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Table of contents

1 Introduction

1.1 Document

Version 1.5

1.2 About this manual

In this manual you get to know:

- The command value und control card VT-HACD-1
- The software BODAC (Bosch Rexroth Operator interface for Digital Axis Controller)
- Application examples

This manual is intended to familiarize you with the BODAC Software (Bosch Rexroth Operator interface for Digital Axis Controller). It provides information about the menus and window contents of the software, their settings and parameters.

Selected application examples will clarify the functionality, systematic and appropriate procedures in starting up the “VT-HACD-1 Digital Command Value and Control Card for Electromechanical and Electrohydraulic Drives".

The software description assumes basic familiarity with a PC and appropriate knowledge of the user interface and control elements of Windows™

For additional information, read the relevant sections in the Microsoft Windows user’s manual or use Windows online help.

Information about installing and operating the HACD control card can be found in the manual „Installation and Operation of the HACD Control Card".

A complete listing of the HACD documentation can be found in the datasheet RE 30143.

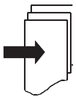
1.3 Characters and Symbols

The following characters and symbols are used in this manual:

➢ Action symbol: The text following this symbol describes actions. These should be performed, from top to bottom, in the given order.

✓ Result symbol: The text following this symbol describes the results of an ac tion.

Following this symbol you will find notes and useful tips for optimal use of the controller card.



Following this symbol you will find references to additional documentation.

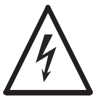
Warning symbols

Special safety notes are provided at the relevant locations. These are indicated by the following symbols.

General hazard potential

Indicates a potentially hazardous condition which, if not avoided, could result in death or serious injury.

If the hazard source can be specifically indicated, the corresponding pictogram will be used.



Electrical current hazard

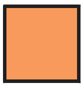
This symbol refers to a hazardous condition caused by electrical current which, if not avoided, could result in death or serious injury.

Equipment damage

This symbol pertains to actions which could result in damage to equipment.

Symbols used in illustrations

The following symbols are used in Chapter 7 and serve to illustrate user entries. The symbols have the following meaning:



Physical in- and outputs (current or voltage)

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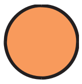
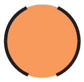
www.hyquip.co.uk



Internal signals visible in the Motion Data screen of BODAC



Virtual internal signals (not visible in the Motion Data screen)

Conversion of the physical in- and outputs to the standardized internal signals and vice versa

Mathematical operations, signal links or other options in the structure

Values for the specified parameters.

1.4 Introduction into the automation tasks

Operation of the machine part

Turning a handwheel causes the machine part to move forwards and backwards. The position of the handwheel corresponds to the position of the part. The turning speed of the handwheel corresponds to the travel speed.

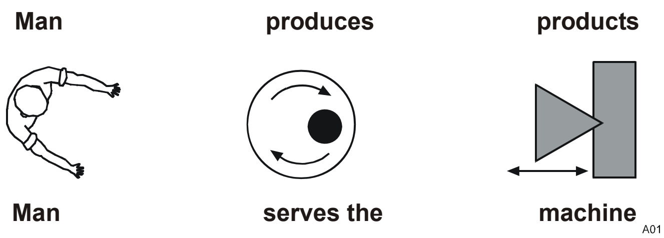


Fig. 1 Man works with machines

General formulation of the tasks

Moving a body m1 forwards and backwards over a distance. The movement over this distance is performed at different speeds.

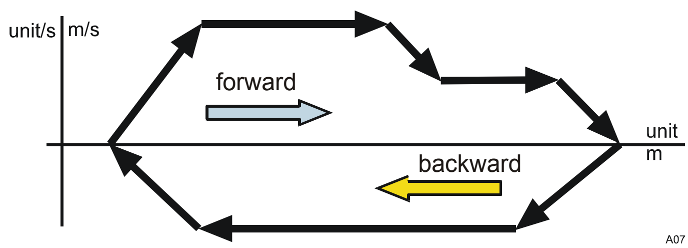


Fig. 2 General task

General description of the solution

The operator has access to the machine process via the “operator panel with display”.

Then, a “sequence control” receives the signals and links them with the conditions of the machine in order to ensure a smooth and safe sequence.

The sequence control initiates machine movements, which require different accuracies depending on the machine process. In order to achieve this also under the influence of disturbing forces and even under differing boundary conditions, a so-called “closed-loop control device” is used.

The control action puts output signals of the closed-loop control device into actual, physical action (e.g. force, velocity, position) and therefore has an influence on the controlled variable.

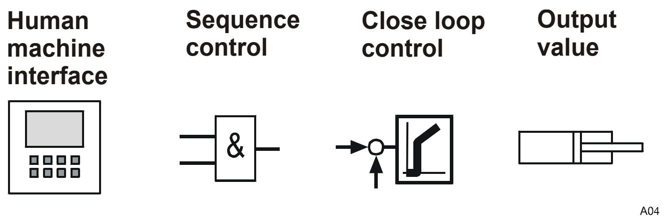


Fig. 3 Typical function groups for automated movements

2 Command value and Controller Card HACD-1

2.1 General

The Command value and Controller Card HACD-1 can be used as

- Command value card

  Generating, linking and normalization of signals

- Controller card with 1 control loop

  One PIDT1 controller

- Controller card with 2 control loops

  Two PIDT1 controller
  Analog values or **one** SSI transducer or one Incremental transducer are possible as feedback signal.
  The analog output AO2 has a resolution of 11 bits only.

- Controller card as override controller

  Preferred use as override controller with bumpless transfer between position and pressure control or for two control loops with PIDT1 controller
  The actual value signal my be in the form of analogue values or SSI encoder values. Only one SSI encoder is possible.

Detailed information on the HACD-1 can be found in Datasheet RE°30143

2.2 Pin assignment of edge connector

Under “signal“ you can find the general pin assignment of HACD-based plug-in cards.

Row d

Pin	Signal	Description
2	DI 1	Digital input
4	DI 2	Digital input
6	DI 3	Digital input
8	DI 4	Digital input
10	DI 5	Digital input
12	DI 6	Digital input
14	DI 7	Digital input
16	DI 8	Digital input
18	DI9	Enable
20	DO 1	Digital output
22	OK	Ready for operation
24	Data +	Local CAN Bus In-/Output
26	DO 2	Digital output
28	Data –	Local CAN Bus In-/Output
30	AO 1	Analog output
32	AO 2	Analog output

Table 1 Pin assignment of edge connector row d

Row b

Pin	Signal	Description
2	AI3+	Differential input
4	AI3-	Differential input
6	AI2+	Differential input
8	AI2-	Differential input
10	AI1+	Differential input
12	AI1-	Differential input
14	AI4+	Differential input
16	AI4-	Differential input
18	AI5+	Differential input
20	AI5-	Differential input
22	AI6+	Differential input
24	AI6-	Differential input
26	AO3	Analog output
28	AGND	Analog GND
30	REF-	Reference voltage -10V
32	REF+	Reference voltage +10V

Table 2 Pin assignment of edge connector row b

Row z

Pin	Signal	Description
2	MA+	Solenoid A+
4	MA-	Solenoid A-
6	MB+	Solenoid B+
8	MB -	Solenoid B-
10	Shield	Shield
12	L1O-	Valve position transducer supply -
14	L1I-	Valve position transducer actual value -
16	L1I+	Valve position transducer actual value +
18	L1O+	Valve position transducer supply +
20	System ground	System ground
22	DO 3	Digital output
24	DO 4	Digital output
26	DO 5	Digital output
28	DO 6	Digital output
30	U_B	Supply voltage
32	LO	Ground

Table 3 Pin assignment of edge connector row z

Row f

Pin	Signal	Description
2	DO 7	Digital output
4	SSI Clk+	SSI encoder clock output
6	SSI Clk-	SSI encoder clock output
8	SSI Data+ / INC Ua1	Signal input of SSI encoder or incremental encoder
10	SSI Data -/ INC /Ua1	Signal input of SSI encoder or incremental encoder
12	Ua2	Signal input of incremental encoder
14	/Ua2	Signal input of incremental encoder
16	Ua0	Signal input of incremental encoder
18	/Ua0	Signal input of incremental encoder
20	L2O-	n. c.
22	L2I-	n. c.
24	L2I+	n. c.
26	L2O+	n. c.
28	GND_CAN	CAN bus reference
30	CANL	CAN bus input/output
32	CANH	CAN bus input/output

Table 4 Pin assignment of edge connector row f

Connection of the proportional valve

When connecting the proportional valve, install the connection cables of the solenoids separately from other cables, especially from the cables of inductive position transducers.

It is recommended that solenoid connection cables be shielded.

Up to a length of 50 m, the use of a connection cable 2 x 1.5 mm² of type LiYCYCY is recommended. When double shielded cables are used, the outer shied can be connected at the input in the control cabinet, and the inner shield be routed to the controller card.

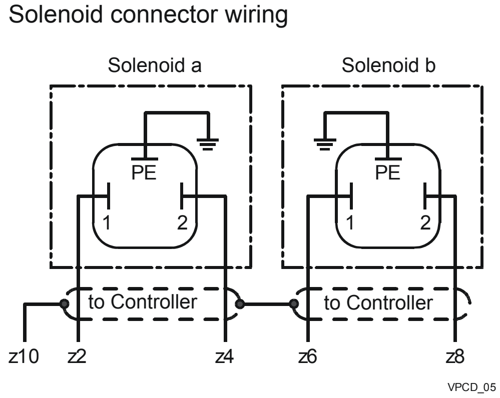


Fig. 4 Connection of the solenoids to the mating connector

For the connection of the solenoids, use a mating connector type CECc 75301-803-A002FA-H3008-G according to DIN EN 175 301-803 und ISO 4400.

- Solenoid “a”, mating connector color grey
  Separate order stating material no. **R901017010**
- Solenoid “b”, mating connector color black
  Separate order stating material no. **R901017011**

Connection of the valve position transducer

The figure below shows the connection of the valve position transducer.

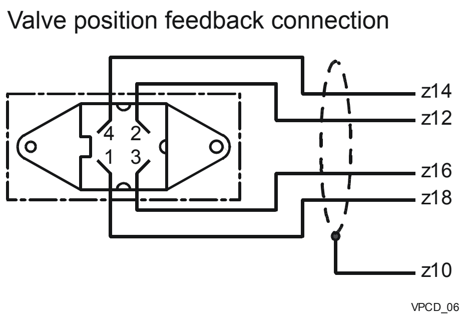


Fig. 5 Connection of the valve position transducer

The transducer is connected by means of a 4-pin mating connector Pg7-G5W1F, which must be ordered separately, material no. R900023126.

Up to a length of 50 m, the use of a connection cable 4 x 0.25 mm² of type LiYCYCY is recommended. When double shielded cables are used, the outer shied can be connected at the input in the control cabinet, and the inner shield be routed to the controller card.

The shield must only be connected on the supply side to pin z10 of the edge connector.

2.3 Overview of modes

Three different modes are offered for the HACD-1

Which mode is set determines to a large extent the functionality of the HACD. This mode is defined by the parameter set.

- Mode 1 – Block call-up (default mode)

  The 32 blocks can be called using the binary combination of the digital inputs DI1...DI5.
  This mode is compatible with the VT-SWKD.

  Parameter set name:
  HACD1_Mode1_Block.param

- Mode 2 – Motion profile

  A command value profile is stored which represents the typical application for position control.

  Parameter set name:
  HACD1_Mode2_Profi.param

- Mode 3 – Structure editor

  The structure editor is enabled. Users can create their own motion sequences.

  Parameter set name:
  HACD2_Mode3_Editor.param

The mode can be changed at any time by writing a different parameter set to the card.

The HACD is loaded with the default parameter set for „Block call-up“ mode. The two other modes (motion profile and structure editor) are included with the BODAC software, or can be downloaded from http://www.boschrexroth.com/hacd.

Load these into the HACD as follows:

➢ Open the parameter set using the „Open“ command from the File menu.

➢ Load the parameter set into the HACD with the „Write parameters“ command from the Controller menu.

➢ Save the file in the HACD’s permanent memory using the “Set parameters to memory“ command from the Controller menu.

✓ The new parameter set is now permanently stored in the HACD.

Depending on the mode, the Application Window menu will contain different entries and different symbols will appear in the toolbar.

2.4 Mode 1 – Block call-up

Overview

The 32 blocks are fixed coded and can be called using the binary combination of digital inputs DI1…DI5 and the binary enable input DI6.

The HACD-1 is shipped in this mode. By saving the parameter set "HACD1_Mode1_Block.param" to the card the HACD-1 can be converted to this mode.

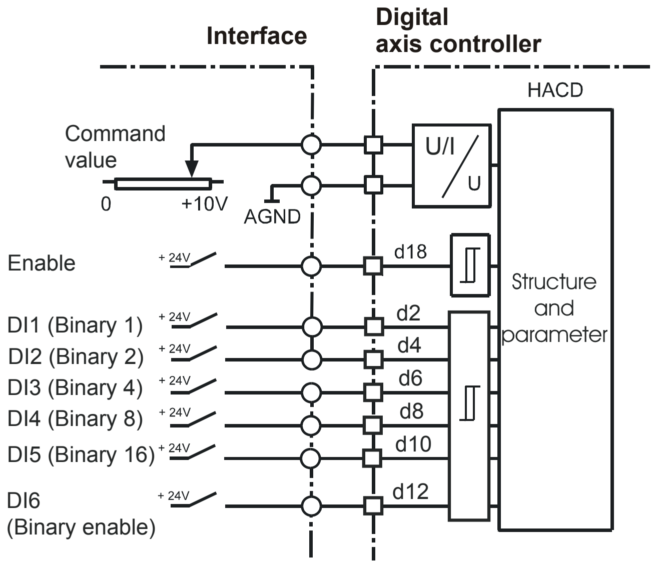


Fig. 6 Block call-up

Various functions for this mode are displayed in special application windows.

Block call-up

Binary 1...16 (DI1 to DI5) Digital inputs DI1 to DI5 are interpreted as a binary word. Digital input DI1 is the LSB.

Binary Enable (DI6) Digital input DI6 sets the binary word as valid. Only if this input is High are the patterns for inputs DI1 to DI5 are accepted, otherwise there is no change to the active block!

The current state remains valid until there is another state change.

In the process display, inputs DI1 to DI5 are only updated if DI6 is High.

The active block can be calculated as follows:

Active block = 16*DI5 + 8*DI4 + 4*DI3 + 2*DI2 + 1*DI1

where DIx = 0 if input is Low (0V)
DIx = 1 if input is High (24V).

The following list shows the relationships of the digital inputs in the form of a truth table:

Active Block	**DI5** Binary 16	**DI4** Binary 8	**DI3** Binary 4	**DI2** Binary 2	**DI1** Binary 1
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	1
…					
24	1	1	0	0	0
25	1	1	0	0	1
26	1	1	0	1	0
27	1	1	0	1	1
28	1	1	1	0	0
29	1	1	1	0	1
30	1	1	1	1	0
31	1	1	1	1	1

A higher end controller using the digital inputs according to this table can activate the blocks.

When the enable is set without “Binary valid“, Block 0 is activated.

Controller parameters

Four controller parameter sets are available for each loop.

Active Block	Controller parameter set
0…7	1
8…15	2
16…23	3
24…31	4

The parameter sets 2...4 can be configured in such a way that the controller parameter set 1 is used in all cases.

Digital outputs

Functions are assigned to the 7 digital outputs of the HACD-1.

Digital output	Function
DO1	Command value 1 = actual value 1 (loop 1)
DO2	Command value 2 = actual value 2 (loop 2)
DO3	Actual value 1 ≥ threshold
DO4	Actual value 2 ≥ threshold
DO5	Actual value 1 ≤ threshold
DO6	Actual value 2 ≤ threshold
DO7	Fault 1

Configuration and parameterization

To make operation easier and clearer, BODAC provides corresponding “Application Screens“.

The Structure Editor is not available for this mode, i.e.; no internal sequences can be implemented.
Various functions of BODAC are not required and are therefore unavailable.

2.5 Mode 2 – Motion profile

Overview

For position control of a drive, a motion profile is pre-programmed. This profile contains the move between Position A and Position B with or without slow traverse as well as a manual mode operation.

The parameter set "HACD1_Mode2_Profil.param" contains this motion profile. By saving the parameter set to the card the HACD-1 can be converted to.

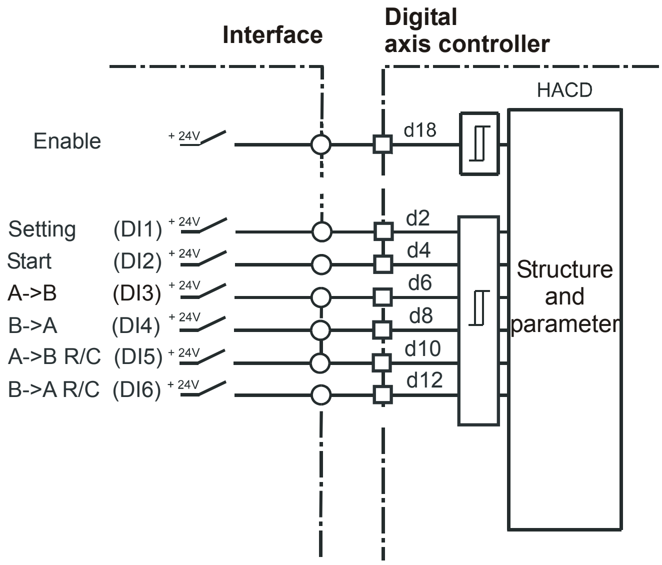


Fig. 7 Motion profile

Various functions for this mode are displayed in special application windows.

Motion profile

The motion profile distinguishes between automatic and setup mode.

Automatic mode

Auto (DI2) This input can be used to activate the automatic operating mode. The drive moves at the set speed to the start position.

If “0“ is assigned to the velocity, the drive will remain controlled at the current position.

Home (DI1) When this input is activated, the Home Position is approached at the set speed.

Digital output DO3 is set (high level), when the Home Position B is reached.

A→B (DI3) By setting this input the drive moves from Position A to Position B with an adjustable acceleration ramp, velocity and deceleration ramp.

Digital output DO1 is set (High) when Position B is reached within an adjustable target window.

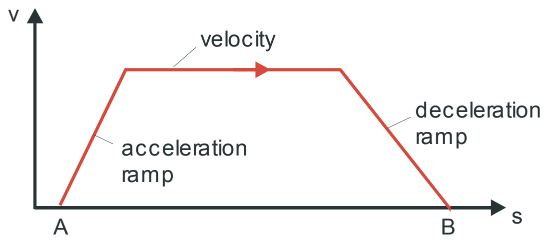


Fig. 8 Motion profile A→B

B→A (DI4) By setting this input the drive moves from Position B to Position A with an adjustable acceleration ramp, velocity and deceleration ramp.

Digital output DO2 is set (High) when Position A is reached within an adjustable target window.

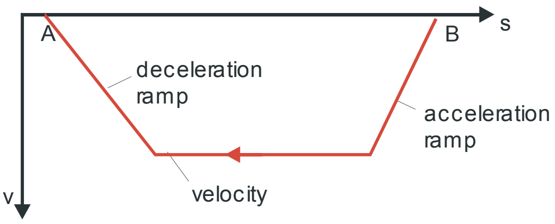


Fig.. 9 Motion profile B→A

A→B E/S (DI5)

By setting this input the drive moves from Position A to Position B. A distinction is made between slow and rapid traverse. For rapid traverse the acceleration ramp, velocity and deceleration ramp are defined. The switch to slow traverse speed is made at a selected position; velocity and deceleration ramp for slow traverse can also be specified.

Digital output DO1 is set (High) when Position B is reached within an adjustable target window.

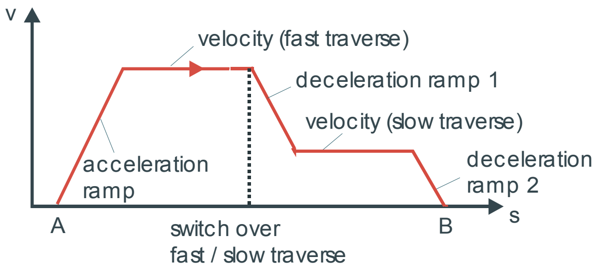


Fig. 10 Motion profile A→B with rapid/slow traverse speed

B→A E/S (DI6)

By setting this input the drive moves from Position B to Position A. A distinction is made between slow and rapid traverse. For rapid traverse the acceleration ramp, velocity and deceleration ramp are defined. The switch to slow traverse speed is made at a selected position; velocity and deceleration ramp for slow traverse can also be specified.

Digital output DO2 is set (High) when Position A is reached within an adjustable target window.

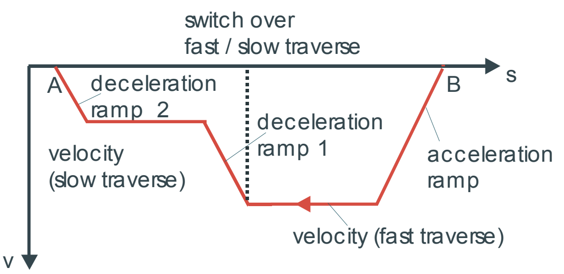


Fig. 11 Motion profile B→A with rapid/slow traverse speed

Set-up (DI1)

This input is used to activate Set-up Mode for Motion profile.

In this mode the drive is moved in Open Loop. You can set the control actions for A□B and B□A separately. The move from A□B is started using DI3, and from B□A with DI4.

Set mode

Auto (DI2) This input must be inactive (low level)

Setup (DI1) With this input you can activate the setup mode. In this operational state, the drive is operated under open-loop control.

Jog+ (DI3) By activating this input you start an open-loop controlled movement A→B with the set control action.

Jog- (DI4) By activating this input you start an open-loop controlled movement B→A with the set control action.

Controller parameters

The move from A→B and B→A each have their own controller parameter set.

The same controller parameter set can be used for both moves if necessary.

Digital outputs

Functions are assigned to the 7 digital outputs of the HACD-1.

Digital output	Function
DO1	Position B reached
DO2	Position A reached
DO3	Position Home reached
DO4	Slow traverse A → B
DO5	Slow traverse A ← B
DO6	Fault 1
DO7	Fault 1

Configuration and parameterization

To make operation easier and clearer, BODAC provides corresponding “Application Screens“.

The Structure Editor is not available for this mode, i.e.; no internal sequences can be implemented.
Various functions of BODAC are not required and are therefore unavailable.

2.6 Mode 3 – Structure editor

The structure editor is enabled. Customized motion sequences can be created.

Creating customized motion sequences (setting the trigger conditions) presumes corresponding knowledge on the Structure Editor. The basics are explained in the section “The Structure Editor”. Examples can be found in the section “Application Examples”.

By saving the parameter set HACD2_Mode3_Editor.param" the HACD-1 can be converted to this mode.

3 User interface BODAC - General

3.1 Software Tool and Data Handling

The BODAC Software

BODAC is a software tool for startup. It must be installed on the PC or laptop that is used for the initial startup.

BODAC stands for:
Bosch Rexroth **O**perator interface for **D**igital **A**xis **C**ontroller for in- and output matching, controller structuring, parameterizing, process display and diagnostics.

This software tool can be downloaded from the Internet at
http://www.boschrexroth.com/hacd.

Data exchange between BODAC and the HACD

Establish a connection between the PC and the HACD so that the desired data can be set, saved and duplicated.

The connection is based on RS232. A fixed baud rate is set in the card.

- ➢ Connect PC to HACD using an RS232 cable (1:1 cable)
- ➢ Turn on PC and HACD
- ➢ Install BODAC
- ➢ Start BODAC (see document RE 30143-B)
- ✓ BODAC automatically loads the parameter set from the HACD

If BODAC does not load automatically, no connection was made. In this case check the “Configuration of the serial interface”, the serial connection and the supply voltage to the HACD.

Save file

It is recommended that the parameter set be saved in a file. This allows you to restore the current status of the HACD at any time.

Assign a file name and save the output state.

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Save the working state

This allows for easily storing all parameters and structure specifications during startup. If work is interrupted, it can be resumed at a later stage without any loss of data.

When finished, also save the files in the permanent memory of the HACD Control Card.
See also: “Save”.
See also: “Set parameter to memory”.

3.2 Main Form

After starting the BODAC program you will find yourself first in the Main Form. This contains various elements as shown in Fig. 12 BODAC Main Form.

These include:

- The Title bar
- The Menu bar
- The Toolbar
- The Status bar

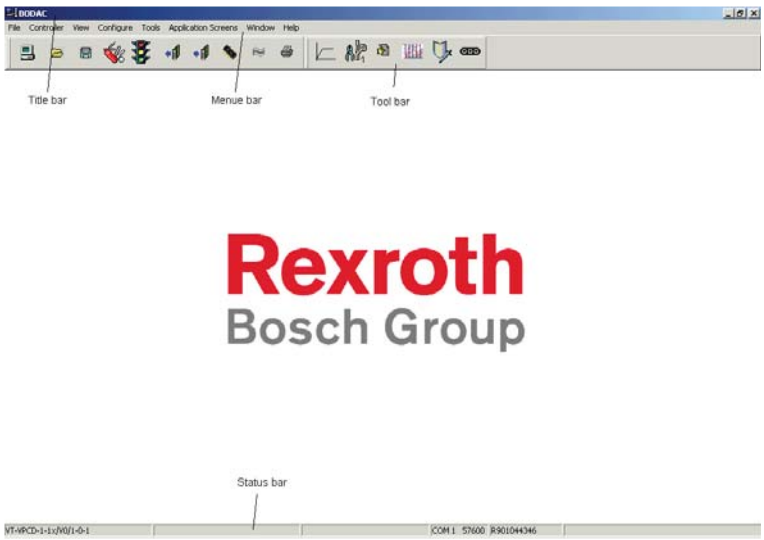


Fig. 12 BODAC Main Form

Title bar

The title bar contains the name and standard Windows buttons. Information about the standard Windows buttons can be found in the Windows online help.

Menu bar

The menu bar contains all the menus and commands available in BODAC.

The following menus are available:

- File menu
- Controller menu
- View menu
- Configuration menu
- Tools menu

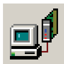
- Application Screens menu
- Window menu
- Help menu

Toolbar

The toolbar contains buttons with icons. These icons will execute often-used functions, commands or open windows.

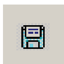
Following is a list of the functions executed by the icons:

“Offline“: Interrupts the connection to the control card. The icon is only visible when there is an active connection to the control card.

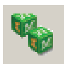


“Connect“: The icon is only visible if there is no active connection to the control card.

“Open“: Opens the window in which you can select stored BODAC data files.

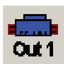


“Save file as“: Opens the window in which you can save the parameters in a file.

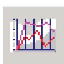


“Structure Edit“ window.

"Parameter Edit" window.



Opens the “Output Edit“ window.



Opens the "Motion Data" window.

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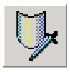
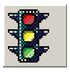
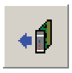
www.hyquip.co.uk

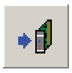

Opens the "Analog I/O“ window.

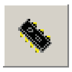

Opens the "Digital I/O“ window.


Opens the "Faults" window.


Opens the "Status" window.


“Read Parameters“ reads the parameter data stored in the control card and transfers it to the BODAC program.

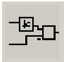

“Write Parameters“ sends the current parameter data from BODAC to the control card.

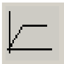

“Save Parameters in Memory“ stores the current parameter data in the memory chip on the control card.

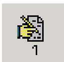

Opens the “Language“ window.


Opens the "Print Forms” window.

Application-specific icons


Opens the “Controller“ window, which provides an overview of the current structure of the HACD. This function is only available for Modes 1 (block call-up) and 2 (motion profile).


Opens the “Control Values“ window to configure the control values for all 32 blocks. This function is only available for Mode 1 (block call-up).

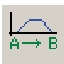


Opens the “Controller Parameters 1” window for setting the controller parameters of Loop1. This function is only available for Mode 1 (block call-ups).

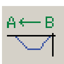
Opens the “Controller Parameters 2" window for setting the controller parameters of Loop2. This function is only available for Mode 1 (block call-ups).


Opens the “Controller Parameters” window for setting the controller parameters. This function is only available for Mode 2 (motion profile).

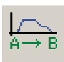

Opens the “Start position“ window. This function is only available for Mode 2 (motion profile).



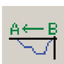
Opens the ”A to B“ window. This function is only available for Mode 2 (motion profile).



Opens the “B to A“ window. This function is only available for Mode 2 (motion profile).

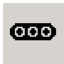


Opens the “A to B“ (rapid traverse/slow traverse) window. This function is only available for Mode 2 (motion profile).

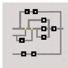


Opens the “B to A“ (rapid traverse/slow traverse) window. This function is only available for Mode 2 (motion profile).

Opens the “Setup“ window. This function is only available for Mode 2 (motion profile).



Opens the “Test Jack” window.



Opens the “Controller 1” window or the “Controller 2” window. Both windows are only available in security level 2.

Opens the "Inside the bus" window. This window is only available in security level 2.

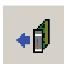
Opens the window “Configure valve“. This window is only available in safety level 2 and for the following amplifier cards:

- VT-HACD-1-1x/V0/1-P-1

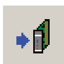
Window toolbar

The window toolbar contains buttons with symbols (icons) which the user can click on to execute the most commonly used functions and to invoke commands or open windows.

Following is a list of the included functions:

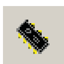


See section 4.2 ”Read Parameters”.



See caption 4.2 Write Parameters.

Clicking on this icon writes only the current changed parameter value to the controller card.



The command “Set Parameters to Memory” sends the current data from BODAC to the memory chip on the controller card.

If you are in an entry field, clicking on the icon increments the entry field contents. BODAC simultaneously writes this parameter to the controller card.
Exception: Multiplot, see "Multiplot toolbar"

If you are in an entry field, clicking on the icon decrements the entry field contents. BODAC simultaneously writes this parameter to the controller card.
Exception: Multiplot, see "Multiplot toolbar"

The Undo icon in the toolbar undoes the last entry

Clicking on the multiplot icon in the toolbar opens the BODAC window "Multiplot"

To view signals in the Multiplot window, click on the name of the desired signal in the Motion Data window. The signal name is highlighted in red to indicate that it has been selected for viewing in the Multiplot window. Then click on the Multiplot icon in the toolbar to open the Multiplot window. The signals that were selected in the Motion Data window will be displayed.
Within the "Multiplot " window additional signals can be added.

A maximum of 8 signals can be selected.

For additional information on the "Multiplot " window, see Section 4.3 "Multiplot".

Clicking on the printer icon in the toolbar opens the Windows system window "Print". You will receive a printout of the actual window.

The Help symbol in the toolbar generates a help pointer. Clicking with the help pointer on a parameter field opens the help for this parameter field.

Status bar

The status bar contains useful information about the active window. For example: In the Main Form the current connection status is shown in the status box.

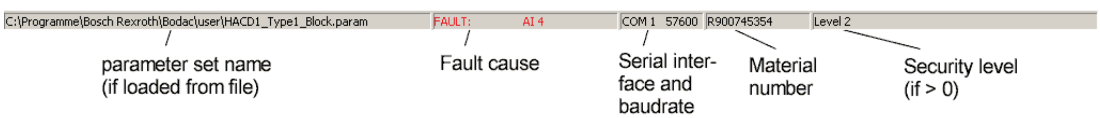


Fig. 13 BODAC Status bar

Short cut keys list

The function keys below are short cuts to important operations in the BODAC program.

F1	Opens BODAC Help. (see also "Help menu")
F2	Reads the parameter data stored in the control card and transfers it to the BODAC program. (see also “Read parameters“)
F3	Sends the current parameter data from BODAC to the control card. This action overwrites the previously stored data in the volatile memory. (see also “Write parameters“)
F11	In an entry field, pressing „F11“increments the value. BODAC simultaneously writes this parameter to the control card.
F12	In an entry field, pressing „F12“ decrements the value. BODAC simultaneously writes this parameter to the control card.
Page down	Within the structure or parameter editor in the Block entry field, “Page down“ is used to increment the entry field con-tents. This opens up the next higher block.
Page up	If you are within the structure or parameter editor in the Block entry field, “Page up“ is used to decrement the entry field contents. This opens up the next lower block.

4 BODAC – Menu description

4.1 File

The File menu contains commands for administrating and printing data.

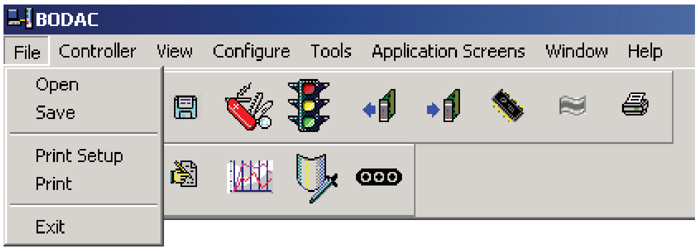


Fig. 14 File menu "

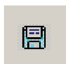
Open

Opens a window in which you can load a complete parameter structure, which was previously created and saved in BODAC. The profile contains all the values and parameters that were specified and entered before saving in BODAC.

