayed in the upper line of the display.

Fig. 20
Press A key.
If no code number was entered (factory default) PA flashes on the display. Hold down the A key for approximately 3 s.
If a code number was entered (not shown in this figure), PA and ⊸ flash. Use C and D keys to set the code number in the upper line of the display (3). Then, press A key.

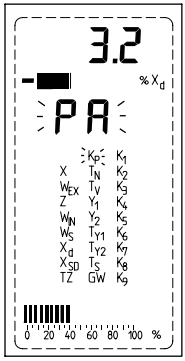


Fig. 21

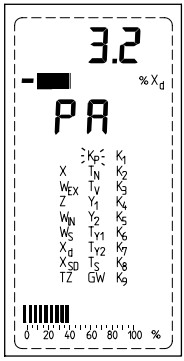


Fig. 22

Fig. 21
K_P and PA flash.
Enter new K_P value by pressing the C and D keys (in this example, 3.2).
Fig. 22
Press A key to accept.
The new K_P value is stored. Only K_P flashes.

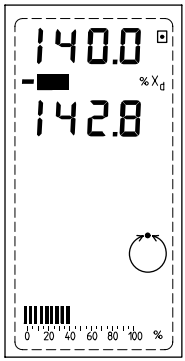


Fig. 23

Fig. 23
Press F key.
The process control station has returned to the OPERATING level.

6.4. CONFIGURATION level

The configuration blocks can be displayed and modified in the CONFIGURATION level. When the control station operates with a code number (code number mode), the configuration blocks can only be modified after having entered the valid code number. Configuration blocks determine the control functions. These blocks and the associated functions are described in more detail in *Configuration manual KH 6412 E*.

The configuration blocks are designated C1 to C59. The control mode selected determines which configuration blocks are relevant. Only these blocks can be displayed and modified.

6.4.1. Operating the CONFIGURATION level

See last page of this manual for the designations of the keys and displays! Operation of this CONFIGURATION level is described, starting from the OPERATING level. Fig. 24 is a simplified representation of how to set a configuration block.

Accessing the CONFIGURATION level and displaying the configuration blocks

1. Press A key. I-O appears on the display.
2. Press C key several times until CO appears on the display.
3. Press A key. Now, the upper line of the display shows the setting of the configuration block (e.g. - 1), and the associated designation of this block (e.g. C 1) is indicated in the lower line of the display. When accessing the CONFIGURATION level for the first time, the display always shows the configuration block which was viewed or modified last.
4. The individual configuration blocks can be viewed by pressing the C or D key.

Modifying configuration blocks

1. Follow steps 1 to 3 listed under "Accessing the CONFIGURATION level and displaying the configuration blocks".
2. Select the configuration block to be modified by pressing the C or D key.
3. Press A key.

   What comes up on the display now depends on whether the process control station operates either with or without a code number.

   If no code number was entered, CO flashes on the display. Hold down the A key for approx. 3 s. Continue as described under 4.

   If a code number was entered, CO and ⊸○ flash on the display. Use the C and D keys to set the code number in the upper digital display field (3). Then, press A key. Should CO and ⊸○ still flash on the display, the wrong code number was entered. Re-enter the code number or exit the CONFIGURATION level as described below.
4. C and – flash on the display.
5. Select new value for the configuration block, using the C and D keys. Then, press A key to accept.
6. Select other configuration block with the C and D keys. Press A key. Continue as described under 5. or exit the CONFIGURATION level.

Exiting the CONFIGURATION level

1. Press F key.
   After having modified the configuration blocks, the control station returns to the OPERATING level and is in the MANUAL mode.

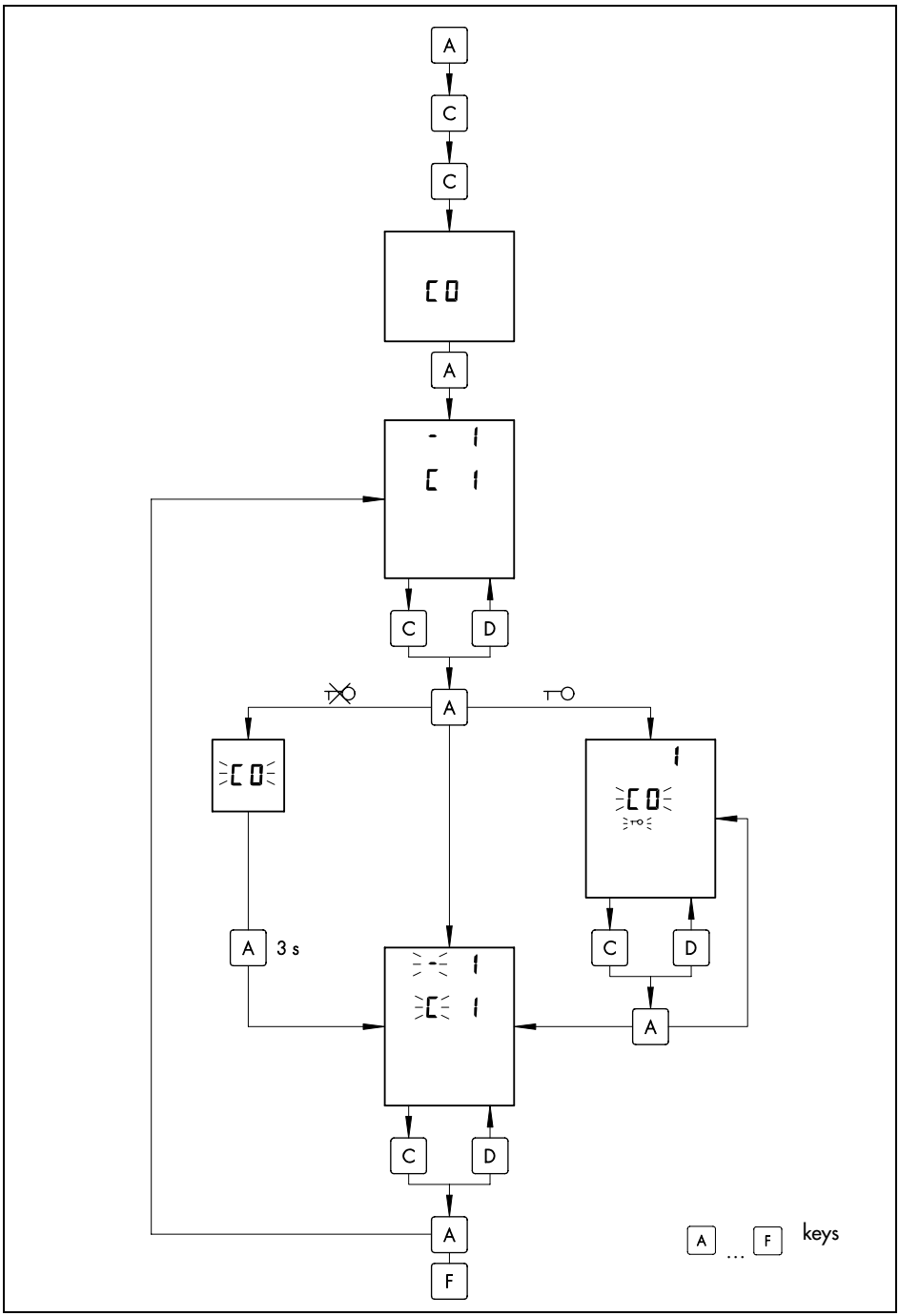


Fig. 24 · Simplified configuration diagram

6.4.2. Example how to modify a configuration block

This section describes how to modify a configuration block, using C5 (configuration of controller outputs) as an example. All other configuration blocks have to be modified accordingly.

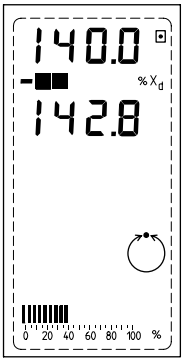


Fig. 25

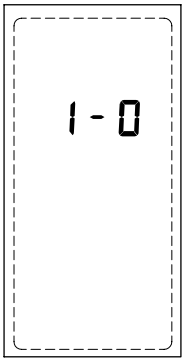


Fig. 26

Fig. 25
The process control station is in the standard operating mode and the display is, for example as shown in Fig. 25 .

Fig. 26
Press A key. I-O comes up on the display.

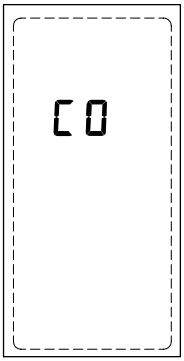


Fig. 27

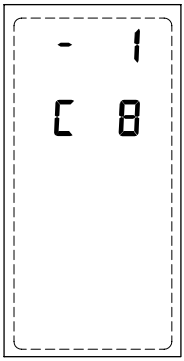


Fig. 28

Fig. 27
Press C key twice. CO appears on the display.

Fig. 28
Press A key. The configuration block modified last and its setting are displayed (here C 8 and -1).

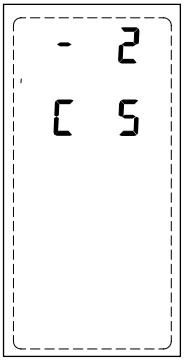


Fig. 29

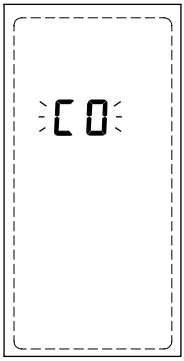


Fig. 30

Fig. 29
Press C or D several times until C 5 is displayed. The valid setting for C 5 (here - 2) is shown in the upper line of the display.

Fig. 30
Press A key.
If no code number was entered (factory default) CO flashes on the display. Hold down the A key for approximately 3 s.
If a code number was entered (not shown in this figure), CO and ⊶ flash. Use C and D keys to set the code number in the upper line of the display (3). Then, press A key.

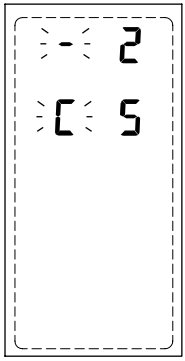


Fig. 31

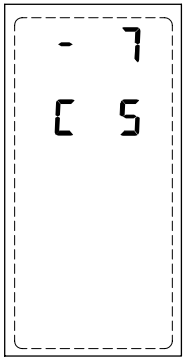


Fig. 32

Fig. 31
C and - flash.
Select new setting for C 5 by pressing the C and D keys (in this example 7).

Fig. 32
Press A key to accept.
The new setting C 5-7 is stored. The display stops flashing.

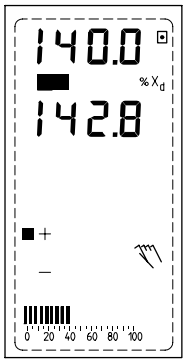


Fig. 33

Fig. 33
Press F key.
The process control station has returned to the OPERATING level and is in the MANUAL mode.

6.5. I-O level (displaying all input and output variables)

In the I-O level (Input-Output), all input and output signals of the process control station, except of bo3, can be displayed as absolute values.

This level is also used to check the software assignment of the respective analog inputs to an internal signal.

Accessing the I-O level

The process control station is in the OPERATING level.

1. Press A key. I-O appears on the display.
2. Press A key to open the I-O level. "in 1" for analog input 1 comes up on the display.
3. Press C key to display other inputs and outputs.
   By pressing the D key, it is possible to go through the displays in a reverse order.

Exiting the I-O level

1. Press F key.
   The process control station returns to the OPERATING level.

6.6. Si level (setting the RS-485 interface)

The station number (Stn), the timeout period information (tiF), the status timeout period information (tiF on/oFF) and the status of the RS-485 interface (Si on/oFF) are defined in this level. For further details, see section 9.1., p. 60.

Accessing the Si level

The process control station is in the OPERATING level.

1. Press A key. I-O appears on the display.
2. Press C several times until Si appears on the display.
3. Press A key. Si is indicated in the lower line of the display and the status of the RS-485 interface is shown in the upper line of the display (on or oFF).
4. Press A key.
   What comes up on the display now depends on whether the process control station operates either with or without code number.
   If no code number was entered, Si flashes on the display. Hold down the A key for approx. 3 s. Continue as described under 5.
   If a code number was entered, CO and ⊸ flash on the display. Use C and D keys to set the code number in the upper line of the display (3). Then, press A key. Should CO and ⊸ still flash, the wrong code number was entered. Re-enter the code number or leave the Si level as described below.
5. The Si level is open. Stn (for station number) comes up in the lower line of the display and the entered number is indicated in the upper line of the display.
6. The parameters of the Si level can be viewed by pressing the C or D key.

Modifying parameters in the Si level

1. Access the Si level as described above.
2. Select a parameter (Stn, TiF, TiF on/oFF, Si on/oFF) by pressing either the C or D key .
3. Press A key. The parameter flashes.
4. Modify setting or value, using the C or D key. Then, press A key to accept.
5. If an other parameter is to be modified, continue as described under 2.
   Proceed as described below to exit the Si level.

Exiting the Si level

1. Press F key.
   The process control station returns to the OPERATING level.

6.7. Ai level (adjustment and calibration)

This level is used to display the inputs Ai 1 to Ai 4 as standardized values.

When setting configuration block C14-2, the user can adjust zero and span for inputs Ai 1 to Ai 4 or calibrate the input characteristic via 5 coordinates. This calibration procedure can compensate for small non-linearities in the measurement of the connected transmitters. The span can be calibrated for the controller outputs Y1 and Y2 and the analog output Ao 1.

The zero adjustment range is ±3 %, the span adjustment range is ±6 %.

Accessing the Ai level

The process control station is in the OPERATING level.

1. Press A key. I-O appears on the display.
2. Press C key several times until Ai appears on the display.
3. Press A key. Ai 1 appears in the lower line of the display, and the associated value is indicated in the upper line of the display.

Exiting the Ai level

1. Press F key.
   The process control station returns to the OPERATING level.

Displaying the analog inputs Ai 1 to 4 as standardized values

1. Access the Ai level as described above.
2. Select an input Ai 1 to Ai 4, using the C key. The associated value is indicated in the upper line of the display.
3. Exit the Ai level as described above.

Requirements for calibration

In principle, the soldering jumpers used to define the inputs and outputs are assumed to be set as required for the respective application (see section 4., p.14).

In addition, the following steps have to be carried out:

1. Set C14-2 in the CONFIGURATION level (see section 6.4., p. 36).
2. Press F key to exit the CONFIGURATION level.

Zero and span adjustment for the inputs Ai 1 to Ai 4

1. Make the settings required for calibration (see previous section).
2. Access the Ai level as described above.
3. Select the input to be adjusted (Ai 1 to Ai 4) by pressing the C key. CAL oFF appears on the display (see "Calibrating the input characteristic" below).
4. Use a highly-accurate adjustment device to adjust the initial value of the input signal range. When the input signal is within the adjustment range, three black bars appear in the left bottom corner of the display. In addition, the selected input, e.g. Ai 1 and AdJ (for adjust) alternate in the lower line of the display.
5. Press A key to accept the zero point adjustment. 0.0 appears in the upper line of the display.
6. Use a highly-accurate adjustment device to adjust the maximum value of the input signal range (span adjustment). When the input signal is within the adjustment range, three black bars appear in the right bottom corner of the display field. In addition, the selected input, e.g. Ai 1 and AdJ (for adjust) alternate in the lower line of the display.
7. Press A to accept the span adjustment. 100.0 appears in the upper line of the display.
8. Repeat steps 3. to 6. to adjust zero and span for the next input or exit the Ai level (see above).