Clicking on the preceding icon, which is part of the toolbar, also opens the window in which saved data files can be selected. A list of existing short cuts for the toolbar can be found in the “Toolbar” section.

Save

Opens a window in which all the data can be saved that was entered in BODAC. The saved file can then be used in other cards to duplicate the functionality.



Clicking on the preceding icon, which is part of the toolbar, also opens the window in which you can save the data entered in BODAC. A list of icons for the toolbar can be found in the “Toolbar” section.

Save the complete parameter structure after the installation is complete! When replacing a defective card the existing parameters/structure can be transferred to the new controller card. This card is then ready to be used with all the previously defined parameters and settings. The existing parameter files can also be send to identical or similar applications.

Print Setup

This menu item opens the standard Windows screen “Print setup”. Information about setting up a printer can be found in the Windows online help.

Print

This menu item opens the “Print“ window as shown in the illustration below.

Clicking on the preceding icon, which is part of the toolbar, also opens the window “Print forms”. A list of icons for the toolbar can be found in the “Toolbar” section in chapter 3.2 of BODAC.

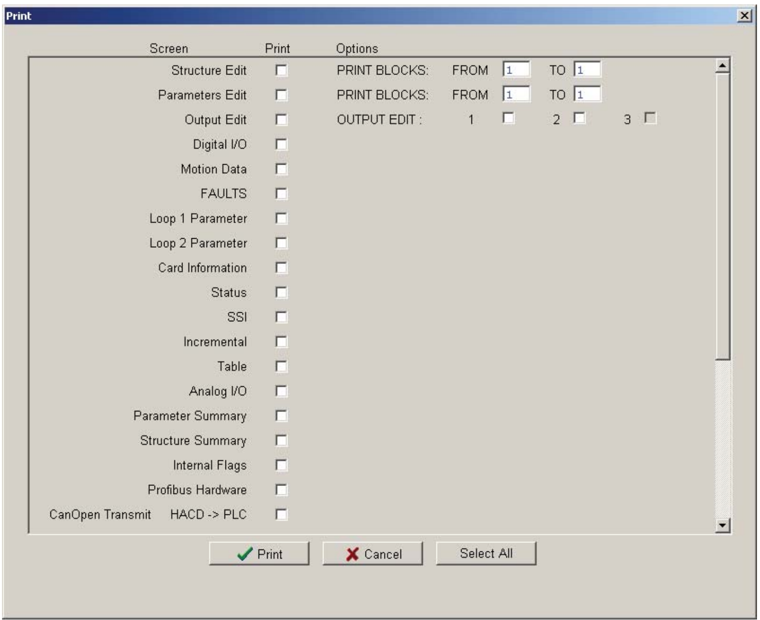


Fig. 15 “Print“ window

The window is divided into several columns. In the Print column, select the BODAC window to be printed. If the selected BODAC window consists of more than one sheet, use Options to select the number of data sheets to be printed.

Clicking on the Print button opens the standard Windows „Print“ screen. Information about the Print system window can be found in Windows online help.

Exit

Closes all currently active windows and exits the BODAC program.

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www.hyquip.co.uk

4.2 Controller

The Controller menu contains commands for direct communication with the controller card. The commands are used to send data to and from the controller card.

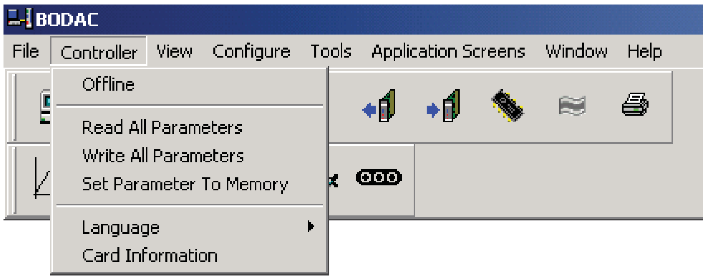


Fig. 16 Controller menu

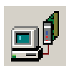
Offline

Interrupts the connection to the controller card. The “Offline” command is only selectable if there is an active connection to the controller card.

Clicking on the preceding icon, which is part of the toolbar, also generates the “Offline” command. The icon is only visible if there is an active connection to the controller card. A listing of icons for the toolbar can be found in Section "Toolbar".

Connect

Establishes the connection between BODAC and the controller card. The “Connect” command can only be selected if there is no active connection to the controller card.



Clicking on the preceding icon, which is part of the toolbar, also generates the “Connect” command. The icon is only visible if there is an active connection to the controller card. A listing of icons for the toolbar can be found in Section "Toolbar".

Search Card

The command “Search Card” opens the window “Search Card”, searches for active cards on the local bus and lists them in a tabular form.

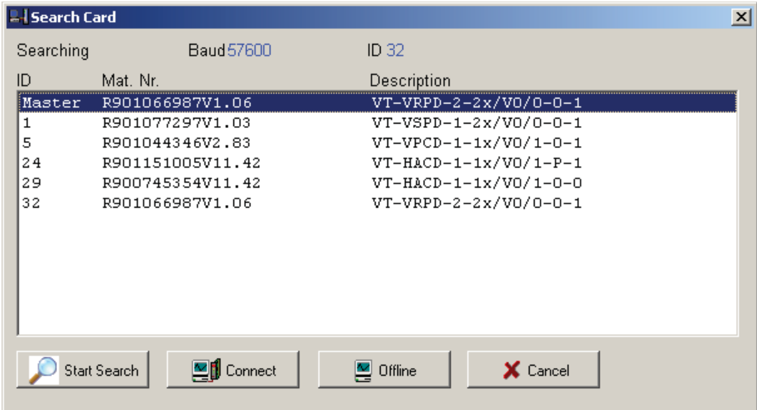


Fig. 17 Window “Search Cards“

Start Search Cards are searched for on the local bus.

Connect Bodac connects to the selected card.

Offline Bodac changes over to the offline mode and closes the connection with the active card.

Cancel The search for cards is interrupted, and Bodac maintains the connection with the active card.

In the first column “ID“ the bus address of the card is shown. The master bus address is not listed, but must differ from the bus addresses of other cards.

The second column “Mat. Nr.“ includes the material number of the card and the version number of the configuration. (see “Card Information“).

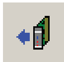
The third column “Description“ shows the text presented on the display. This text can be changed in the window “Card Information“.

If there are more cards connected to the bus, than there are listed, please check the Setting of the Transmit-Delay Time in the LocalBus Transmit Screen.

For additional information, see Section Local Bus.

Read Parameters

The “Read Parameters“ command reads the data currently stored in the controller card (Parameter set) and sends it to the BODAC program.



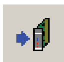
Clicking on the preceding icon, which is part of the toolbar, also reads the settings and entries stored in the controller card and sends it to BODAC. A listing of icons for the toolbar can be found in Section "Toolbar".

Write Parameters

The "Write Parameters" command sends the settings and entries, made in BODAC, to the controller card and overwrites the previously saved data in the volatile memory.

The new data is available as long as supply voltage is present on the controller card.
Interrupting supply voltage to the controller card will result in loss of data.

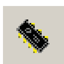
To permanently store data on the controller card, see Section "Set Parameters to Memory".



Clicking on the preceding icon, which is part of the toolbar, also sends the settings and entries you made to the controller card and overwrites the previously saved data in the volatile memory. A listing of icons for the toolbar can be found in Section "Toolbar".

Set Parameters to Memory

Sends the current data in BODAC to the permanent memory on the controller card. This permanently saves the data in the controller card and makes it available even after power is cycled.



The preceding icon, which is part of the toolbar, also sends the current data from BODAC to the controller card memory. A listing of icons for the toolbar can be found in Section "Toolbar".

Language

The "Language" menu contains the following options:

- English
- Deutsch

The preceding icon, which is part of the toolbar, opens a selection menu in which you can also select the language. A listing of icons for the toolbar can be found in Section "Toolbar".

English Displays the entire text of the entries, windows, menus, etc. in English.

Deutsch Displays the entire text of the entries, windows, menus, etc. in German.

The language selection component of the software also affects the language version of your controller card.
The menu tree, accessible through the buttons on the front panel of the controller card, is likewise switched over to the selected language.
The language selection is saved in the controller card.

Card Information

Opens the "Card Information“ window in which all the relevant data concerning hardware and firmware for the controller card are shown.

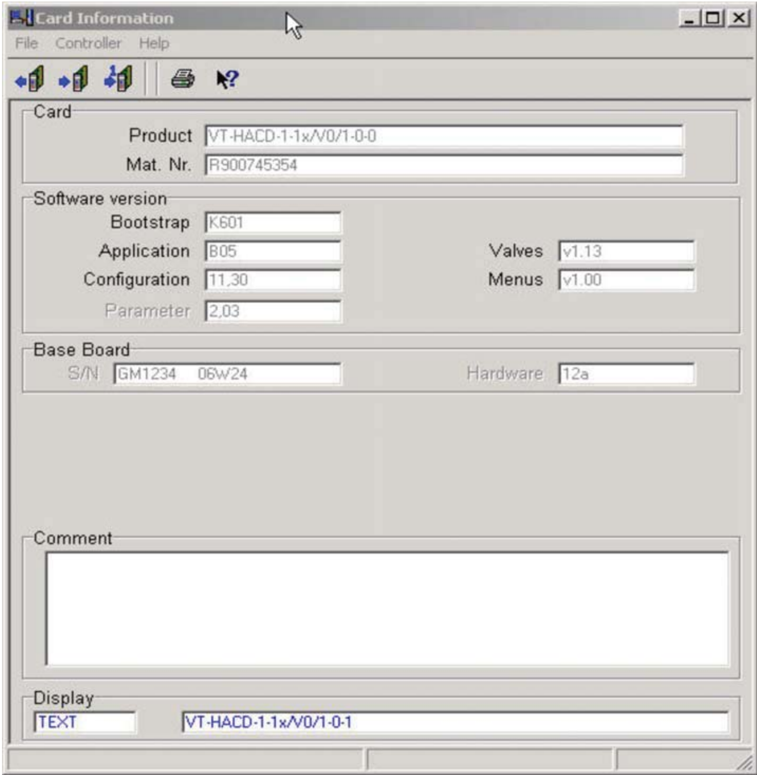


Fig. 18 "Card Information“ window“

Card Information – File menu

The File menu, in the "Card Information“ window, corresponds to the BODAC main window "File menu“.

Card Information – Controller menu

Contains commands for reading, writing and changing parameters.

Card Information – Help menu

Takes you directly to the current topic, or to the contents page of BODAC windows help

Card Information – Toolbar

Buttons are provided for frequently used functions. These are described in section "Toolbar “.

In the upper area of the "Card information“ window you will find the manufacturer data that exactly describes your controller card.

When contacting product support, have the following information ready:

- Product (contains the unique product number of your controller card.)
- S/N 1 (contains the serial number of the controller card.)
- PN (part number) (contains the part number of your controller card.)

Versions This is a list of the hard- and software used.

Comments In the entry field you can enter relevant comments that refer to your application and settings or important details.

You can refer to this information later should you require startup details.

Display Text The field contains a standard text entered by Bosch Rexroth. The text entered here is shown in run mode as a running text on the controller card display. This text can be edited to the users need. In addition, a signal from the controller can be displayed.

Additional information “Installation and Operation of the Controller Card“, Section Menu Tree for Settings and parameters, Menu Tree “Setup”

4.3 View

The View menu contains commands that give you a quick overview of

- the current parameters “Parameter Summary”
- the current data structure “Structure Summary”
- the active processes “Motion Data”
- the present signals “Voltmeter”
- the status of the controller card “Status”

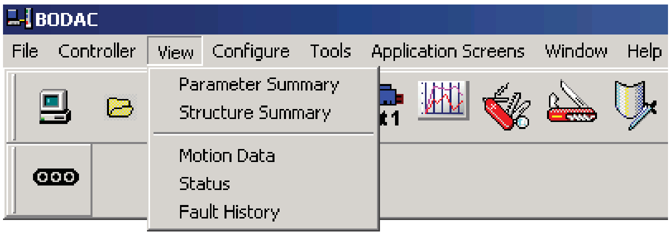


Fig. 19 View menu

Parameter Summary

The “Parameter Summary“ window displays a table of the active control circuit parameters.

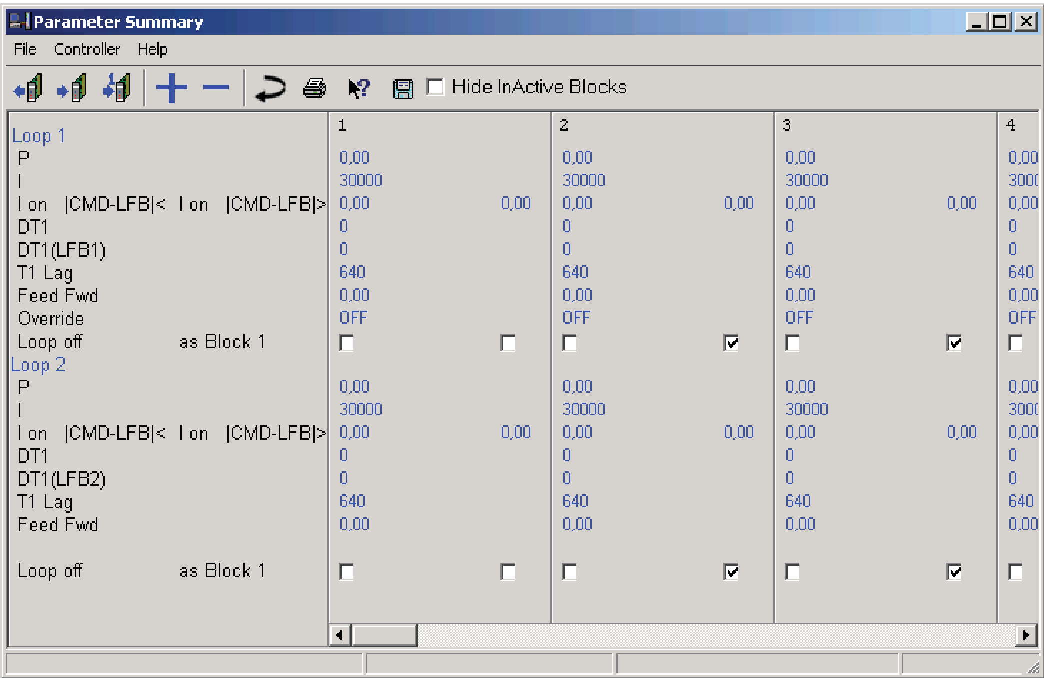


Fig. 20 “Parameter Summary“ window

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Parameter Summary – File menu

The File menu in the “Parameter Summary“ window corresponds to the BODAC main window “File Menu".

Parameter Summary – Help menu

Takes you directly to the help function for the current topic, or to the contents page of the BODAC windows help.

Parameter Summary – Toolbar

Buttons are provided for frequently used functions. These are described in section “Toolbar “.

The first column lists the parameter names for a PID controller. The proportional, integral and differential terms are shown by line for Blocks 1 to 32. For additional information on the individual parameters, see Section 6.2 "Parameter Editor".

Clicking on one of the listed parameter values will open the „Parameter Editor“, where the parameter can be changed

The parameter summary is only available for Mode 3 – Structure editor.

Structure Summary

Like the Parameter Summary window, the “Structure Summary“ window is divided into columns. The first column lists the description of the available entries.

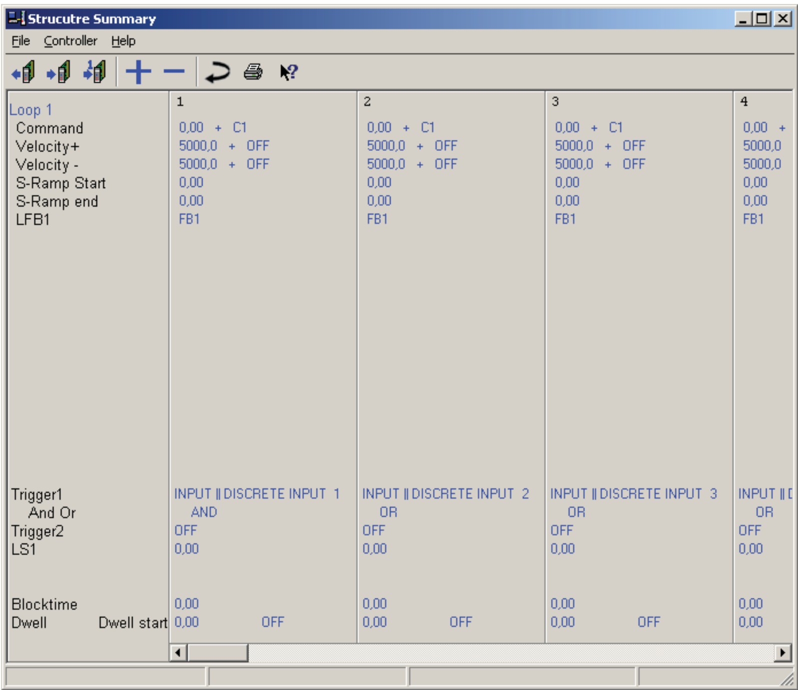


Fig. 21 „Structure Summary“ window

Structure Summary – File menu i

The Menu file in the “Structure Summary“ window corresponds to the BODAC main window “File Menu“.

Structure Summary – Help menu

Takes you directly to the help function for the current topic, or to the contents page of the BODAC windows help.

Structure Summary – Toolbar

Buttons are provided for frequently used functions. These are described in section “Toolbar “.

Following are the current settings for Blocks 1 to 32. Use the scroll bar on the lower edge of the window to scroll left and right.

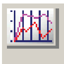
Clicking on one of the listed parameter values will open the window where the parameter can be changed. The parameter will already be highlighted.

For additional information on the available entries, see Section "Structure Editor".

The structure overview is only available for Mode 3 – Structure Editor

Motion Data

The "Motion Data " window shows you the entire signal sequence for your control circuit in real-time.



Clicking on the preceding icon, which is part of the toolbar, also opens the "Motion Data". A list of icons for the toolbar can be found in Section "Toolbar".

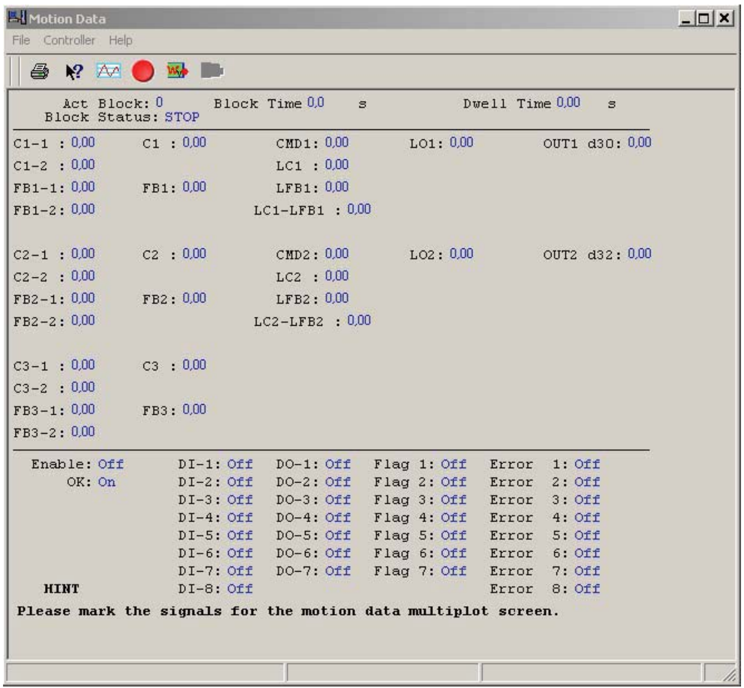


Fig. 22 "Motion Data" window

Motion Data – File menu

The Menu file in the „Structure Summary" window corresponds to the BODAC main window "File Menu".

Motion Data – Help menu

Takes you directly to the help function for the current topic, or to the contents page of the BODAC windows help.

Motion Data – Toolbar

Buttons are provided for frequently used functions. These are described in section "Toolbar ".

The signal names correspond to the representation in the BODAC Structure Editor. The Motion Data window shows an overview of all signals used in the input matrix, block matrix, loop matrix and output matrix.

For additional information on the signals that can be selected in BODAC, see Section "Structure Editor".

The lower third of the window shows the digital in- and outputs and the internal flags with their current status (on/off).

For additional information on the digital in- and outputs, see Section "Digital I/O" and "Internal Flags".

Process display may contain various parameters depending on the mode (1...3) (see „Mode Overview").

Clicking on the preceding icon, which is part of the toolbar, also opens the "Motion Data Multiplot" window. A list of icons for the toolbar can be found in Section "Toolbar".

Clicking on the preceding icon, which is part of the toolbar, starts saving of all signals in the motion data window whenever the block is changed over.

Clicking on the preceding icon, which is part of the toolbar also opens the "WinView recording" window.

Multiplot

The Multiplot window shows you the signal trace for selected signals.

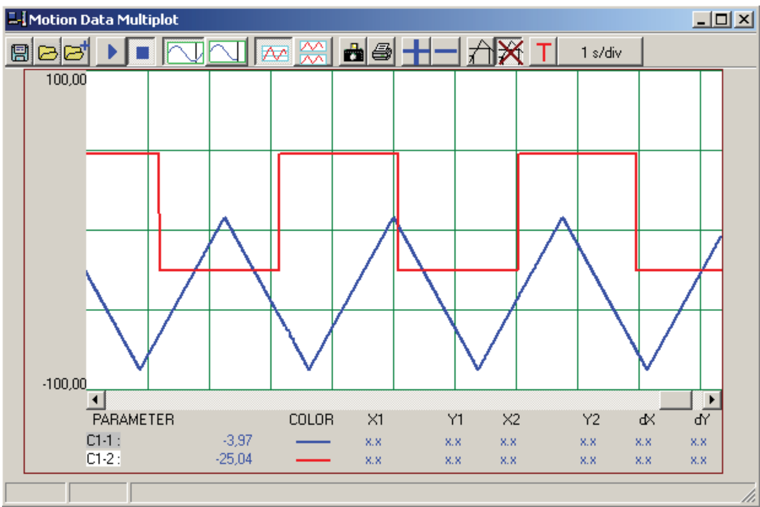


Fig. 23 "Multiplot" window

This window is a convenient software representation of an oscilloscope.

You can get to Multiplot from the window:

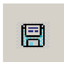
- Motion Data
- Voltmeter

Multiplot toolbar

This toolbar contains buttons with which all the functions of the Multiplot can be executed.

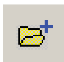
Fig. 24 Multiplot toolbar

The following functions are available:

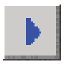


“Save”: signal traces can be saved as a file with the “.plt“ extension. The file can be loaded again as needed. You can also import the file into Excel.

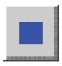
“Open”: previously saved signal traces can be loaded into the Multiplot window.



“Open”: previously saved signal traces can be loaded into the Multiplot window. The new signal trace is superimposed over the existing one.



“Run”: starts the recording and displaying the Multiplot selected signals.



“Pause”: stops recording the signal and freezes the display until it is reactivated using the „Run“ button.

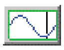
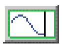
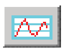


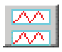
Chart Recorder Mode: Moves the signal display from right to left. The signal trace is shown as a moving band.



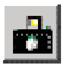
Scope Mode: Anchors the signal display. The signal trace starts on the left and ends at the right edge in constant repetition.



All selected signals are shown together in one graph.



Each signal is shown individually.



Generates a screenshot of the current representation of the Multiplot. Opens the “Save file as” window where you can save the signal trace in a “Windows Meta File”.

Opens the “Print“ window. You will receive a printout of the Multiplot.

“Add”: Opens a window in where analog and digital signals can be added using two selection menus.

“Delete”: Opens a window in which you can delete a selected signal from the Multiplot window.
To delete a signal you have to click on the name of the desired signal in the “Signal Display” legend.
The signal is then displayed with a white background. Non-selected signals are displayed with a gray background.

“Show Cursor”: Puts two cursors on the signal trace of the displayed signals. By selecting a signal in the “Signal Display Legend”, you can use the mouse or the left/right arrow keys to position the trace as desired.
The coordinates are shown in the „Signal Display Legend“ as X and Y coordinates.

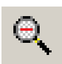
“Hide Cursor”: Removes the cursors from the display.

“Trigger”: Opens a window in which you can set the trigger condition for displaying the trace. A selection menu allows you to set the trigger condition. Enter the value in units [Unit] for the trigger level.

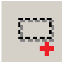
1 s/div

The signal display division is shown by green grid lines in the X-Y coordinates. Change the X-coordinate divisions by clicking on the preceding field. In the present display the signal will travel 1 grid field in the X direction in one second. To learn how to configure the Y-coordinate, see Section "Multiplot Display Legend".

Magnifies the value set in the time base by one increment. With the current representation of 1s/div, the X-axis would magnify to 500ms/div.



Reduces the value set in the time base by one increment. With the current representation of 1s/div, the X-axis would reduce to 2s/div.



The section selected with the mouse cursor is enlarged to the size of the table signal display.

Reduces the signal display to the original size.

Multiplot Display

The signal display is a graphical representation of the signal over time.

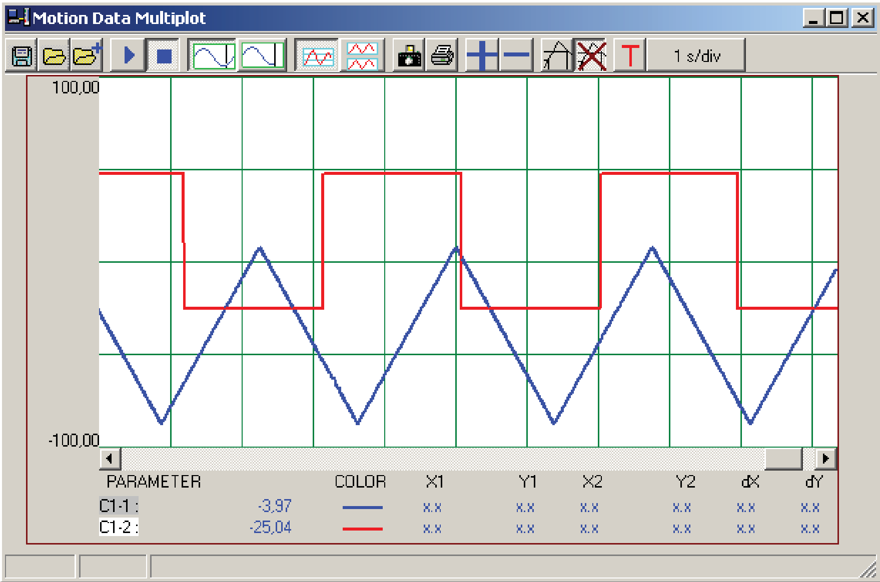


Fig. 25 Real-time Oscilloscope Signal Display

The distance is shown in the Y direction. It is based on your entries in the “Structure Editor”. The X-direction represents a time axis.

The display corresponds to a standard oscilloscope.

Multiplot Display Legend

The signal display legend shows the relevant information for the displayed signals in column format.

PARAMETER		COLOR	X1	Y1	X2	Y2	dX	dY
C1-1 :	0,00	——	x.x	x.x	x.x	x.x	x.x	x.x
Dwell Time	0,62 s	——	x.x	x.x	x.x	x.x	x.x	x.x

Fig. 26 Real-time Oscilloscope Signal Display Legend

Parameters The Parameters column lists the signals by name. Clicking with the mouse on a signal name changes the background to white. This means the signal is selected.

Double-clicking on a signal name opens the “Adjust Graphs“ window.

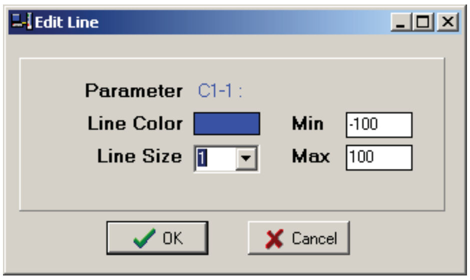


Fig. 27 Adjust Graphs window

The “Adjust Graphs“ window is used to change the display of the selected signal. Clicking on the “Color” field opens a color table in which you can select a new display color.

The “Weight” field contains a selection menu for the line thickness of the signal.

Set the scaling in the Y-axis of the signal display for the selected signal in the “Min“ and “Max“ entry fields.

The current parameter value is shown in the signal display legend after the signal name.

Color The Color column contains the display color for ensuring association and recognizability in the signal display

X1/Y1 Columns “X1“ and “Y1“ are directly related to the “Show cursor“ button. By moving the cursor for Marking 1 to a particular point in the trace you can read off the X-Y coordinates of the displayed signal in the X1/Y1 column.

X2/Y2 Lists the coordinates of Marking 2 in the “X2“/“Y2“ column.

dX/dY The "dX" and “dY” columns display the increase/decrease of the trace.

Winview recording

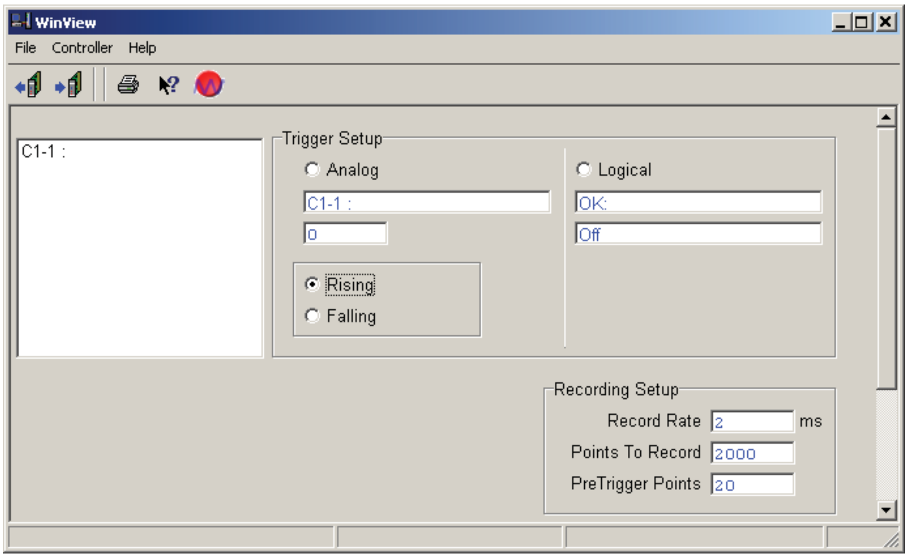


Fig. 28 “Winview Recording” window

Winview recording – File menu Corresponds to the BODAC main window “File Menu”

Winview recording – Help menu Takes you directly to help for the current topic or to the contents page of BODAC windows help.

Winview recording – Toolbar Buttons are provided for frequently used functions. These are described in section “Toolbar “.

The designation of the signals corresponds to the representation in the BODAC Structure Editor, in which they are clearly represented on the basis of the input matrix, the block matrix, the loop matrix and the output matrix.

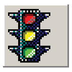
Further information about the designation of signals that can be selected in BODAC can be found in the chapter “Structure Editor”.

Trigger Setup Here, you can set the signal, which triggers the start of recording.

Recording Setup In this box you can set the conditions for signal recording. The number of points that can be recorded is limited to 16384. This is valid for the total of all signals.
The record rate can be set within the range from 2ms to 32766ms. It is useful to select only record rates that can be divided by 2.
The PreTrigger Points can be adjusted within a range from 0 to 163844ms. If the trigger point occurs before the set pre-trigger points were recorded, fewer pre-trigger points are shown on the signal display.

Status

The „Status“ window provides an overview of the current faults that were detected while the controller card was running.



Clicking on the preceding icon, which is part of the toolbar, also opens the "Status" window. A listing of existing short commands for the toolbar can be found in Section "Toolbar".

Error handling is specified in the "Faults" window.

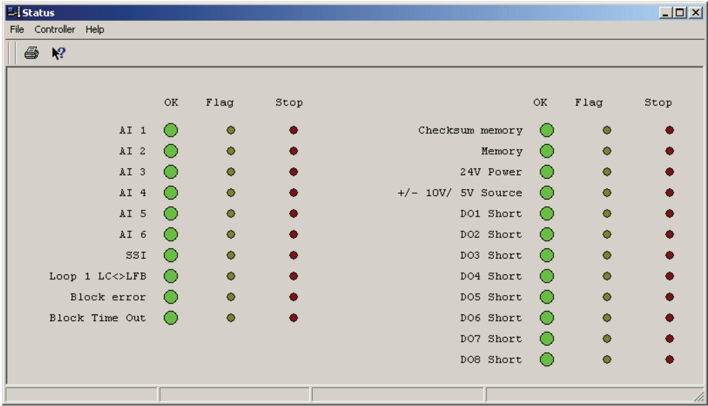


Fig. 29 "Status" window

Status-Help menu Takes you directly to help for the current topic, or to the contents page of BODAC windows help.

Status – Toolbar Buttons are provided for frequently used functions. These are described in section “Toolbar “.

OK Shows bright green as long as no error occurs.

Flag Is bright yellow when a fault has been detected. If a monitored signal has been set to “Flag” in the “Faults” window, operation of the controller card is not interrupted. The error is detected, saved and the process is continued.

Stop Glows bright red when a fault has been detected. The controller card stops the process. To enable this, set the monitored signal in the “Faults” window to “Stop”.

Further information about dealing with errors can be found in chapter 4.4 “Faults”.

AI 1 to 6 Error display of analog inputs AI1 through AI6

SSI Error Error display of the SSI encoder. The SSI settings are made in the Configuration menu, "SSI".

Control Error 1 Indicates if a discrepancy between the target value and the actual value in loop 1 that is big enough to trigger a fault.

Control Error 2 Indicates if a discrepancy between the target value and the actual value in loop 2 that is big enough to trigger a fault.

Block Error Multiple Blocks are triggered simultaneously.

Block Timeout An error is indicated if, in a block that you have defined in the Structure Editor, the defined dwell time is exceeded.

Encoder Channel A An error occurred in channel A of the incremental encoder.

Encoder Channel B An error occurred in channel B of the incremental encoder.

Memory checksum The checksum for the memory chip results in a deviation from the currently saved data for the chip.

Ram error The Ram chip in the controller card is defective.

Supply voltage 24V The supply voltage is absent or incorrect (short circuit or effect of additional connected consumers)

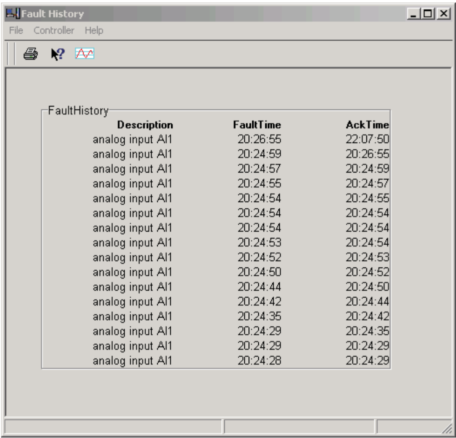
Reference voltage The reference voltage +/- 10V on the edge connector deviates by 0.5%.

Short circuit DO1 to DO8 One of the digital outputs. 1 through 0 is short-circuited.

Local Bus An error is indicated if the Local Bus receiver does not receive a message within the time set in LocalBus Receive-Timeout.

Fault History

The window “Fault History” provides an overview of the last 16 faults occurred.



Description	FaultTime	AckTime
analog input AI1	20:26:55	22:07:50
analog input AI1	20:24:59	20:26:55
analog input AI1	20:24:57	20:24:59
analog input AI1	20:24:55	20:24:57
analog input AI1	20:24:54	20:24:55
analog input AI1	20:24:54	20:24:54
analog input AI1	20:24:54	20:24:54
analog input AI1	20:24:53	20:24:54
analog input AI1	20:24:52	20:24:53
analog input AI1	20:24:50	20:24:52
analog input AI1	20:24:44	20:24:50
analog input AI1	20:24:42	20:24:44
analog input AI1	20:24:35	20:24:42
analog input AI1	20:24:29	20:24:35
analog input AI1	20:24:29	20:24:29
analog input AI1	20:24:28	20:24:29

Fig. 29 “Fault History” window

Description Listing of the fault in clear text. The texts correspond to the fault texts in the “Status” window

Fault Time Time when the fault was recognized. The timer starts when the enable is set and stops when the enable is reset.

AckTime Time, when the rectification of the fault was recognized. In this case, the enable must be set.

The timer runs only when the enable is set.
Errors are only recognized while the enable is set.

4.4 Configuration menu

The Configuration menu contains commands used to define/configure the separate modules that make up the application.

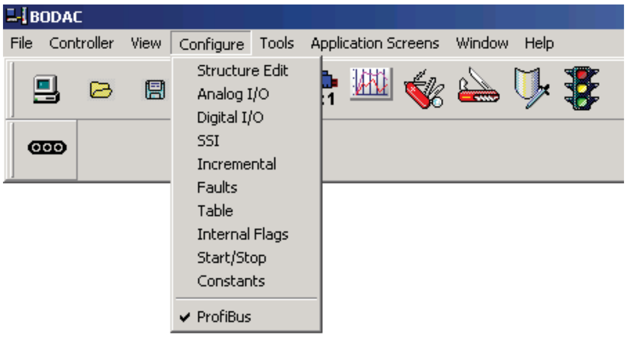


Fig. 30 Configuration menu

Structure Editor

The Structure Editor is used to define the desired motion sequence.

There are 32 blocks available for using various trigger conditions to influence the target values and control parameters (switching conditions).

Special control algorithms for hydraulic drives are available to select from.

Clicking on the preceding icon, which is part of the toolbar, also opens the "Structure Editor". A list of existing icons for the toolbar can be found in Section "Toolbar".

A detailed description of the Structure Editor can be found in Section "The Structure Editor".

The structure editor is only available for Mode 3 – Structure Editor.

Analog I/O

The “Analog I/O“ window is where the analog in- and outputs on the controller card have to be configured.

Clicking on the preceding icon, which is part of the toolbar, also opens the "Analog I/O" window. A list of existing icons for the toolbar can be found in Section "Toolbar".

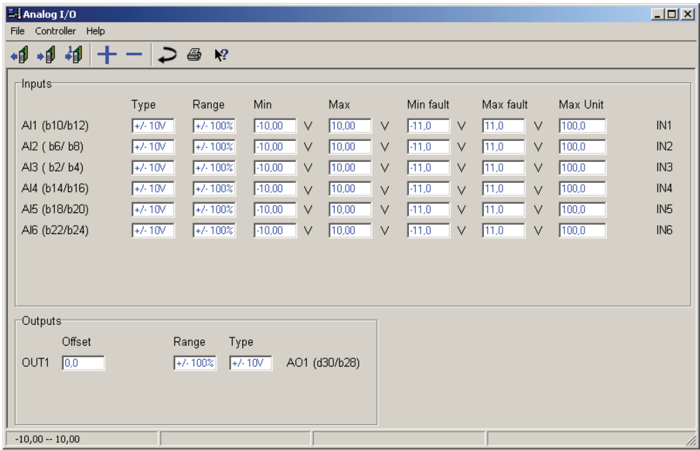


Fig. 31 “Analog I/O” window

Analog I/O – File menu
The File menu in the “Analog I/O” window corresponds to the BODAC main window “File Menu”

Analog I/O – Controller menu
Contains commands for reading, writing and changing parameters.

Analog I/O – Help menu
Takes you directly to help for the current topic, or to the contents page of BODAC windows help.

Analog I/O – Toolbar
Buttons are provided for frequently used functions. These are described in section “Window toolbar“.

Inputs field

The first column in the Inputs field lists the names of analog inputs AI1 to AI6. In addition to the name you will see the terminal designation for the edge connector.

(Example: The pins for analog input 1 are in Row b, Pin 10 (+) and Row b, Pin 12 (-) on the edge connector.

For additional information on pin assignments for the edge connector, see the manual „Installation and Operation of the HACD Controller Card“, Section “Edge Connector Terminals and Pin Assignments on the Edge Connector”.

In the remaining columns the parameter values for the analog input signals are specified.

Type Clicking on the „TYPE“ entry field opens a pulldown menu containing the following:

- +/-10V
  The expected input signal ranges from (–10V) to (+10V).
- 0~10V
  An input signal of (0V) to (+10V) is expected.
- 0~20mA
  The current value of the input signal ranges from (0mA) to (20mA).
- 4~20mA
  The current value of the input signal ranges from (4mA) to (20mA).

Range The value range of the signal in [%] is et in the „Range“ column. If the selection +/-10V is made in the “Type” column a signal of (-10V) corresponds to a signal of (-100%) when the range setting is □100%.

The graphic below illustrates the relationship. (see Fig. Analog I/O field inputs)

Min The “Min“ value sets the minimum for the input signal. Depending on the setting of “Type” and “Range” this value is translated to the minimum value of the “Range” setting.

If for example you enter -5V , with Type=+/-10V and Range=+/-100%, a signal of -5V is interpreted as -100%. (see Fig. Analog I/O input adjustments)

Max The “Max“ setting is the opposite of „Min“. If +9V is entered, a signal of +9V is interpreted as +100%. (see Fig. Analog I/O input adjustments)

min Fault If the value falls below the entered value, BODAC uses the "Status" window and the "Status bar" to indicate that a fault has occurred. Specifying the error response is done in the "Faults" window.

max Fault If the value exceeds the entered value, BODAC uses the "Status" window and the "Status bar" to indicate that a fault has occurred. Specifying the error response is done in the "Faults" window.

max Unit The „max Unit“ specifies the conversion from Range [%] to Units [Unit].

After the analog signals are converted the value in Units is passed along to the “Structure Editor“ designations “IN1” through “IN6”.

The table and graphic below show the parameters for a signal adjustment in the Inputs field.

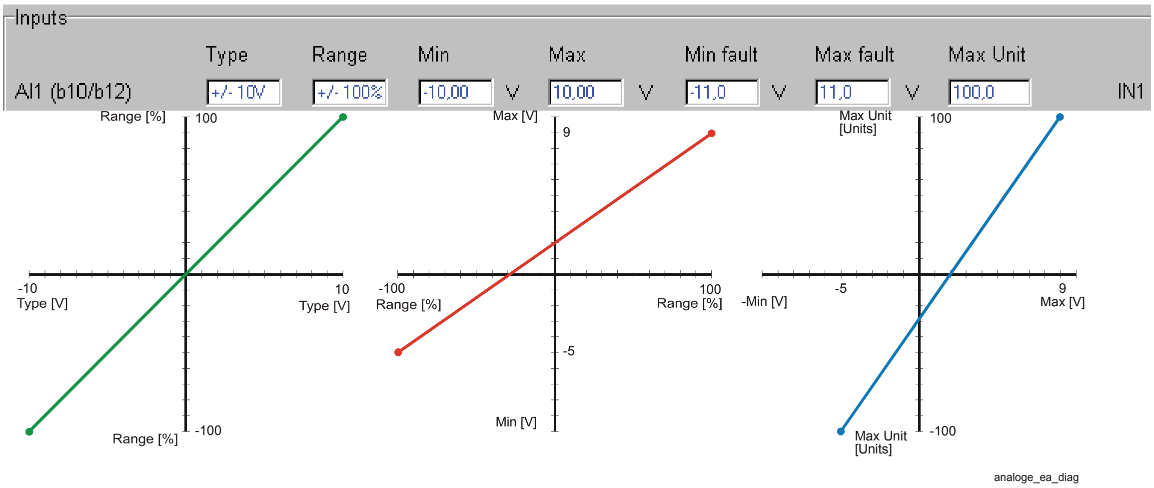


Fig. 32 Analog I/O input adjustments

See also: "Adjust analog input to command value".

Outputs field

The first column in the “Outputs“ field lists the names of the analog outputs, which are used symbolically in the Structure Editor as „Out1" and „Out2". The signals Out1 and Out2 are to be calculated in the unit [%].

In the following columns you determine the parameter values of the analog output signals.

Type Corresponds to the entry value “Type“ in the “Inputs field “ section.

Range Corresponds to the entry value “Range“ in the “Inputs field“ section.

Offset The entry value “Offset“ is used to correct the deviation from the zero point of the system.

The resulting signals will be present on the analog outputs (AO1 to AO3) of the controller card.

For diagnostic purposes you can also access the signal that is present on analog output AO3 (Row b, Pin 26/28) on “X1“ of the front panel.

For additional information on pin assignments for the edge connector, see the manual "Installation and Operation of the HACD Controller Card", Section "Edge Connector Terminals and Pin Assignments on the Edge Connector".

Digital I/O

The "Digital I/O" window is where you configure the eight digital inputs and seven digital outputs on the controller card. The window contains two fields, "Outputs" and "Inputs".

Clicking on the preceding icon, which is part of the toolbar, also opens the "Digital I/O" window. A list of existing icons for the toolbar can be found in Section "Toolbar".

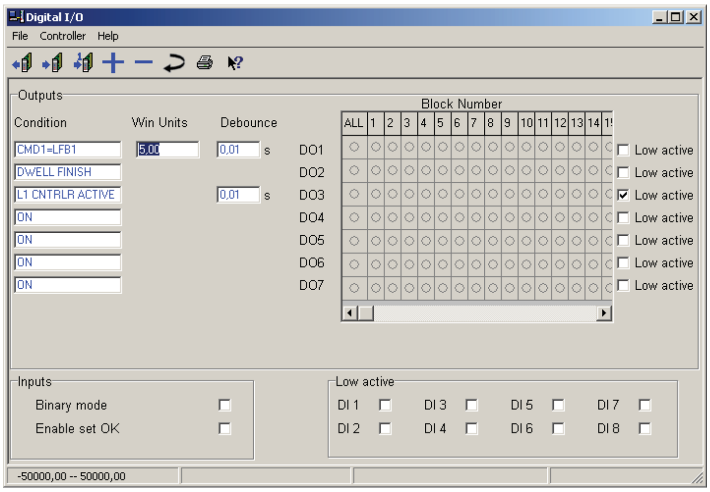


Fig. 33 "Digital I/O" window

Digital I/O – File menu
The File menu in the "Digital I/O" window corresponds to the BODAC main window "File menu".

Digital I/O – Controller menu
Contains commands for reading, writing and changing parameters.

Digital I/O – Help menu
Takes you directly to help for the current topic, or to the contents page of BODAC windows help.

Digital I/O – Toolbar
Buttons are provided for frequently used functions. These are described in section "Window toolbar".

Outputs field

The “Outputs“ field is where the digital outputs DO1 to DO7 are set to “On” or “Off” using the following:

Condition

In the “Condition“ entry field the trigger condition can be selected for digital outputs 1 through 7 from a pull down menu. If parameter value comparisons and/or time-dependent trigger conditions are selected two additional entry fields will be shown. If for example the parameter comparison “CMD1=LFB1” is selected, BODAC will also show the “Win Units” and “Debounce” entry fields.

Condition	Explanation
ON	The digital output is activated.
CMDx = LFBx	The digital output is activated when CMDx is equal to LFBx within the window after the debounce time.
LFBx ≥ Window	The digital output is activated when signal LFBx is greater than or equal to the window value after the de-bounce time.
LFBx ≤ Window	The digital output is activated when signal LFBx is less than or equal to the window value after the debounce time.
Table completed	The digital output is activated when a table function has been completed
Waiting time com-pleted	The digital output is activated when the set waiting time of a block has elapsed.
Block Timeout	The digital output is activated when the set block time of the block has elapsed.
Lx controller active	The digital output is activated when the corresponding control loop (Loop) is active in the case of alternating control.
Ramp x completed	The digital output is activated when the ramp function has been completed.
Error	The digital output is activated when an error flag (1...8) was set.
ABS(LFBx) ≤ Window	The digital output is activated when the absolute value of signal LFBx is less than or equal to the window value after the debounce time.
ABS(LCx) ≤ Window	The digital output is activated when the absolute value of signal LCx is less than or equal to the window value after the debounce time.
Zero Channel = 0	The digital output is activated when the Zero Channel of the incremental encoder is equal to 0.
ABS(LOx) <= Window	The digital output is activated when the absolute value of signal LOx is less than or equal to the window value after the debounce time.
Fault Status	The present fault is output as a combination of pulses. The output can be fed to an optional output DO1 to DO7 depending on the configuration.

x = 1...2

Fault Status

Fault code	Fault
1	Range error for analog input AI1.
2	Range error for analog input AI2.
3	Range error for analog input AI3.
4	Range error for analog input AI4.
5	Range error for analog input AI5.
6	Range error for analog input AI6.
7	Not used.
8	Not used.
9	LVDT secondary side.*
10	Not used.
13	Short Circ Solenoid.*
14	LVDT primary side.*
15	Error of incremental encoder channel A.
16	Error of incremental encoder channel B.
17	Erro block timeout.
18	Fault of SSI encoder cable.
19	Block error.
20	Control error Loop 1.
21	Control error Loop 2.
22	Not used.
23	Parameter file checksum error .
24	Not used.
25	24V supply voltage fault.
26	Reference voltage fault.
27	Fault short-circuit of digital output DO1.
28	Fault short-circuit of digital output OK.
29	Fault short-circuit of digital output DO2.
30	Fault short-circuit of digital output DO3.
31	Fault short-circuit of digital output DO4.
32	Fault short-circuit of digital output DO5.
33	Fault short-circuit of digital output DO6.
34	Fault short-circuit of digital output DO7.
35	Fault, maximum frequency of incremental encoder exceeded.
36	Not used.
37	Bus fault, master not active (CANOpen, DeviceNet).

38	Not used.
39	Not used.
40	Not used.
41	Not used.
42	Not used.
43	Not used.
44	Not used.
45	Not used.
46	Range fault LVDT.*

* only for VT-HACD-1-1x/V0/1-P-1

The fault code is issued as follows:
Tens digits: A longe pulse of 2 seconds
Ones digits: A short pulse of 0.5 seconds
The fault code is repeated after a break of 5 seconds.

The figure below shows fault code 18 (fault of SSI encoder cable).

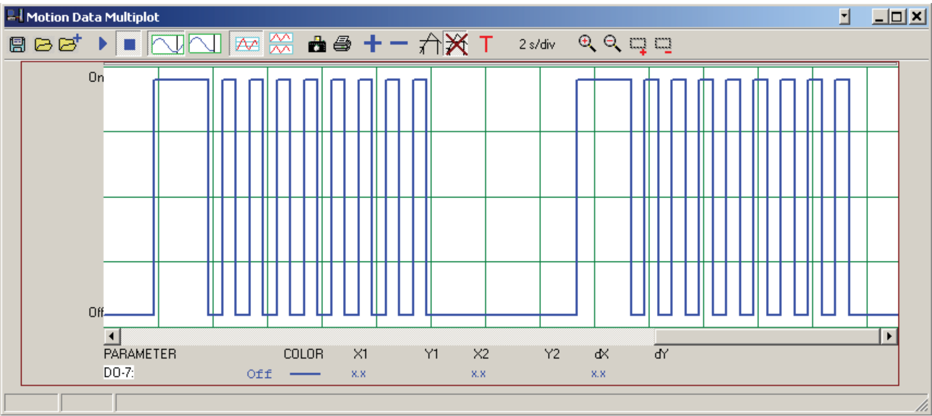


Fig. 34 Example: Output of a fault code via a digital output

Win Units In this entry field you can set the maximum deviation (tolerance) of the command/actual value comparison. The condition is regarded as fulfilled, as soon as the value to be compared is within the tolerance window.

Debounce The “Debounce” field is where you set the maximum delay time until the previously defined condition is considered to be TRUE.

Block number Select Block 1 to 32 in the tabular selection field „Block number“. The condition will be checked only in these selected blocks.

Low Act./High Act. If **NO** check mark is entered, the signal switches from Low to High when the condition is met.

If the check mark is entered, the signal switches from High to Low when the condition is met.

Inputs field

The „Inputs“ field is where adjustments for the eight digital inputs on the controller card are made.

Binary mode

The „Binary mode“ selection field is used to decide how the digital inputs are used. If **NO** check mark is entered behind “Binary mode”, each digital input is considered as an independent trigger condition. In this case, the Structure Editor has 8 digital inputs available as a switching condition.

Activating “Binary mode” (check mark) means the digital inputs DI1 through DI5 are interpreted as a binary combination. The 5 digital inputs can create 32 different states. As a result of this the “Structure Editor” provides 32 software switches (binary 0 to binary 31) as a trigger condition.

Digital input DI1 is the LSB.

Digital input DI6 sets the binary word as valid.
For this binary combination to be accepted, DI6 must be High. When this input is High any changes on inputs DI1 through DI5 will take effect immediately and generate a new trigger condition.

Digital inputs 7 and 8 are not used.

The defined base state in “Binary mode“ is “binary 0“.

The current state remains valid until there is a change in state.

The following table illustrates the relationship between the digital inputs and the trigger condition (Software switch):

Software switch	DI5	DI4	DI3	DI2	DI1
binary 0	0	0	0	0	0
binary 1	0	0	0	0	1
binary 2	0	0	0	1	0
binary 3	0	0	0	1	1
binary 4	0	0	1	0	0
binary 5	0	0	1	0	1
binary 6	0	0	1	1	0
binary 7	0	0	1	1	1
…					
binary 24	1	1	0	0	0
binary 25	1	1	0	0	1
binary 26	1	1	0	1	0
binary 27	1	1	0	1	1
binary 28	1	1	1	0	0

binary 29	1	1	1	0	1
binary 30	1	1	1	1	0
binary 31	1	1	1	1	1

Low active

Checking “low active“ for one or more of the digital inputs reverses the action of the inputs.

If for example all digital inputs are “low active“, all the values for the digital inputs in the table are inverted.

Enable Set OK

Placing a check mark by „Enable Set OK“ means that the digital output “OK” is set if the Enable is High and there are NO Errors.

Leaving this unchecked means that „OK“ is set if there is supply voltage present and no error has occurred. The status of Enable is ignored.

See also: "Digital signal input".

The “Digital I/O“ window may contain various parameters depending on the mode (1...3) (see “Mode Overview“).

SSI

The SSI window contains the definitions for using an appropriate encoder for measuring the actual position. With the specification for a “Synchronous Serial Interface” in mind position data can be read and processed.

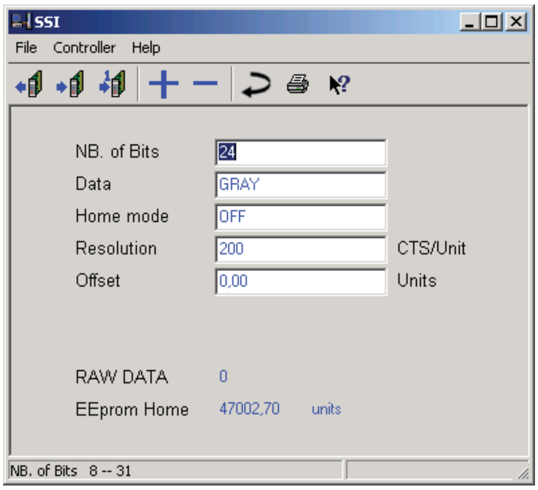


Fig. 34 "SSI" window

SSI – File menu
Das The File menu in the “SSI“ window corresponds to the BODAC main window „File menu“.

SSI – Controller menu
Contains command for reading, writing and changing parameters.

SSI – Help menu
Takes you directly to help for the current topic, or to the contents page of BODAC windows help.

SSI – Toolbar
Buttons are provided for frequently used functions. These are described in section “Window toolbar “.

Programmable or non-programmable encoders can be used.

Number of bits
Enter the prescribed number of bits depending on the data protocol and the encoder type used.

Data
Here BODAC makes it possible to accommodate various encoders. The value entered is dependent on requirements of the encoder.

Offset
In this field you can set the mode for adjusting the encoder zero point.

Condition	Explanation
OFF	The encoder zero point is adjusted by changing the "Offset" parameter.
Digital input 1...8	The zero point of the encoder is determined by the event

	of setting a digital input (1...8). This results in the automatic setting of the "Offset" parameter. As soon as the selected input is active, the zero point is continuously re-set.
Block 1...32, start or end	The encoder zero point is determined by the event of starting or completing a block (1..32). This results in the automatic setting of the "Offset" parameter.

Resolution Scaling in [Counts/Unit].

Offset "Offset" determines the zero point of the system.

RAW Data Raw data read by the encoder without evaluation; conversion by the HACD amplifier card.

EEProm Home Value that was determined by the "Zero point mode" and saved in the HACD.

The figure below illustrates the interrelationship of various offsets and their effectiveness.

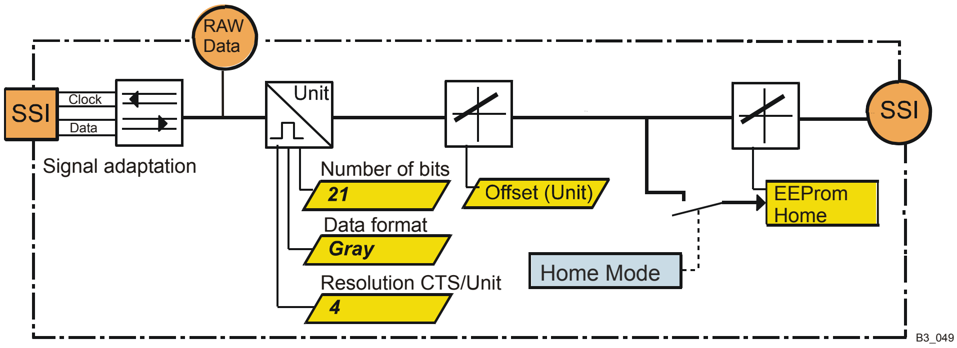


Fig. 35 Signal path of the SSI encoder within the HACD

Incremental

The "Incremental" window contains definitions for the use of an incremental encoder for actual position measurements.

NOTE!

Caution!

The evaluation logic for the incremental encoder has a limit frequency of 100 kHz. In the case of faster impulses, these are no longer evaluated correctly and the current position may be wrongly determined.

When using this encoder type, select the maximum traversing speed so that the max. Frequency of 100 kHz is not exceeded taking into account the encoder resolution.

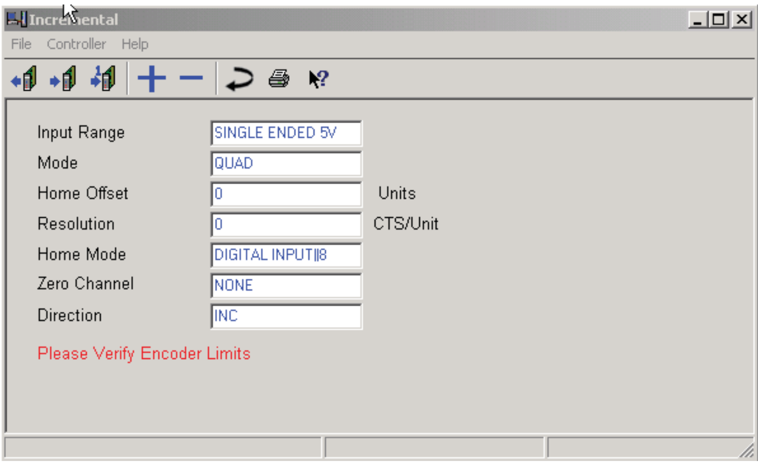


Fig. 36 "Incremental" window

SSI – File menu
The "File" menu in the "Incremental" window corresponds to the BODAC main window "File Menu".

SSI – Controller menu
Contains commands for reading, writing and changing parameters.

SSI – Help menu
Takes you directly to the help for the current topic or to the contents page of BODAC windows help.

SSI – Toolbar
Buttons are provided for frequently used functions. These are described in the section "Window toolbar ".

You can use various types of incremental encoders.

Input Range
This selects the type of encoder used. Fault monitoring (Encoder Channel A or B) is only active when Diff is selected.

Input range	Encoder type
SE 5V	Enoder type with single ended outputs (5V signal level)
DIFF	Encoder type with differential output signals (5V signal level)
SE 24V	Encoder type with single ended outputs (24V signal level)

Mode This selects the type of encoder used.

QUAD	Quadrature ended encoder signal (suitable for recognizing the direction of movement)
SINGLE	Single ended encoder signal (not suitable for recognizing the direction of movement)

Offset In the entry field "Offset" you can determine the zero point of the system.

Resolution This parameter determines the resolution of the encoder in CTS/Unit.

Home Mode Here, you can determine, how the zero point of the encoder is to be set.

Condition	Explanation
Digital input 1...8 or enable	The zero point of the encoder is determined by the event of setting a digital input (1…8) or by an enable. This sets the "Offset" parameter automatically. As long as the selected input is active, the zero point is continuously re-set.
Block 1...32, start or end	The zero point of the encoder is determined by the event of starting or ending a block (1..32). This sets the "Offset" parameter automatically.

Zero Channel Here, you can determine the type of zero channel of the encoder. The zero channel is only read in in conjunction with the signal selected in the Home Mode.

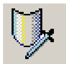
Condition	Explanation
None	Zero channel is not used.
Rising edge	The rising edge of the zero channel is evaluated.
Falling edge	The falling edge of the zero channel is evaluated.

Direction Set the counting direction of the encoder here.

Condition	Explanation
INC	Forward counting pulses will increase the feedback signal.
DRC	Forward counting pulses will decrease the feedback signal.

Faults

The settings in the “Faults“ window affect response to internal and external faults.



Clicking on the preceding icon, which is part of the toolbar, also opens the "Faults" window. A list of existing icons for the toolbar can be found in Section "Toolbar".

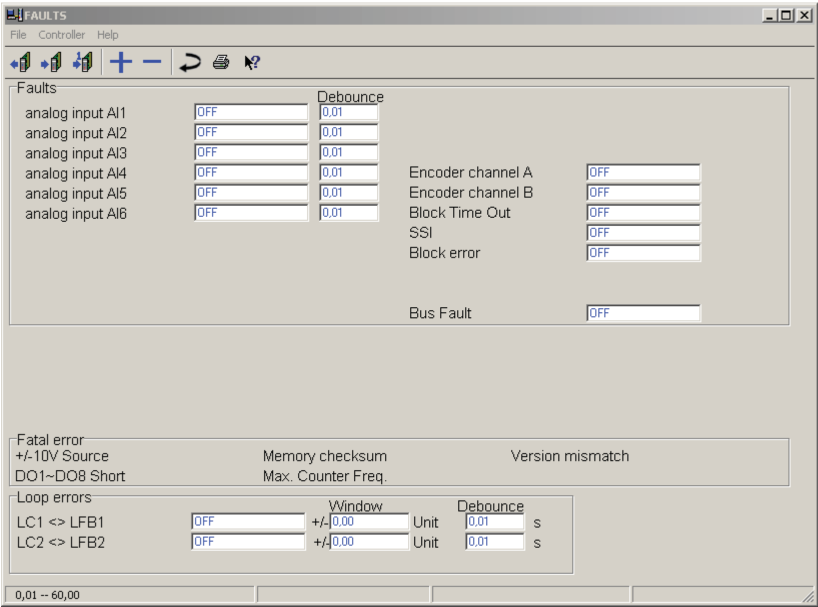


Fig. 37 „Faults“ window

Faults – File menu The File menu in the „Faults“ window corresponds to the BODAC main window “File menu“.

Faults – Controller menu Contains command for reading, writing and changing parameters.

Faults – Help menu Takes you directly to help for the current topic, or to the contents page of BODAC windows help.

Faults – Toolbar Buttons are provided for frequently used functions. These are described in section “Toolbar “.

If an actual value deviates from the preset value by the prescribed amount the “Faults” window is used to specify the response of the controller card when a fault is detected.

When the controller card detects a fault it can respond in 3 various ways:

Off The signal deviation is ignored. The controller card does not register a fault, and there is no error response.

Stop The controller card detects a signal deviation, sets the analog outputs to zero and resets the „OK“ digital output. No parameters are processed until the error has been corrected.

Flag The controller card detects the signal deviation and uses the “Status” window to indicate that a fault was detected. If a Flag is set an additional entry window is shown in which the user can assign error1 through error8 to this Flag. These Flags are available as a trigger condition in the Block Matrix and the Digital I/O window to respond specifically to a particular event.

The „Faults“ window is divided into 3 fields. Each field corresponds to a fault category.

The various faults are divided into

- Faults
- Fatal Faults
- Loop Error

The “Faults“ window may contain various parameters depending on the mode (1...3) (see „Mode Overview“).

“Faults“ field

The “Faults“ field specifies the response of the controller card when the following events occur:

- Error on one of the analog inputs
- Block Timeout error
- SSI error
- Incremental encoder fault
- Block error
- Local Bus

Analog inputs AI1 to AI6 The signals on the analog inputs are monitored during the entire run process. If a signal deviates from the value specified in the "Analog I/O" window, the error response can be assigned using the selections **Off, Stop, Flag** as described above.

Be sure that the analog inputs are completely parameterized in the „Analog I/O“ window before the error response is set in the “Faults” window. Use the entry fields “min Fault” and “max Fault” in the “Analog I/O” window to influence the error response.

Fault Encoder Channel A/B Signals a cable break in the incremental encoder circuit.

Block Time Out The block time is specified in the „Parameter Editor“. The block timer will start as soon as the block is activated. If the block is active longer than the set block time a Block Time Out will be generated. The response associated with **Off, Stop, Flag** will occur at that moment.

SSI Indicates a cable break in the SSI encoder circuit.

Block error If an block processing error occurs, this is indicated by the “Block error“ signal.

Local Bus The “Local Bus” Fault indicates a timeout, if the Local Bus receiver does not receive a message within the time set in LocalBus Receive-Timeout.