Calibrating the input characteristic via 5 coordinates

The five coordinates for the calibration curve are set at 0; 25; 50; 75 and 100 % of the input signal. For an input signal in the range from 4 to 20 mA, these coordinates are, for example, 4; 8; 12; 16 and 20 mA.

Proceed as follows:

1. Make the settings required for calibration.
2. Access the Ai level as described above.
3. Press C key until CAL oFF appears on the display.
4. Press A key. "on" flashes in the upper line of the display.
5. Press A key until "on" stops flashing (approx. 5 s).
6. Press C key. Ai 1 for input 1 and CAL alternate on the display.
7. Select the desired input (Ai 1 to Ai 4), using the C key.
8. Use a highly-accurate adjustment device to set the input signal to 0 %. In the above mentioned example, this would be 4 mA. When the input signal is within the calibration range, a scale (0 to 100 %) comes up at the bottom of the display and two black bars appear over the valid value (0 %). CAL and the selected input alternate in the lower line of the display.
9. Press A key to accept the first coordinate value.
10. Repeat steps 8 and 9 in order to set the other four coordinate values (25; 50; 75; 100 %) one after the other.
11. Repeat steps 7. to 10. for the next input or exit the Ai level by pressing the F key.

Note:

The inputs must be re-calibrated in the Ai level after exchanging the EPROM or the input board.

Calibrating the span for the outputs Y1, Y2 and Ao1

When calibrating the span for the outputs Y1, Y2 and Ao1, proceed as follows:

Connect a highly-accurate meter to the output to be calibrated.

First, follow steps 1. to 6. listed under "Calibrating the input characteristic via 5 coordinates" (see above).

7. Select desired output Y1, Y2 or Ao1 by pressing the C key. A scale from 0 to 100 % comes up at the bottom of the display.
8. Use the G and H keys to adjust the desired end value of the output signal range. Check this value with the highly-accurate meter. When the output signal is within the calibration range, CAL and the selected output alternate in the lower line of the display.
9. Press A key to accept the calibrated end value.
10. Repeat steps 7 to 9 to calibrate the other outputs or exit the Ai level by pressing the F key.

6.8. Fir level (displaying the firmware number)

This level is used to view the version number of the EPROM used in the process control station, as well as the current RS-485 interface version. Should you have any inquiry about the device, always specify the version number of your process control station because the software might have been modified for the following versions.

Proceed as follows:

The process control station is in the OPERATING level.

1. Press A key. I-O appears on the display.
2. Press D key until "Fir" comes up on the display.
3. Press A key. C (for controller = process control station) appears in the lower line of the display, and the valid version number is indicated in the upper line of the display.

   Press C key. Si (for serial interface) appears in the lower line of the display, and the valid version number is indicated in the upper line of the display. If 0.0 appears here, this means that no interface board is installed.
5. Press F key to exit the Fir level.

6.9. CHE level (checking the display panel)

This level is used to check proper functioning of all the display elements shown on the last page of this manual.

Proceed as follows:

The process control station is in the OPERATING level.

1. Press A key. I-O appears on the display.
2. Press D key until CHE comes up on the display.
3. Press A key. All display elements are indicated on the display, as shown on the last page of this manual.
4. Press F key to exit the CHE level.

6.10. PA level (code number for the PARAMETER level)

This level can be used to define the code number for the PARAMETER level. The level is only accessible, however, when the process control station operates in the code number mode (see section 4.3., p. 19) and the operator knows the code number for servicing. In order to prevent this code number for servicing from being accessed by unauthorized persons, either cut out or scribble over the number on page 97.

To modify the code number for the PARAMETER level, take the following steps:

The process control station is in the OPERATING level.

1. Press A key. I-O appears on the display.
2. Press C or D key until PA and are displayed.
3. Press A key. flashes on the display. "1" comes up in the upper line of the display.
4. Enter the code number for servicing in the upper line of the display, using the C or D key.
5. Press A key. The currently valid code number is displayed and PA flashes.
6. Enter the new code number with the C or D key.
7. Press A key. PA no longer flashes.
8. Press F key to exit this level.

6.11. CO level (code number for the CONFIGURATION level)

This level can be used to define the code number for the CONFIGURATION level. The level is only accessible, however, when the process control station is in the code number mode (see section 4.3., S. 19) and the operator knows the code number for servicing. In order to prevent this code number for servicing from being accessed by unauthorized persons, either cut out or scribble over the number on page 97.

To modify the code number for the CONFIGURATION level, take the following steps:

The process control station is in the OPERATING level.

1. Press A key. I-O appears on the display.
2. Press C or D key until CO and are displayed.
3. Press A key. flashes on the display. "1" comes up in the upper line of the display.
4. Enter the code number for servicing in the upper line of the display, using the C or D key.
5. Press A key. The currently valid code number is displayed and CO flashes.
6. Enter the new code number with the C or D key.
7. Press A key. CO no longer flashes.
8. Press F key to exit this level.

6.12. Ini level (resetting the process control station to its default values)

Resetting the process control station to its default values can be useful in the start-up phase or when the control tasks to be solved with the process control station have changed. This function is based on the setting of configuration block C56. The Ini level can only be accessed when C56 > 1.

C56	Resetting to default values
-1	No
-2	Configuration and parameterization
-3	Configuration
-4	Parameterization
-5	Zero and span adjustment of the analog inputs
-6	Span adjustment of the analog outputs
-7	Code number
-8	Controller ID number
-9	Adaptation parameters

The following steps have to be carried out:

The process control station is in the OPERATING level.

1. Set configuration block C56>1 (see above and section 6.4., p.36), then exit the CONFIGURATION level again.
2. Press A key. I-O appears on the display.
3. Press D key. Ini appears on the display.
4. Press A key twice. End and Ini appear on the display.
5. Press F key to exit this level.

Note:
After having executed this function, configuration block C56 is only reset to C56-1 when it was previously set to C56-2 or C56-3! With all other settings, the Ini level remains active! We therefore recommend to reset the configuration block to C56-1 after carrying out the function, in order to prevent the control station from starting up by mistake.

6.13. AdP level (adaptation of the control parameters)

The objective of this adaptation function is to calculate the optimum control parameters without the need to make many adjustments on the process control station or without having much previous knowledge of the process to be controlled.

The TROVIS 6412/42 Process Control Station supports the following adaptation procedures:

– Single adaptation (adaptation during the start-up phase) (see section 6.13.1.)
– Scheduling dependent on the actual value signal or output variable signal (see section 6.13.2.)
– Scheduling dependent on an external signal (see section 6.13.3.)

These adaptation procedures are suitable to be used for self-regulating processes, simple integrating controlled systems, and systems with dead times, as well as for oscillating systems.

After having terminated the adaptation procedure, the process control station uses the calculated adaptation parameters as long as – AdP on – is set in the ADAPTATION level. Otherwise, it operates with the control parameters set in the PARAMETER level. The calculated adaptation parameters can be viewed in the ADAPTATION PARAMETER level –PA AdP– at any time and can also be modified by the user, except for the parameters K_P, T_N, T_V and K_3. The parameter K_3 characterizes the type of the controlled system. K_3=1 characterizes a self-regulating system, whereas K_3=2 stands for a system which is not self-regulating.

The adaptation parameters calculated by the adaptation algorithm ensure an optimum behaviour of the controlled system when disturbances occur in the process. The parameter K5 can be used to activate an adjustable filter for the set point (reference variable) in order to obtain satisfactory reference action of the process control station when there is a step change in the set point (reference variable).

The current values of the controlled variable and the output variable are indicated on the display during the entire adaptation run.

Note:

Configuration block C56-9 resets all parameters calculated in the adaptation procedure to their default values (see also p. 45).

Requirements for adaptation

The following adjustments have to be made before conducting the adaptation:

1. Use configuration block C51 to configure the desired type of adaptation and, for cascade control, additionally C52 (for cascade control, note section 6.13.4., p. 53; how to set a configuration block is described in section 6.4., p. 36).
2. Regulate the controlled system, preferably in the MANUAL mode, and check whether the system has assumed a calm state.
3. Access the ADAPTATION level and set the adaptation parameters required for the desired adaptation procedure, see sections 6.13.1. to 6.13.3. (how to set a parameter is described in the following sections).

Opening the ADAPTATION level and accessing the adaptation steps

The process control station is in the OPERATING level. All settings required for adaptation have been made (1. and 2.).

1. Press A key.
2. Press C key twice. AdP appears on the display.
3. Press A key. AdP and oFF appear on the display.
4. Press A key. oFF changes to on which flashes on the display.
5. Press A key. The display no longer flashes.
6. Use C and D keys to change over between the following adaptation steps:
   AdP and flashing PA (adaptation parameters can be set)
   AdP and flashing Aut (controller conducts adaptation automatically)
   AdP and flashing nb (noise measurement can be initiated manually)
   AdP and flashing idF (identification can be initiated manually; not possible until after noise measurement)
   AdP and flashing Scd and AdP (calculation of section factors can be manually initiated for scheduling; not possible until after noise measurement and identification)
   AdP and on (adaptation can be switched on/off)
7. Selected the desired adaptation step, then press the A key.
   The selected adaptation step is executed.

Modifying adaptation parameters

1. Follow steps 1. to 6. as described above under "Opening the ADAPTATION level and accessing the adaptation steps". For step 6, select PA AdP .
2. Press A key. The parameter table and AP or AP 1 appear on the display. AP stands for the adaptation parameters of the fixed set point, follow up, ratio or synchro controller; AP1 stands for the parameters of the master controller.
3. The individual adaptation parameters can be selected and modified in the same way as the parameters in the PARAMETER level (see p. 32).

Completing or aborting an adaptation step

1. When defining the adaptation parameters, the parameter table and AP or AP1 appear on the display. Press F key. Press A key for all other adaptation steps. The process control station remains in the ADAPTATION level. An other adaptation step can be selected.

Completing or aborting the adaptation

1. Press F key. The process control station switches to the OPERATING level.

6.13.1. Single adaptation (adaptation during the start-up phase)

Use C 51-2 to select single adaptation. Also use C52-2 with cascade control.

The following adaptation parameters must be set before starting the adaptation algorithm:

GW X ⩡	Min. limit for the controlled variable test range in %
GW X ⩠	Max. limit for the controlled variable test range in %
GW Y_1 ⩡	Min. limit for the output variable test range in %
GW Y_1 ⩠	Max. limit for the output variable test range in %
T_S K_3	Pulse duration of the output test signal in s (for positive values) and min (for negative values)
K_5	Factor for set point (reference variable) filter

The adaptation algorithm runs through the steps noise band measurement (nb) and identification (idF).

In the noise measurement procedure, the noise band of the controlled variable is determined in several tests. The sequence of operations can be followed on the display of the process control station where changing status displays appear (see Fig. 34).

For the identification procedure, the operator has to excite the controlled system with a control pulse (T_SK_3) whose time and amplitude is limited. Then, the process control station waits for any change in behaviour of the controlled system and permanently monitors the response of the controlled variable. If the controlled variable is stationary while the pulse is still active, the adaptation algorithm determines the type of control process, the process gain, and the dynamic behaviour of the controlled process, and calculates the control parameters for, e.g. an increasing output signal.

The controlled variable is considered to be stationary when it does not exceed or fall below a factory-adjusted deviation for a certain period of time.

The control pulse is switched off when the control parameters for the increasing output signal have been calculated. The control station monitors the behaviour of the controlled system again. When the controlled variable is stationary, the control station calculates the parameters for a decreasing output signal.

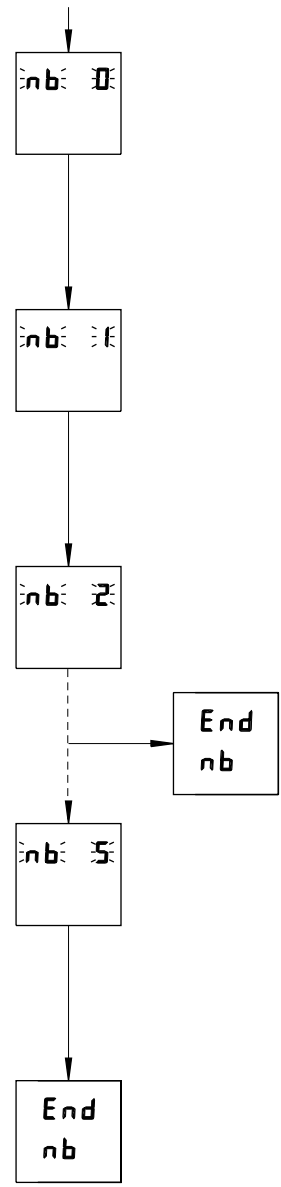
Should the controlled variable not become stationary, the process control station will provide an error message (see p. 90).

If the controlled variable threatens to leave the test range (adjusted by the operator) after exciting the controlled system, the control pulse is inactivated. A new amplitude-corrected pulse value is calculated from the characteristic of the controlled variable until the time when the pulse is switched off, and the procedure described above is repeated.

The pulse is also switched off when it exceeds the pulse time. Then, the same takes place as described above.

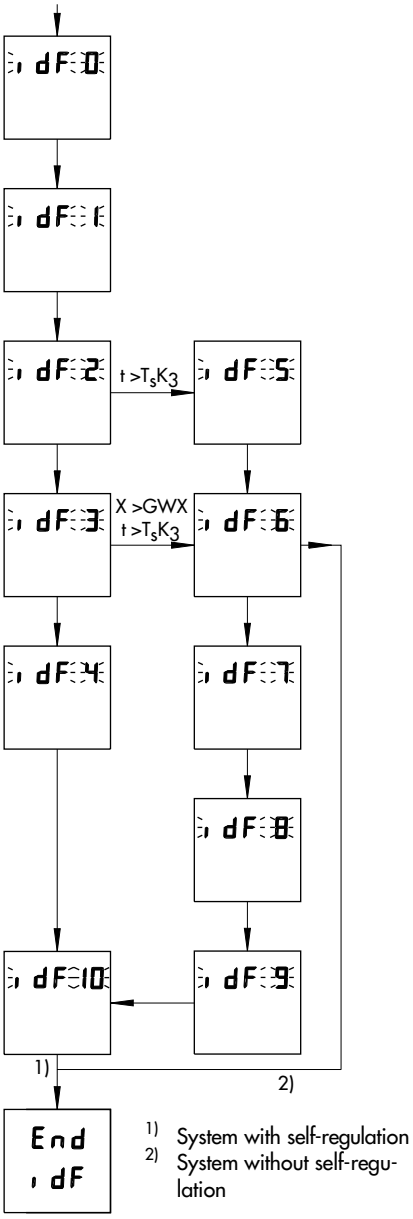
In the identification procedure, the adaptation steps are indicated on the display of the process control station in the sequence illustrated in Fig. 35. Individual steps are omitted, depending on which type of controlled system was determined.