Fatal Faults field

+/- 10V/5V Source The reference voltage □10V is deviating by more than 0.5%.

24VDC POWER There is a fault in the supply voltage to the controller card. The voltage is less than 18 volts or greater than 36 volts.

DO1~DO8 short circuit A short circuit has occurred on one or more digital outputs.

Flash Checksum The checksum for the memory chip does not agree with the current data. The card is defective.

Memory The memory chip in the controller card has a fault. The card is defective.

Version Mismatch Checking the controller card version resulted in a fault. Use the hard- and software that are compatible with each other.

Loop Errors Field

LC1<>LFB1 A discrepancy between the target value “LC1“ and the actual value “FB1“ was detected.

LC2<>LFB2 A discrepancy between the target value “LC2“ and the actual value “LFB2“ was detected.

Use the **Off, Stop, Flag** responses to influence the error response.

Use the „Window“ field to specify the tolerance limit in [Unit] when comparing target and actual values.

Use the “Debounce“ field to specify the time the control deviation has to be outside the tolerance limit for this amount of time for the fault to become valid.

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Table

The “table” window can be used for recording, editing and saving signal traces. The signal traces saved on the card as “Table 1” or “Table 2” can be used like an internal command value input.

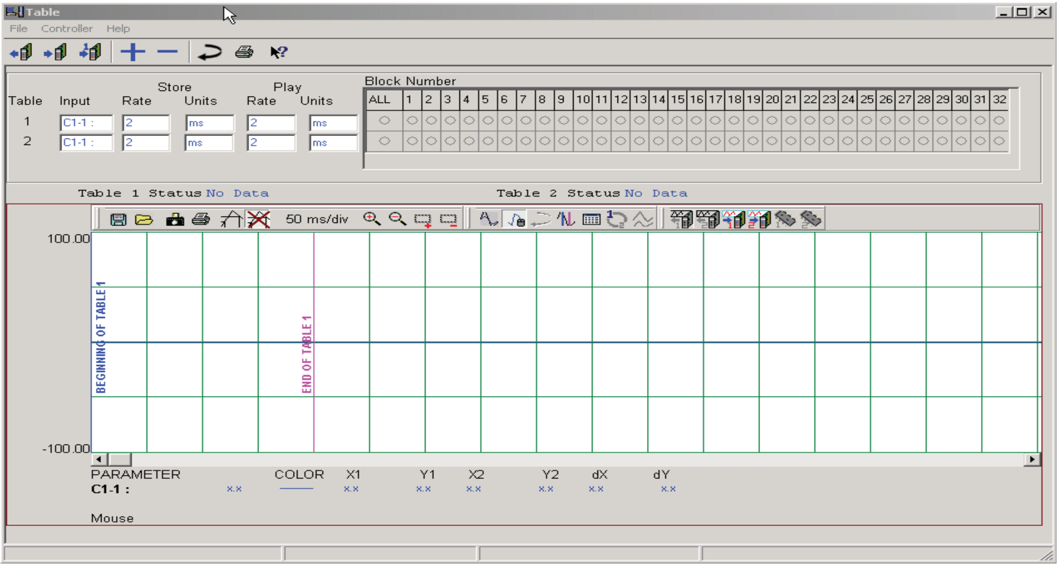


Fig. 38 "Table" window

Table – File menu The File menu in the “Table” window corresponds to the BODAC main window “File menu”.

Table – Controller menu Contains commands for reading, writing and modifying parameters.

Table – Help menu Takes you directly to the help for the current topic or to the contents page of the BO-DAC windows help.

Table – Toolbar Buttons are provided for frequently used functions. They are described in the section “Toolbar”.

Table Table 1 and Table 2 can be recorded and edited independently of each other.

Input A pull-down menu is provided for the selection of the signal that is to be recorded.

Store Rate Determines at which time intervals the measurement is to be taken.
For example, when Store – Units = “ms” is selected, a setting of 2 means that for the duration of recording, the current value is saved in the table every 2ms.

Store - Units Indicates the time unit required for saving values.

Save Gibt das Ereignis an, bei dem die Tabelle in den Speicher (Flash) geschrieben wird

Play - Rate Determines, at which time intervals the recorded signal is to be played. When the table is read in in the Table signal display, this setting is used as a basis for the representation.
In the Table signal display, the values to be played are connected by a straight line. This results in the line shape of the signal shown.

Play - Units Specifies the time unit required for playing the values.

Block Number Sets the recording conditions for the tables. If no block is selected for a table, no values can be recorded in this table.

- ALL
  As soon as a block is active, the selected signal is recorded. Recording can only be stopped by exiting all blocks.
- 1 - 32
  The blocks selected under Block Number determine, at which time a signal is recorded. While a selected block is active, the table is being recorded. Recording is only stopped when a non-selected block is activated or all blocks are exited.

Table 1 Status The following statuses are possible for Table 1:

- No data
  At present, no values are being recorded or saved.
- Recording
  The recording condition (selected Block Number = active) is fulfilled. The table is currently being recorded.
- Table recorded
  Recording of the table is completed. The table can be read in, edited and saved in the Table signal display by clicking the icon "Read from table 1" in the Table toolbar.
- Data overflow
  Not all data were recorded. The recording intervals (see Store Rate, Store Units) may have been set too short. After the end of the table was reached, not all of the recording conditions were fulfilled.
- Table blocked
  The table is currently being used for the command value input. Recording and playing is not possible simultaneously. The table is blocked for the duration of playing.

Table 2 Status The following statuses are possible for Table 2:

- No data
  At present, no values are being recorded or saved.
- Recording
  The recording condition (selected Block Number = active) is fulfilled. The table is currently being recorded.
- Table recorded
  Recording of the table is completed. The table can be read in, edited and saved in the Table signal display by clicking the icon "Read from table 2" in the Table toolbar.
- Data overflow
  Not all data were recorded. The recording intervals (see Store Rate, Store Units) may have been set too short. After the end of the table was reached, not all of the recording conditions were fulfilled.

- The table is currently being used for the command value input. Recording and playing is not possible simultaneously. The table is blocked for the duration of playing.

BODAC is not required for recording a signal.
BODAC is used for setting the conditions for the card. The card records the signal on its own.

Structured list for proceeding when working with tables

Open file

This icon in the Table toolbar can be used for reading in an existing table of plt format in the Table signal display.
If you read in a plt file in the Table signal display in this way, you can skip the following points “recording condition”, “play condition” and “recording”.

Recording condition

Determines, which signal is to be recorded at which time.
Table 1 and Table 2 are available for recording.

- The signal to be recorded can be selected using the pull-down menu “Input"
- With the help of the "Store - Rate" entry field and the “Store – Units” pull-down menu you can determine, at which time intervals the values of the signal to be recorded will be recorded.
- The Block Number determines, when values are recorded. Recording starts when a selected block is activated. As soon as a selected block is exited, recording is terminated as well.

A maximum of 16380 values can be recorded.
Exceeding of this range is signaled by “data overflow” in the status display.
Possibilities of preventing data overflow:
- Increase the time interval between the values to be recorded
- Select shorter recording conditions (e.g. block dwell time, fewer blocks, etc.)

Playing condition

Determines, how the recorded signal is played.
(Corresponds to the representation of the Table signal display)

- In the "Play - Rate" entry field and the "Play - Units" pull-down menu you can determine, at which time intervals the values of the signal to be recorded will be played. In the Table signal display the values to be played are connected by means of a straight line. This results in the line shape of the displayed signal.

Recording

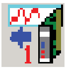
To record Table 1 and / or Table 2, proceed as follows:

- Recording starts as soon as a determined recording condition is fulfilled, e.g. if "Block 1" was selected as recording condition, recording continues until Block 1 is no longer active.
- Completion of recording is indicated in the status display by "Table recorded".

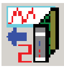
The recording condition can also consist of several or all blocks. It will remain active until a block is activated that was not selected as recording condition.
If all blocks were selected as recording condition, recording is only completed when no block is active any longer.

View and editing

Reads a table for viewing / further processing. In total, 2 tables can be read in and edited.
The required icons are included in the Table toolbar.



Adds a signal trace of the table by reading in Table 1 from the card

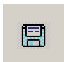


Adds a signal trace of the table by reading in Table 2 from the card

Inserts a signal trace of the table by opening a saved signal

Saving

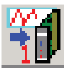
The following options are provided for saving a Table signal display of an existing table:



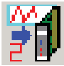
Save as plt-file

Write to the memory module of the card as "Table 1"

Write to the memory module of the card as "Table 2



Save in the working memory of the card as "Table 1"



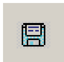
Save in the working memory of the card as “Table 2”

Table toolbar

The toolbar comprises buttons to call the individual functions of the table with the click of a mouse.

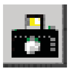
Fig. 39 Table toolbar

The functions included are listed below:



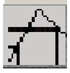
Opens the widow "Save file as", in which you can save a signal trace as file with the extension ".plt". The file can be read in again when required. In addition, you can import the file in EXCEL.

Opens the window “Open”, in which you can load a previously saved signal trace in the window “Table signal display”.



Creates a screenshot of the current representation of the “Table signal display” window.
Opens the widow "Save file as", in which you can save the representation of the signal trace as "**W**indows **M**eta **F**ile" (WMF-file).
This file format can be used in almost every commercial word processing or graphic program.

Opens the “Print” window. The Table signal display will be printed.



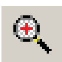
Shows two markers on the signal trace of the displayed signals. You can approach any position of the signal trace by means of the mouse or the right/left arrow keys.
The coordinates are shown in the “Table signal display legend” as X and Y coordinates.
The markers for the beginning of table and end of table cannot be changed simultaneously. For this reason, the icon “Set table marker” is deactivated again.

Removes the markers of the X/Y coordinates from the signal display

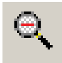
.

1 s/div

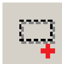
The signal display grid is shown with green grid lines in the X and Y coordinate. You can change the grid of the X coordinate by clicking the preceding field. In the current representation, the signal runs within one second through 1 grid field in the X-direction.
How to change the grid of the Y coordinate is described in the chapter “Table signal display legend”.



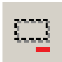
Increases the value set in the time base by one increment. In the current representation of 1s/div the X-axis would be enlarged to 500ms/div.



Reduces the value set in the time base by one increment. In the current representation of 1s/div the X-axis would be reduced to 2s/div.



The section selected with the mouse pointer is increased to the complete size of the table signal display.



Reduces the signal representation to the original size.

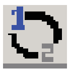
Smoothes the line currently enabled for editing (table values).

Allows free-hand changes with the mouse pointer to the line (table values) released for editing. The position currently selected for editing is shown with a drawing marker (x).
The cursor X/Y coordinates cannot be changed simultaneously. The icon "Show cursor" is therefore deactivated again.

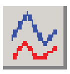
Undoes the last change made in the table values.

Sets the table markers "Beginning of table" and "End of table" in the table released for editing. "Beginning of table" defines the start of the value table and "End of table" the end of the value table.
The position of these markers can be shifted with the help of the mouse in the table released for editing.
The cursor X/Y coordinates cannot be changed simultaneously. The icon "Show cursor" is therefore deactivated again

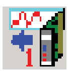
Opens the value table. Allows viewing and editing of the exact values of the table.
See also the description of the Plot data.



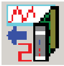
Switches between two tables. The figure highlighted by the blue color in the icon indicates the line (table value) currently released for editing.
The icon is only active if both tables were read in from the card before.



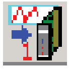
This function can be used for displaying additionally the table that is currently not released for editing.
The icon is only active if both tables were read in from the card before.



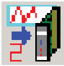
Reads the values currently saved in Table 1 on the card in the Table signal display.
The icon is only active, if Table 1 was recorded before.



Reads the values currently saved in Table 2 on the card in the Table signal display.
The icon is only active, if Table 2 was recorded before.



Writes Table 1 from the Table signal display to the working memory of the card.
The icon is only active, if at least one table was read in in the Table signal display.



Writes Table 2 from the Table signal display to the working memory of the card.
The icon is only active, if at least one table was read in in the Table signal display.

Writes Table 1 from the Table signal display to the memory module of the card.
The icon is only active, if at least one table was read in in the Table signal display.

Writes Table 2 from the Table signal display to the memory module of the card.
The icon is only active, if at least one table was read in in the Table signal display.

Table signal display

The signal display is a graphic representation of the signal trace in a travel-time diagram.

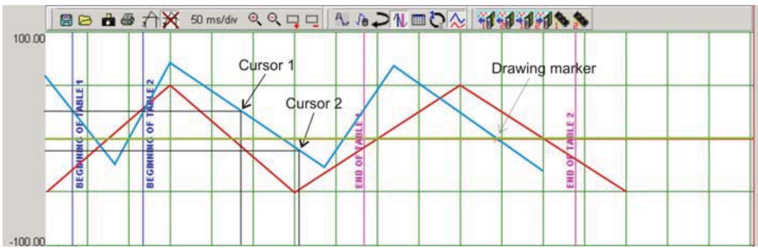


Fig. 40 Table signal display

The X-axis represents the time, the Y-axis the signal magnitude.

The representation corresponds to that of a commercial oscilloscope. The signal traces shown correspond to the time set for playing (see setting under Play – Rate, Play - Units).

The representation of “Beginning of table 1”, “Beginning of table 2“, “End of table 1”, “End of table 2", "Cursor 1" "Cursor 2" and the "Drawing markers" are auxiliary instruments for functions that can be selected in the Table toolbar.

Table signal display legend

The legend of the signal display shows the relevant information about the signals in a tabular form.

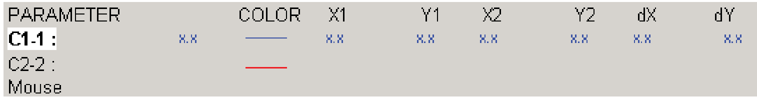


Fig. 41 Table signal display legend

Parameter The column “Parameter” shows the signals and their names. Clicking on the signal name highlights the signal name in white. The signal is thus selected.

Double-click with the mouse on the selected signal name to open the window “Edit line”.

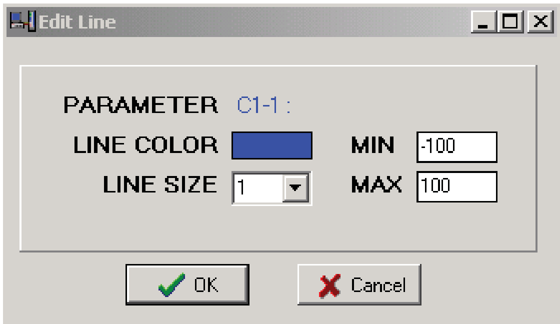


Fig. 42 “Edit Line” window

In the “Edit Line” window you can edit the representation of the selected signal. If you click on the color field “Line Color”, a color table opens, from which you can select another color for representation.

The field “Line Size” contains a selection menu for changing the line thickness of the signal.

In the entry fields "Min" and "Max" you can adjust the scaling factor in the Y-direction of the signal display for the selected signal.

The current parameter value is shown in the signal display legend after the signal name.

Color The color of representation is shown in this column in order to ensure the correct assignment and recognizability in the signal display.

X1/Y1 The columns "X1" und "Y1" are directly related to the button “Show cursor”. If you use the shown cursor of Marker 1 to a point in the signal trace, you can read the X/Y coordinates of the signal shown in column X1/Y1.

X2/Y2 In column "X2"/"Y2" you can read the coordinates of Marker 2.

dX/dY The columns "dX" and "dY" indicate the value of the signal trace gradient.

Plot data

The Plot Data window can be opened by clicking on the icon in the table toolbar and serves for viewing and editing individual values.

Click this icon in the Table toolbar to open the “Plot Data” window.

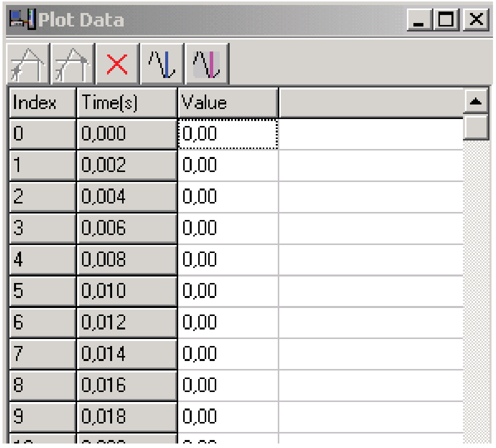


Fig. 43 “Plot Data” window

The toolbar comprises buttons, with the help of which you can call all functions of the table.

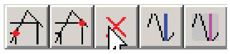
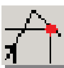


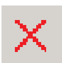
Fig. 44 Plot data toolbar

The functions provided are listed below:

Jumps to the position of Cursor 1 within the table.



Jumps to the position of Cursor 2 within the table.



Jumps to the position of the drawing marker within the table.

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Jumps to the position of the “Beginning of table” marker within the table.

Jumps to the position of the “End of table” marker within the table.

The position of the markers “Beginning of table”, “End of table”, “Cursor 1“ and “Cursor 2“ can be adjusted as follows:

- Select the cell with the mouse pointer, into which the marker is to be set (in the right-hand column)
- Press the left or right mouse button
- Select the desired marker in the open menu

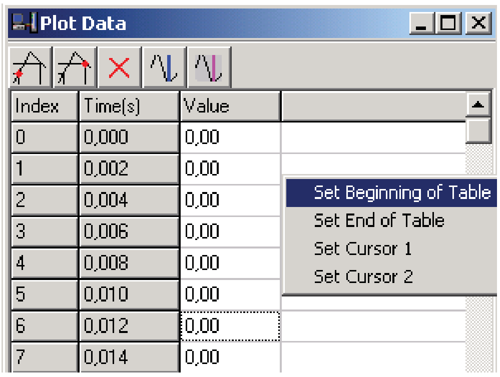


Fig. 45 “Plot data” window – marker position

The values in the column “Value” can be selected with the help of the mouse pointer and changed by entering new values.

PLT-file

You can create a PLT-file and then read in and edit this file as table.
The PLT-file can be edited with any ASCII Editor.

The PLT-file must be structured as follows:

V;1,0;
P,C1-1 :,,1, FF0000,10F00C,4,2,327.670013,0.000000,100.000000,-100.000000,
0; 0,000000;38,34;
1; 0,002000;39,36;
2; 0,004000;40,38;
3; 0,006000;41,34;
4; 0,008000;42,35;
5; 0,010000;43,42;
6; 0,012000;44,39;
7; 0,014000;45,41;
8; 0,016000;46,42;
9; 0,018000;47,49;
10; 0,020000;48,51;
11; 0,022000;49,47;
etc.

Observe the following points when creating a PLT-file:

- The first two lines contain important information for further processing in BODAC. For this reason, they must be taken over as indicated above.

- From the third line on, the following structure must be adhered to: ⟨*serial number*⟩;⟨*blank*⟩⟨*time in sec.*⟩;⟨*value*⟩;

  Additional information for input:

  - ⟨*Serial number*⟩
  - Start with "0"
  - Serial number = number of the preceding line +1
  - Permissible maximum number = 16379

  - ⟨*Time in sec.*⟩
  - Enter time with 6 places after the decimal point
  - Smallest entry possible = 2ms
  - Separator = comma
  - All time entries must be a multiple of 2ms
  - The time intervals between the lines must be identical

  - ⟨*Value*⟩
  - Enter value with 2 places after the decimal point
  - Separator = comma

Internal Flags

The seven internal flags are configured in the “Internal Flags“ window.

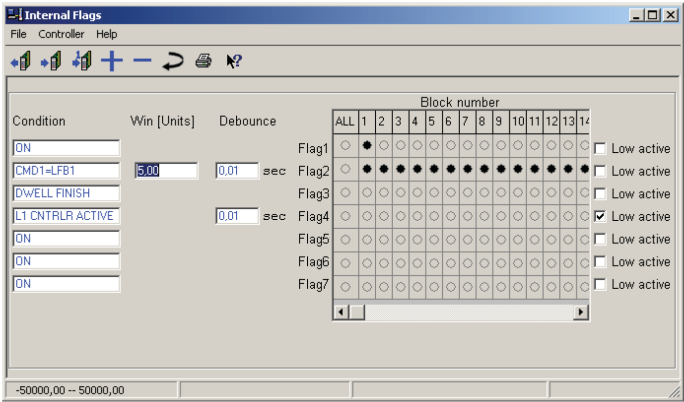


Fig. 46 “Internal Flags“ window

Internal Flags – File menu
The File menu in the “Internal Flags“ window corresponds to the BODAC main window “File menu“.

Internal Flags – Controller menu
Contains command for reading, writing and changing parameters.

Internal Flags – Help menu
Takes you directly to help for the current topic, or to the contents page of BODAC windows help.

Internal Flags – Toolbar
Buttons are provided for frequently used functions. These are described in section "Toolbar".

The „Internal Flags“ window is used to set flags 1 to 7 using the following adjustments.

Condition
In the „Condition“ entry field the trigger condition can be selected for internal flags 1 through 7 from a pull down menu. If parameter value comparisons and/or time-dependent trigger conditions are selected two additional entry fields will be shown. If for example the parameter comparison “CMD1=LFB1” is selected, BODAC will also show the “Win Units” and “Debounce” entry fields.

Condition	Explanation
ON	The digital output is activated.
CMDx = LFBx	The digital output is activated, when CMDx is equal to LFBx within the window after the debounce time.
LFBx ≥ window	The digital output is activated, when signal LFBx is greater than or equal to the window value after the debounce time.
LFBx ≤ window	The digital output is activated, when signal LFBx is less than or equal to the window value after the debounce time.

Table completed	The digital output is activated when the table function is completed
Waiting time completed	The digital output is activated when the set waiting time of the block has elapsed.
Block timeout	The digital output is activated when the set block time of the block has elapsed.
Lx controller active	In the case of alternating control the digital output is activated when the corresponding control loop (loop) is activated.
Ramp x completed	The digital output is activated when the ramp function is completed.
Fault	The digital output is activated when a fault flag (1...8) has been set.
ABS(LFBx) ≤ window	The digital output is activated when the absolute value of signal LFBx is less than or equal to the window value after the debounce time.
ABS(LCx) ≤ window	The digital output is activated when the absolute value of signal LCx is less than or equal to the window value after the debounce time.
Zero channel = 0	The digital output is activated when the zero channel of the incremental encoder is equal to 0.

x = 1...3

Win Units In the “Win Units” entry field you the maximum deviation (tolerance) for the nominal/actual comparison. The condition is considered to be met as soon as the value to be compared is within the tolerance window.

Debounce The “Debounce” field is where you set the maximum delay time until the previously defined condition is considered to be TRUE.

Block Number Select Block 1 to 32 in the tabular selection field “Block number“. The condition will be checked only in these selected blocks.

Low Act./High Act. If **NO** check mark is entered, the internal flag switches from Low to High when the condition is met.

If the check mark is entered, the internal flag switches from High to Low when the condition is met.

The “Internal Flags“ window is only available for Mode 3 – Structure Editor.

Start/Stop

In the "Start/Stop" window you can determine the characteristics of the control card when starting after a pause of a block chain. See also “Trigger conditions”.

A block chain is started using a digital input. When this input is inactive, the controller card stops. Depending on the setting of the parameter “command value”, the associated control loop is open or closed. The movement can only be resumed by starting the block chain.

A block chain is started using a digital input. If further blocks within the block chain are started with a further digital input, it is possible to pause within the block, by deactivated the additional input. Depending on the setting of the parameter “command value” the control loop pauses in the open or closed condition. The movement can be resumed at the point of interruption by re-activating the additional digital input.

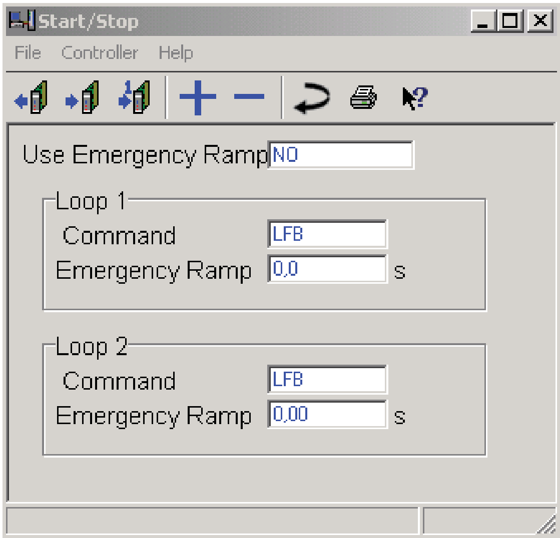


Fig. 47 "Start/Stop" window

Internal Flags – File menu
The “File” menu in the “Start/Stop” window corresponds to the BODAC main window “File menu”.

Interne Flags – Controller menu
Contains commands for reading, writing and changing parameters.

Internal Flags – Help menu
Takes you directly to the current topic or to the contents page of the BODAC windows help.

Internal Flags – Toolbar
Buttons are provided for frequently used functions. These are described in the section “Toolbar”.

Use Emergency Ramp

Here, you can determine the type and source of the emergency ramp in the case of “Stop” or “Pause” of a block chain.

Emergency ramp	No	No emergency ramp. Command value is set to zero, i.e. the control action is abruptly set to 0.
	Yes	The emergency ramp time corresponds to the parameter “emergency ramp” of the corresponding control loop. The control action is ramped to 0 over the emergency ramp. When the control action reaches “zero and”: "Command value = 0", no controller is activated (open-loop controlled), and with "Command value = LFB", the command value is set equal to the actual value, the controller is activated with the controller parameters of the block last active. **Exception: If the controller is switched off in the last active block, “Command value = 0” is always used!**
	Block 1…32	The emergency ramp time corresponds to the velocity of the corresponding block (1…32). The control action is ramped to 0 over the emergency ramp. When the control action reaches “zero” and: "Command value = 0", no controller is activated (open-loop controlled), and with "Command value = LFB", the command value is set equal to the actual value, the controller is activated with the controller parameters of the relevant block (1…32).

Command

Here, you can determine, whether the controller card goes to the open or closed-loop controlled mode after a stop or pause.

If you use an emergency ramp, the current control action is ramped to zero over the emergency ramp time. Then, it changes over to the open or closed-loop control mode depending on the setting.

Command	0	When a block chain starts, the command value starts from 0. In addition, this parameter determines the characteristics when a block chain stops or pauses (see emergency ramp).
	LFB	When a block chain starts, the command value is set equal to the current actual value (LFB). Moreover, this parameter determines the characteristics when a block chain stops or pauses (see emergency ramp). Note: This setting should be selected for closed-loop controlled drives. It prevents uncontrolled movements when a block chain is started.

Constants

In the “Constants” window, values can be assigned to 8 constants. They can be integrated at various places of the structure. See Structure Editor.

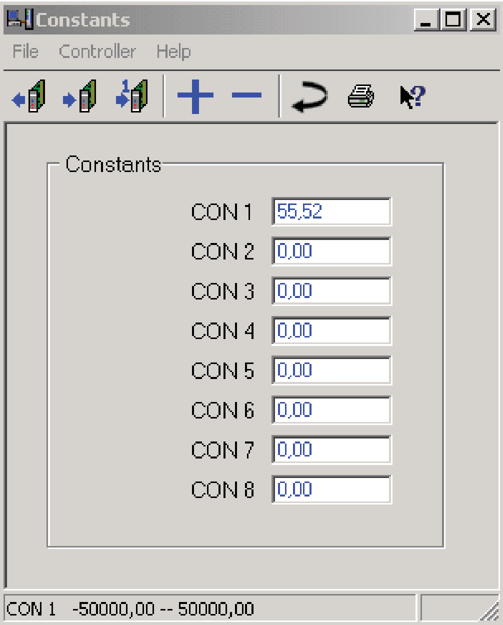


Fig. 48 “Constants” window

Constants – File menu The file menu in the “Constants” window corresponds to the BODAC main window “File menu".

Constants – Controller menu Contains commands for reading, writing and changing parameters.

Constants – Help menu Takes you directly to the current topic or to the contents page of the BODAC windows help.

Constants – Toolbar Buttons are provided for frequently used functions. These are described in section “Toolbar”.

Busmanager (Profibus, CANopen, DeviceNet)

In the "Busmanager" window you can adjust the parameters for bus communication and determine the parameters that are to be transmitted via the bus.

For the purpose of explanation, Profibus is used as an example.

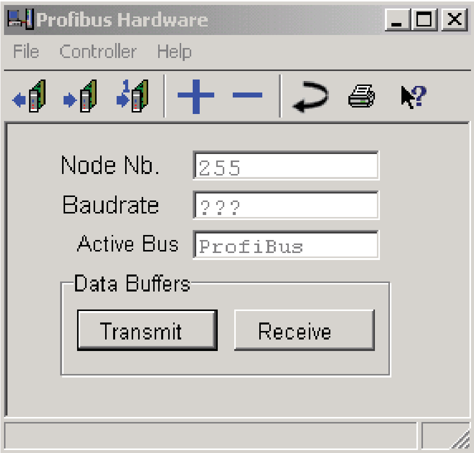


Fig. 49 "Profibus" window

Profibus – File menu
The File menu in the "Profibus" window corresponds to the BODAC main window "File menu".

Profibus – Controller menu
Contains commands for reading, writing and changing parameters.

Profibus – Help menu
Takes you directly to the current topic or to the contents page of the BODAC windows help.

Profibus – Toolbar
Buttons are provided for frequently used functions. They are described in the section "Toolbar".

In this window, bus parameters can be displayed and, where applicable, changed.

Transmit
Here, you can determine the parameters to be transmitted from the controller card to the bus master (e.g. PLC).

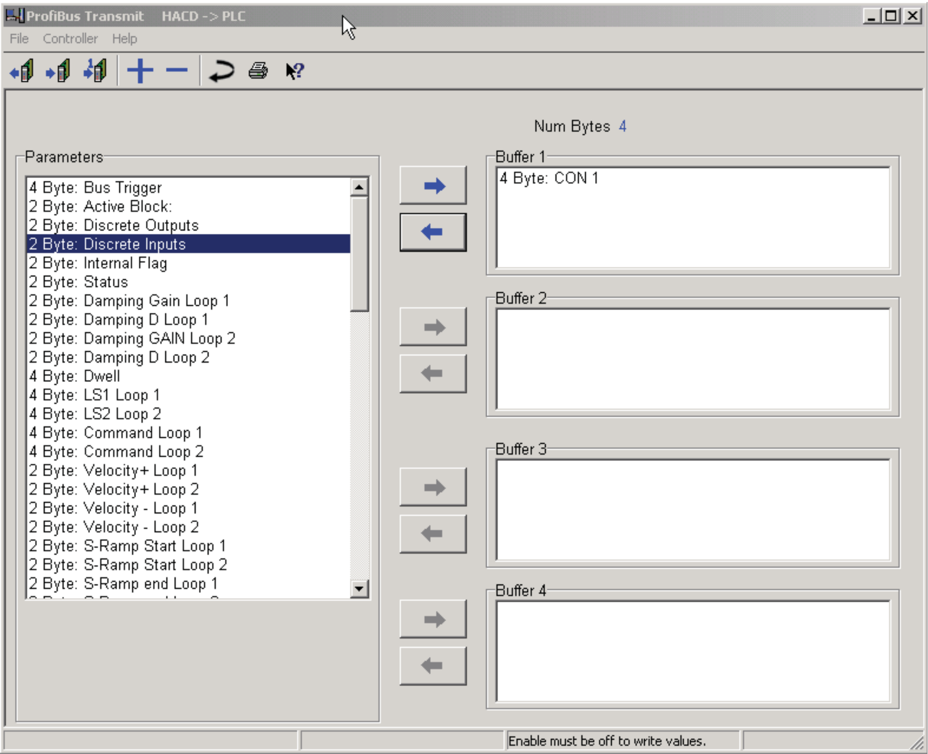


Fig. 50 Window "Profibus, Transmit HACD -> PLC"

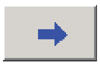
Profibus Transmit HACD->PLC– File menu
The File menu in the "Profibus" window corresponds to the BODAC main window “File menu”.

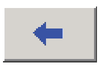
Profibus Transmit HACD->PLC– Controller menu
Contains commands for reading, writing and changing parameters.

Profibus Transmit HACD->PLC– Help menu
Takes you directly to the current topic or to the contents page of the BODAC windows help.

Profibus Transmit HACD->PLC– Toolbar
Buttons are provided for frequently used functions. They are described in the section “Toolbar”.

The selection field “Parameters" lists all parameters available in the HACD. A maximum of 32 bytes can be transmitted via DP V0. These are subdivided into 4 buffers.


Parameters from the selection list are taken over for bus transmission.


Parameters are removed from the bus transmission.

If parameters that are available in several blocks are selected for bus transmission, the block number must be selected additionally.

Receive

Determines the parameters received by the controller card (HACD) from the bus master (e.g. PLC).

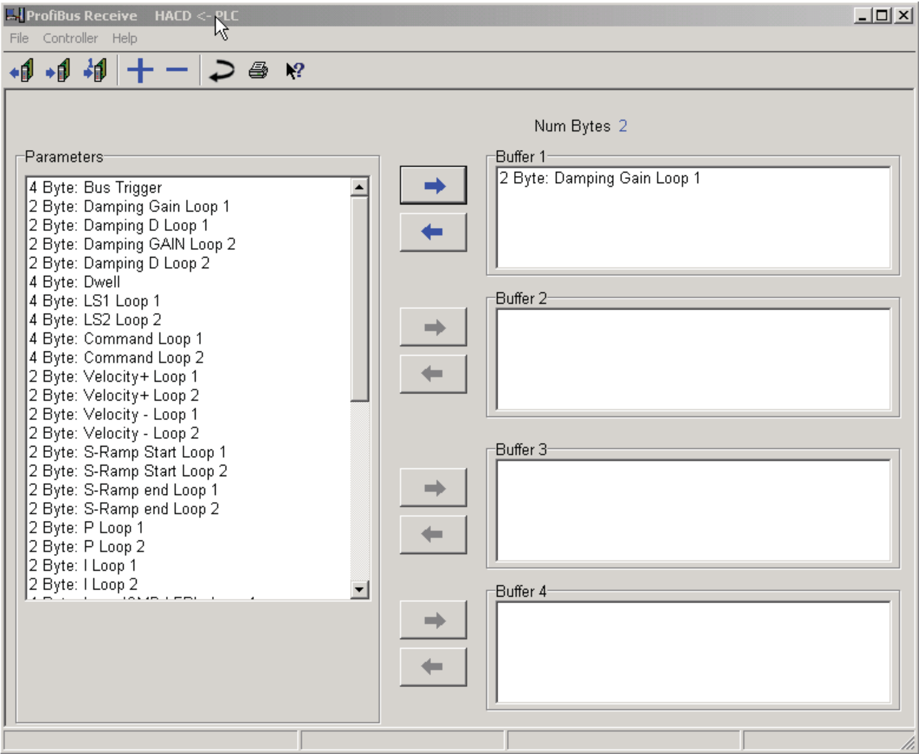


Fig. 51 Window "Profibus, Receive PLC -> HACD"

Profibus Receive PLC ->HACD – File menu

The File menu in the "Profibus" window corresponds to the BODAC main window "File menu"

Profibus Receive PLC ->HACD – Controller menu

Contains commands for reading, writing and changing parameters.

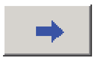
Profibus Receive PLC ->HACD – Help menu

Takes you directly to the current topic or to the contents page of the BODAC windows help.

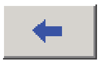
Profibus Receive PLC ->HACD – Toolbar

Buttons are provided for frequently used functions. They are described in the section "Toolbar".

The selection field "Parameters" lists all parameters available in the HACD. A maximum of 32 bytes can be transmitted via Profibus DP V0. These are subdivided into 4 buffers.



Parameters from the selection list are taken over for bus transmission.



Parameters are removed from the bus transmission.

If parameters that are available in several blocks are selected for bus transmission, the block number must be selected additionally.

Local Bus

In General

The local bus is used to connect the individual amplifier cards of the HACD family. Data can be sent from one HACD to another or Bodac can use the local bus to communicate with any card on the bus without physically changing the connection.

Up to 32 cards can be connected. Each card must be assigned a unique local bus ID. The connection is established using a CAN protocol with a baud rate of 250 kbit. The maximum length of the most distant amplifier cards must not exceed 280m. Moreover, the maximum length of the branch lines of 1 m must be observed.

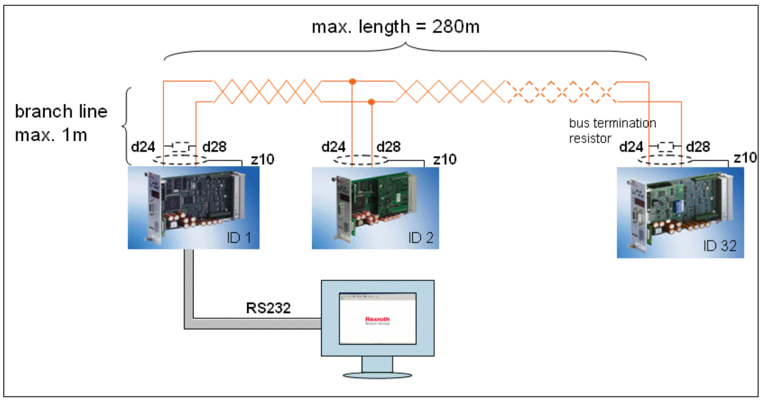


Fig. 52 Schematic structure of “Local Bus“

Data is to be transmitted via a shielded twisted-pair cable.

Two bus terminating resistors of 120 Ohm are required.

Using Local Bus to send data from one HACD to another takes priority over communicating with any other card via Bodac. Please make sure, that the Time of Transmit Delay is adhered (see Setting the Transmit-Delay Time), otherwise there will be no time left to hold a communication via Bodac to another card. In this case no other cards will be listed in the Search Card Screen.

LocalBus Hardware

In the window "LocalBus Hardware", you must set the bus address of the amplifier card for the local bus.

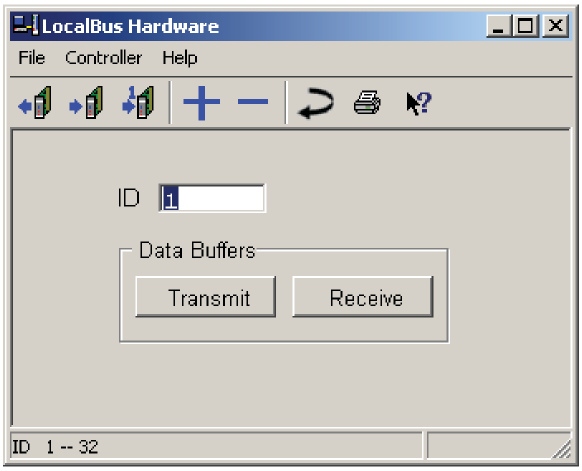


Fig. 53 Window "LocalBus Hardware"

Local Bus – File menu The File menu in the window "Local Bus" corresponds to the BODAC main window "File" menu.

Local Bus – Controller menu Contains commands for reading, writing and modifying parameters.

Local Bus – Help menu Takes you directly to help for the current topic or to the contents page of the BODAC windows help.

Local Bus – Toolbar Buttons are provided for frequently used functions. They are described in "Window toolbar".

LocalBus Transmit

List of signals that can be transmitted over the Local Bus

LS1 Loop 1	FOR ALL 32 BLOCKS
LS2 Loop 2	FOR ALL 32 BLOCKS
COMMAND LOOP1	FOR ALL 32 BLOCKS
VELOCITY + LOOP1	FOR ALL 32 BLOCKS
VELOCITY - LOOP1	FOR ALL 32 BLOCKS
COMMAND LOOP2	FOR ALL 32 BLOCKS
VELOCITY + LOOP2	FOR ALL 32 BLOCKS
VELOCITY - LOOP2	FOR ALL 32 BLOCKS
C*-1	* = 1,2 OR 3
C*-2	* = 1,2 OR 3
FB*-1	* = 1,2 OR 3
FB*-2	* = 1,2 OR 3
C*	* = 1,2 OR 3
FB*	* = 1,2 OR 3
LC**	** = 1 or 2
LFB**	** = 1 or 2
LC**-LFB**	** = 1 or 2
LO**	** = 1 or 2
OUT**	** = 1 or 2
Constant ***	*** = 1 through 8

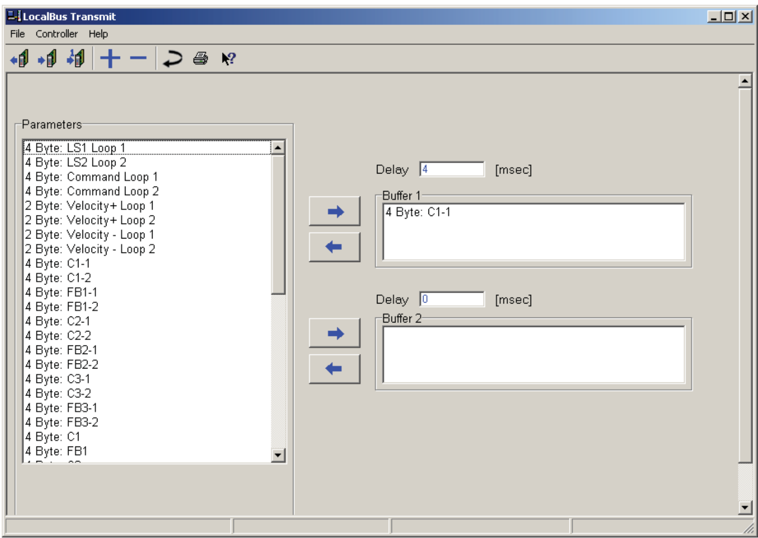


Fig. 54 Window "LocalBus Transmit"

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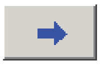
LocalBus Transmit– File menu
The File menu in the "LocalBus Transmit" window corresponds to the BODAC main window "File menu".

LocalBus Transmit– Controller menu
Contains commands for reading, writing and changing parameters.

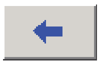
LocalBus Transmit– Help menu
Takes you directly to the current topic or to the contents page of the BODAC windows help.

LocalBus Transmit– Toolbar
Buttons are provided for frequently used functions. They are described in the section "Toolbar".

LocalBus Transmit– Buffer
The selection field "Parameters" lists all parameters available to be sent over the Local Bus. Either one or two parameters can be sent or received in a single buffer.



Parameters from the selection list are taken over for Local Bus transmission.



Parameters are removed from the Local Bus transmission.

If parameters that are available in several blocks are selected for bus transmission, the block number must be selected additionally.

Setting the Transmit-Delay Time
Transmitting a signal over the Local Bus takes time. It is only possible to send one buffer within 2 msec. So the fastest possible Transmit Delay Time transmitting two buffers is 4 msec, also if the user edits 2 msec.

Another 4 msec Transmit-Delay is required, if the user wants to use the Local Bus feature: Communicating with any card on the bus. So if the user wants to transmit two buffers and wants to read for example the motion data screen from another card, then he should select 8 ms as Transmit-Delay Time for both buffers.

LocalBus Receive

Determines in which parameters of the HACD the information of the Local Bus is stored.

These following signals can be selected:

LS1 Loop 1	FOR ALL 32 BLOCKS
LS2 Loop 2	FOR ALL 32 BLOCKS
COMMAND LOOP1	FOR ALL 32 BLOCKS
VELOCITY + LOOP1	FOR ALL 32 BLOCKS
VELOCITY - LOOP1	FOR ALL 32 BLOCKS
COMMAND LOOP2	FOR ALL 32 BLOCKS
VELOCITY + LOOP2	FOR ALL 32 BLOCKS
VELOCITY - LOOP2	FOR ALL 32 BLOCKS
Constant ***	*** = 1 through 8

If the user wants to read a signal received over the Local Bus to his structure editor, he has to select a Constant.

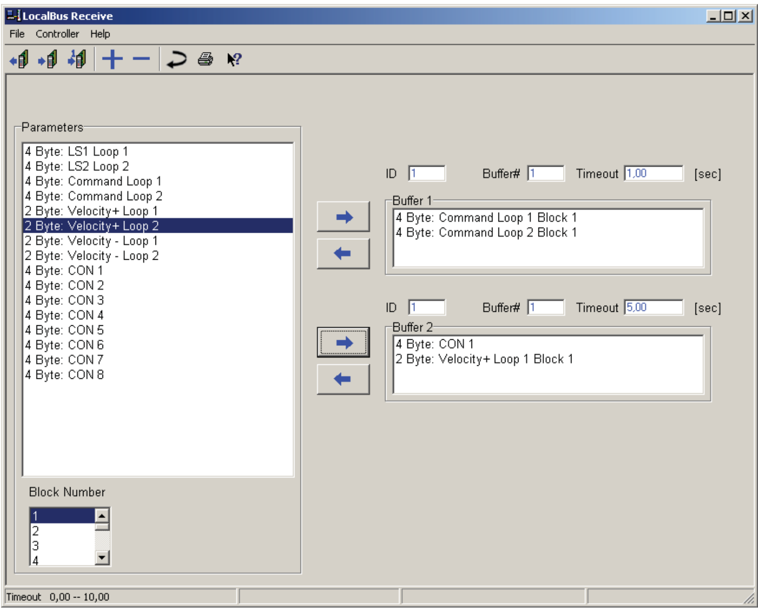


Fig. 55 Window "LocalBus Receive"

LocalBus Receive – File menu

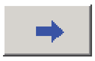
The File menu in the "LocalBus Receive" window corresponds to the BODAC main window "File menu"

LocalBus Receive – Controller menu
Contains commands for reading, writing and changing parameters.

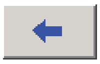
LocalBus Receive – Help menu
Takes you directly to the current topic or to the contents page of the BODAC windows help.

LocalBus Receive – Toolbar
Buttons are provided for frequently used functions. They are described in the section “Toolbar”.

LocalBus Receive– Buffer
The selection field “Parameters" lists all parameters of the controller to which the LocalBus info can be written. The assignment of one or two parameters is done by transferring the appropriate parameter to the Buffer.



Parameters from the selection list are taken over for Local Bus reception.



Parameters are removed from the Local Bus reception.

If parameters that are available in several blocks are selected for bus transmission, the block number must be selected additionally.

LocalBus Receive–ID
The “ID” is the ID number of the transmitter of information on the Local Bus.

LocalBus Receive–Buffer#
The “Buffer#” is the Buffer number (either one or two) of the transmitter of information on the Local Bus.

LocalBus Receive–Timeout
The “Timeout” will set a timer that will fault if the receiver does not receive a message within the time set in LocalBus Receive-Timeout.

4.5 Tools menu

The "Tools" menu is used to configure BODAC for communicating with the controller card depending on the users preferences.

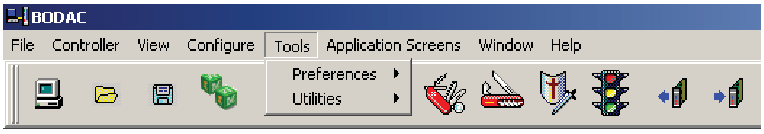


Fig. 56 Tools menu

Communication interface between the PC and controller card, the access authorization and the behavior for data synchronization with the controller card can be specified in the "Preferences" submenu.

The Utilities submenu contains update functions and an option for resetting the controller card to its factory settings.

Preferences

Com

The "COM" window is the dialog window for configuring the serial port.

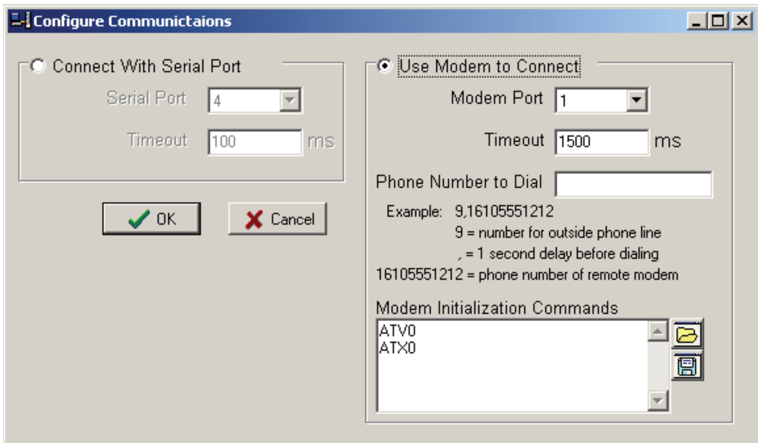


Fig. 57 "COM" window

Connect with Serial Port Select the radio button "Connect with Serial Port" if you want to connect with the PC to the VT-HACD using the Serial Port connection.

Serial Port With the "Serial Port" entry field the user specifies which serial port of the PC is used to communicate with the controller card.

Timeout The "Timeout" field is the delay for "Cable break" detection by BODAC. This value can be changed in Security Level 2.

Use Modem to Connect Select the radio button “Use Modem to Connect” if you want to connect with the PC to the VT-HACD remotely using a modem connection.

Modem Port With the “Modeml Port“ entry field the user specifies which serial port of the PC is used to communicate with the controller card using a modem connection.

Timeout The “Timeout“ field is the delay for “Cable break” detection by BODAC. This value should be at least 1500 ms.

Phone Number to Dial The “Phone Number to Dial” field is used to enter the phone number of the remote modem.

Modem Initialization Commands AT commands are stringssent to the modem connected to the PC to configure it before dialing. There is a basic command set, the Hayes Command Set, that most modems have implemented.
For specific information regarding commands that are used in your modem please refer to the modem manufacturer documentation. At a minimum the modem codes should be set to numeric(ATV0) and the results codes should be set to 0(ATX0).

Opens a file with previously saved Modem Initialization Commands

Saves the Modem Initialization Commands listed in the window.

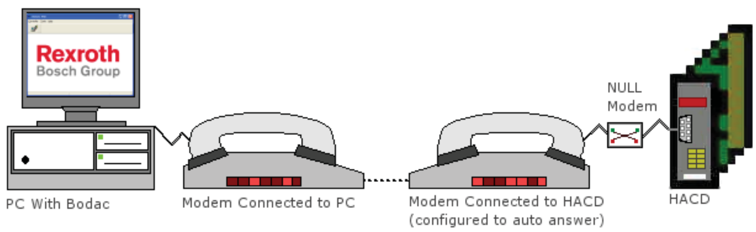


Fig. 55a Modem configuration

Configuration of the modems In order to communicate successfully both the local and remote modems need to be configurated. The HACD communicates at a defined baud rate; therefore the modem connected to the HACD must be configured to communicate at the HACD baud rate.Setting of the baud rate that matches the VT-HACD baud rate can be achieved using dipswitches or AT commands depending on the modem being used (For details regarding setting of the modem baud rate please refer to the modem documentation)

Local Modem connection:

With an external modem a standard serial cable is used. The local modem must be set to return numeric results (Hayes Command ATV0) and basic results codes (Hayes Command ATX0). Depending on the modem used this can either be accomplished through dip switches on the modem or through the use of Hayes Commands.

Remote Modem connection:

The external remote modem must be able to answer incoming calls.The connection between the remote modem and the VT-HACD card must **be a NULL modem cable**. The remote modem must be configured to auto answer an incoming call (Hayes Command ATS0=1 => sets auto answer to 1 ring). The remote modem DTR (Date Terminal Ready) should be set to override (Hayes Command AT&D0), because otherwise the modem will not answer since the VT-HACD does not control the DTR line.

NULL modem cable

Signal Name	DB-9 Pin		DB-9 pIN	Signal Name
TD (Transmit Data)	3	-	2	RD
RD (Receive Data)	2	-	3	TD
SG (Signal Ground)	5	-	5	SG

It is recommended that a Winview recording is used when monitoring actual signals. The communication speed due to the modem connection is not fast enough to get the required resolution.

Establishing the connection using this method will take some. After the connection is established BODAC can be used as if there were a direct serial connection to the card although the communication rate is significantly lower.

Options

The “Options“ window defines the frequency and type of data transmission to the controller card.

General

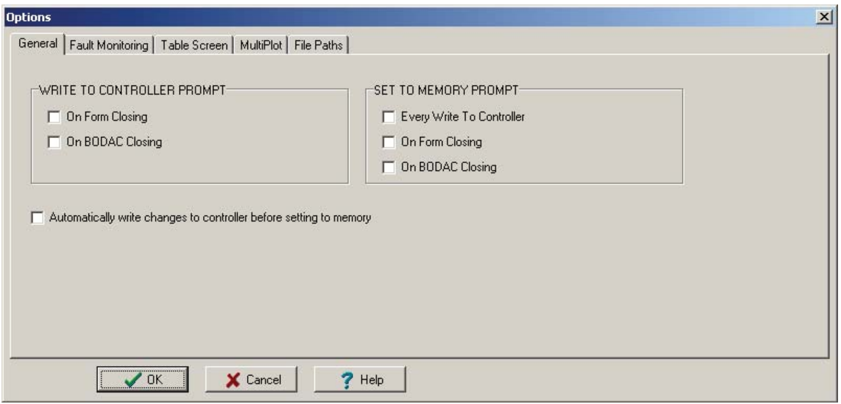


Fig. 58 Window "Options, General"

Set, which change routine BODAC is to execute automatically after a change of data.

WRITE TO CONTROLLER PROMPT: If settings or parameters were changed in BODAC without saving them in the controller card, BODAC can display a corresponding warning window:
- When the window is closed, in which the changes were made
- When BODAC is closed

SET TO MEMORY PROMPT: When changed values are being written to the controller, they are only saved in the volatile memory of the controller card. For permanent saving, they must be stored in the memory. Here, you can set, when BODAC is to save values automatically in the permanent memory of the controller card:
- Every time when writing to the controller.
- When closing the relevant window.
- When BODAC is exited

With the selection “Automatically write changes to controller before setting to memory”, you can ensure that the parameters changed by you in BODAC are transmitted first, before they are saved in the permanent memory of the controller.

If you deactivate these monitoring functions, you can nevertheless ensure that changed parameters are transmitted to the controller card and saved in the permanent memory at least at the end of commissioning.

Fault Monitoring

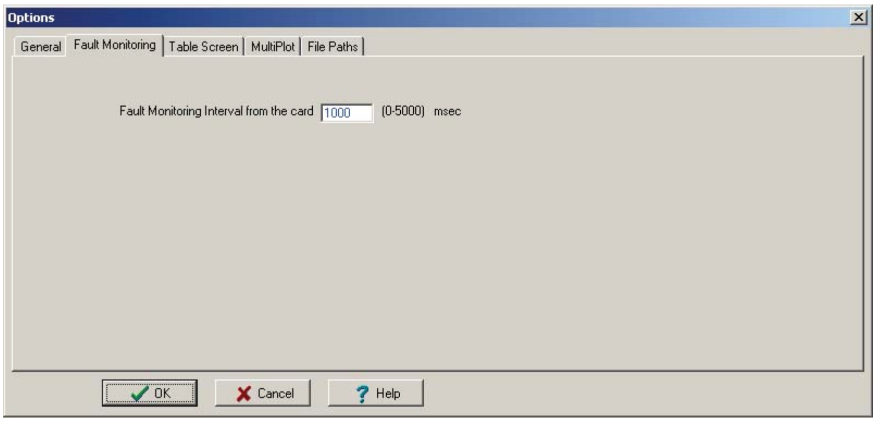


Fig. 59 Window "Options, Fault Monitoring"

The operator program BODAC queries at regular intervals the fault states of the controller card. The interval can be set here.

Table Screen

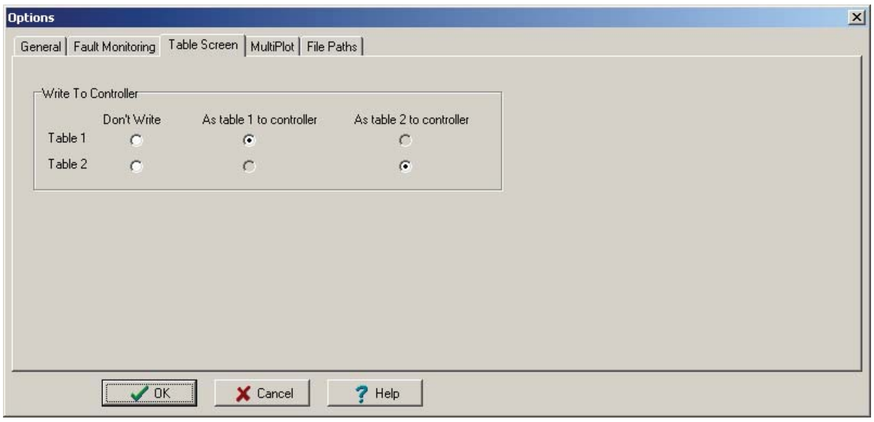


Fig. 60 Window "Options, Table Screen"

Here, you can select the basic settings for the function “write table to controller”. When this selection was made and if you close the window “Table” without having written the table to the controller, the table is written automatically to the controller.

MultiPlot

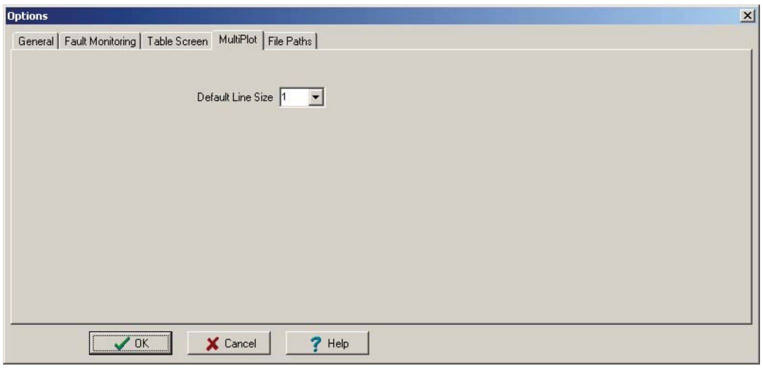


Fig. 61 Window "Optionen, MultiPlot"

Please select here the default line size of the MultiPlot in your Motion data display.

File Paths

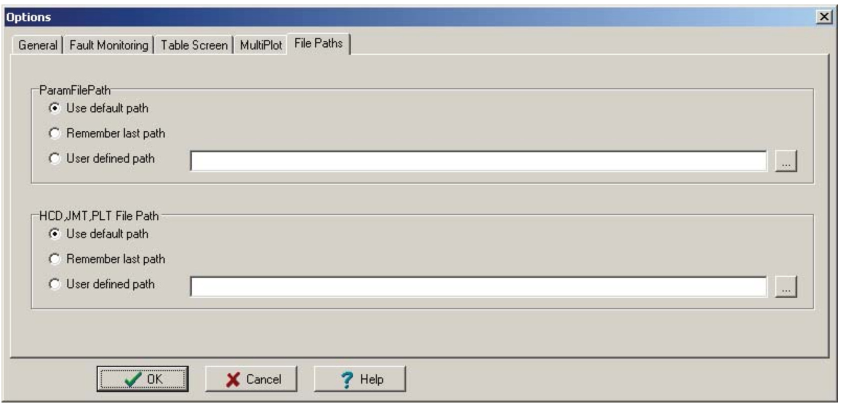


Fig. 62 Window "Optionen, File Paths"

Here, you can determine the basic paths for saving parameter files and reading up-date files.

Security

3 security levels are provided for using BODAC. This allows the BODAC users to be divided into groups ensuring that only qualified and trained personnel can change critical settings.

The security levels are as follows:

- Level 4 = Bosch Rexroth AG
- Level 3 = Bosch Rexroth AG
- Level 2 = Customer (Default password = 2)
- Level 1 = Customer (Default password = 1)
- Level 0 = Customer (Default password = 0)

WARNING!

The restrictions in changing parameters and process data have been created for your own security!

Never attempt to circumvent the security levels through program manipulation or changes of any kind.

Personal injury and severe damage to equipment may result when the controller card no longer operates properly due to unauthorized manipulation.

This will also result in loss or warranty provision and/or liability on the part of the manufacturer!

Please document the passwords assigned to you and your customers.

Login

The BODAC software always starts up in Level 0.

The user logs in from the „Login“ window by entering the password he has received for his user group. After successful login, any setting or parameter change allowed for this group can be made.

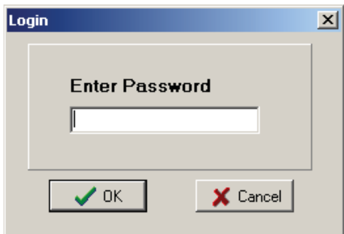


Fig. 63 “Login“ window

Passwords

The “Passwords” window is where the password is assigned to the defined security levels.

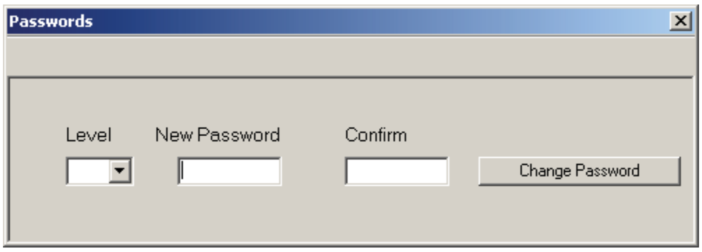


Fig. 64 „Password“ window

If the BODAC software is in security level “2”, the window below opens. In this window you can assign a password for the display on the front panel of the controller card.

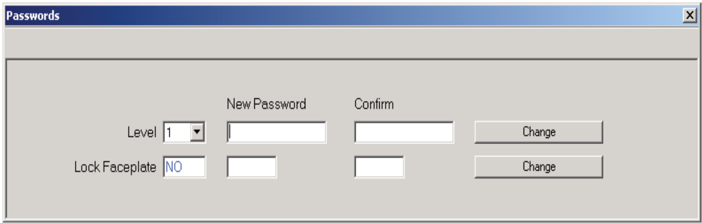


Fig. 65 Window “Password“ Level 2

Without this password, values cannot be changed by means of the display and the control keys, but only viewed.

Configure screens

The “Configure screens“ window allows the user to specify which user group shall have access to the various BODAC screens.

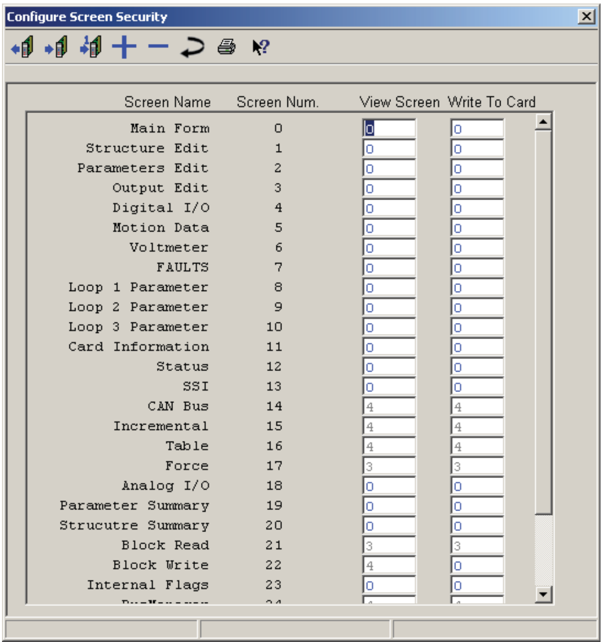


Fig. 66 Window configuration of the security levels

The fields are used to assign security levels per window. Use the “View” and “Set” columns to determine which user group has view-only privileges for certain windows and which group is allowed to change parameters.

Utilities

Send firmware

Program changes (updates) for BODAC are in the form of files having extensions:

- .hcd
- .jmt
- .pkg

Clicking on the menu item „Send firmware“ allows you to select the update file in the resulting „Open“ window. The BODAC program guides you through the successive steps until the program changes have been completed.

Read HCD File From Memory

The “Read HCD File From Memory“ command generates a file of the entire controller card structure.
BODAC automatically generates this file.

Use Default Parameter Data

Resets the values and parameters for the controller card back to their factory settings.

WARNING!

Resetting the values and parameters on the controller card to factory default results in loss of all data previously entered!

4.6 Application screens

The „Application screen“ contains entry menus which are especially constructed for various applications. The menus represent meaningful associations for making it easier to enter parameters, i.e. parameters which are otherwise spread out over multiple windows are combined here specifically for the application.

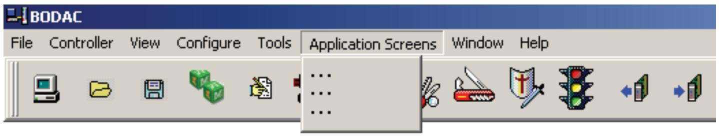


Fig. 67 Menü „Application screens“ menu

For a description of the application screens for the various HACD modes, see “Description of Application Screens”.

4.7 Window menu

The Window menu contains commands for saving and opening specified window arrangements. You can directly select already opened windows from here.

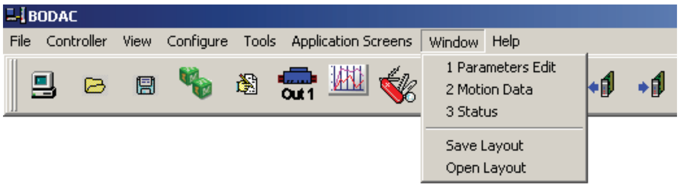


Fig. 68 Window menu

When BODAC is first started up and after the program has been loaded, only the main window is opened. The “Save layout” function saves your current appearance of BODAC with all the currently opened windows and window positions in a file. This allows you to save preferred window combinations for working with BODAC and open them at any time as needed.

Select opened windows

Already opened windows (for example: 1 Structure Editor) are directly selected with a mouse click. This allows you to quickly navigate through opened windows.

Save layout

The “Save layout” function saves the current layout of BODAC with all currently opened windows and window positions in a file. This allows you to save preferred window combinations for working with BODAC and open them at any time as needed.