The adaptation procedure can run automatically. Then, the adaptation step –Aut AdP– has to be accessed in the ADAPTATION level (see p. 46). At the end of the adaptation cycle, End Aut comes up on the display. The operator can carry out each adaptation step individually. In this case, first access adaptation step –nb AdP– , then –IbF AdP– (see p 46).



Status display	Sequence of operations
0	Checks starting condition
1	Start Measurement 1st interval
2	Measurement 2nd interval Calculates noise band
3	Measurement 3rd interval Calculates noise band
4	Measurement 4th interval Calculates noise band
5	Measurement 5th interval Calculates noise band
End nb	End of noise measurement

Fig. 34 · Operational flow chart for noise measurement



Status display	Sequence of operations
0	Checks starting condition Checks if system has assumed a calm state
1	Checks if pulse was imposed on system
2	Activates control pulse Waits for system response
3	System response determined
4	Controlled system stationary First calculation of control parameter set 1 (basic values) Inactivates control pulse for system response
5	Inactivates control pulse for system response
6	Inactivates control pulse First calculation of control parameter sets 1 and 2 (basic values). Changes over to selected operating mode or calculates correction of control pulse Waits for system to become stationary
7	Activates corrected control pulse Waits for system response
8	System response determined Waits for system to become stationary First calculation of control parameter set 1 (basic values)
9	Inactivates control pulse Waits for system response
10	System response determined Waits for system to become stationary First calculation of control parameter set 2 (basic values) Changes over to selected operating mode
End IdF	End of identification

Fig. 35 · Operational flow chart for identification

6.13.2. Scheduling dependent on the actual value signal or output variable signal

Scheduling dependent on the actual value signal has to be selected with configuration block C51-3, whereas scheduling dependent on the output variable signal has to be configured with C51-4. In the cascade control mode, C52-3 or C52-4 can be set to implement adaptation for the master controller loop. Note that scheduling is only supported in systems with self-regulation.

The following parameters must be set before starting the adaptation algorithm:
All parameters as for single adaptation (see section 6.13.1.) and additionally:

GW $K_2 \preceq$ Min. limit for the adaptation range in %
GW $K_2 \succ$ Max. limit for the adaptation range in %
K_4 Number of sections (maximum 7)

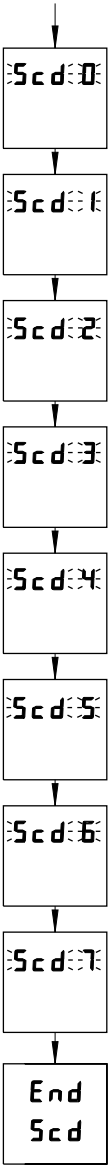
For scheduling dependent on the actual value signal, the control station must be put to the AUTOMATIC mode.

Scheduling has the objective to compensate for measurable, static non-linearities occurring in a process. This scheduling procedure is used to determine the optimum controller settings for definable sections of a selected adaptation range. The operator can choose among two scheduling procedures: 1) scheduling dependent on the controlled variable (CO 51-3) or 2) scheduling dependent on the output variable (CO 51-4). As already described above, limits for the adaptation range have to be entered, meaning, for example a range for the controlled variable. In addition, the number of sections into which this adaptation range shall be divided have to be defined. In the scheduling procedure, the controller calculates a factor for each of these sections, which modifies the proportional-action coefficient K_p. These section factors are stored as parameters $K_1\succ$ to $K_7\succ$. The reference points for the scheduling procedure are located in the middle of each section. The control parameters are linearly interpolated between these reference points. The values calculated before the first and after the last reference point are maintained constant.

First, the scheduling algorithm runs through the steps described in section 6.13.1.. Then, the process control station goes to the lower limit of the defined adaptation range and waits for the controlled system to become stationary. As soon as the system is stationary, the control station accesses the first operating point. This is done abruptly (step change) with scheduling dependent on the output variable and regularly (controlled) with scheduling dependent on the controlled variable. The operating points are located exactly on the limits of the individual sections. After having gone to the operating point, the process control station waits again for the controlled system to become stationary. Subsequently, the adaptation algorithm calculates the factor for the respective section. The procedure described above is repeated for each section.

The last part of the scheduling procedure can be followed on the display of the process control station as described in Fig. 36 .

As for single adaptation, the scheduling steps either run automatically (AdP Aut) one after the other or each step can be accessed individually (nb-idF-Scd), see. p. 46.
Also, it is possible to set all parameters to be calculated in the ADAPTATION PARAMETER level.



Display field	Status display	Sequence of operations
Scd 0	0	Checks starting condition Control pulse Beginning of adaptation range Waits for system to become stationary
Scd 1	1	Control pulse for 1st section Waits for system to become stationary Calculates section factor K_1
Scd 2	2	Control pulse for 2nd section Waits for system to become stationary Calculates section factor K_2
Scd 3	3	Control pulse for 3rd section Waits for system to become stationary Calculates section factor K_3
Scd 4	4	Control pulse for 4th section Waits for system to become stationary Calculates section factor K_4
Scd 5	5	Control pulse for 5th section Waits for system to become stationary Calculates section factor K_5
Scd 6	6	Control pulse for 6th section Waits for system to become stationary Calculates section factor K_6
Scd 7	7	Control pulse for 7th section Waits for system to become stationary Calculates section factor K_7 Changes over to selected operating mode
End Scd	End Scd	End of scheduling

Fig. 36 · Operational flow chart for scheduling

6.13.3. Scheduling dependent on an external signal

Scheduling dependent on the Y_{Actuat}-signal has to be selected with configuration block C51-5, whereas scheduling dependent on the Z-signal has to be configured with C51-6. In the cascade control mode, C52-5 or C52-6 can also be set to implement adaptation for the master controller loop.

The following parameters must be set before starting the adaptation algorithm:
All parameters as for single adaptation (see section 6.13.1.) and additionally:

GW $K_2 \preceq$	Min. limit for the adaptation range in %
GW $K_2 \succeq$	Max. limit for the adaptation range in %
K4	Number of sections (maximum 7)
$K_1 \succeq$ to $K_7 \succeq$	Factor for sections 1 to 7

The scheduling procedure dependent on an external signal is the same as the one dependent on the controlled variable or output variable signal (see section 6.13.2.). The section factors, however, are not calculated by the adaptation algorithm, but have to be entered manually in the ADAPTATION PARAMETER level PA AdP.

The adaptation range set in the factory is 10% to 90 %. The section factors are assigned the value 1.

6.13.4. Notes on adaptation

In a cascade control arrangement, adaptation must be first carried out in the follow-up or secondary control loop. The operator has to open the cascade in the OPERATING level (press B key). Then, a ■ appears in the top right corner of the display. The control station can be put either in the MANUAL or AUTOMATIC mode. After having carried out adaptation for the follow-up control loop, the cascade must be closed (press B key) and the controller must be set to the AUTOMATIC mode. Subsequently, adaptation can be implemented for the master controller loop.

The factory settings for the controlled variable test range and the output variable test range for adaptation are from 10 % to 90 %. If the operator modifies these two values, the two values should always be the same in the beginning. Should the control station indicate insufficient oscillation of the controlled variable during adaptation (cin 202, accept with A key), the output variable test range ($GWY_1 \preceq$, $GWY_1 \succeq$) has to be expanded or, if this is not permitted, the length of the control pulse (T_SK_3) has to be increased.

In case of an error, the adaptation algorithm provides different error messages. These are described in more detail in the table Error messages starting on page 90.

6.13.5. Summary of the adaptation parameters

The parameters characterized by AP apply for fixed set point, follow-up, ratio, and synchro control, as well as for the follow-up control loop in cascade control arrangements.

The parameters characterized by AP1 apply for the master control loop in a cascade control arrangement.

Parameter	Parameter-set	Designation	Range of values	Factory default
K_P	AP	Proportional-action coefficient	0.1 ... 100.0	
T_N	AP	Reset time	-1999 ... 1999	
T_V	AP	Rate time	-1999 ... 1999	
K_3	AP	Type of controlled system[1)]	0 ... 2	0
K_5	AP	Factor for set point (reference variable) filter	0.00 ... 19.99	0.00
GWK_1	AP	Noise bandwidth	0.1 ... 10.0	0.0
GWX⌅	AP	Min. limit for the controlled variable test range	0.0 ... 110.0	10.0
GWX⌃	AP	Max. limit for the controlled variable test range	0.0 ... 110.0	90.0
GWY1⌅	AP	Min. limit for the output variable test range	0.0 ... 110.0	10.0
GWY1⌃	AP	Max. limit for the output variable test range	0.0 ... 110.0	90.0
GWK_2⌅	AP	Min. limit for the adaptation range	0.0 ... 110.0	10.0
GWK_2⌃	AP	Max. limit for the adaptation range	0.0 ... 110.0	90.0
T_SK_3	AP	Pulse duration, control pulse (output test signal)	-1999 ... 1999	50.0
K_1	AP	System gain (increasing output signal)	0.1 ... 100.0	0.0
TZK_1	AP	Dead time (increasing output signal)	-1999 ... 1999	0.0
K_2	AP	System gain (decreasing output signal)	0.1 ... 100.0	0.0
TZK_2	AP	Dead time (decreasing output signal)	-1999 ... 1999	0.0
K_PK_1	AP	Basic value (increasing output signal) P-coeff.	0.1 ... 100.0	1.0
T_NK_1	AP	Basic value (increasing output signal) reset time	-1999 ... 1999	60.0
T_VK_1	AP	Basic value (increasing output signal) rate time	-1999 ... 1999	5.0
K_PK_2	AP	Basic value (decreasing output signal) P-coeff.	0.1 ... 100.0	1.0
T_NK_2	AP	Basic value (decreasing output signal) reset time	-1999 ... 1999	60.0
T_VK_2	AP	Basic value (decreasing output signal) rate time	-1999 ... 1999	5.0
K_4	AP	Number of sections	1 ... 7	5
K_1⌃	AP	Section factor 1	0.00 ... 19.99	1.00
K_2⌃	AP	Section factor 2	0.00 ... 19.99	1.00
K_3⌃	AP	Section factor 3	0.00 ... 19.99	1.00
K_4⌃	AP	Section factor 4	0.00 ... 19.99	1.00
K_5⌃	AP	Section factor 5	0.00 ... 19.99	1,00
K_6⌃	AP	Section factor 6	0.00 ... 19.99	1.00
K_7⌃	AP	Section factor 7	0.00 ... 19.99	1.00
K_P	AP1	Proportional-action coefficient	0.1 ... 100.0	

Parameter	Parameter-set	Designation	Range of values	Factory default
T_N	AP1	Reset time	-1999 … 1999	
T_V	AP1	Rate time	-1999 … 1999	
K_3	AP1	Type of controlled variable[1)]	0 … 2	0
K_5	AP1	Factor for set point (reference variable) filter	0.00 … 19.99	0.00
GWK_1	AP1	Noise bandwidth	0.1 … 10.0	0.0
GWX⌟	AP1	Min. limit for the controlled variable test range	0.0 … 110.0	10.0
GWX⌜	AP1	Max. limit for the controlled variable test range	0.0 … 110.0	90.0
GWY1⌟	AP1	Min. limit for the output variable test range	0.0 … 110.0	10.0
GWY1⌜	AP1	Max. limit for the output variable test range	0.0 … 110.0	90.0
GWK_2⌟	AP1	Min. limit for the adaptation range	0.0 … 110.0	10.0
GWK_2⌜	AP1	Max. limit for the adaptation range	0.0 … 110.0	90.0
T_SK_3	AP	Pulse duration, control pulse (output test signal)	-1999 … 1999	50.0
K_1	AP1	System gain (increasing output signal)	0.1 … 100.0	0.0
TZK_1	AP1	Dead time (increasing output signal)	-1999 … 1999	0.0
K_2	AP1	System gain (decreasing output signal)	0.1 … 100.0	0.0
TZK_2	AP1	Dead time (decreasing output signal)	-1999 … 1999	0.0
K_PK_1	AP1	Basic value (increasing output signal) P-coeff.	0.1 … 100.0	0.1
T_NK_1	AP1	Basic value (increasing output signal) reset time	-1999 … 1999	240
T_VK_1	AP1	Basic value (increasing output signal) rate time	-1999 … 1999	20.0
K_PK_2	AP1	Basic value (decreasing output signal) P-coeff.	0.1 … 100.0	0.1
T_NK_2	AP1	Basic value (decreasing output signal) reset time	-1999 … 1999	240
T_VK_2	AP1	Basic value (decreasing output signal) rate time	-1999 … 1999	20.0
K_4	AP1	Number of sections	1 … 7	5
K_1⌜	AP1	Section factor 1	0.00 … 19.99	1.00
K_2⌜	AP1	Section factor 2	0.00 … 19.99	1.00
K_3⌜	AP1	Section factor 3	0.00 … 19.99	1.00
K_4⌜	AP1	Section factor 4	0.00 … 19.99	1.00
K_5⌜	AP1	Section factor 5	0.00 … 19.99	1.00
K_6⌜	AP1	Section factor 6	0.00 … 19.99	1.00
K_7⌜	AP1	Section factor 7	0.00 … 19.99	1.00

[1)] 1: System with self-regulation
2: System without self-regulation

7. TROVIS 6482 Configuration and Parameterization Program

The TROVIS 6482 Configuration and Parameterization software program is a user-friendly MS Windows application. In addition to entering configuration and parameter data, this program also contains functions for documenting the process control station. These functions are, for example editing of plant texts, printing of configuration and parameter data, storage of different parameter and configuration data, and graphical display of analog inputs and outputs, as well as binary status displays.

The TROVIS 6482 Configuration and Parameterization program runs under Windows 3.1 or higher. The user is required to have previous knowledge of other Windows programs, which should enable him to easily operate TROVIS 6482.

TROVIS 6482 comes together with a special COPA adapter (configuration and parameterization adapter, order no. 1170-1141). This adapter enables the user to couple the process control station with a PC via the front-panel serial interface. One side of the COPA adapter is a connector, designed for connecting it to the front-panel of the process control station, whereas the other side is a 9 pin D sub socket which connects to the Com1 or Com2 interface of the PC.

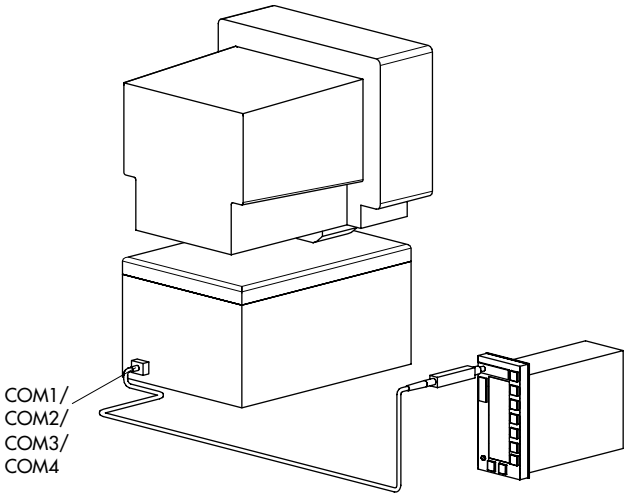


Fig. 37 · Connecting the COPA adapter to the PC

8. COPA pen

The COPA pen (COnfiguration and PArameterization pen) can be used to write to or read from the process control station all data applicable to the CONFIGURATION or PARAMETER levels. In this way, it is possible to quickly transfer data to other TROVIS 6412 or 6442 Process Control Stations.