Open layout

Opens a window in which already saved layouts of BODAC can be recalled. BODAC restores the saved window combination after opening the file.

4.8 Help menu

Go to BODAC online help as follows:

- Press the F1 key

or

- Click on „Topics“ in the Help menu

or

- Click on the Help button in the active window

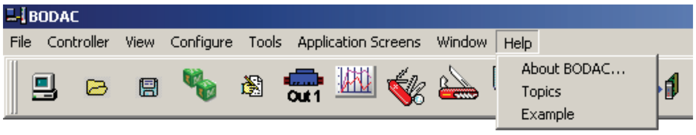


Fig. 69 Help menu

In addition, an info text is displayed on the element below your mouse cursor.

About BODAC...

This is an information window which provides information about the version and origin of BODAC.

Topics

Opens a summary of BODAC online help. From this contents window the user can navigate to any area and any available knowledge topic.

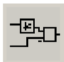
5 BODAC – Description of the Application Window

5.1 Mode 1 – Block Call-up

The Application Window menu contains the specific commands for Parameter Set Mode 1 – Block Call-up

Controller

In the “Controller“ window the configuration of the HACD can be set. You can select command and actual value inputs and specify the linking of both signals.
The window also provides links to other windows.



Clicking on the preceding symbol, which is a component of the toolbar, also opens the “Controller” window. A list of existing shortcuts for the toolbar can be found in Section “Toolbar”.

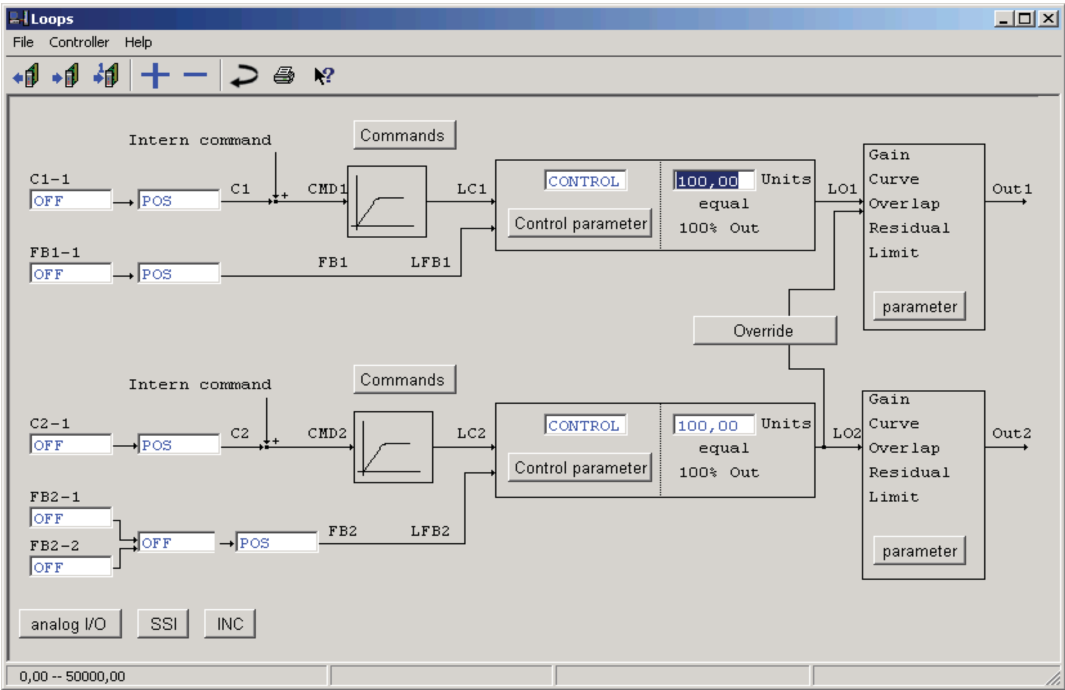


Fig. 70 Controller – Block call-up window

Controller – File menu Corresponds to the BODAC main window “File menu”.

Controller – Controller menu Contains commands for reading, writing and modifying parameters.

Controller – Help menu

Takes you directly to the help for the current topic, or to the con-tents page of the BODAC windows help.

Controller – Toolbar

Buttons are provided for frequently used functions. These are de-scribed in section “Toolbar”.

Input configuration

In the input configuration area the external signals for the application are selected. Mathematical operations are used to link 2 signals and the sign has to be specified for subsequent processing.

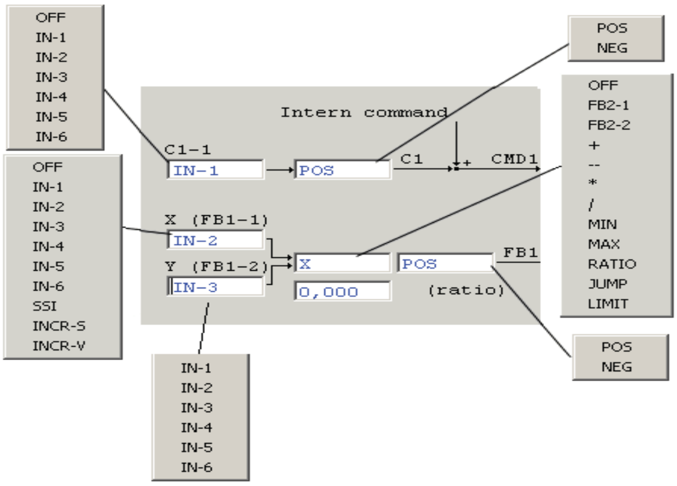


Fig. 71 Block call-up – Input configuration

Select one of the 6 analog inputs as the external command value input (C1-1).

Two actual value inputs X (FB1-1) and Y (FB1-2) are provided. Se-lect one of the 6 analog inputs or the SSI encoder for the actual value input X (FB1-1). If 2 actual value signals need to be linked with each other (e.g., force control), select one of the 6 ana-log in-puts as the second actual value input Y (FB1-2).

The two actual value inputs can be mathematically linked, see also “Input configura-tion”.
For selection RATIO, the entry field (ratio) is provided under the mathematical link selection. The entry field represents the desired ratio.

The third field for input configuration is used to specify the sign of the provided signal by entering “POS” (positive) or “NEG” (negative).

Linking/ Controller

The two signals LC1 and LFB1 are linked here and the selection can either be mathematical functions or a controller. The resulting signal (LO1) is passed along as a control signal.

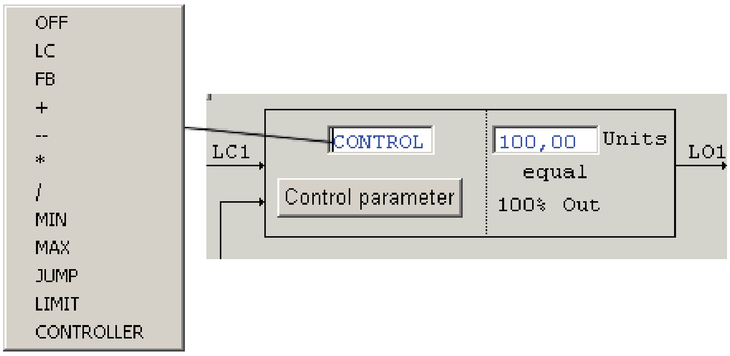


Fig. 72 Block call-up Linking/Controller

Use the factor to adjust the internal unit to 100% output value.

The individual logical operations (except for the controller) are explained in the chapter “Structure Editor, input adjustments.

Override

In this window you can set the operating principle of the two controllers. “Override” links the two control loops for override control.

You can set override control by means of "POSITIVE", "NEGATIVE" and "BOTH". The two controller outputs LO1 and LO2 are fed via a minimum value generator to output link 1, i.e. the smaller amount of the two values is output. The I-components of the two controllers (if used) are corrected accordingly in order to prevent the inactive controller from advancing.

One of the settings must be selected according to the work quadrant.
"POSITIVE“: Both control actions must have a positive polarity in order that alternating control can be active.
"NEGATIVE“: Both control actions must have a negative polarity in order that alternating control can be active.
"BOTH“: The control actions can have a positive and/or negative polarity in order that alternating control is active. However, in this case, the first loop (Controller1) must be the closed position control loop and the second loop (Controller2) the closed control loop of pressure, force. The command value for the pressure and force control loop is always positive.

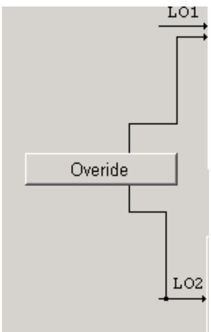
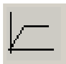


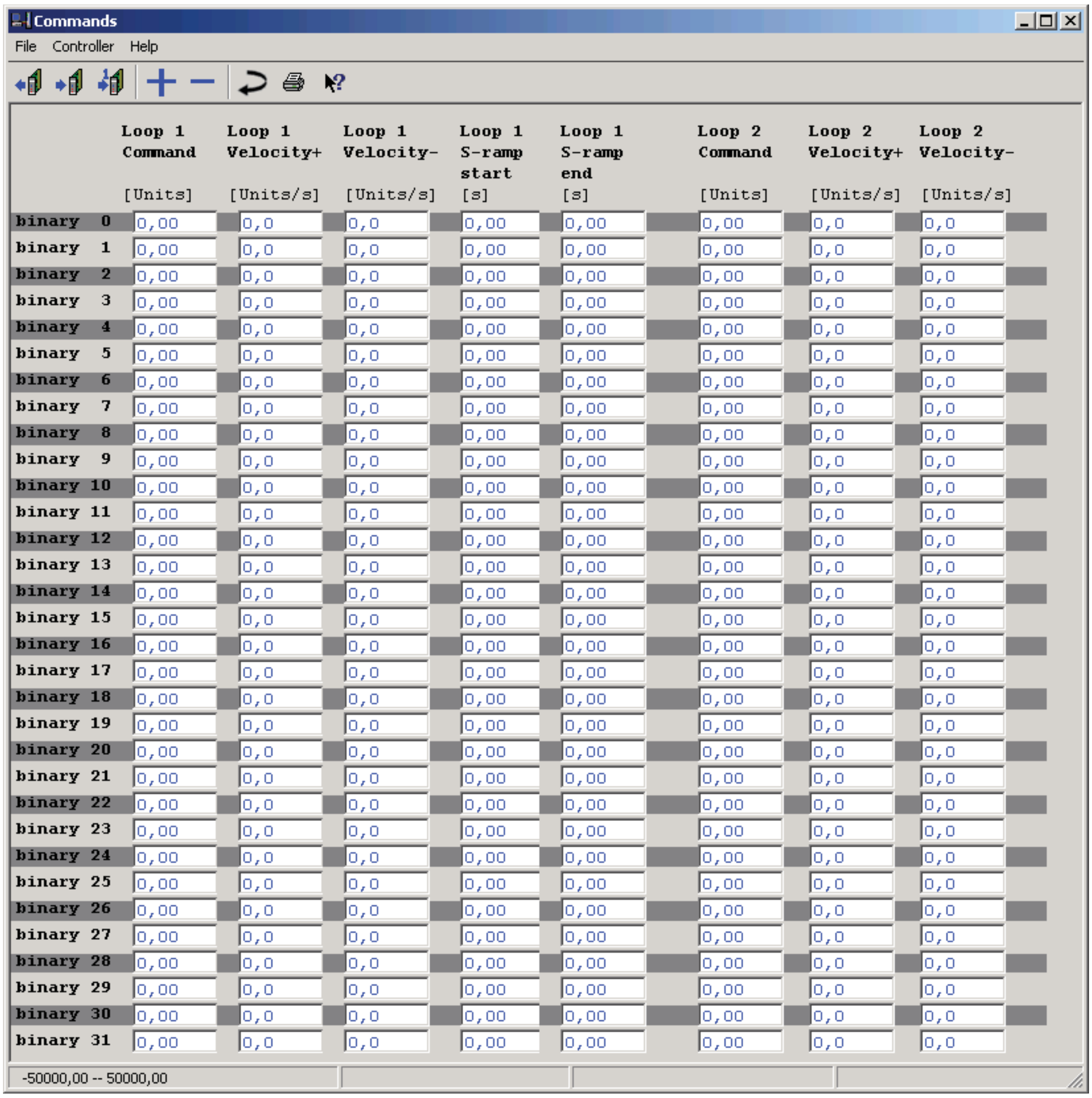
Fig. 73 Block call-up Override function

Commands

In the “Commands” window you set the command value, velocity and S-ramps for all 32 blocks.



Clicking on the preceding symbol, which is a component of the toolbar, also opens the “Commands” window. A listing of existing shortcuts for the toolbar can be found in Section “Toolbar”.



	Loop 1 Command [Units]	Loop 1 Velocity+ [Units/s]	Loop 1 Velocity- [Units/s]	Loop 1 S-ramp start [s]	Loop 1 S-ramp end [s]	Loop 2 Command [Units]	Loop 2 Velocity+ [Units/s]	Loop 2 Velocity- [Units/s]
binary 0	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 1	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 2	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 3	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 4	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 5	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 6	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 7	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 8	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 9	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 10	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 11	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 12	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 13	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 14	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 15	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 16	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 17	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 18	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 19	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 20	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 21	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 22	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 23	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 24	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 25	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 26	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 27	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 28	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 29	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 30	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0
binary 31	0,00	0,0	0,0	0,00	0,00	0,00	0,0	0,0

Fig. 74 Block call-up – Command values window

Command values – File menu Corresponds to the BODAC main window “File menu”.

Command values – Controller menu Contains commands for reading, writing and modifying parameters.

Command values – Help menu Takes you directly to the help for the current topic, or to the con-tents page of the BODAC windows help.

Command values – Toolbar Buttons are provided for frequently used functions. These are de-scribed in section “Toolbar”.

Control parameters 1

The “Control parameters 1” window is used to set the control pa-rameters of loop 1 if “controller” is selected in the “Link/Controller” window.

Clicking on the preceding symbol, which is a component of the toolbar, also opens the “Control parameters” win-dow. A list of existing short-cuts for the toolbar can be found in Section “Toolbar”.

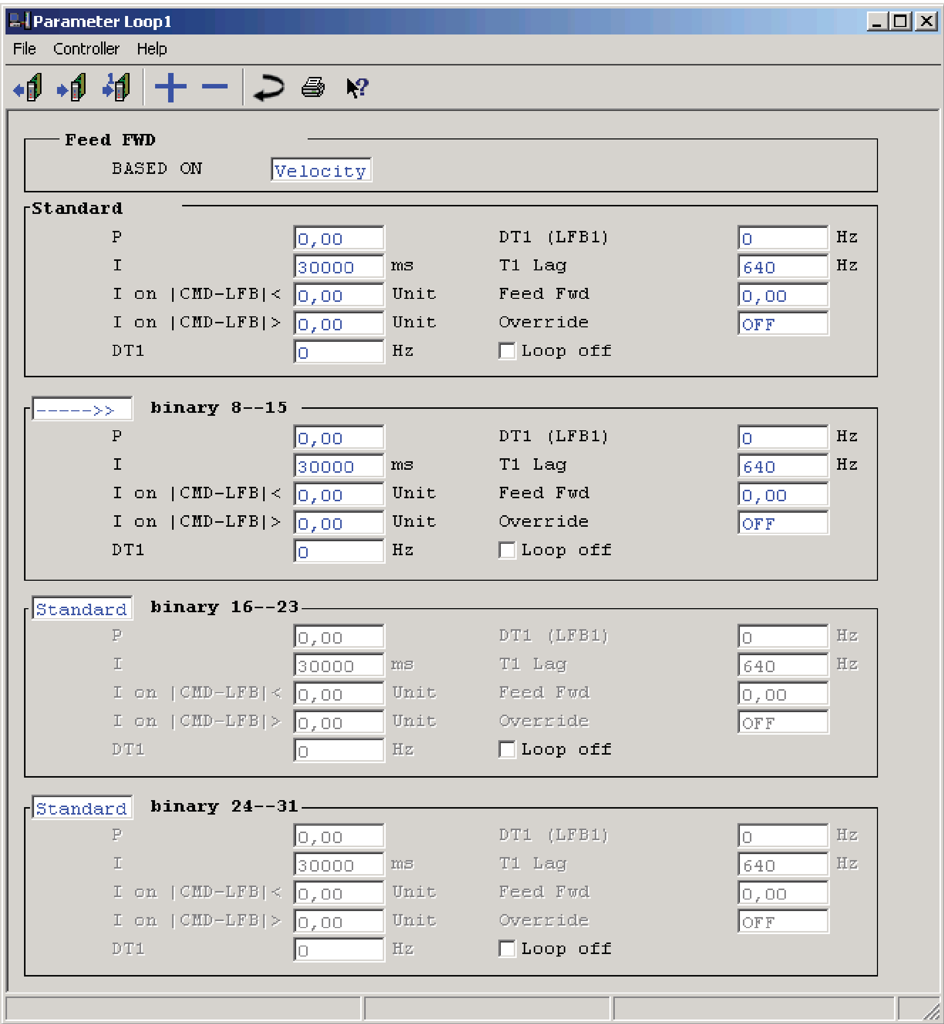


Fig. 75 Control parameters – Block call-up window

Control parameters – File menu

Corresponds to the BODAC main window “File menu”.

Control parameters – Controller menu

Contains commands for reading, writing and modifying parameters.

Control parameters – Help menu

Takes you directly to the help for the current topic, or to the con-tents page of the BODAC windows help.

Control parameters – Toolbar

Buttons are provided for frequently used functions. These are de-scribed in section "Toolbar".

Feed FWD

The calculation regulations for command value feedforward integrated in the controller structure can be set here.

Based on	Explanation
Velocity	The created command value (LCx) is differentiated and used for determining the rate of the command value change. This command value change is multiplied by the factor "command value feedforward" and added to the con-trol action.
Command value	The created command value (LCx) is multiplied by the factor "command value feedforward" and added to the control action.

Control parameter

You can use different control parameters sets for blocks 0...7, 8...15, 16...23 and 24...31.

Block no.	Setting	Effective controller parameter
0...7	Standard	The standard controller parameter set is active.
8...15	Standard	The standard controller parameter set is active.
8...15	---->>	The controller parameter set "binary 8—15" is active.
16..23	Standard	The standard controller parameter set is active.
16..23	---->>	The controller parameter set "binary 16—23" is active.
24...31	Standard	The standard controller parameter set is active.
24...31	---->>	The controller parameter set "binary 24—31" is active.

The controller structure and the individual controller parameters are described in the chapter "Controller parameters".

Control parameters 2

The “Control parameters 2” window is used to set the control parameters of loop 2 if “controller” is selected in the “Link/Controller” window.

Clicking on the preceding symbol, which is a component of the toolbar, also opens the “Control parameters” window. A list of existing short-cuts for the toolbar can be found in Section “Toolbar”.

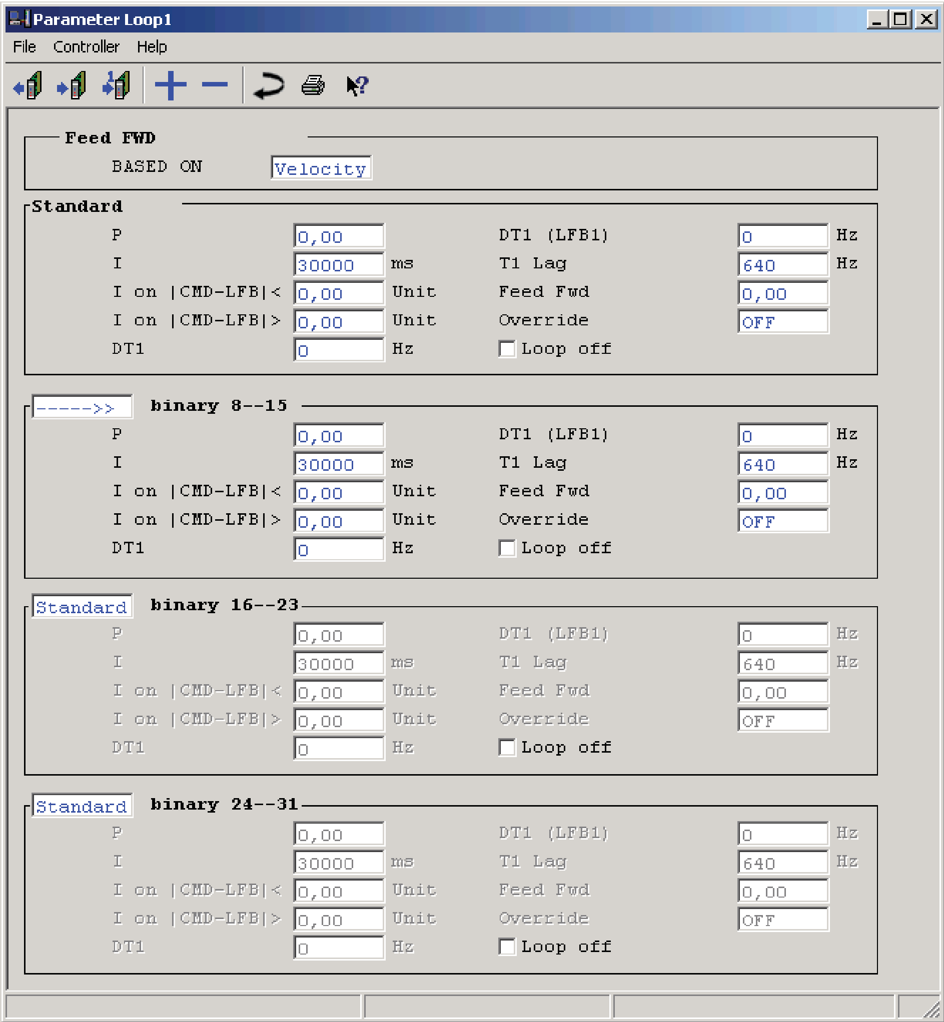


Fig. 76 Control parameters – Block call-up window

For the description, see control parameters 1

Digital I/O

In the "Digital I/O" window the OK output as well as the seven digital outputs of the HACD are configured. The window contains two fields, "Outputs" and "Inputs".

Clicking on the preceding symbol, which is a component of the toolbar, also opens the "Digital I/O" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

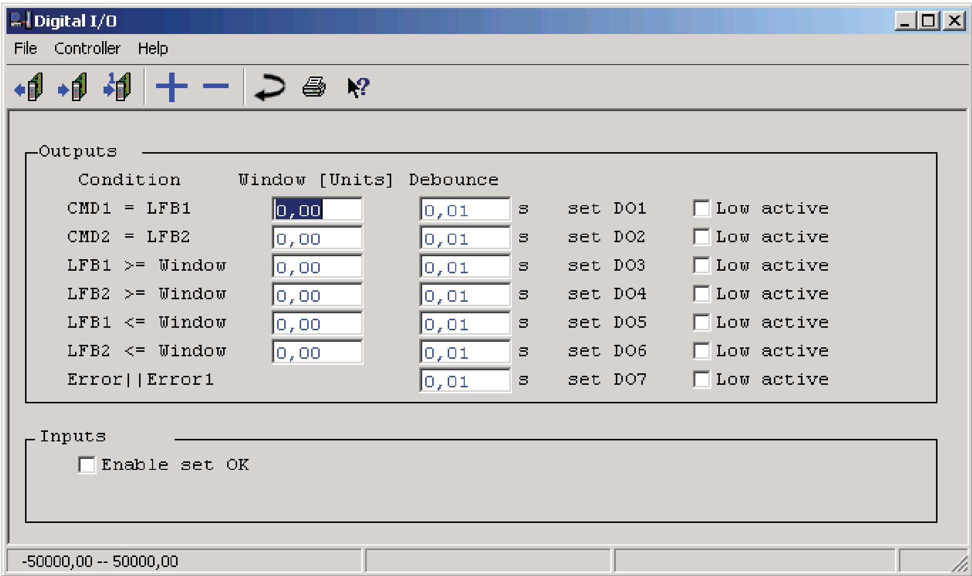


Fig. 77 Block call-up window - Digital I/O

Digital I/O - File menu Corresponds to the BODAC main window "File menu".

Digital I/O - Controller menu Contains commands for reading, writing and modifying parameters.

Digital I/O - Help menu Takes you directly to the help for the current topic, or to the contents page of the BODAC windows help.

Digital I/O - Toolbar Buttons are provided for frequently used functions. These are described in section "Toolbar".

Condition The condition is fixed for the 7 outputs.

Digital output	Condition	Description
DO1	CMD1 = LFB1	Output is set if command value is equal to actual value of loop 1.
DO2	CMD2 = LFB2	Output is set if command value is equal to actual value of loop 2.
DO3	LFB1 ≥ window	Output is set if actual value (loop 1) is less than or equal to a configurable value (window).
DO4	LFB2 ≥ window	Output is set if actual value (loop 2) is less than or equal to a configurable value (window).
DO5	LFB1 ≤ window	Output is set if actual value (loop 1) is less than or equal to a configurable value (window).
DO6	LFB2 ≤ window	Output is set if actual value (loop 2) is less than or equal to a configurable value (window).
DO7	Fault 1	Output is set if Fault flag 1 is set.

Window In the entry field “Window” (depending on the condition) the maxi-mum deviation (tolerance) or a threshold is set.

Debounce time In the “Debounce time” field you enter the maximum delay time un-til the previously defined condition is considered to have been met.

Low Active If **not** checked, the signal changes from Low to High when the con-dition is met.

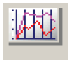
If checked, the signal changes from High to Low when the condi-tion is met.

Enable sets OK If checked, deactivating the enable also resets “OK”, even if no fault has occurred.

If “Enable sets OK” is not checked, “OK” is set regardless of whether the enable is activated. The prerequisite is that supply voltage is present and no fault has occurred.

Motion Data

The “Motion Data” window shows the command and actual signals which are relevant to the block call-up in real time.



Clicking on the preceding symbol, which is a component of the toolbar, also opens the “Motion Data” window. A listing of existing shortcuts for the toolbar can be found in Section “Toolbar”.

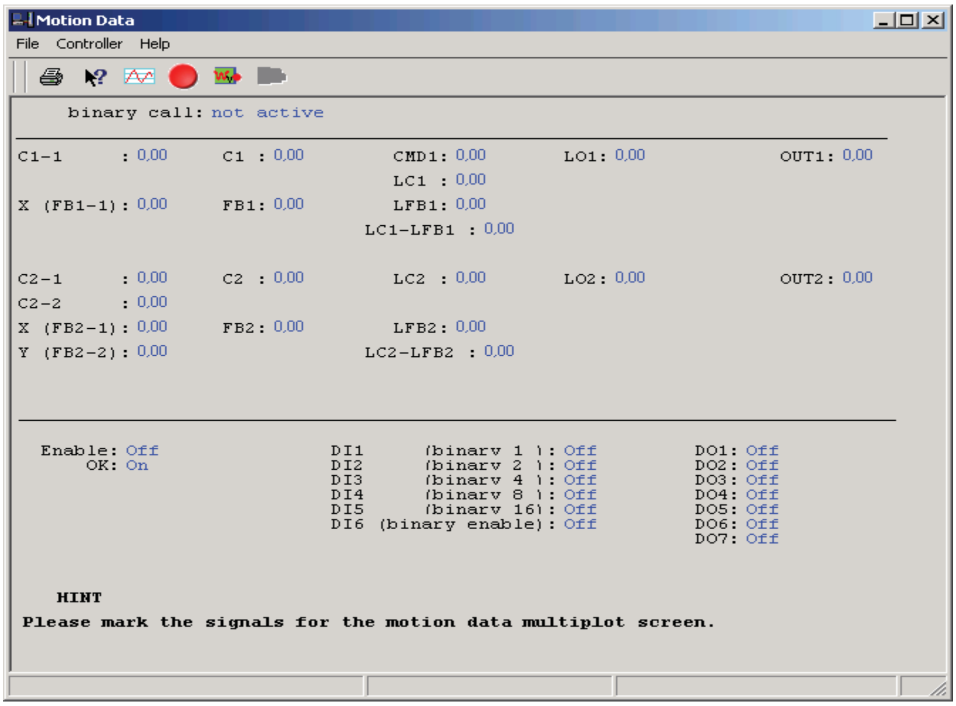


Fig. 78 Block call-up window – Motion Data

Process display - File menu
Corresponds to the BODAC main window “File menu”.

Process display - Controller menu
Contains commands for reading, writing and modifying parameters.

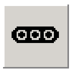
Process display - Help menu
Takes you directly to the help for the current topic, or to the con-tents page of the BODAC windows help.

Process display - Toolbar
Buttons are provided for frequently used functions. These are de-scribed in section “Toolbar”.

For a description, see “Motion Data” and “Multiplot”.

Test jacks

In the “Test jacks” window the user assigns the signals that can be measured for diagnostic purposes on diagnostics terminal “X1” and “X2” on the front panel of the HACD.



Clicking on the preceding symbol, which is a component of the toolbar, also opens the “Test jacks” window. A listing of existing shortcuts for the toolbar can be found in Section “Toolbar”.

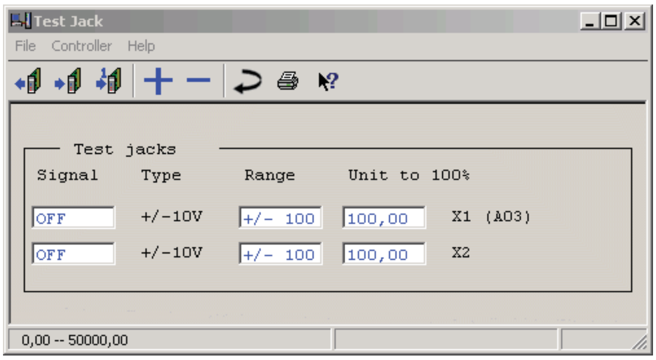


Fig. 79 Block call-up window – Test jacks

Test jacks - File menu Corresponds to the BODAC main window “File menu”.

Test jacks - Controller menu Contains commands for reading, writing and modifying parameters.

Test jacks - Help menu Takes you directly to the help for the current topic, or to the con-tents page of the BODAC windows help.

Test jacks - Toolbar Buttons are provided for frequently used functions. These are de-scribed in section “Toolbar”.

Signal Clicking on the Signal entry field opens a selection menu which contains the available signals.

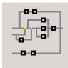
Range Selects the value range in [%].

Unit Matches the internal unit to 100% output value.

For additional information on the diagnostics terminal of the control card, see Technical Bulletin RE 30 143-01-B “Installation and Opera-tion of the Controller Card”, Section “Diagnostic Options on the Control Card”.

Loop 1

In the window "Loop 1", the internal states of the controller of the first loop can be observed.



Clicking on the preceding icon, which is part of the toolbar, also opens the window "Loop 1". A list of existing shortcuts of the toolbar can be found in chapter "Toolbar".

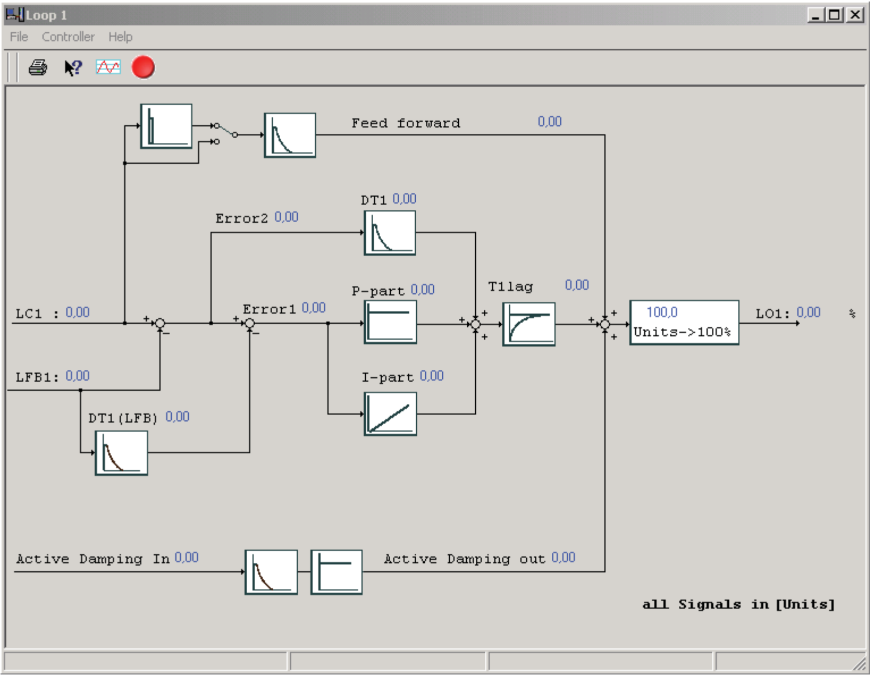


Fig. 80 "Loop 1" window

Loop 1 – File menu
Corresponds to the BODAC main window "File Menu".

Loop 1 – Controller menu
Contains commands for reading, writing and changing parameters.

Loop 1 – Help menu
Takes you directly to the help for the current topic or to the contents page of the BODAC windows help.