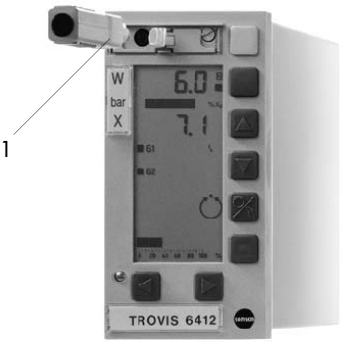
The COPA pen is assigned an identification number which is transferred to it when data is written to the pen. This number can only be defined in the TROVIS 6482 Configuration and Parameterization Program as any value between 0 and 1999, and can be used, for example for a special configuration. When plugging the COPA pen into the process control station, the control station first compares the identification number of the COPA pen with its own identification number. If these ID numbers do not correspond, COP and the identification number of the COPA pen, as well as C and the identification number of the process control station alternate on the display. In this case, data transfer is only possible when:

– The ID number of the COPA pen is 0 or
– The ID number of the process control station is 0 or was reset respectively. The ID number of the process control station can be reset with C56-8, see section 6.12., p. 45.

Proceed as follows to transfer data to or retrieve data from the COPA pen:

1. Plug COPA pen with the white marking facing upwards into the associated connector (1) located on the front-panel of the process control station. COP and the ID number appear on the display. If the ID numbers of pen and process control station do not correspond, the display alternates as described above.
2. Press A key. C and out (flashes) appear on the display. With this setting, data can be read from the process control station.

   If the data contents of the COPA pen shall be written to the process control station, press C or D key so that COP appears in the upper line of the display.
3. Press A key. After approx. 1 s End comes up in the lower line of the display.
4. Remove COPA pen. After having transferred data from the COPA pen to the process control station, the MANUAL mode is active.



1 Interface for COPA pen (adapter)

Fig. 38 · Connecting the COPA pen

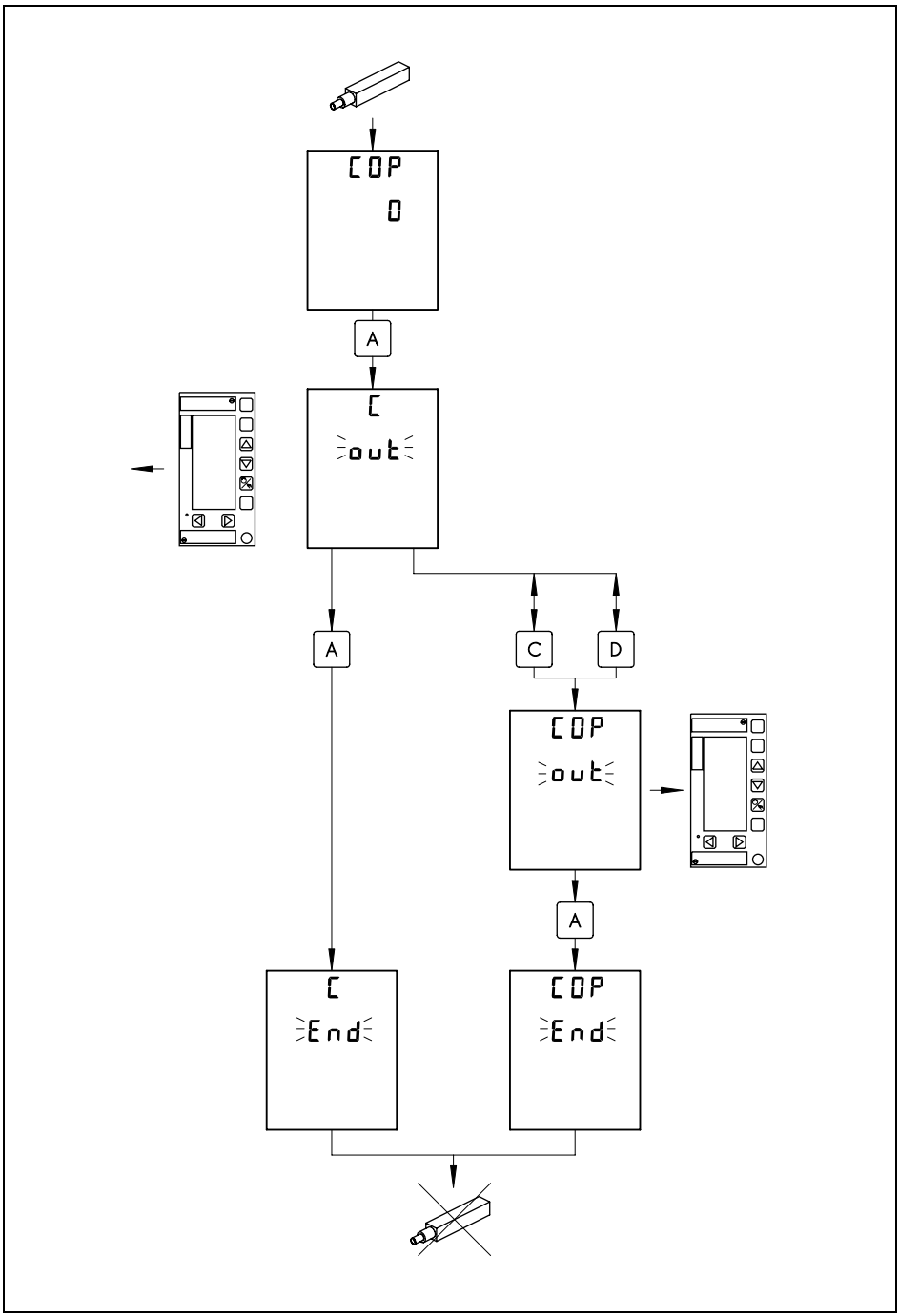


Fig. 39 · Simplified diagram showing how to use the COPA pen

9. Interface RS-485

The process control station can be optionally equipped with a serial RS-485 interface. This interface enables the user to integrate TROVIS 6412 into a process control system and, by means of a suitable software, establish a complete automation system for process control applications. The hardware configuration needed for such an automation system is described in section 9.2. The serial interface hardware meets the RS-485 (RS = Recommended Standard acc. to EIA) requirements. Communication is based on the Modbus protocol. The functions supported by the Modbus protocol are described in section 9.5. Other data are listed in the table "Technical data", starting on page 8.

The RS-485 interface of the process control station is a PCB (printed circuit board) which is installed in the associated slot of the controller case (see p. 13 , Fig. 5). If the TROVIS 6412 process control station is retrofitted with this interface board, proceed as described in section 9.6..

Fig. 7 , p. 22 and Fig. 9 , p. 24 show how to connect the data lines, based on the controller case version used.

9.1. Interface mode

Several settings of the RS-485 interface are made by means of soldering jumpers. Please note section 4.4., p. 20. The soldering jumpers on the interface board determine the baud rate, the bus termination, two-wire or four-wire connection, and the character parity.

When the RS-485 interface is to be used for communication, the following parameters have to be set in the Si level (See also section 6.6., p. 40).

- Station number (Address of process control station, range of values from 1 to 246)
- Timeout period (During this time, the central control station must have interrogated the process control station at least once. Otherwise an error is indicated on the display of the process control station. The Timeout period is only valid, when the status Timeout period is switched on (see below); range of values: –1999 to –1 for minutes; 0.1 to 1999 for seconds.)
- Status Timeout period (Timeout period can be switched –on– or –oFF–)
- Status RS-485 interface (switch interface mode –on– or –oFF–)

The interface mode is active as soon as the status RS-485 interface is switched on.

If internal communication between the process control station and the RS-485 interface is interrupted, an error is indicated after 10 s. At the same time, the symbol C ■ for "external system not ready" flashes on the display.

9.2. Network construction

Fig. 40 shows an example how to construct a network for an automation system in which data exchange is based on the Modbus protocol. A total amount of maximum 246 devices can be interrogated. First a converter, which converts the RS-232 signal from the PC into a RS-485 signal, has to be connected to the PC. A repeater is to be provided if the connecting lines are longer than 1200 m or more than 32 stations are connected to the bus. We recommend to connect a maximum of three repeaters in series. In this way, the connecting lines can cover a distance of up to 4800 m. A max. of 10 such lines can be connected in parallel when further expanding the network. A bus termination is to be provided at the end of each line segment, for example between converter and repeater, in order to discharge highly-resistive voltages.

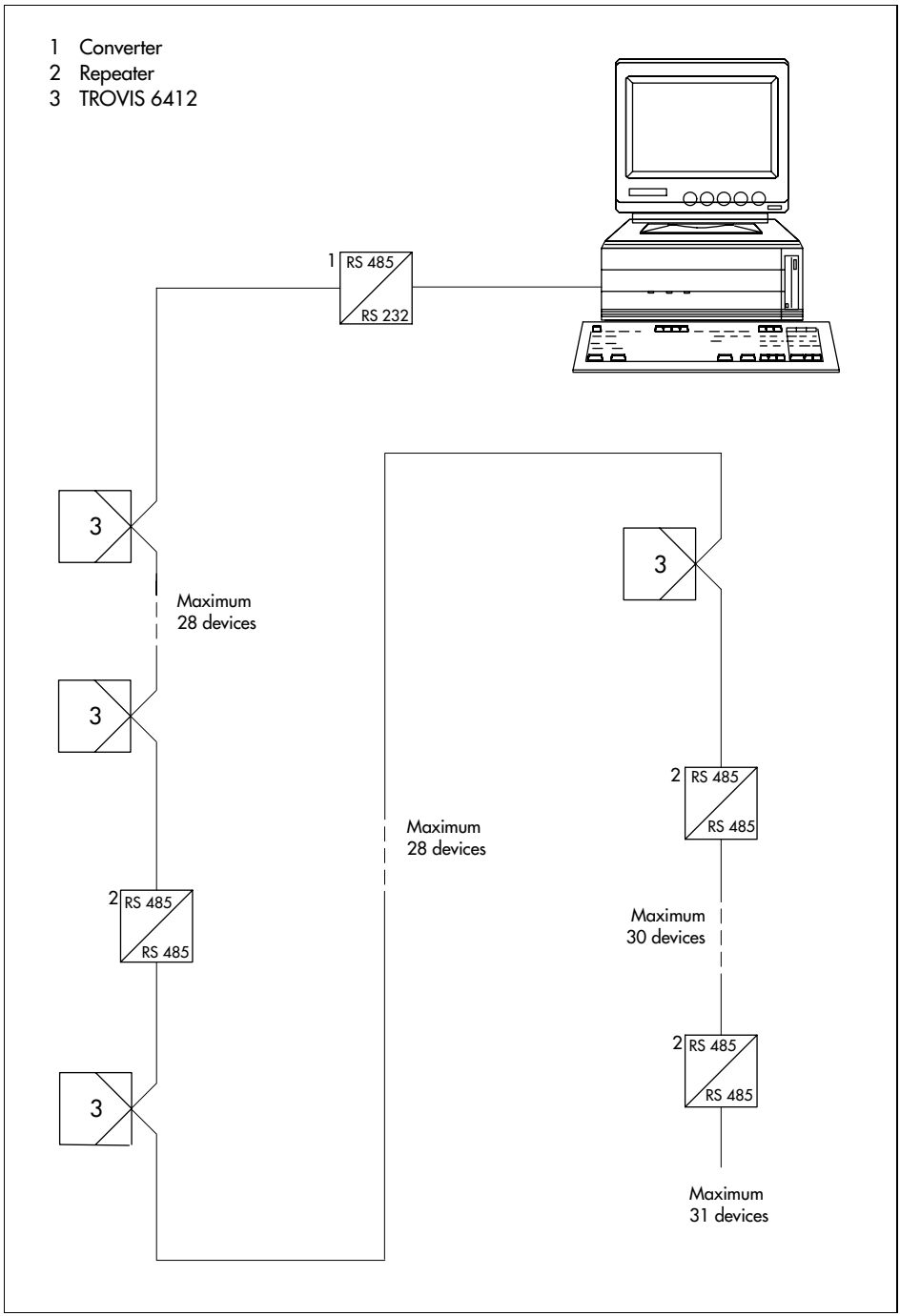


Fig. 40 · Constructing a network with converters and repeaters

9.3. Network interconnections

The individual network components can communicate with each other via the Modbus protocol, both in a four-wire system and in a two-plus-two-wire system.

In a four-wire system, the repeaters automatically switch over the direction of data transmission.

In the two-plus-two-wire system, the direction of data transmission is determined by two control lines.

9.4. Operation

The RS-485 interface is assigned its own operating level which is described in section 6.6., p. 40.

9.5. Functions supported by the Modbus protocol

The Modbus protocol covers the rules for communication between the process control station and the central control station. It is a master-slave protocol where the central control station is the master and the process control station is the slave. The process control station (slave) can therefore only reply to queries from the central control station. The Modbus function codes supported by the process control station are described in the following and explained by means of examples.

9.5.1. Function code 01 (Read Coil Status)

This function code allows to read binary information such as fault alarms, relay states or operating messages from the process control station and transmit these to the central control station.

Example: Read coils 10 to 21 from the process control station with the address 11.

Query from the central control station							
Address	Function	Starting address		Quantity of coils		Checksum	
		high	low	high	low	low	high
0B	01	00	0A	00	0C	1C	A7

Response of the process control station						
Address	Function	Quantity of bytes	Byte 1 Coil 10…17	Byte 2 Coil 18…21	Checksum	
					low	high
0B	01	02	A3	02	D8	CC

In this example, coils 10, 11, 15, 17 and 19 are set to "1". The coils in the byte have to be read from the right to the left.

Coil	17	16	15	14	13	12	11	10	
	1	0	1	0	0	0	1	1	$= A3_H$

The second byte contains the coils 18 to 21. The first four bits are "0".

Coil	X	X	X	X	21	20	19	18	
	0	0	0	0	0	0	1	0	$= 02_H$

9.5.2. Function code 02 (Read Input Status)

This function code allows to read the current status of the binary inputs bi 1, bi 2 and bi 3 directly at the input of the slave, no matter whether the respective binary input was configured in the process control station.

For the query from the central control station and the response from the process control station, see Read Coil Status (Function code 01).

9.5.3. Function code 05 (Force Single Coil)

The central control station can modify a logic condition in the process control station.

Example: Write coil 09 (MANUAL/AUTOMATIC changeover).
coil 09 must set to "0" in order to place the process control station in the AUTOMATIC mode.
In this example, the address of the process control station is 12.

Query from the control station							
Address	Function	Coil		Coil		Checksum	
		high	low	on	off	low	high
0C	05	00	09	FF	00	5D	25

Response from the process control station							
Address	Function	Coil		Coil		Checksum	
		high	low	on/off		low	high
0C	05	00	09	FF	00	5D	25

The fourth byte contains number 9 (hexadecimal). If a coil is set to "1", byte 5 must transmit the information FF. If it is to be deleted, 00 has to be transmitted.

9.5.4. Function code 03 (Read Holding Register)

Analog variables can be read from the process control station and, after conversion to the numeric format, displayed on the PC (controlled variable, set point (reference variable) etc.),.

Example: Read holding register no. 1
This register contains the device identification. The address of the process control station is 1.

Query from the control station							
Address	Function	Holding register no.		Quant. of holding registers		Checksum	
		high	low	high	low	low	high
01	03	00	00	00	01	84	0A

Response from process control station						
Address	Function	Quantity of bytes	Value of register 1		Checksum	
			high	low	low	high
01	03	02	19	0C	B3	D1

Since, in this example, only register 1 is read and this register always contains the decimal value 6412, it can be used to check the device identification.

9.5.5. Function code 04 (Read Input Register)

With this function code, the current status of the analog inputs in 1, in 2, in 3 and in 4 can be read directly at the input of the slave, no matter whether the respective analog input has been assigned the variable X, W_{EX}, Z or Y_{ACTUAT}.

For the query from the central control station and response from the process control station, see Read Holding Register (Function code 03).

9.5.6. Function code 06 (Preset Single Register)

With this function code, analog values, such as the value of the set point (reference variable) or K_P can be modified.

Example: Write holding register 106.
This is the value of the set point (reference variable) which can be written serially. The process control station has the station address 18 and operates as a fixed set point controller. A set point (reference variable) value of 10.0 is to be transmitted from the central control station to the process control station.

Query from the central control station							
Address	Function	Holding register no.		Value in register 35		Checksum	
		high	low	high	low	low	high
12	06	00	6A	00	64	AA	9E

Response from the process control station							
Address	Function	Holding register no.		Value in register 35		Checksum	
		high	low	high	low	low	high
12	06	00	6A	00	64	AA	9E

9.5.7. Function code 15 (Force Multiple Coils)

This function code allows modifying the status of multiple coils.

Example: 10 coils, starting at address 20 (13_H), are written to the process control station with the address 17. For this purpose, two bytes are transmitted.

Byte 1 = CD_H =	1	1	0	0	1	1	0	1
Coil no.	27	26	25	24	23	22	21	20
Byte 2 = 00_H =	0	0	0	0	0	0	0	0
Coil no.	0	0	0	0	0	0	29	28

In this example, "1" is written to coils 27, 26, 23, 22 and 20; "0" is written to the remaining coils.

Query from the central control station										
Address	Function	Coil address		Quant. of coils		Byte count field	Data coil 20 to 27	Data coil 28 to 29	CRC	
		high	low	high	low				low	high
11	0F	00	13	00	0A	02	CD	00	7E	CB

Response from the process control station							
Address	Function	Coil address		Quantity of coils		CRC	
		high	low	high	low	low	high
11	0F	00	13	00	0A	26	99

The master only writes to coils that are marked with R/W. When attempts are made to write to Read-Only coils, no error message is issued by the process control station. The Modbus response is sent while the Write command is still being carried out. It is therefore possible that any following Write commands are answered with error code 6 ("Busy").

9.5.8. Function code 16 (Preset Multiple Register)

This function code is used to modify values of multiple holding registers.

Example: Two holding registers, starting at address 135, are sent to the process control station with the device address 17.

Query from the central control station												
Address	Function	Address		Quant. holding reg.		Byte count field	1 data value		2 data value		CRC	
		high	low	high	low		high	low	high	low	low	high
11	10	00	87	00	02	04	00	0A	01	02	4E	BA

The value 10 (corresponds to $000A_H$) is placed into holding register 13 and the value 258 (corresponds to 0102_H) is placed into holding register 136.

Response from the process control station							
Address	Function	Coil address		Quantity of coils		CRC	
		high	low	high	low	low	high
11	10	00	87	00	02	F3	71

The master only writes to coils that are marked with R/W. When attempts are made to write to Read-Only coils, no error message is issued by the process control station. The Modbus response is sent while the Write command is still being carried out. It is therefore possible that any following Write commands are answered with error code 6 ("Busy").

9.5.9. Error messages

The process control station responds with an error message upon illegal operations between the control station (Modbus-Master) and the process control station (Modbus slave):

- Error code 01: Illegal function requested
- Error code 02: Query containing an undefined data address
- Error code 03: Query containing an illegal data value
- Error code 06: Query while the process control station is busy, COPA pin or COPA adapter with software TROVIS 6482 are being used ("Busy" message)

Example: Query for the undefined holding register 500

Query from the central control station							
Address	Function	Addressholding register		Quantity holding registers		Checksum	
		high	low	high	low	low	high
01	03	01	F4	00	01	C4	04

Response from the process control station				
Address	Function	Error message	Checksum	
			low	high
01	83	02	C0	F1

In case of an error, the function byte is combined exclusive OR with 80_H, i.e. bit 7 is set. This indicates the master (central control station) that an error has occurred.

9.5.10. Other functions

Broadcast commands of the central control station are supported.

9.6. Retrofitting the RS-485 interface

Important! When retrofitting the interface board, the soldering jumpers LB1, LB2 and LB3 on the logic board have to be closed (see section 4.2., p. 19).

Install the interface board as follows:

1. Open case of the process control station, see p. 12, section 3.3. , step 1.
2. Withdraw the controller unit from the case from the front side.
3. Unscrew the four screws (1, 2) and remove the two distance bolts (4) (see Fig. 5 , p.13).
4. Carefully withdraw the input board from the case.
5. Insert the interface board in the associated slot (s. p. 13 , Fig. 5), making sure that the components on the board face the input board and the logic board.
6. Reinstall the input board.
7. Then proceed as described under 8. to 10. in section 3.3., p. 13.

10. Start-up procedure

Before installing or putting the process control station into operation, all characteristics of the input and output signals and the code number have to be determined by means of the associated soldering jumpers (see section 4., p. 14).

When all input and output connections are made and power is supplied to the process control station, it has to be tuned for the respective control task. For this purpose, the process control station must be configured. This can be done either manually by setting the configuration blocks in the CONFIGURATION level (see section 6.4.), by means of a COPA pen (see section 8.), or by using the TROVIS 6482 Configuration and Parameterization Program (see section 7.). The configuration settings made can be recorded in a checklist given in Appendix C . The TROVIS 6482 Configuration and Parameterization Program provides the option of printing a similar list on request. The options assigned to the individual configuration blocks are described in more detail in *Configuration manual KH 6412 E*.

The parameters K_P, T_N and Tv can be set and modified either by means of the adaptation algorithm of the process control station (see section 6.13., p. 46) or in a manual optimization procedure. The latter is described in general in the following section.

10.1. Optimization (tuning the process control station to the controlled system)

The process control station must be tuned to the dynamic behaviour of the loop, using the parameters K_P, T_N and Tv in order to compensate for control deviations caused by disturbances by reducing these to zero or maintain them in very confined limits.

If you do not have previous experience in selecting values for the control loop, proceed according to the following basic procedure:

The connected control valve must be closed, before starting the optimization.

1. Switch the MANUAL/AUTOMATIC mode selector key (E) to MANUAL mode. The symbol comes up on the display.
2. Hold down the (H) key until only the first bar of the bar graph for the output variable (14) is displayed.
3. Proceed according to the control mode selected (see below).

Proportional (P) controller

- Specify K_P = 0.1 in the PARAMETER level.
- Enter the desired value of the set point (reference variable) in the OPERATING level.
- Then modify the output variable by pressing the (G) key until the control valve slowly opens and the error X_d is eliminated.
- Switch over to AUTOMATIC mode by pressing the MANUAL/AUTOMATIC key.
- Increase the K_P value in the PARAMETER level until the controlled systems tends to hunt.
- Slightly reduce the K_P value until oscillation cannot be determined any more.
- Eliminate steady-state deviation as follows: Switch the controller to the MANUAL mode. Modify the output variable until the error X_d = 0. Read off the displayed output variable and enter this value for parameter K_1.

Important: Any modification of the set point (reference variable) causes a change of the operating point K_1!

Proportional-plus-integral (PI) controller

- Specify K_P = 0.1 ; T_N = 1999 in the PARAMETER level.
- Enter the value of the desired set point (reference variable) in the OPERATING level.
- Then modify the output variable by pressing the (G) key until the control valve slowly opens and the error X_d is eliminated.
- Switch over to AUTOMATIC mode by pressing the MANUAL/AUTOMATIC key.
- Increase the K_P value in the PARAMETER level until the controlled system tends to hunt.
- Slightly reduce the K_P value until oscillation cannot be determined any more.
- Reduce the T_N value in the PARAMETER level until the controlled system tends to hunt.
- Slightly increase the T_N value until oscillation cannot be determined any more.

Proportional-plus-derivative (PD) controller

- Specify K_P = 0.1; Tv = 1 and the rate gain TvK_1 = 1 in the PARAMETER level.
- Enter the value of the desired set point (reference variable) in the OPERATING level.
- Then modify the output variable by pressing the (G) key until the control valve slowly opens and the error X_d is eliminated.
- Switch over to AUTOMATIC mode by pressing the MANUAL/AUTOMATIC key.
- Increase the K_P value in the PARAMETER level until the controlled system tends to hunt.
- Increase the Tv value until oscillation cannot be determined any more.
- Increase the K_P value until oscillation reoccurs.
- Increase the Tv value again until oscillation cannot be determined any more.
- Repeat this procedure several times until oscillation cannot be suppressed any longer.
- Slightly reduce the K_P value and the Tv value so that the system can recover.
- Eliminate steady-state deviation as follows:
- Set configuration block C28-2. This activates setting of the operating point via the MANUAL mode.
- Switch to MANUAL mode by pressing the MANUAL/AUTOMATIC key.
- Modify the output variable until the error X_d is eliminated.
- Switch to AUTOMATIC mode by pressing the MANUAL/AUTOMATIC key.
  The output variable is stored and applied to the controller output as operating point.

Important: Any modification of the set point (reference variable) causes a change of the operating point.

Proportional-plus-integral-plug-derivative (PID) controller

- Specify K_P = 0.1 ; T_N = 1999 and Tv = 1 in the PARAMETER level.
- Enter the value of the desired set point (reference variable) in the OPERATING level.
- Then modify the output variable by pressing the (G) key until the control valve slowly opens and the error X_d is eliminated.
- Switch over to AUTOMATIC mode by pressing the MANUAL/AUTOMATIC key.
- Increase the K_P value in the PARAMETER level until the controlled system tends to hunt.
- Increase the Tv value until oscillation cannot be determined any more.
- Increase the K_P value until oscillation reoccurs.
- Increase the Tv value again until oscillation cannot be determined any more.
- Repeat this procedure several times until oscillation cannot be suppressed any longer.
- Slightly reduce the K_P value and the Tv value so that the system can recover.
- Reduce the T_N value until the control loop tends to hunt again, and then slightly increase value again until oscillation cannot be determined any more.

Appendix A Data Point List for the RS 485-Interface

Holding Registers Data Point List

HR No.	Designation of data point	Access [1]	Transmission range	Display range	Comments
1	Device identification	R	6412	6412	Register only readable; transmits the device identification
2	Variant/version	R	100 ... 64999	0...64/1.00...9.99	0 = Standard variant 1 = Special variant 2 = Development variant /version number
Controller inputs according to their assignment to the analog inputs (C10,C11,C12,C13)					
3	X	R/W	-200 ... 1200	-20.0% ...120.0% [6]	Internally used variables according to their assignment to the analog inputs; can only be written to when no analog input is assigned
4	W_{EX}	R/W	-200 ... 1200	-20.0% ...120.0% [6]	
5	Z	R/W	-200 ... 1200	-20.0% ...120.0% [6]	
6	Y_{STELL}	R/W	-200 ... 1200	-20.0% ...120.0% [6]	
Analog outputs					
7	Y_1	R	-100 ... 1100	-10.0% ... 110.0%	Analog variables which are available at the respective analog output
8	Y_2	R	-100 ... 1100	-10.0% ... 110.0%	
9	Ao1	R	-100 ... 1100	-10.0% ... 110.0%	
Operating data					
10	Set point (reference variable) display 1 acc. to C4	R	-100 ... 1100	-10.0% ... 110.0%	
11	Controlled variable display 1 acc. to C4	R	-100 ... 1100	-10.0% ... 110.0%	
12	Set point (reference variable) display 2 acc. to C4	R	-100 ... 1100	-10.0% ... 110.0%	
13	Controlled variable display 2 acc. to C4	R	-100 ... 1100	-10.0% ... 110.0%	

HR No.	Designation of data point	Access [1]	Transmission range	Display range	Comments
14	Internal Y_{PID}-signal	R/W	-100 … 1100	-10.0% … 110.0%	Adjustable in MANUAL mode
15	Controller ID number	R/W[10]	0 … 19990	0.0 … 1999.0	4-digit number to identify the controller in the plant, see also p. 58
16	Timeout period Interface	R/W[10]	-19990… -10 10 … 19990	-1999.0…-1.0 (minutes) 1.0…1999.0 (seconds)	Time during which the device must have been interrogated at least once by the central control station, otherwise cin 6 error display and LED and bo3 alternate
17	Reserved				
18	Reserved				
19	Reserved				
20	Reserved				
21	Reserved				
Status messages					
22	Transmitter fault	R	0 … 65535	0 … 15	Display: Values out of measuring range
23	Checksum error Data	R	0 … 65535	0 … 32 [5]	Checksum of permanently stored data has changed without operator intervention; check data
24	Program error Data	R	0 … 65535	0 … 16 [5]	Re-program
25	Adaptation Status	R	0 … 65535	0 …100	[9]
26	Adaptation Program	R	0 … 65535	0 … 255	[9]
27	Programming Status	R	0 … 65535	0 … 255	[9]

HR No.	Designation of data point		Access [1]	Transmission range	Display range	Comments
28		Programming Error	R	0 … 65535	0 …255	[9]
29		Reserved				
Configuration blocks [7], [10]						Details, see *KH 6412 E*
30	C 1	Control mode	R/W[10]	0 … 16	0 … 16	
31	C 2	Secondary controlled variable/feedforward control	R/W[10]	0 … 16	0 … 16	
32	C 3	Calculation specification, feedforward control	R/W[10]	0 … 16	0 … 16	
33	C 4	Configuration of digital displays	R/W[10]	0 … 16	0 … 16	
34	C 5	Configuration of controller outputs	R/W[10]	0 … 16	0 … 16	
35	C 6	Inversion of error signal	R/W[10]	0 … 16	0 … 16	
36	C 7	Function generation	R/W[10]	0 … 16	0 … 16	
37	C 8	Combination of input variables	R/W[10]	0 … 16	0 … 16	
38	C 9	Root extraction of input variables	R/W[10]	0 … 16	0 … 16	
39	C10	Assignment of controller inputs to X - input	R/W[10]	0 … 16	0 … 16	
40	C11	Assignment of controller inputs to W_{EX} - input	R/W[10]	0 … 16	0 … 16	
41	C12	Assignment of controller inputs to Z - input	R/W[10]	0 … 16	0 … 16	
42	C13	Assignment of controller inputs to $Y_{ACTUAT.}$ - input	R/W[10]	0 … 16	0 … 16	
43	C14	Zero and span adjustment, analog inputs and outputs	R/W[10]	0 … 16	0 … 16	
44	C15	Monitoring of measuring range	R/W[10]	0 … 16	0 … 16	
45	C16	Set point (reference variable) ramp	R/W[10]	0 … 16	0 … 16	
46	C17	Configuration of binary input bi 1	R/W[10]	0 … 16	0 … 16	
47	C18	Configuration of binary input bi 2	R/W[10]	0 … 16	0 … 16	
48	C19	Configuration of binary input bi 3	R/W[10]	0 … 16	0 … 16	
49	C20	Set point (reference variable) limitation or reciprocal set point or actual value ratio	R/W[10]	0 … 16	0 … 16	
50	C21	Set point (ref. variable) upon failure of external system	R/W[10]	0 … 16	0 … 16	
51	C22	Assignment of internal set point	R/W[10]	0 … 16	0 … 16	