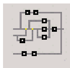
Loop 1 – Toolbar
Buttons are provided for frequently used functions. These are described in section "Toolbar".

The designation of the signals corresponds to the representation in the BODAC Structure Editor. The signals can be selected and graphically represented in the Multiplot window.

This window is only visible in safety level 2. Further information about the safety levels can be found in chapter 4.5 “Security “

Loop 2

In the “Loop 2” window you can observe the internal states of the controller of the second loop.



Clicking on the preceding icon, which is part of the toolbar, also opens the “Loop 2” window. A list of existing icons for the toolbar can be found in chapter "Toolbar".

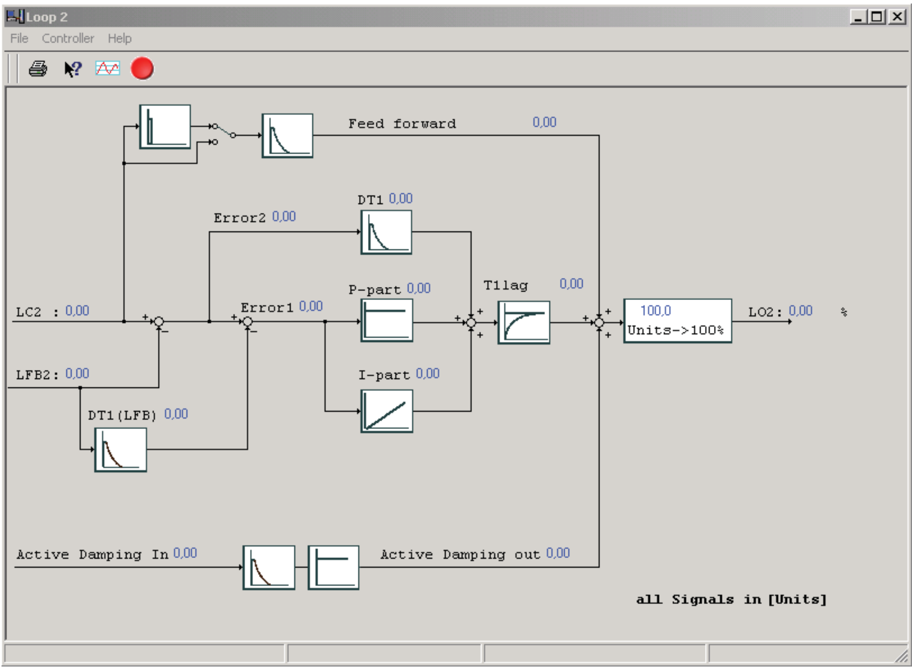


Fig. 81 “Loop 2” window

Loop 2 – File menu Corresponds to the BODAC main window “File Menu”.

Loop 2 – Controller menu Contains commands for reading, writing and changing parameters.

Loop 2 – Help menu Takes you directly to the help for the current topic or to the contents page of the BODAC windows help.

Loop 2 – Toolbar Buttons are provided for frequently used functions. These are described in section “Toolbar”.

The designation of the signals corresponds to the representation in the BODAC Structure Editor. The signals can be selected and graphically represented in the Multiplot window.

This window is only visible in safety level 2. Further information about the safety levels can be found in chapter 4.5 "Security"

Inside the Bus

In the window "Inside the Bus" you can observe the bus triggers. The blocks activated via the bus are shown here.

Clicking on the preceding icon, which is part of the toolbar, also opens the "Loop 2" window. A list of existing icons for the toolbar can be found in chapter "Toolbar".

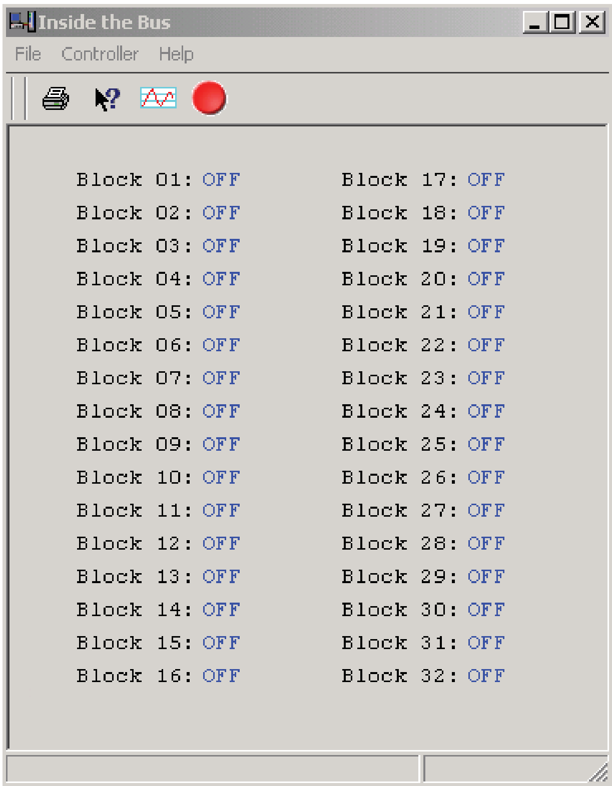


Fig. 82 Window "Inside the Bus"

Inside the Bus – File menu
Corresponds to the BODAC main window "File Menu".

Inside the Bus – Controller menu
Contains commands for reading, writing and changing parameters.

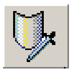
Inside the Bus – Help menu Takes you directly to the help for the current topic or to the contents page of the BODAC windows help.

Inside the Bus – Toolbar Buttons are provided for frequently used functions. These are described in section "Toolbar".

This window is only visible in safety level 2. Further information about the safety levels can be found in chapter 4.5 "Security"

Faults

In the "Faults" window the fault behavior of the HACD is configured.



Clicking on the preceding symbol, which is a component of the toolbar, also opens the "Faults" window. A list of existing shortcuts for the toolbar can be found in Section "Toolbar".

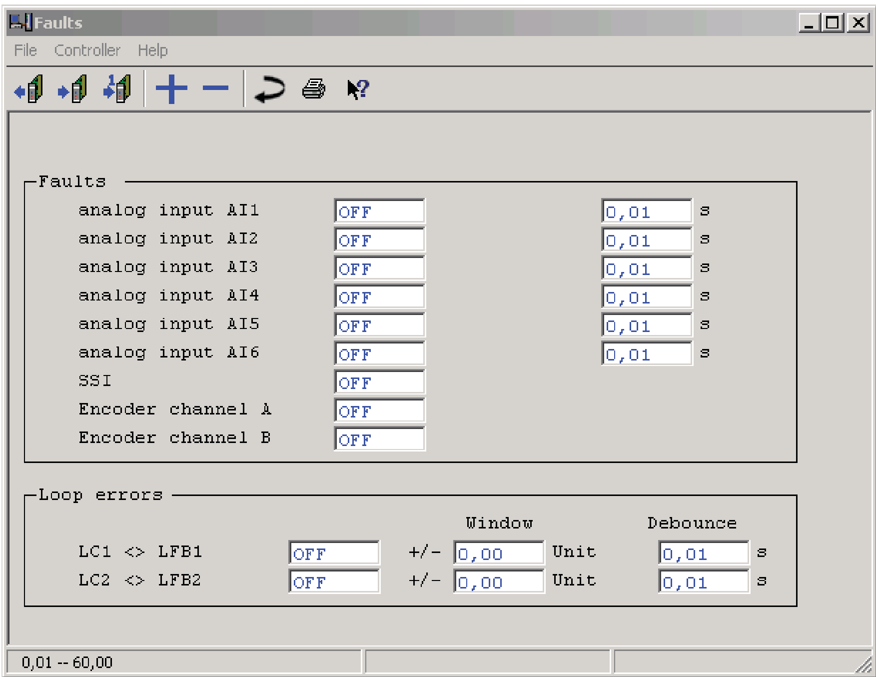


Fig. 83 Block call-up window - Faults

Faults – File menu Corresponds to the BODAC main window "File menu".

Faults – Controller menu Contains commands for reading, writing and modifying parameters.

Faults – Help menu Takes you directly to the help for the current topic, or to the con-tents page of the BODAC windows help.

Faults – Toolbar Buttons are provided for frequently used functions. These are de-scribed in section “Toolbar”.

In the Faults window the response of the HACD Control Card for various monitoring settings is specified.

Setting	HACD response
OFF	The HACD does not register any faults, and there is no fault re-sponse.
STOP	The HACD sets the analog outputs to zero and resets the “OK” digi-tal output.
FAULT	The HACD detects the signal deviation and in the “Status” window signals that a fault was detected. You can use Faults 1 to 3 for set-ting digital outputs, see Digital I/O. The “OK” signal is not affected and the sequence not stopped.

Analog input The HACD can monitor the 6 analog inputs for overshoot or undershoot of thresholds. These are set in the “Analog I/O” window.

SSI Monitoring cable break on the SSI encoder

Encoder Channel A Monitoring for cable break in channel A of the incremental encoder.

Encoder Channel B Monitoring for cable break in channel B of the incremental encoder.

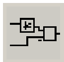
Control fault A deviation between the command value (LC1) and the actual value (LFB1) or the command value (LC2) and the actual value (LFB2) was detected.
In the “Window” field you specify the tolerance limit in [Unit] which is used when com-paring the command/actual values.
In the „Delay“ field the time unit is entered. The control deviation must lie in the toler-ance window of the “Window” field for a mini-mum of time specified in the “Debounce” window.

5.2 Mode 2 – Motion Profile

The Application Window menu contains specific commands for the parameter set Mode 2 – Motion profile with one control loop.

Loop

In the "Loop" window you can set the configuration of the HACD. You can select actual value (feedback) inputs and determine logical operations of the signals. Moreover, the window provides links to other windows.



Clicking on the preceding icon, which is part of the toolbar, also opens the "Loop" window. A list of existing icons for the toolbar can be found in chapter "Toolbar".

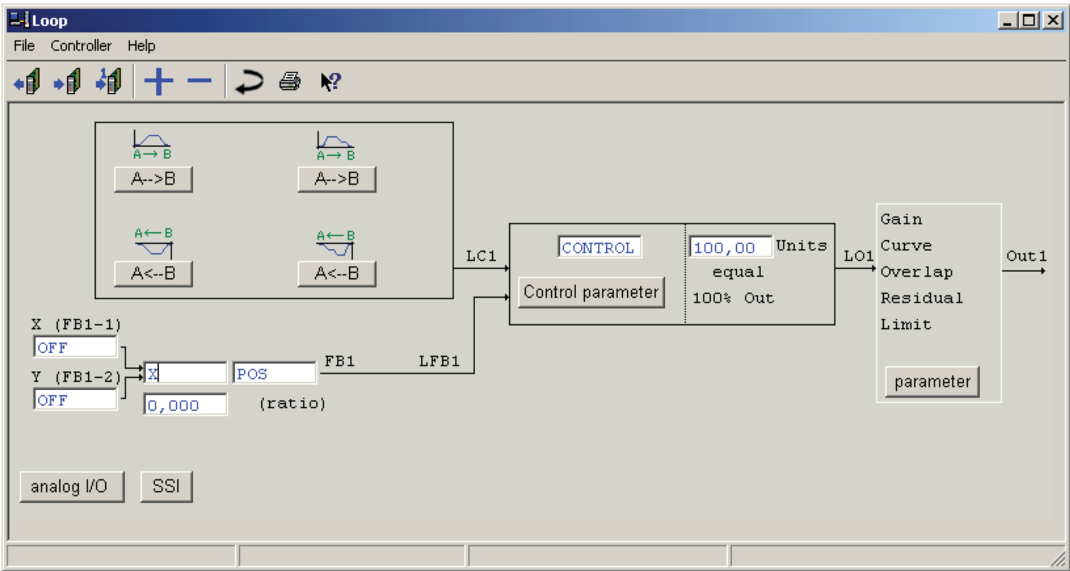


Fig. 84 Window "Motion Profile – Loop"

Loop – File menu Corresponds to the BODAC main window "File Menu".

Loop – Controller menu Contains commands for reading, writing and changing parameters.

Loop – Help menu Takes you directly to the help for the current topic or to the contents page of the BODAC windows help.

Loop – Toolbar Buttons are provided for frequently used functions. These are described in section "Toolbar".

Input adjustments In the "input adjustment" section you can select the actual value for your application. You use mathematical operations and determine the sign of the signal for further processing.

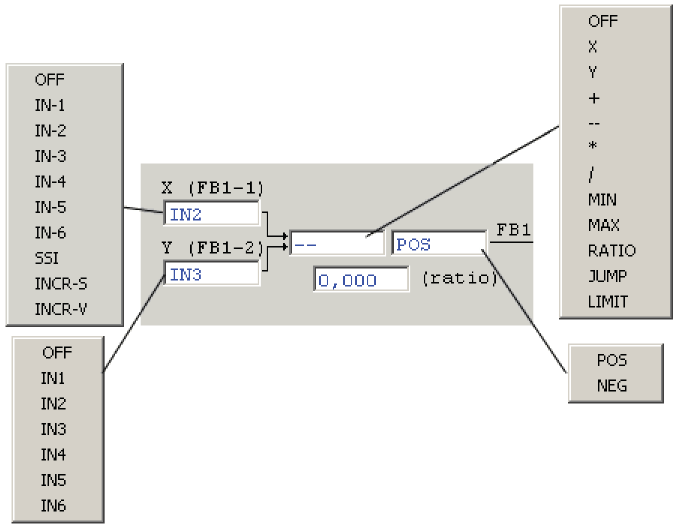


Fig. 85 Motion Profile – input adjustments

2 actual value (feedback) inputs, FB1-1 and FB1-2, are provided. Select one of the 6 analog inputs for actual value input FB1-1, the SSI encoder or the incremental encoder (position or velocity). If you wish to link 2 feedback signals (e.g. closed-loop force control), select one of the 6 analog inputs for the second actual value input FB1-2.

The individual logical operations are explained in the chapter "Structure Editor", input adjustments.

You can mathematically link the two actual value inputs. See also "Input adjustments". For the selection RATIO, an entry field (ratio) is provided under the selection of logic operations, where you can enter the required ratio.

In the third field of input adjustments you can determine the sign of the actual value by entering "POS" (positive) or "NEG" (negative).

Linking / Loop Here, you can link the two signals LC1 (command value, is defined in Motion Profile) and LFB1 (actual value). You can select both, mathematical functions or a controller. The resulting signal (LO1) will then be passed on as control action.

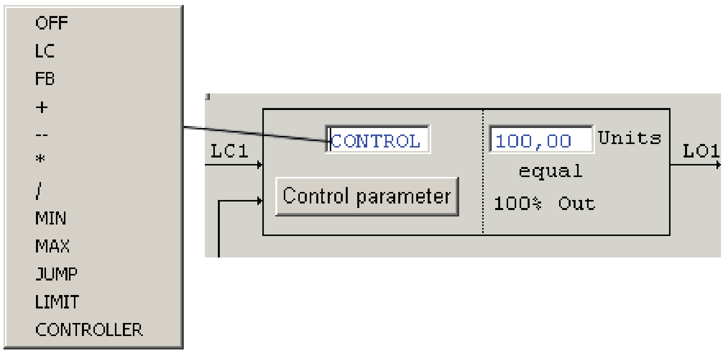


Fig. 86 Motion Profle – Linking/Loop

Adjust the internal unit to 100% of the output variable by means of a factor.

The individual logical operations (except for the controller) are described in the chapter “Structure Editor, input adjustments”.

Control parameter

In the window "Control parameter" you can set the controller parameters, if you selected the controller as logical link.

Clicking on the preceding icon, which is part of the toolbar, also opens the “Control parameter” window. A list of existing icons for the toolbar can be found in chapter "Toolbar".

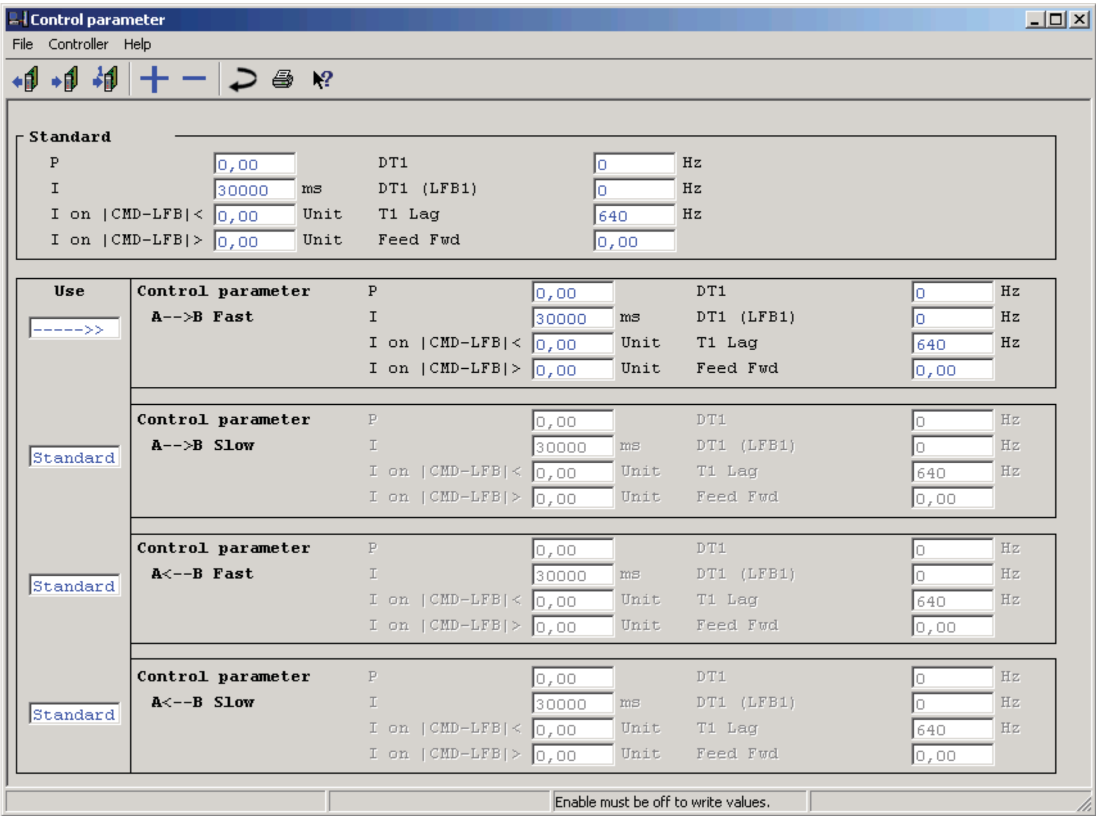


Fig. 87 Window “Motion profile – Control parameter”

Control parameter – File menu

Corresponds to the BODAC main window “File Menu”.

Control parameter – Controller menu

Contains commands for reading, writing and changing parameters.

Control parameter – Help menu Takes you directly to the help for the current topic or to the contents page of the BODAC windows help.

Control parameter – Toolbar Buttons are provided for frequently used functions. These are described in section “Toolbar”.

Control parameter For the movements A→B und B→A you can use both, standard controller parameters and profile-specific controller parameter sets.

The controller structure and the individual controller parameters are described in the chapter “Controller parameters”.

Start

In the "Start" window you can set the start position and the traversing velocity to the start position.

Clicking on the preceding icon, which is part of the toolbar, also opens the “Start” window. A list of existing icons for the toolbar can be found in chapter "Toolbar.

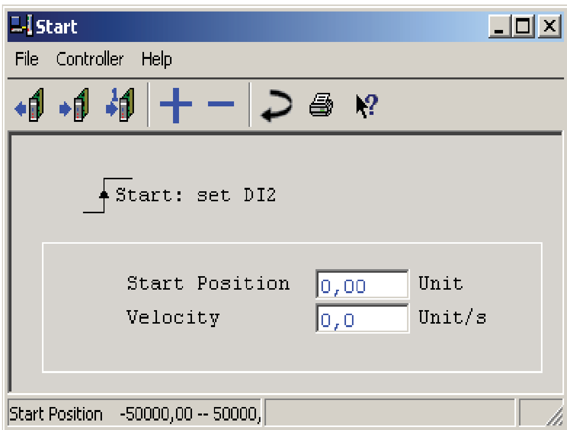


Fig. 88 Motion Profile - Start

Start – File menu Corresponds to the BODAC main window “File Menu”.

Start – Controller menu Contains commands for reading, writing and changing parameters.

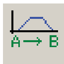
Start – Help menu Takes you directly to the help for the current topic or to the contents page of the BODAC windows help.

Start – Toolbar Buttons are provided for frequently used functions. These are described in section “Toolbar”.

See also “Motion profile".

A to B

In the window "A to B" you can define the motion sequence A→B with acceleration ramp, velocity and deceleration ramp.



Clicking on the preceding icon, which is part of the toolbar, also opens the "A to B" window. A list of existing icons for the toolbar can be found in chapter "Toolbar".

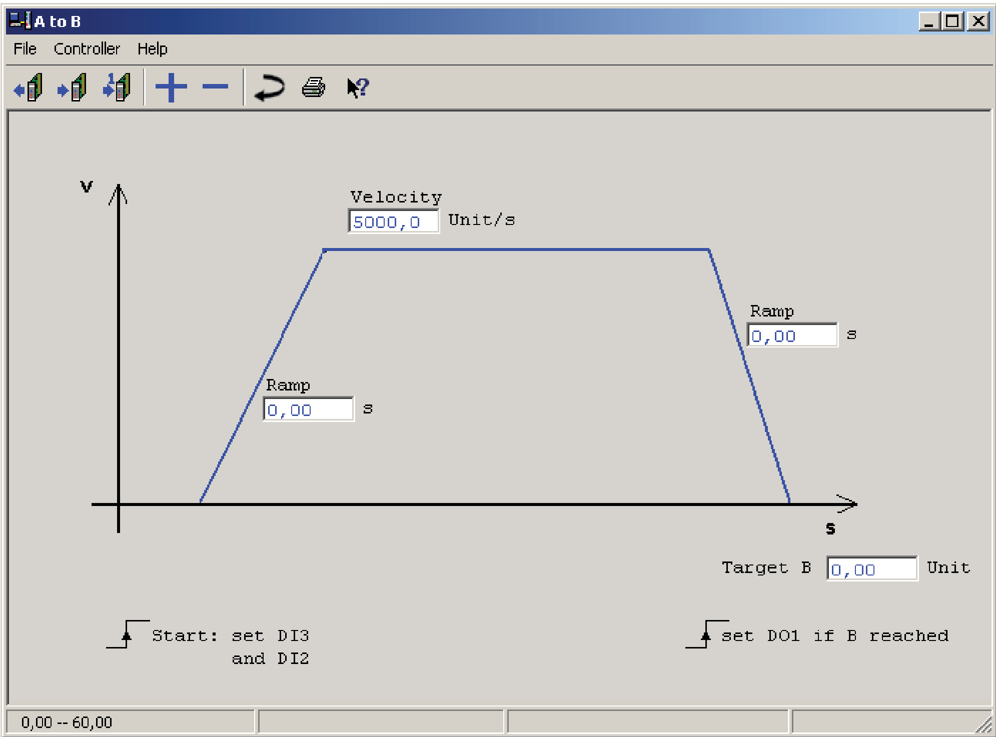


Fig. 89 Motion profile – A to B

A to B – File menu Corresponds to the BODAC main window "File Menu".

A to B – Controller menu Contains commands for reading, writing and changing parameters.

A to B – Help menu Takes you directly to the help for the current topic or to the contents page of the BODAC windows help.

A to B – Toolbar Buttons are provided for frequently used functions. These are described in section "Toolbar".

Acceleration ramp Here, you can set the acceleration time in s. The drive will accelerate within this time from standstill to the set velocity.

Velocity Enter the traversing velocity of the drive in Units/s.

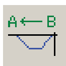
Deceleration ramp In this entry field you can set the deceleration time in s. The drive will decelerate within this time from the current velocity to standstill

Target B Enter target position B in this field.

See also “Motion profile”.

B to A

In the window "B to A" you can define the motion sequence B→A with acceleration ramp, velocity and deceleration ramp.



Clicking on the preceding icon, which is part of the toolbar, also opens the “B to A” window. A list of existing icons for the toolbar can be found in chapter "Toolbar”.

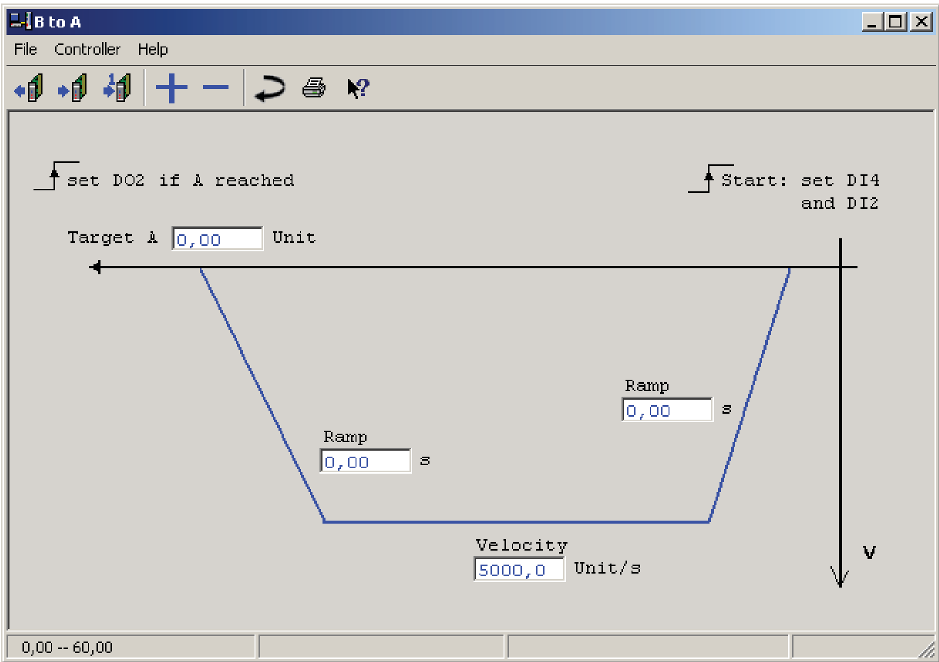


Fig. 90 Motion Profile – B to A

B to A – File menu Corresponds to the BODAC main window “File Menu”.

B to A – Controller menu Contains commands for reading, writing and changing parameters.

B to A – Help menu Takes you directly to the help for the current topic or to the contents page of the BO-DAC windows help.

B to A – Toolbar Buttons are provided for frequently used functions. These are described in section "Toolbar".

.

Acceleration ramp Here, you can set the acceleration time in s. The drive will accelerate within this time from standstill to the set velocity.

Velocity Enter the traversing velocity of the drive in Units/s.

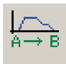
Deceleration ramp In this entry field you can set the deceleration time in s. The drive will decelerate within this time from the current velocity to standstill

Target A Enter target position A in this field.

See also "Motion profile".

A to B (F/S)

In the window "A to B (F/S)" you can define the motion sequence A→B with change-over from fast to slow traverse as well as acceleration ramp, velocities and deceleration ramps.



Clicking on the preceding icon, which is part of the toolbar, also opens the “A to B (F/S)” window. A list of existing icons for the toolbar can be found in chapter "Toolbar”.

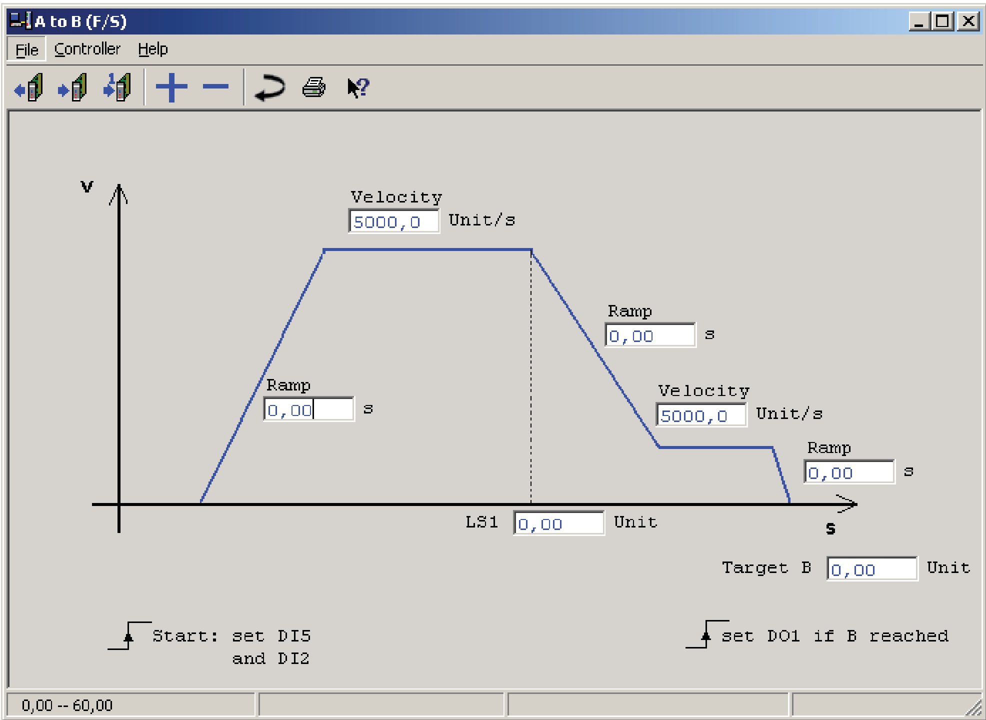


Fig. 91 Motion profile – A to B (fast/slow traverse)

A to B (F/S) – File menu
Corresponds to the BODAC main window “File Menu”.

A to B (F/S) – Controller menu
Contains commands for reading, writing and changing parameters.

A to B (F/S) – Help menu
Takes you directly to the help for the current topic or to the contents page of the BODAC windows help.

A to B (F/S) – Toolbar
Buttons are provided for frequently used functions. These are described in section “Toolbar”.

Acceleration ramp
Here, you can set the acceleration time in s. The drive will accelerate from standstill to the set fast traverse velocity within this time.

Fast traverse velocity Enter the traversing velocity of the drive for fast traverse in Units/s.

LS1 Here, you can enter the position, at which the drive is to change from fast traverse to slow traverse.

Deceleration ramp fast/slow traverse In this field you have to enter the deceleration time in s for the changeover from fast to slow traverse. The drive will be decelerated from the current fast traverse velocity to the slow traverse velocity within this time.

Slow traverse velocity Here, you have to enter the slow traverse velocity of the drive in Units/s.

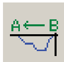
Slow traverse deceleration Enter the deceleration time in s in this field. The drive will be decelerated within this time from the current slow traverse velocity to standstill.

Target B Enter target position B.

See also “Motion profile".

B to A (F/S)

In the window "B to A (F/S)" you can define the motion sequence B→A with change-over from rapid to slow traverse as well as acceleration ramp, velocities and deceleration ramps.



Clicking on the preceding icon, which is part of the toolbar, also opens the “B to A (F/S)” window. A list of existing icons for the toolbar can be found in chapter "Toolbar”.

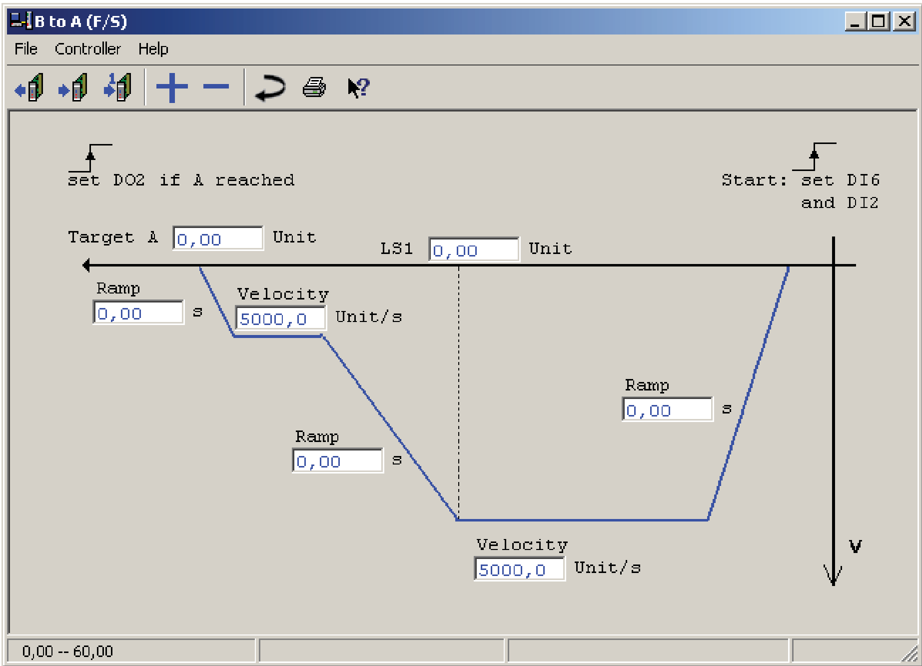


Fig. 92 Motion profile – B to A (fast/slow traverse)

B to A (F/S) – File menu Corresponds to the BODAC main window “File Menu”.