HR No.	Designation of data point		Access [1]	Transmission range	Display range	Comments
52	C23	X-tracking	R/W10)	0 … 16	0 … 16	
53	C24	Dynamic behaviour of controller output	R/W10)	0 … 16	0 … 16	
54	C25	Dynamic behaviour of controller output (MaC, LiC)	R/W10)	0 … 16	0 … 16	
55	C26	Assignment of D-element	R/W10)	0 … 16	0 … 16	
56	C27	Filtering of input variables and error signal	R/W10)	0 … 16	0 … 16	
57	C28	Operating point adjustment via manual mode	R/W10)	0 … 16	0 … 16	
58	C29	Change of control action	R/W10)	0 … 16	0 … 16	
59	C30	Operating point adjustment via set point (ref. variable)	R/W10)	0 … 16	0 … 16	
60	C31	Output signal ranges	R/W10)	0 … 16	0 … 16	
61	C32	Output signal action	R/W10)	0 … 16	0 … 16	
62	C33	Externally or internally controlled output signal limitation	R/W10)	0 … 16	0 … 16	
63	C34	Output ramp or limitation of the rate of output changes	R/W10)	0 … 16	0 … 16	
64	C35	Output signal limitation	R/W10)	0 … 16	0 … 16	
65	C36	Output signal limitation inactivated in manual mode	R/W10)	0 … 16	0 … 16	
66	C37	Changeover to manual mode upon transmitter failure	R/W10)	0 … 16	0 … 16	
67	C38	Assignment of output variable display	R/W10)	0 … 16	0 … 16	
68	C39	Inversion of output variable display	R/W10)	0 … 16	0 … 16	
69	C40	Assignment of limit relay G 1	R/W10)	0 … 16	0 … 16	
70	C41	Assignment of limit relay G 2	R/W10)	0 … 16	0 … 16	
71	C42	Display of control valve - closed position	R/W10)	0 … 16	0 … 16	
72	C43	Restart conditions following power supply failure	R/W10)	0 … 16	0 … 16	
73	C44	Configuration of binary output bo 1	R/W10)	0 … 16	0 … 16	
74	C45	Configuration of binary output bo 2	R/W10)	0 … 16	0 … 16	
75	C46	Repetition rate of digital displays	R/W10)	0 … 16	0 … 16	
76	C47	Display range of error signal	R/W10)	0 … 16	0 … 16	

HR No.	Designation of data point		Access [1]	Transmission range	Display range	Comments
77	C48	Assignment of analog output Ao 1	R/W[10]	0 … 16	0 … 16	
78	C49	Power frequency	R/W[10]	0 … 16	0 … 16	
79	C50	Dynamic behaviour of PD - elements	R/W[10]	0 … 16	0 … 16	
80	C51	Adaptation of control parameters (FSP,FU,RC,SY) (FoC,PrC)	R/W[10]	0 … 16	0 … 16	
81	C52	Adaptation of control parameters (MaC)	R/W[10]	0 … 16	0 … 16	
82	C53	Adaptation of measuring range of X-/W_{EX}-input	R/W[10]	0 … 16	0 … 16	
83	C54	Input board used	R/W[10]	0 … 16	0 … 16	
84	C55	Selection of thermocouple	R/W[10]	0 … 16	0 … 16	
85	C56	Standard initialization	R/W[10]	0 … 16	0 … 16	
86	C57	Decimal point in digital display fields	R/W[10]	0 … 16	0 … 16	
87	C58	Decimal point in digital display fields (PrC, FoC)	R/W[10]	0 … 16	0 … 16	
88	C59	Locking of operator button/security option for preventing modification of configuration and parameters	R/W[10]	0 … 16	0 … 16	
89	C60	Reserved	R	0	0	
90	C61	Reserved	R	0	0	
91	C62	Reserved	R	0	0	
92	C63	Reserved	R	0	0	
93	C64	Reserved	R	0	0	
Parameters [7]						Details, see *KH 6412 E*
94		Internally used	R	-19990…19990	-1999.0…1999.0 [2]	
95	Xmin	Min. measuring range limit	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
96	Xmax	Max. measuring range limit	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
97		Internally used	R	-19990…19990	-1999.0…1999.0 [2]	
98	W_{EX}min	Min. measuring range limit	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
99	W_{EX}max	Max. measuring range limit	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
100		Internally used	R	0 … 1999	0…19.99 [3]	

HR No.	Designation of data point		Access [1]	Transmission range	Display range	Comments
101	Zmin	Min. limitation (RC1, RC2)	R/W[10]	0 … 1999	0…19.99 [3]	
102	Zmax	Max. limitation (RC1, RC2)	R/W[10]	0 … 1999	0…19.99 [3]	
103		Internally used	R	-19990…19990	-1999.0…1999.0 [2]	
104	Zmin	Min. measuring range limit	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
105	Zmax	Max. measuring range limit	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
106	W_{IN}	Internal set point	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
107	W_{IN}min	Min. measuring range limit	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
108	W_{IN}max	Max. measuring range limit	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
109	$W_{IN}K_1$min	Set point adjustment range	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
110	$W_{IN}K_1$max	Set point adjustment range	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
111	W_{IN}	Internal set point ratio (RC1, RC2)	R/W[10]	0 … 1999	0.00…19.99 [3]	
112	W_{IN}min	Min. limitation (RC1, RC2)	R/W[10]	0 … 1999	0.00…19.99 [3]	
113	W_{IN}max	Max. limitation	R/W[10]	0 … 1999	0.00…19.99 [3]	
114	W_S	Safety set point	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
115	$W_S$min	Min. measuring range limit	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
116	$W_S$max	Max. measuring range limit	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
117	W_S	Safety set point ratio (RC1, RC2)	R/W[10]	0 … 1999	0.00 …19.99 [3]	
118		Internally used	R	0 … 65535	0 … 65535	
119		Reserved 26	R	0	0	
120		Reserved 27	R	0	0	
121	TZX_d	Dead band, error signal	R/W[10]	0 … 1100	0.0 … 110.0	
122	$X_{SD}Y_1$	Hysteresis, limiting controller	R	0	0	
123	$X_{SD}Y_2$	Hysteresis, on-off/3-step output	R/W[10]	1 … 1000	0.1 … 100.0	
124	X_{SD}G1	Hysteresis, limit relay	R/W[10]	1 … 1000	0.1 … 100.0	
125	X_{SD}G2	Hysteresis, limit relay	R/W[10]	1 … 1000	0.1 … 100.0	
126	TZ	Dead band, 3-step output/threshold	R/W[10]	1 … 1000	0.1 … 100.0	
127	TZY_1	Dead band point, split-range mode	R/W[10]	1 … 1000	0.1 … 100.0	

HR No.	Designation of data point		Access [1]	Transmission range	Display range	Comments
128	TZY_2	Dead band point, split-range mode	R/W[10]	1 … 1000	0.1 … 100.0	
129	K_P	Proportional-action coefficient	R/W[10]	1 … 1000	0.1 … 100.0	
130	T_N	Reset time	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
131	T_V	Rate time	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
132	T_VK_1	Rate gain	R/W[10]	1 … 100	0.1 …10.0	
133	K_PY_1	Gain, output variable	R/W[10]	1 … 100	0.1 …10.0	
134	K_PY_2	Gain, output variable	R/W[10]	1 … 100	0.1 …10.0	
135	K_PK_2	Gain, PD-element 1	R/W[10]	1 … 1000	0.1 …100.0	
136	T_VK_2	Rate time, PD-element 1	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
137	K_{PK3}	Gain, PD-element 2	R/W[10]	1 …1000	0.1 …100.0	
138	T_{VK3}	Rate time, PD-element 2	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
139	Y_{1K3}	Constant for Y_{PID}	R/W[10]	-100 …1100	-10.0 …110.0	
140	Y_1	Internally used	R	-100 …1100	-10.0 …110.0	
141	Y_1K_1	Safety output value	R/W[10]	-100 …1100	-10.0 …110.0	
142	Y_1min	Output variable limit, min.	R/W[10]	-100 …1100	-10.0 …110.0	
143	Y_1max	Output variable limit, max.	R/W[10]	-100 …1100	-10.0 …110.0	
144	Y_2	Internally used	R	-100 …1100	-10.0 …110.0	
145	Y_2K_1	Safety output value	R/W[10]	-100 …1100	-10.0 …110.0	
146	Y_2min	Output variable limit, min.	R/W[10]	-100 …1100	-10.0 …110.0	
147	Y_2max	Output variable limit, max.	R/W[10]	-100 …1100	-10.0 …110.0	
148	T_{Y1}	Period/actuating time	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
149	T_{Y1}min	Min. on-time	R/W[10]	1 … 100	0.1 …10.0	
150	Y_1K_2	Gain, threshold	R/W[10]	0 … 1100	0.0 … 110.0	
151	T_{Y2}	Period/actuating time	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
152	T_{Y2}min	Min. on-time	R/W[10]	1 … 100	0.1 …10.0	
153	Y_2K_2	Gain, threshold	R/W[10]	0 … 1100	0.0 … 110.0	
154	T_S_X	Time parameter X-filter	R/W[10]	1 … 1000	0.1 … 100.0	

HR No.	Designation of data point		Access [1]	Transmission range	Display range	Comments
155	T_S_W_{EX}	Time parameter W_{EX}-filter	R/W[10]	1 … 1000	0.1 … 100.0	
156	T_S_Z	Time parameter Z-filter	R/W[10]	1 … 1000	0.1 … 100.0	
157	T_S_X_d	Time parameter X_d-filter	R/W[10]	1 … 1000	0.1 … 100.0	
158	T_S	Time parameter, set point ramp	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
159	Y_2K_3min	Min. switch point, maintained signal	R/W[10]	-100 … 1100	-10.0 … 110.0	
160	Y_2K_3max	Max. switch point, maintained signal	R/W[10]	-100 … 1100	-10.0 … 110.0	
161	T_SK_1	Time parameter, output ramp	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
162	T_SK_2	Time parameter, change of control action	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
163	GWG1	Limit value, limit relay 1	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
164	GWG2	Limit value, limit relay 2	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
165		Reserved 72	R	0	0	
166		Reserved 73	R	0	0	
167		Reserved 74	R	0	0	
168		Reserved 75	R	0	0	
169		Reserved 76	R	0	0	
170		Reserved 77	R	0	0	
171		Reserved 78	R	0	0	
172		Reserved 79	R	0	0	
173		Reserved 80	R	0	0	
174		Reserved 81	R	0	0	
175		Reserved 82	R	0	0	
176		Reserved 83	R	0	0	
177		Reserved 84	R	0	0	
178		Reserved 85	R	0	0	
179		Reserved 86	R	0	0	
180		Reserved 87	R	0	0	
181		Reserved 88	R	0	0	

HR No.	Designation of data point		Access [1]	Transmission range	Display range	Comments
182		Reserved 89	R	0	0	
183		Reserved 90	R	0	0	
184		Reserved 91	R	0	0	
185		Reserved 92	R	0	0	
186		Reserved 93	R	0	0	
187		Reserved 94	R	0	0	
188		Reserved 95	R	0	0	
189		Reserved 96	R	0	0	
190		Reserved 97	R	0	0	
191		Reserved 98	R	0	0	
192		Reserved 99	R	0	0	
193		Reserved 100	R	0	0	
194		Reserved 101	R	0	0	
195		Reserved 102	R	0	0	
196		Reserved 103	R	0	0	
197		Reserved 104	R	0	0	
198		Reserved 105	R	0	0	
199		Reserved 106	R	0	0	
200		Reserved 107	R	0	0	
201		Reserved 108	R	0	0	
202		Reserved 109	R	0	0	
203	K_1	Y-rate action	R/W[10]	-1100 ... 1100	-110.0 ... 110.0	
204	K_1min	Input signal, coordinate 1 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
205	K_1max	Output signal, coordinate 1 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
206	K_2	Constant	R/W[10]	-1100 ... 1100	-110.0 ... 110.0	
207	K_2min	Input signal, coordinate 2 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
208	K_2max	Output signal, coordinate 2 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	

HR No.	Designation of data point		Access [1]	Transmission range	Display range	Comments
209	K_3	Constant	R/W[10]	0 … 1100	0.0 … 110.0	
210	K_3min	Input signal, coordinate 3 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
211	K_3max	Output signal 3 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
212	K_4	Constant	R/W[10]	0 … 1999	0.00 … 19.99 [3]	
213	K_4min	Input signal, coordinate 4 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
214	K_4max	Output signal, coordinate 4 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
215	K_5	Constant	R/W[10]	-1100 … 1100	-110.0 … 110.0	
216	K_5min	Input signal, coordinate 5 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
217	K_5max	Output signal, coordinate 5 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
218	K_6	Constant	R/W[10]	0 … 1100	0.0 … 110.0	
219	K_6min	Input signal, coordinate 6 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
220	K_6max	Output signal, coordinate 6 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
221	K_7	Constant	R/W[10]	-1100 …1100	-110.0 …110.0	
222	K_7min	Input signal, coordinate 7 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
223	K_7max	Output signal, coordinate 7 (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
224	K_8	Correction factor for Y-input	R/W[10]	0 … 1999	0.00 … 19.99 [3]	
225	K_8min	Min. output signal (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
226	K_8max	Max. output signal (function generation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
227	K_9	Constant	R/W[10]	-1999 … 1999	-19.99…19.99 [3]	
228		Reserved 135	R	0	0	
229		Reserved 136	R	0	0	
230	W_{IN}	Internal set point (FoC, MaC)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
231	W_{IN}min	Min. measuring range limit (FoC, MaC)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
232	W_{IN}max	Max. measuring range limit (FoC, MaC)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
233	$W_{IN}K_1$min	Set point adjustment range (FoC, MaC)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
234	$W_{IN}K_1$max	Set point adjustment range (FoC, MaC)	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
235		Internally used	R	-1100 … 1100	-110.0 … 110.0	

HR No.	Designation of data point		Access [1]	Transmission range	Display range	Comments
236	K_P	Proportional-action coefficient	R/W[10]	1 … 1000	0.1 … 100.0	
237	T_N	Reset time	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
238	T_V	Rate time	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
239	T_VK_1	Rate gain	R/W[10]	1 …100	0.1 …10.0	
240	K_1	Y-rate action	R/W[10]	-1100 …1100	-110.0 … 110.0	
241	Y_1min	Output variable limit, min. (FoC, MaC)	R/W[10]	0 … 1100	0.0 … 110.0	
242	Y_1max	Output variable limit, max. (FoC, MaC)	R/W[10]	0 … 1100	0.0 … 110.0	
243	K_1_X	Constant	R/W[10]	-1999…1999	-19.99…19.99 [3]	
244	K_1_Z	Constant	R/W[10]	-1999…1999	-19.99…19.99 [3]	
245	K_2_X	Constant	R/W[10]	-1999…1999	-19.99…19.99 [3]	
246	K_2_Z	Constant	R/W[10]	-1999…1999	-19.99…19.99 [3]	
247	K_1_W_{EX}	Constant	R/W[10]	-1999…1999	-19.99…19.99 [3]	
248	K_PK_1	Gain Ao 1 - output	R/W[10]	1 … 100	0.1 … 10.0	
249	Y_1K_4	Safety output (FoC, MaC)	R/W[10]	-100 … 1100	-10.0 …110.0	
250	GWK$_1$min	Min. measuring range limit in 1	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
251	GWK$_1$max	Max. measuring range limit in 1	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
252	GWK$_2$min	Min. measuring range limit in 2	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
253	GWK$_2$max	Max. measuring range limit in 2	R/W[10]	-19990…19990	-1999.0…1999.0 [2]	
254	Y_1K_5	Constant	R/W[10]	0 … 1100	0.0 … 110.0	
255	$W_{IN}K_2$	Set point step change	R/W[10]	0 … 1100	0.0 … 110.0	
256	GWK$_3$	Switch point, change of control action	R/W[10]	0 … 1100	0.0 … 110.0	
257	GWK$_4$	Switch point, change of control action	R/W[10]	0 … 1100	0.0 … 110.0	
258	GWK$_5$	Switch point, change of control action	R/W[10]	0 … 1100	0.0 … 110.0	
259	GWK$_6$	Switch point, change of control action	R/W[10]	0 … 1100	0.0 … 110.0	
260		Reserved 167	R	0	0	
261		Reserved 168	R	0	0	
262		Reserved 169	R	0	0	

HR No.	Designation of data point		Access [1]	Transmission range	Display range	Comments
263		Internally used	R	1 …1000	0.1 …100.0	
264		Internally used	R	-19990…19990	-1999.0…1999.0 [2], [8]	
265		Internally used	R	-19990…19990	-1999.0…1999.0 [2], [8]	
266		Internally used	R	0 … 7	0 … 7	
267	K_5_C1	Factor for set point (reference variable) filter (adapt.)	R/W[10]	0 … 1999	0.00 … 19.99 [3]	
268	GWK_1_C1	Noise bandwidth (adaptation)	R/W[10]	1 … 100	0.1 … 10.0	
269	GWXmin_C1	Min. limit for controlled variable test range (adapt.)	R/W[10]	0 … 1100	0.0 … 110.0	
270	GWXmax_C1	Max. limit for controlled variable test range (adapt.)	R/W[10]	0 … 1100	0.0 … 110.0	
271	GWY_1min_C1	Min. limit for output variable test range (adaptation)	R/W[10]	0 … 1100	0.0 … 110.0	
272	GWY_1max_C1	Max. limit for output variable test range (adaptation)	R/W[10]	0 … 1100	0.0 … 110.0	
273	GWK_2min_C1	Min. limit for adaptation range (adaptation)	R/W[10]	0 … 1100	0.0 … 110.0	
274	GWK_2max_C1	Max. limit for adaptation range (adaptation)	R/W[10]	0 … 1100	0.0 … 110.0	
275	T_SK_3_C1	Pulse duration, control pulse (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
276	K_1_C1	System gain (increasing) (adaptation)	R/W[10]	1 … 1000	0.1 … 100.0	
277	TZK_1_C1	Dead time (increasing) (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
278		Internally used	R	-19990…19990	-1999.0…1999.0 [2], [8]	
279	K_2_C1	System gain (decreasing) (adaptation)	R/W[10]	1 … 1000	0.1 … 100.0	
280	TZK_2_C1	Dead time (decreasing) (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
281		Internally used	R	-19990…19990	-1999.0…1999.0 [2], [8]	
282		Internally used	R	-19990…19990	-1999.0…1999.0 [2], [8]	
283		Internally used	R	-19990…19990	-1999.0…1999.0 [2], [8]	
284	K_PK_1_C1	Basic value (increas.) P-action coefficient (adaptation)	R/W[10]	1 … 1000	0.1 … 100.0	
285	T_NK_1_C1	Basic value (increasing) reset time (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
286	T_VK_1_C1	Basic value (increasing) rate time (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
287	K_PK_2_C1	Basic value (decreasing) P-action coeff. (adaptation)	R/W[10]	1 … 1000	0.1 … 100.0	
288	T_NK_2_C1	Basic value (decreasing) reset time (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2],[8]	
289	T_VK_2_C1	Basic value (decreasing) rate time (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	

HR No.	Designation of data point		Access [1]	Transmission range	Display range	Comments
290	K_4_C1	Number of sections (adaptation)	R/W[10]	1 … 7	1 … 7	
291	K_1max_C1	Section factor 1 (adaptation)	R/W[10]	0 …1999	0.0 …19.99 [3]	
292	K_2max_C1	Section factor 2 (adaptation)	R/W[10]	0 …1999	0.0 …19.99 [3]	
293	K_3max_C1	Section factor 3 (adaptation)	R/W[10]	0 … 1999	0.0 …19.99 [3]	
294	K_4max_C1	Section factor 4 (adaptation)	R/W[10]	0 … 1999	0.0 …19.99 [3]	
295	K_5max_C1	Section factor 5 (adaptation)	R/W[10]	0 … 1999	0.0 …19.99 [3]	
296	K_6max_C1	Section factor 6 (adaptation)	R/W[10]	0 … 1999	0.0 …19.99 [3]	
297	K_7max_C1	Section factor 7 (adaptation)	R/W[10]	0 … 1999	0.0 …19.99 [3]	
298		Reserved 205	R	0	0	
299		Reserved 206	R	0	0	
300		Reserved 207	R	0	0	
301		Reserved 208	R	0	0	
302		Reserved 209	R	0	0	
303		Internally used	R	1 … 1000	0.1 … 100.0	
304		Internally used	R	-19990…19990	-1999.0…1999.0 [2], [8]	
305		Internally used	R	-19990…19990	-1999.0…1999.0 [2], [8]	
306		Internally used	R	0 … 7	0 … 7	
307	K_5_C2	Factor for set point (reference variable) filter (adapt.)	R/W[10]	0 …1999	0.00 …19.99 [3]	
308	GWK_1_C2	Noise bandwidth (adaptation)	R/W[10]	1 … 100	0.1 … 10.0	
309	GWXmin_C2	Min. limit for controlled variable test range (adapt.)	R/W[10]	0 … 1100	0.0 … 110.0	
310	GWXmax_C2	Max. limit for controlled variable test range (adapt.)	R/W[10]	0 … 1100	0.0 … 110.0	
311	GWY_1min_C2	Min. limit for output variable test range (adaptation)	R/W[10]	0 … 1100	0.0 … 110.0	
312	GWY_1max_C2	Max. limit for output variable test range (adaptation)	R/W[10]	0 … 1100	0.0 … 110.0	
313	GWK_2min_C2	Min. limit for adaptation range (adaptation)	R/W[10]	0 … 1100	0.0 … 110.0	
314	GWK_2max_C2	Max. limit for adaptation range (adaptation)	R/W[10]	0 … 1100	0.0 … 110.0	
315	$T_S K_3$_C2	Pulse duration, control pulse (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
316	K_1_C2	System gain (increasing) (adaptation)	R/W[10]	1 … 1000	0.1 … 100.0	

HR No.	Designation of data point		Access [1]	Transmission range	Display range	Comments
317	TZK_1_C2	Dead time (increasing) (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
318		Internally used	R	-19990…19990	-1999.0…1999.0 [2], [8]	
319	K_2_C2	System gain (decreasing) (adaptation)	R/W[10]	1 … 1000	0.1 … 100.0	
320	TZK_2_C2	Dead time (decreasing) (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
321		Internally used	R	-19990…19990	-1999.0…1999.0 [2], [8]	
322		Internally used	R	-19990…19990	-1999.0…1999.0 [2], [8]	
323		Internally used	R	-19990…19990	-1999.0…1999.0 [2], [8]	
324	K_PK_1_C2	Basic value (increas.) P-action coefficient (adaptation)	R/W[10]	1 … 1000	0.1 … 100.0	
325	T_NK_1_C2	Basic value (increasing) reset time (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
326	T_VK_1_C2	Basic value (increasing) rate time (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
327	K_PK_2_C2	Basic value (decreas.) P-action coefficient (adaptation)	R/W[10]	1 … 1000	0.1 … 100.0	
328	T_NK_2_C2	Basic value (decreasing) reset time (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], [8]	
329	T_VK_2_C2	Basic value (decreasing) rate time (adaptation)	R/W[10]	-19990…19990	-1999.0…1999.0 [2], 8]	
330	K_4_C2	Number of sections (adaptation)	R/W[10]	1 … 7	1 … 7	
331	K_1max_C2	Section factor 1 (adaptation)	R/W[10]	0 … 1999	0.00 … 19.99 [3]	
332	K_2max_C2	Section factor 2 (adaptation)	R/W[10]	0 … 1999	0.00 … 19.99 [3]	
333	K_3max_C2	Section factor 3 (adaptation)	R/W[10]	0 … 1999	0.00 … 19.99 [3]	
334	K_4max_C2	Section factor 4 (adaptation)	R/W[10]	0 … 1999	0.00 … 19.99 [3]	
335	K_5max_C2	Section factor 5 (adaptation)	R/W[10]	0 … 1999	0.00 … 19.99 [3]	
336	K_6max_C2	Section factor 6 (adaptation)	R/W[10]	0 … 1999	0.00 … 19.99 [3]	
337	K_7max_C2	Section factor 7 (adaptation)	R/W[10]	0 … 1999	0.00 …1 9.99 [3]	
338		Reserved 245	R	0	0	
339		Reserved 246	R	0	0	
340		Reserved 247	R	0	0	
341		Reserved 248	R	0	0	
342		Reserved 249	R	0	0	
343		Reserved 250	R	0	0	

HR No.	Designation of data point	Access [1]	Transmission range	Display range	Comments
344	Reserved 251	R	0	0	
345	Reserved 252	R	0	0	
346	Reserved 253	R	0	0	
347	Reserved 254	R	0	0	

1) R : Read Only, R/W: Read and Write
2) For values up to +/- 199.9, one place behind the decimal is supported; from 200.0 onwards, the decimal remains 0
3) Values from -19.99 to +19.99 (-1999…+1999) are supported
5) Is reset with Coil 66
6) Can only be written to when no analog input is assigned
7) For all configuration blocks and parameters applies: Not all values can be adjusted. For details, see *Configuration manual KH 6412 E*
8) Input of zero is not permitted
9) Software version 1.3 or higher
10) Data is written to the non-volatile memory (EEPROM) of the process control station. The lifetime of this type of memory is limited to approx. 100000 write cycles, meaning automatic, permanent writing to it is not permitted.

Coil - Status Data Point List for the TROVIS 6412 Industrial Controller

CL No.	Designation of data point	Access [1]	Status		Comments
			0 (= Off)	1 (= On)	
001	Centralized fault	R	0= None	1= Active	Active when holding registers 22, 23, 24 <> 0
002	Cold restart	R	0= None	1= Active	[4]
003	Data changes	R/W	0= None	1= Were made	Active when data were changed by the operator; reset with COIL 65
004	Local operation	R	0= None	1= Active	TROVIS 6412 is operated either with the COPA pen, the TROVIS 6482 program or by means of the front-panel keys; any displayed data are not updated
005	Reserved	R	0		
006	Reserved	R	0		
007	Reserved	R	0		
008	Reserved	R	0		
Operating modes					
009	Manual/Automatic mode	R/W	0= Automatic mode	1= Manual mode [2]	Cannot be changed when controlled by binary input
010	Master/follower controller	R/W[6]	0= Master controller	1= Follower controller	
011	Internal/external set point active	R/W[6]	0= Internal	1= External	
012	External position feedback	R	0	1	
013	External system ready	R	0	1 [4]	
014	Timeout	R/W[6]	0	1	
015	Adaptation on/oFF	R/W[6]	0	1	[4]
016	Adaptation (runs automatically)	R/W	0	1 = Activated	[5] If active, holding registers 25, 26 show the current status
Status message					
017	Min. limitation of output variable	R	0	1	
018	Max. limitation of output variable	R	0	1	

CL No.	Designation of data point	Access [1]	Status		Comments
			0 (= Off)	1 (= On)	
019	Min. limitation of reference variable	R	0	1	
020	Max. limitation of reference variable	R	0	1	
021	Locking of output variable	R	0	1	
022	Safety output value master controller	R	0	1	Master - PID is compensated
023	Safety output value follower controller	R	0	1	Follower - PID is compensated
024	X-tracking	R	0	1	
025	Output ramp active	R	0	1	
026	Set point ramp active	R	0	1	
027	Safety output value Y_1	R	0	1	Only acts on output
028	Safety output value Y_2	R	0	1	Only acts on output
029	Reserved	R	0		
030	Reserved	R	0		
031	Reserved	R	0		
032	Reserved	R	0		
Binary inputs/outputs					
033	Binary output bo 3	R	0	1	
034	Internally used				
035	Binary output Y-	R	0	1	
036	Binary output Y+	R	0	1	
037	Binary output bo 2	R	0	1	
038	Binary output bo 1	R	0	1	
039	Limit relay output G2	R	0	1	
040	Limit relay output G1	R	0	1	
041	Binary input bi 1	R/W	0	1	[3]
042	Binary input bi 2	R/W	0	1	[3]
043	Binary input bi 3	R/W	0	1	[3]
044	Reserved	R	0		

CL No.	Designation of data point	Access [1]	Status		Comments
			0 (= Off)	1 (= On)	
045	Reserved	R	0		
046	Reserved	R	0		
047	Reserved	R	0		
048	Reserved	R	0		
049	Reserved	R	0		
050	Reserved	R	0		
051	Reserved	R	0		
052	Reserved	R	0		
053	Reserved	R	0		
054	Reserved	R	0		
055	Reserved	R	0		
056	Reserved	R	0		
057	Reserved	R	0		
058	Reserved	R	0		
059	Reserved	R	0		
060	Reserved	R	0		
061	Reserved	R	0		
062	Reserved	R	0		
063	Reserved	R	0		
064	Reserved	R	0		
065	Resetting Cold restart	R/W	0= Resetting	1= No effect	
066	Resetting Holding Registers 23,24	R/W	0= Resetting	1= No effect	

[1] R : Read Only, R/W: Read and Write
[2] External position feedback has priority over MANUAL/AUTOMATIC key
[3] Are combined OR with the hardware binary input
[4] Function determined by the configuration. Details, see *KH 6412 EN*
[5] Software version 1.3 or higher
[6] Data are written to the non-volatile memory (EEPROM). The lifetime of this type of memory is limited to approx. 100,000 write cycles, meaning automatic, permanent writing to it is not permitted.

Input - Status Data Point List for the TROVIS 6412 Industrial Controller

IN No.	Designation of data point	Access [1]	Status		Comments
			0 (= Off)	1 (= On)	
001	Binary input bi 1	R	0	1	Inputs are displayed even when not assigned via software
002	Binary input bi 2	R	0	1	
003	Binary input bi 3	R	0	1	
004	NC	R	0		
005	NC	R	0		
006	NC	R	0		
007	NC	R	0		
008	NC	R	0		

[1] R : Read Only, R/W: Read and Write

Input Registers Data Point List for the TROVIS 6412 Industrial Controller

IR No.	Designation of data point	Access[1]	Transmission range	Display range	Comments
001	Input in 1	R	-200 … 1200	-20% … 120%	Inputs are displayed even when not assigned via software
002	Input in 2	R	-200 … 1200	-20% … 120%	
003	Input in 3	R	-200 …1200	-20% … 120%	
004	Input in 4	R	-200 … 1200	-20% … 120%	

[1] R : Read Only, R/W: Read and Write

Appendix B Error Messages

Error	Displays on the front panel		LED	Acknowledge	Status signals for external signals						Change of output signal		Comment
	Display field				Binary outputs bo 1 and/or bo 2			Binary output bo 3					
					No	Yes	1)	No	Yes	2)	No	Yes	
Input values out of measuring range	3) A1		On	No		X			X			X	See C37, C44-3, C45-3
Writing to internal data memory not possible	3) C1 n	1 4) C1 n	Flashes	F key	X				X				EEPROM defective
Configuration changed without operator intervention	3) C1 n	2 4) C1 n											
Parameters /adaptation parameters changed without operator intervention	3) C1 n	3 4) C1 n											Re-enter data, see C44-4
Adjustment values for analog inputs changed without operator intervention	3) C1 n	4 4) C1 n				X			X		X		
Code number changed without operator intervention	3) C1 n	5 4) C1 n											
Communication between central control station and interface is interrupted	3) C1 n	6 4) C1 n											See C44-8, C45-8

1) Contact position after activation
2) Functional diagram
3) Alternates with actual value
4) After pressing the A key

Error	Displays on the front panel		LED	Acknowledge	Status signals for external signals						Change of output signal		Comment
	Display field				Binary outputs bo 1 and/or bo 2			Binary output bo 3					
					No	Yes	1)	No	Yes	2)	No	Yes	
Communication between interface and process control station is interrupted	3) C I n	7 4) C I n	Flashes	F key		X			X				See C44-8, C45-8; check soldering jumpers LB1,LB2, LB3, see page 19
Controller status changed without operator intervention	3) C I n	8 4) C I n	Flashes	F key		X			X		X		Re-enter configuration and parameter data, see C44-4
Locking of output signal active	20 C I n		–	A key									Adaptation aborted/error Reset to Start of adaptation
Output signal limitation active	21 C I n												
Position feedback active	22 C I n												
Limitation of master controller output active	23 C I n												
Output value Y_1K_1 or Y_2K_1 active	24 C I n												
Output value Y_1K_4 active	25 C I n												

1) Contact position after activation 2) Functional diagram 3) Alternates with actual value 4) After pressing the A key

Error	Displays on the front panel		Acknow-ledge	Status signals for external signals						Change of output signal		Comment
	Display field	LED		Binary outputs bo 1 and/or bo 2			Binary output bo 3					
				No	Yes	1)	No	Yes	2)	No	Yes	
MANUAL mode active (with C 51-3 and C52>1)	26 C i n	–	A key									Adaptation aborted/error Reset to Start of adaptation
No noise band defined	201 C i n											
Controlled variable does not change enough	202 C i n											
Limits of output signal test range are identical	203 C i n											
Output variable out of output variable test range at start of adaptation	204 C i n											
Limits of controlled variable test range are identical	205 C i n											
Controlled variable out of controlled variable test range at start of adaptat.	206 C i n											
Controlled variable not stationary; controlled system does not oscillate	207 C i n											
System not calm before being excited with first control pulse	208 C i n											

1) Contact position after activation 2) Functional diagram 3) Alternates with actual value 4) After pressing the A key

Error	Displays on the front panel		Acknow-ledge	Status signals for external signals						Change of output signal		Comment
	Display field	LED		Binary outputs bo 1 and/or bo 2			Binary output bo 3					
				No	Yes	1)	No	Yes	2)	No	Yes	
System does not oscillate or limits for adaptation range are identical	301 cin	–	A key									
Adaptation impossible with selected configuration data	302 cin											Adaptation aborted/error Reset to start of adaptation
Data error in COPA pen	COP crc	–	A key twice									Incompatible data, re-write to COPA pen
Data transmission error, COPA pen	COP rEP											Repeat procedure
COPA pen defective	COP Err											Use new COPA pen
Data transmission error, process control station	C rEP											Repeat procedure

1) Contact position after activation 2) Functional diagram 3) Alternates with actual value 4) After pressing the A key

Appendix C Checklist

Process Control Station Type: 6412 or 6442

Controller no.: Software version:

Power supply: 230/ 120/24 V, 24 V AC/DC (optional)

Input board: IB 1/ IB 2/ IB 3/ IB 4

Input Ai 1:

Input Ai 2:

Input Ai 3:

Input Ai 4:

Outputs

Y1: ☐ 0 to 20 mA ☐ 4 to 20 mA ☐ 0 to 10 V ☐ 2 to 10 V

Y2 (optional): ☐ 0 to 20 mA ☐ 4 to 20 mA ☐ 0 to 10 V ☐ 2 to 10 V

Ao1 (optional): ☐ 0 to 20 mA ☐ 4 to 20 mA ☐ 0 to 10 V ☐ 2 to 10 V ☐ –10 to 10 V

G1 (optional):

G2 (optional):

Settings made on: Signature:

Configuration protocol

	Ex-factory	Selected
C 1	1	
C 2	1	
C 3	0	
C 4	1	
C 5	2	
C 6	1	
C 7	1	
C 8	1	
C 9	1	
C10	2	
C11	1	
C12	1	
C13	1	
C14	1	
C15	1	
C16	1	
C17	1	
C18	1	
C19	1	

C20	1	
C21	2	
C22	1	
C23	1	
C24	2	
C25	0	
C26	1	
C27	1	
C28	1	
C29	1	
C30	1	
C31	1	
C32	1	
C33	1	
C34	1	
C35	1	
C36	1	
C37	1	
C38	2	
C39	1	

C40	1	
C41	1	
C42	1	
C43	5	
C44	1	
C45	1	
C46	1	
C47	2	
C48	1	
C49	1	
C50	1	
C51	1	
C52	0	
C53	0	
C54	1	
C55	0	
C56	1	
C57	2	
C58	0	
C59	1	

0 means that the configuration block is skipped.

Parameters

PA Parameter set for fixed set point, follow-up, ratio or synchro control
PA1 Parameter set for master controller in the cascade control mode
PA2 Parameter set for follower controller in the cascade control mode

Parameter	PA/ PA1	PA2	Unit
X			
$X \leq$			
$X \geq$			
W_{EX}			
$W_{EX} \leq$			
$W_{EX} \geq$			
Z			
$Z \leq$			
$Z \geq$			
W_{IN}			
$W_{IN} \leq$			
$W_{IN} \geq$			
$W_{IN}K_1 \leq$			
$W_{IN}K_1 \geq$			
$W_{IN}K_2$			
W_S			
$W_S \leq$			
$W_S \geq$			
X_d			
TZX_d			
$X_{SD}Y_1$			
$X_{SD}Y_2$			
$X_{SD}G1$			
$X_{SD}G2$			
TZ			
TZY_1			
TZY_2			
K_P			
T_N			
T_V			
T_VK_1			
K_PY_1			
K_PY_2			
K_PK_2			
T_VK_2			

Parameter	PA/ PA1	PA2	Unit
K_PK_3			
T_VK_3			
Y_1K_3			
Y_1			
Y_1K_1			
$Y_1 \leq$			
$Y_1 \geq$			
Y_2			
Y_2K_1			
$Y_2 \leq$			
$Y_2 \geq$			
T_{Y1}			
T_{Y1}			
Y_1K_2			
T_{Y2}			
$T_{Y2} \leq$			
Y_2K_2			
T_SX			
T_SW_{EX}			
T_SZ			
T_SX_d			
T_S			
$Y_2K_3 \leq$			
$Y_2K_3 \geq$			
T_SK_1			
T_SK_2			
GWG1			
GWG2			
K_1			
$K_1 \leq$			
$K_1 \geq$			
K_2			
$K_2 \leq$			
$K_2 \geq$			
K_3			

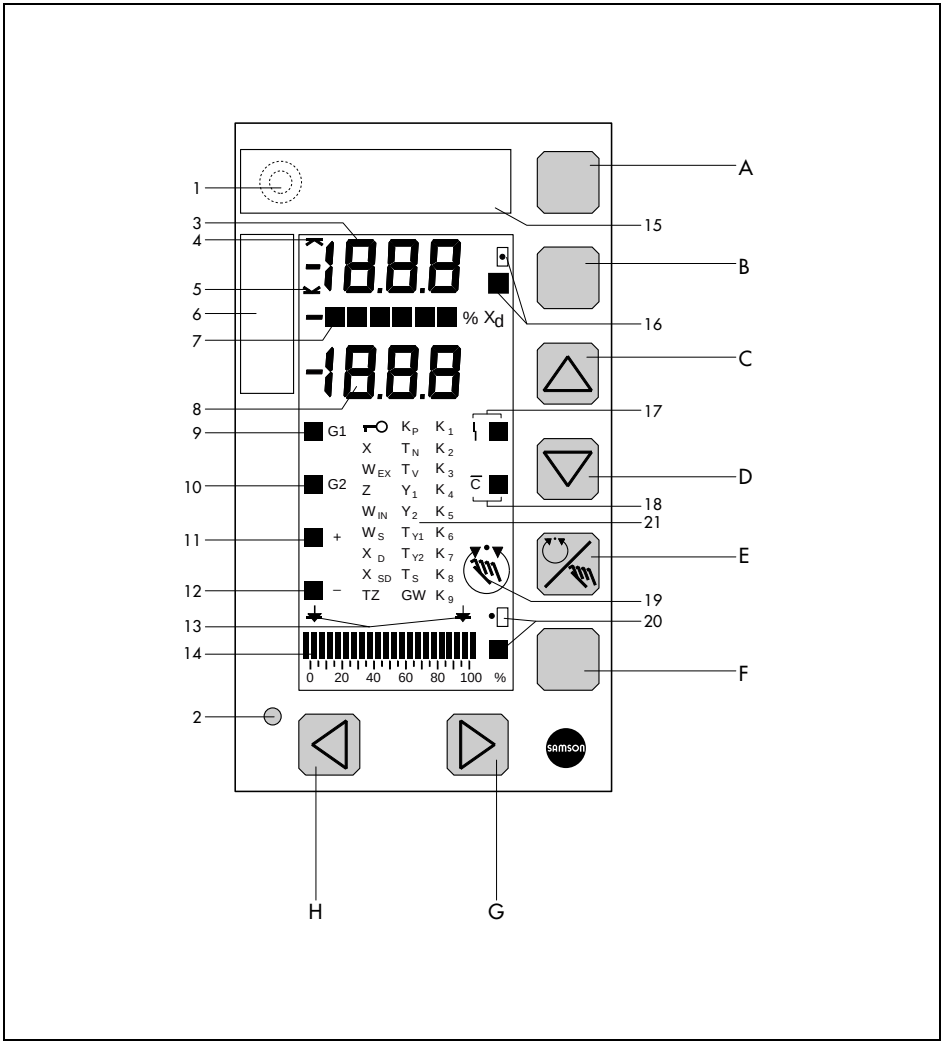
Parameter	PA/ PA1	PA2	Unit
$K_3 \leq$			
$K_3 \geq$			
K_4			
$K_4 \leq$			
$K_4 \geq$			
K_5			
$K_5 \leq$			
$K_5 \geq$			
K_6			
$K_6 \leq$			
$K_6 \geq$			
K_7			
$K_7 \leq$			
K_7			
K_8			
$K_8 \leq$			
$K_8 \geq$			
K_9			
K_1X			
K_1Z			
K_2X			
K_2Z			
K_1W_{EX}			
K_PK_1			
Y_1K_4			
$GWK_1 \leq$			
$GWK_1 \geq$			
$GWK_2 \leq$			
$GWK_2 \geq$			
Y_1K_5			
$W_{IN}K_2$			
GWK_3			
GWK_4			
GWK_5			
GWK_6			

Code number important for servicing 1732

Process display and control panel elements

1 Jack for COPA pen or COPA adapter
2 Red LED for messages or faults
3 $3\frac{1}{2}$-digit digital display for set point (reference variable) (can be switched to output variable), parameter values and values of the configuration blocks
4 Indicator for end of range (e.g. when measuring range and reference variable range are set in the PARAMETER mode)
5 Indicator for start of range (e.g. when measuring range and reference variable range are set in the PARAMETER mode)
6 Exchangeable label for physical unit
7 Bar graph for error (control deviation) in %
8 $3\frac{1}{2}$-digit digital display for controlled variable and configuration block
9 Indicator for limit relay 1
10 Indicator for limit relay 2
11 Indicator for + with three-step signal "OPEN" or for on-off output signal
12 Indicator for - with three-step signal "CLOSED"
13 Indicators for closed position of control valve at 0 or 100 %
14 Bar graph for output variable 0 to 100%
15 Replaceable label for recording of measuring point
16 Indicators for "internal set point valid" or "follower controller set point (reference variable) valid" in cascade control mode
17 Indicators for "monitoring of measuring range"
18 Indicators for "external system not ready", e.g. with SPC or DDC-backup operation
19 Symbol for MANUAL or AUTOMATIC mode
20 Indicators for external control signal
21 Parameter table with :
Symbol for code number
X Controlled variable
W_{EX} External reference variable
Z Disturbance variable
W_{IN} Internal set point (reference variable)
W_S Safety set point
X_d Error (control deviation)
X_{SD} Hysteresis
TZ Dead band
K_P Proportional-action coefficient
T_N Reset time
T_V Rate time
Y_1 Controller output 1
Y_2 Controller output 2
T_{Y1} Actuating time Y1
T_{Y2} Actuating time Y2
T_S Time constant for filter
GW Limit value
K_1 to K_9 Constants

Control panel



A Display and execute key for all levels
B Switch-over key W_I/W_{EX} (internal/external reference variable) or open/close cascade
C Cursor key for increasing values (set point (reference variable)), parameters, configuration blocks)
D Cursor key for decreasing values (set point (reference variable)), parameters, configuration blocks)
E MANUAL/AUTOMATIC mode selector key
F Reset key for switching to the OPERATING level, for switching digital display (3) from reference variable to output signal or from master to follower controller; override of the controller startup following power recovery
G Key for increasing value of the output variable
H Key for reducing value of the output variable
See pervious page for other elements

SAMSON AG · MESS- UND REGELTECHNIK
Weismüllerstraße 3 · 60314 Frankfurt am Main · Germany
Phone +49 49 4009-0 · Fax +49 69 4009-1507
Internet: http://www.samson.de

EB 6412 EN

S/Z 2007-07