B to A (F/S) – Controller menu Contains commands for reading, writing and changing parameters.

B to A (F/S) – Help menu Takes you directly to the help for the current topic or to the contents page of the BODAC windows help.

B to A (F/S) – Toolbar Buttons are provided for frequently used functions. These are described in section “Toolbar”.

Acceleration ramp Here, you can set the acceleration time in s. The drive will accelerate from standstill to the set fast traverse velocity within this time.

Fast traverse velocity Enter the traversing velocity of the drive for fast traverse in Units/s.

LS1 Here, you can enter the position, at which the drive is to change from fast traverse to slow traverse.

Deceleration ramp fast/slow traverse In this field you have to enter the deceleration time in s for the changeover from fast to slow traverse. The drive will be decelerated from the current fast traverse velocity to the slow traverse velocity within this time.

Slow traverse velocity Here, you have to enter the slow traverse velocity of the drive in Units/s.

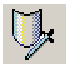
Slow traverse deceleration Enter the deceleration time in s in this field. The drive will be decelerated within this time from the current slow traverse velocity to standstill.

Target A Enter target position A.

See also “Motion profile".

Faults

In the window "Faults" you can configure the fault behavior of the HACD.



Clicking on the preceding icon, which is part of the toolbar, also opens the “Faults” window. A list of existing icons for the toolbar can be found in chapter "Toolbar”.

This window is identical with “Block call-up faults".

Digital I/O

In the window "Digital I/O" you can configure the OK output as well as the seven digital outputs of the HACD. The window includes two fields, the "Outputs" field and the "Inputs" field.

Clicking on the preceding icon, which is part of the toolbar, also opens the "Digital I/O" window. A list of existing icons for the toolbar can be found in chapter "Toolbar".

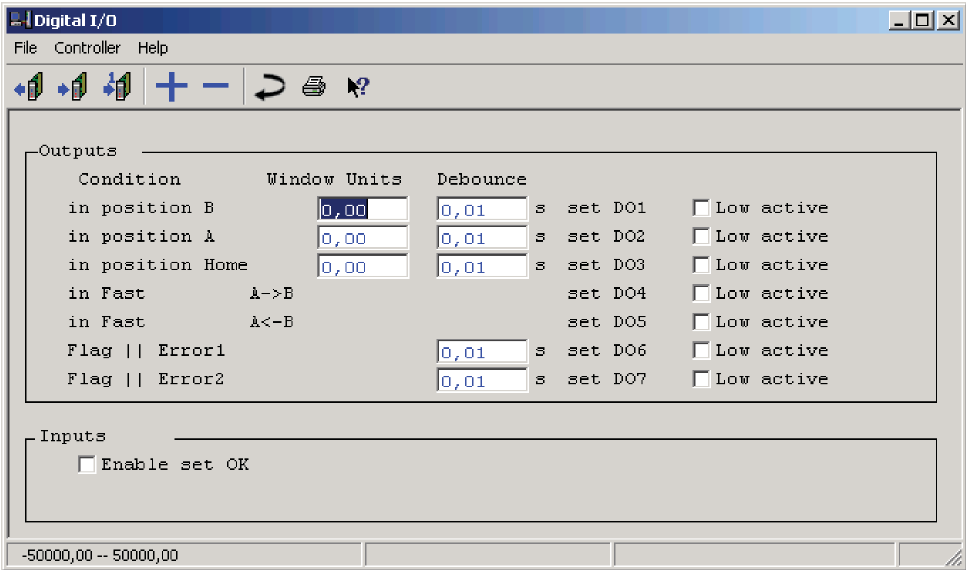


Fig. 93 Window "Motion profile– Digital I/O"

Digital I/O – File menu Corresponds to the BODAC main window "File Menu".

Digital I/O – Controller menu Contains commands for reading, writing and changing parameters.

Digital I/O – Help menu Takes you directly to the help for the current topic or to the contents page of the BODAC windows help.

Digital I/O – Toolbar Buttons are provided for frequently used functions. These are described in section "Toolbar".

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Rexroth Bosch Group
Sales partner

Condition The conditions for the 7 outputs are firmly defined.

Digital output	Condition	Explanation
DO1	In position B	The output is set when position B has been reached.
DO2	In position A	The output is set when position A has been reached.
DO3	In Home position	The output is set when the home position has been reached.
DO4	In slow traverse A→B	The output is set when the drive is in slow traverse from A to B.
DO5	In slow traverse A←B	The output is set when the drive is in slow traverse from B to A.
DO6	Error 1	The output is set, when Flag Error 1 is set.
DO7	Error 2	The output is set, when Flag Error 2 is set.

Window Units In the entry field "Window Units" you have to enter the maximum deviation (tolerance) or a threshold value in dependence upon the condition.

Debounce In the field “Debounce” you have to set the maximum delay time until the condition defined before is regarded as fulfilled.

Low active If **no** check is set, the signal changes from Low to High when the condition occurs.

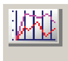
If the check is set, the signal changes from High to Low when the condition occurs.

Enable set OK If you check “Enable set OK”, “OK” is reset when the enable is deactivated, even if no fault has occurred.

If you do not check “Enable set OK”, “OK” is set independently of the activation of the enable. A precondition is that the supply voltage is applied and no fault has occurred.

Motion Data

The window “Motion Data” shows all command and actual value signals, which are relevant for the motion profile, in real time.



Clicking on the preceding icon, which is part of the toolbar, also opens the “Motion Data” window. A list of existing icons for the toolbar can be found in chapter "Toolbar".

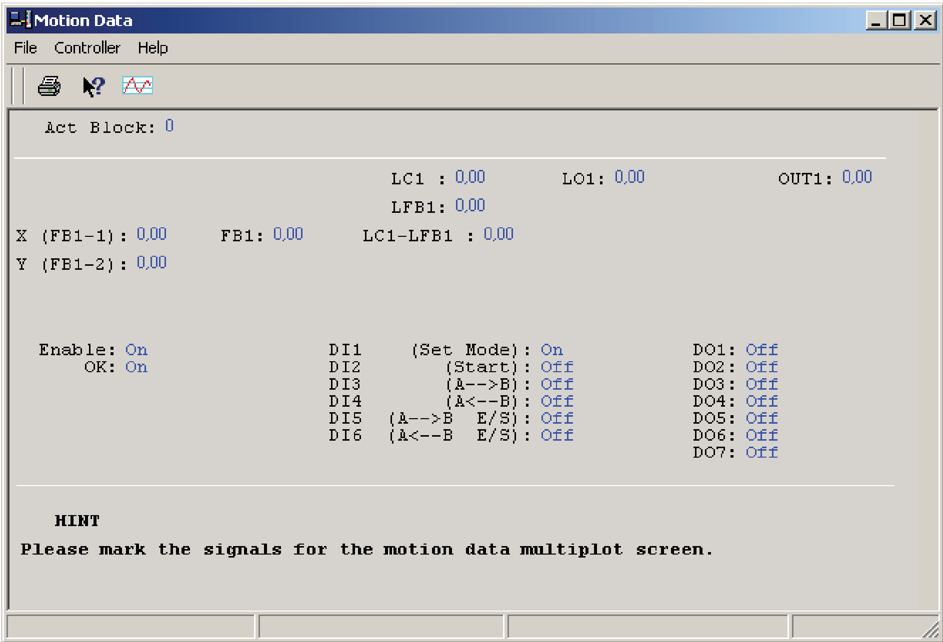


Fig. 94 Window “Profile – Motion Data”

Motion Data – File menu
Corresponds to the BODAC main window “File Menu”.

Motion Data – Controller menu
Contains commands for reading, writing and changing parameters.

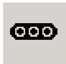
Motion Data – Help menu
Takes you directly to the help for the current topic or to the contents page of the BO-DAC windows help.

Motion Data – Toolbar
Buttons are provided for frequently used functions. These are described in section “Toolbar”.

For the description, see “Motion Data” and "Multiplot".

Test jacks

In the window “Test jacks” the signals are assigned, which you can measure for diagnostics purposes on diagnostics terminal "X1" and "X2" on the front panel of the HACD.



Clicking on the preceding icon, which is part of the toolbar, also opens the “Test jacks” window. A list of existing icons for the toolbar can be found in chapter "Toolbar”.

This window is identical to the window of block call-up test jackets.

Set Mode

In the window “Set Mode” you have to determine the parameters for the setup mode.

Clicking on the preceding icon, which is part of the toolbar, also opens the “Set Mode” window. A list of existing icons for the toolbar can be found in chapter "Toolbar”.

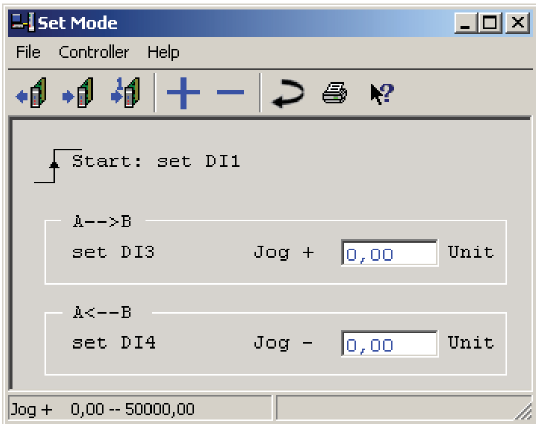


Fig. 95 Motion profile – Set Mode

Set Mode – File menu
Corresponds to the BODAC main window “File Menu”.

Set Mode – Controller menu
Contains commands for reading, writing and changing parameters.

Set Mode – Help menu
Takes you directly to the help for the current topic or to the contents page of the BODAC windows help.

Set Mode – Toolbar
Buttons are provided for frequently used functions. These are described in section “Toolbar”.

Jog + Enter a value, which is used for moving the drive in the direction from A to B under open loop control.

Jog - Enter a value, which is used for moving the drive in the direction from B to A under open loop control.

The conversion factor "Units correspond to 100% OUT" determines the valve aperture that results from the value entered.

This function is only available in safety level 2.

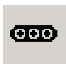
See also "Motion profile".

5.3 Mode 3 – Structure-Editor

The Application Window menu contains the specific commands for Parameter Set Mode 3 – Structure Editor

Test jacks

In the "Test jacks" window you assign the signals which you can measure for diagnostic purposes on diagnostics terminal "X1" and "X2" on the front panel of the HACD.

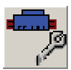


Clicking on the preceding symbol, which is a component of the toolbar, also opens the "Test jacks" window. A list of existing shortcuts for the toolbar can be found in Section "Toolbar".

This window is identical to "Block call-up-Test jacks".

Valve zero point

You can adjust the zero point of the valve in the "Configure valve" window. This window is only visible at safety level 2 and if the amplifier card has a valve daughterboard such as a VT-HACD-1-1x/V0/1-P-1.



The preceding icon, which is part of the toolbar, also opens the "Configure valve" window. A list of existing icons for the toolbar can be found in chapter "Toolbar"

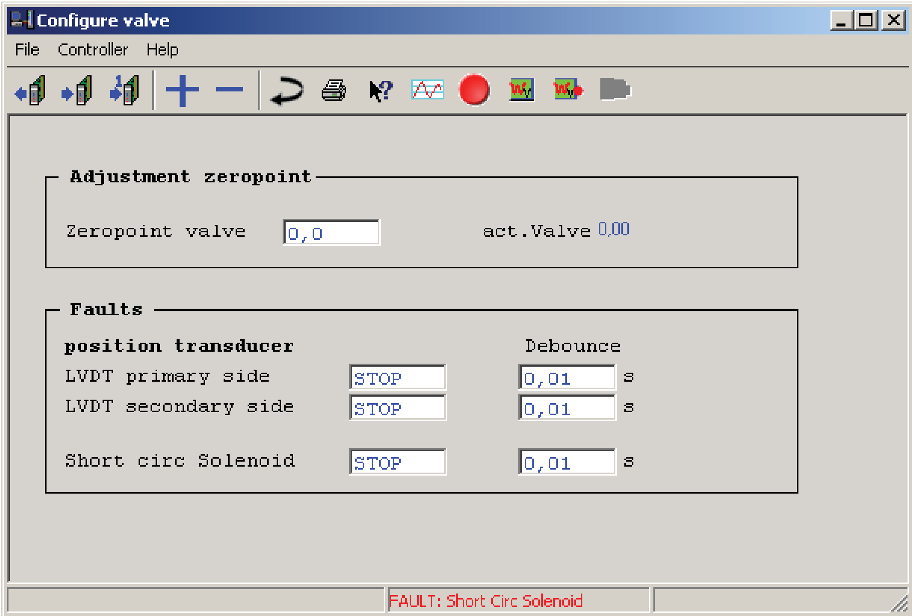


Fig. 92 Configure valve

Setup – File menu Corresponds to the BODAC main window “File menu”

Setup – Controller menu Contains commands for reading, writing and changing parameters.

Setup – Help menu Takes you directly to the help of the current topic or to the contents page of the BODAC Windows help.

Setup – Toolbar Buttons are provided for frequently used functions. They are described in the section “Toolbar”.

Zero point valve Changes the value until the actual value corresponds to the valve zero point.

Faults Here, you can set the behavior of the amplifier if one of the faults “LVDT primary side”, “LVDT secondary side” or “Short circ Solenoid” occurs.

OFF The fault is ignored. The controller card does not detect any faults, there is no fault reaction.

Stop The controller card recognizes the error, sets the analog outputs to zero, blocks the output stage and resets digital output “OK”. Subsequent parameter sets are not processed until the fault is rectified.

6 Settings and Configuration

6.1 Structure Editor

The Structure Editor is divided into 4 areas:

- Input Matrix
- Block Matrix
- Loop Matrix
- Output Matrix

Here the user determines systematically from left to right the structure of the application. Beginning with the “Analog I/O” window, the analog signals (setpoints) “IN1” to “IN6” are transferred in the Structure Editor. Internal signals and actual values can also be selected.

The first adjustments for the selected signals are possible in the “Input Matrix” area.

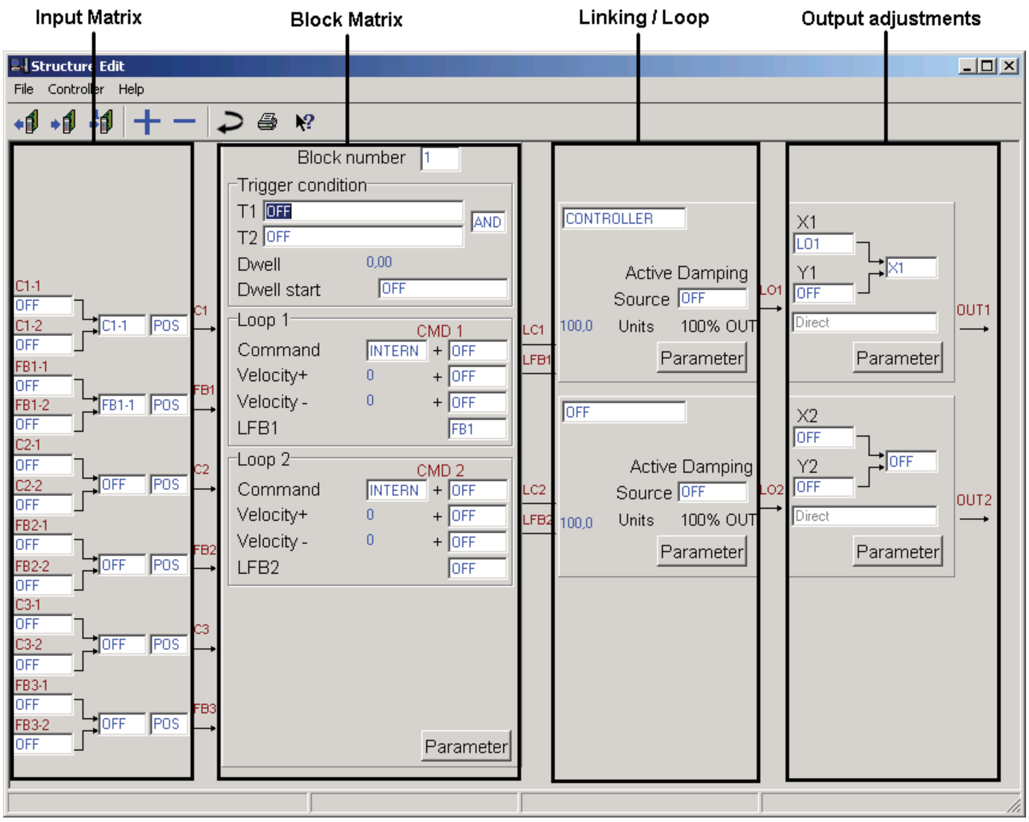


Fig. 96 "Structure Editor" window

Structure Editor – File menu

The File menu in the Structure Editor window corresponds to the BODAC main window „File Menu“.

Structure Editor – Controller menu

Contains commands for reading, writing and changing parameters.

Structure Editor – Help menu

Takes you directly to the help function for the current topic, or to the contents page of BODAC windows help.

Structure Editor – Toolbar

Buttons are provided for frequently used functions. These are described in section “Toolbar”.

Important functions can also be executed using the function keys on the keyboard. A list of hot keys can be found in "Short cut keys list".

Input Matrix

The Input Matrix area is where the inputsignals for the application are selected. Arithmetic operations and polarity of the signal are selected here for further processing in the Block Matrix.

Input signals

Select the desired signal in the first field beneath the name of input signals CI-1 through FB3-2.

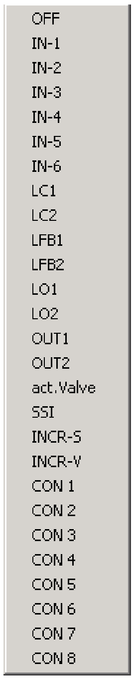


Fig. 97 Available input signals

Input signal	Description
OFF	No input signal is used. Input = 0.
IN1...IN6	A signal of the analog I/O is used.
LC1, LC2	Internal signal LCx (output of block matrix) is used.
LFB1, LFB2	Internal signal LFBx (output of block matrix) is used.
LO1, LO2	Internal signal LOx (output Linking/Loop) is used. The scaling of the signal must be taken into account!
OUT1, OUT2	Internal signal OUTx (output adjustment) is used. The scaling of the signal must be taken into account!
act. Valve	The actual valve value is used. This selection is only possible, when a valve output stage is available on the amplifier card.
SSI	The SSI encoder is used.
INCR-S	The incremental encoder is used as position signal.
INCR-V	The incremental encoder is used as velocity signal.
CON1...CON8	One of the constants is used.

Arithmetic operations

In the second field two input signals are linked using the arithmetic operations provided.

An explanation of the arithmetic operations follows below, using input signal names "FB1-1" and FB1-2" as examples.

Fig. 98 Available operation symbols

Input signal	Description
Off	The selected input signals are not transferred.
FB1-1	Input signal selected in "FB1-1" is ready for further processing.
FB1-2	Input signal selected in "FB1-2" is ready for further processing.
+	The selected input signals are mathematically added, the resulting sum is available for further processing.

-	The mathematical difference between the selected input signals [(FB1-1)-(FB1-2)] is calculated. The resulting signal is ready for further processing.
*****	The selected input signals are multiplied and divided by the fixed factor 100. [(FB1-1)*(FB1-2)/100] The resulting signal is ready for further processing.
/	The selected input signals are divided and multiplied by the fixed factor 100. [(FB1-1)/(FB1-2)*100] The resulting signal is ready for further processing.
Min	The mathematically smaller of the two selected signals is ready for further processing.
Max	The mathematically larger of the two selected signals is ready for further processing.
Ratio	The Ratio function uses the cylinder ratio: for Ratio > 1: FB1=(FB1-1)*Ratio-(FB1-2) for Ratio < 1: FB1=(FB1-1)-(FB1-2)/Ratio (e.g. surface ratio for differential pressure measurements)
Limit	The function represents a signal limiter. It generates the amounts of the input signals and makes the smaller of the two input signals available. The sign of the reference signal determines the sign of the resulting signal. Calculation: FB1=Min(|(FB1-1)|,|(FB1-2)|) * sign(FB1-1)
Jump	The function represents a step generator. It generates the amounts of the input signals and makes the greater of the two input signals available. The sign of the reference signal determines the sign of the resulting signal. Calculation: FB1=Max(|(FB1-1)|,|(FB1-2)|) * sign(FB1-1)

Sign The third field of the Input Matrix can be used to invert the provided signal. Entering “POS”(positive) will pass the signal through unchanged, entering “NEG” (negative) however will invert the provided signal.

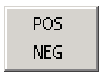


Fig. 99 Sign field

See also: Chapter 7.2 “Input signal structure".

Block Matrix

With the Block Matrix the process structure for the application can be created. Trigger conditions, setpoints and control loop parameters for blocks 1 through 32 are defined in this section.

Block Number The Block Number field allows the user to select the block, 1 through 32, that needs to be displayed/edited.

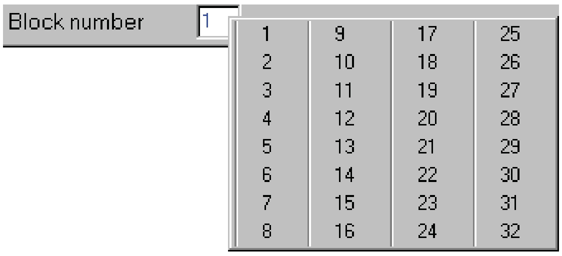


Fig. 100 "Block Number" field

Block Matrix Trigger Field

The Trigger field contains the switching conditions for the respective block.

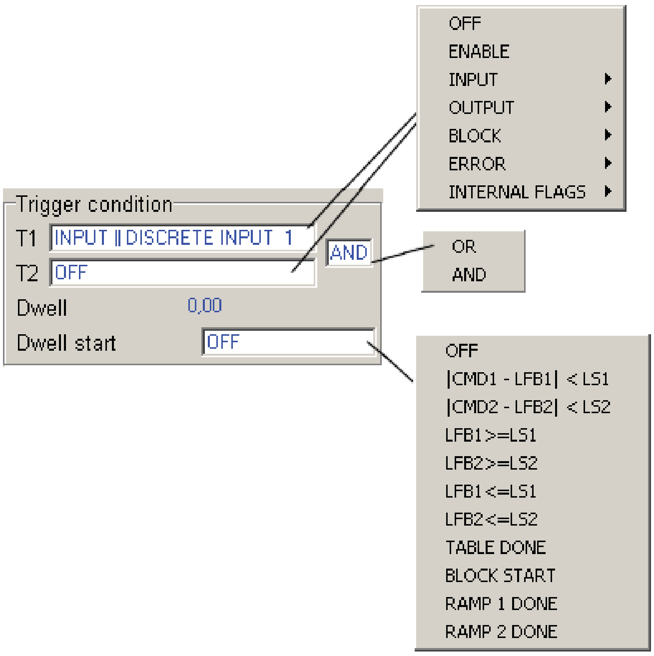
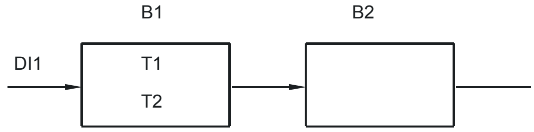
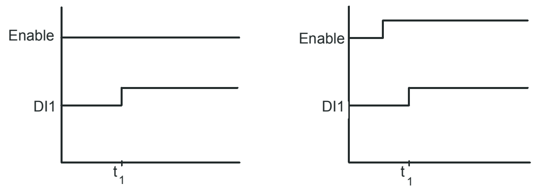
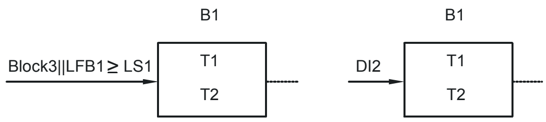
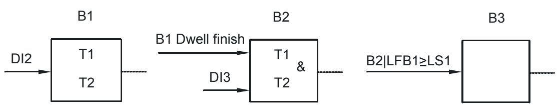


Fig. 101 Block Matrix –"Trigger" field

Two triggers “T1“ and “T2“ are available. To avoid conflicts when both triggers are used at the same time in a block, note the following rules:

Trigger rule	Description
Enable	The Enable signal must be „On“ (High) for a block to run.  Condition isn't met Condition is met  B1 doesn't start at the time t1 B1 starts at the time t1
Start of a block chain	One of the digital inputs DI1 to DI8 or the enable input (hardware trigger) must be used as a trigger to start multiple connected blocks (block chain). A software trigger cannot be used to start a block chain. This digital input must be “On” (High) for the entire time. If this condition is not met, the block chain stops and remains at the last active block. Once the digital input resumes the “On” (High) state after a stop, the block chain starts again with the first block in the chain.  Condition isn't met Condition is met Only a hardware trigger can start a block chain.
Pause	A pause is only possible as long as the process is still at the block in which a digital input was last used as a trigger.  B1: DI2 starts a block chain. B2: Block 2 starts if the dwell time of block 1 is finished and DI3 is activated. If the signal DI3 gets inactive within the active block 2 this will pause. Reactivating of DI3 continues block 2.

	B3: Block 3 starts if LFB1□LS1 in block 2. Block 3 doesn't notice the signal DI3.
Interrupt a block chain	An active block chain can neither be stopped nor interrupted by another block chain (hardware trigger). If this occurs, a block error is generated. The first chain remains active. The second block chain does not start until the trigger condition for the first chain is deactivated
Conflict between block chains	If two block chains start at the same time, the block with the highest priority is activated and at the same time a block error generated. Block 1 generally has the highest priority and Block 32 the lowest priority.

See also: Chapter 7.2 "Define activation of Block 1".

T1/T2 Entry field T1 and/or T2 is used to select the trigger conditions for the displayed block. The selection menus contain the available hardware- and software-controlled trigger conditions.

Off	The trigger is not used
Enable	The enable signal (On/High) is used as the trigger condition (hardware trigger).
Input	Digital input DI1 through DI8 (High) is used as the trigger condition. Configure the digital inputs in the “Digital I/O” window. (hardware trigger)
Output	Digital output 1 through 7 is used as the trigger condition. Configure the digital outputs in the “Digital I/O” window. (software trigger)
Block	When Block is selected as the trigger condition, you get a listing of the following select mechanisms in the submenu Block 1 to Block 32. (software trigger)
Block, Block 1 bis 32, **|CMDx-LFBx| <LSx**	If the internal signal |CMDx-LFBx| is less than the LSx window, this block starts.
Block, Block 1 bis 32, **LFBx >= LSx**	If the LFBx signal for the selected block is greater than or equal to the LSx threshold (LFBx>=LSx), this block starts. The threshold LSx is defined in the "Parameter Editor" window.
Block, Block 1 bis 32, **LFBx <= LSx**	If the LFBx signal for the selected block is less than or equal to the LSx threshold (LFBx<=LSx), this block starts. The threshold LSx is defined in the "Parameter Editor" window.
Block, Block 1 bis 32, **Dwell finish**	If the Dwell time defined for the selected block has ended, the current block starts. The Dwell time is defined in the “Parameter Editor”. (software trigger) The trigger for the Dwell time is defined in the TRIGGER CONDITION section of the Block Matrix.
Block, Block 1 bis 32, **Block Timeout**	If the Block Timer defined for the selected block has ended a Block Time-out will be generated and the current block starts. The block time is defined in in the "Parameter Editor". (software trigger)

Error, **Error 1 to Error 8**	The trigger condition will start the current block if the assigned Error Flag 1 to 8 is set. he Configuration of the Error Flags 1 through 8 is done in the Configuration menu under “Faults”. (software trigger)
Internal flags, **Flag 1 to Flag 7**	The trigger condition generates an event if the assigned Internal Flag 1 to 7 occurs. The Internal Flag configuration is done in the Configuration menu under “Internal Flags”. (software trigger)
OR	The condition for Trigger 1 **OR** the condition for Trigger 2 must be met for the Block to start.
AND	The condition for Trigger 1 **AND** the condition for Trigger 2 must be met for the Block to start.

Dwell Dwell time is defined in the "Parameter Editor Trigger Field" window. The value shown is for information purposes only.

Dwell Start In the Dwell Start field the user specifies which condition starts the Dwell time.

<table>
<tr><td>Off</td><td>Dwell timer is deactivated.</td></tr>
<tr><td>|CMDx-LFBx|
<LSx</td><td>If the internal signal |CMDx-LFBx| is less than the LSx window, the Dwell timer starts.</td></tr>
<tr><td>LFBx >= LSx</td><td>If the LFBx signal of the current block is greater than or equal to the LSx signal, the Dwell timer starts.
The threshold LSx is defined in the "Parameter Editor" window.</td></tr>
<tr><td>LFBx <= LSx</td><td>If the LFBx signal of the current block is less than or equal to the LSx signal, the Dwell timer starts.
The threshold LSx is defined in the "Parameter Editor" window.</td></tr>
<tr><td>Table completed</td><td>The countdown of the dwell time starts as soon as a table function has been completed.</td></tr>
<tr><td>At
Block Start</td><td>As soon as the Block is activated the Dwell timer will start.</td></tr>
<tr><td>Ramp completed</td><td>The countdown of the dwell time starts as soon as a ramp function has been completed.</td></tr>
<tr><td>Table completed</td><td>The countdown of the dwell time starts as soon as a table function has been completed.</td></tr>
<tr><td>At
block start</td><td>The countdown of the dwell time starts at the beginning of the block.</td></tr>
<tr><td>Ramp completed</td><td>The countdown of the dwell time starts as soon as a ramp function has been completed.</td></tr>
</table>

Block Matrix Field 1

In Block Matrix Field 1 the individual signals for the process structure are linked to the application. The setpoint "CMD 1" consists of two signals that are added together. Both signals can be individually configured.

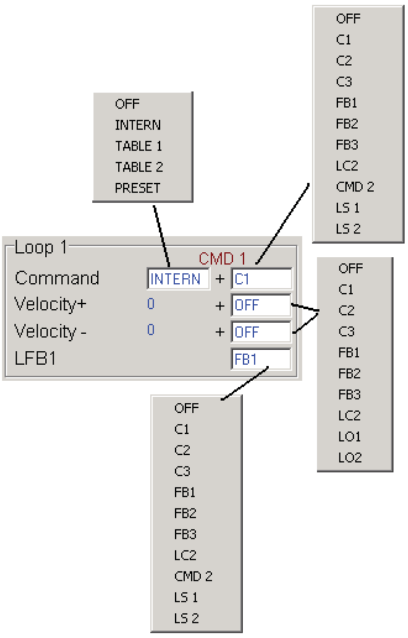


Fig. 102 Block Matrix Field "1"

Command For the definition of the command value. The command value is generated from 2 parts – an internally generated value and an external signal. The resulting command value signal is termed "CMD1".

Off	No internally generated command value is used.
Intern	The internal command value from the parameter editor is used. See "Command parameter block matrix 1"
Table	The internal command value is given by a table. See chapter "Table"
Preset	When the block is activated, the last current command value is frozen. This command value is used for controlling when the controller is active. When the block is exited, the command value is set to the current actual value. This function prevents uncontrolled movements of a drive when a block chain is started.

Additionally, a further signal can be added to the command value.

OFF	No signal is added.
C1…C3	Signal C1, C2 or C3 from the logical input link is added to the command value.
FB1…FB3	Signal FB1, FB2 or FB3 from the logical input link is added to the command value.
LC2	The output signal of the block matrix, Loop2, is added to the command value.
CMD2	The resulting command value signal of the block matrix, Loop2, is added to the command value.
LS1, LS2	Signal LS1 or LS2 is added to the command value. See "Parameter Editor Field Trigger"

Velocity + / Velocity - The velocity of the command value change is pre-selected in the Parameter Editor, see "Command parameter Block matrix 1". Additionally, the velocity can be controlled by an external signal.

OFF	No external signal is used.
C1…C3	Signal C1, C2 or C3 from the logical input link is added to the selected velocity.
FB1…FB3	Signal FB1, FB2 or FB3 from the logical input link is added to the selected velocity.
LC2	The output signal of block matrix, Loop2, is added to the selected velocity.
LO1, LO2	Output signal LO1 or LO2 from Linking / Loop is added to the selected velocity.

LFB1 The actual value signal is selected here.

OFF	No external actual value signal is used. The actual value = 0.
C1…C3	Signal C1, C2 or C3 from the logical input link is used for the actual value.
FB1…FB3	Signal FB1, FB2 or FB3 from the logical input link is used for the actual value.
LC2	The output signal of block matrix, Loop2, is used for the actual value.
CMD2	The resulting command value signal of the block matrix, Loop2, is used for the actual value.
LS1, LS2	Signal LS1 or LS2 is used for the actual value. See "Parameter Editor Field Trigger"

See also: Chapter 7.2 "Defining block-related command and actual value signal processing ".

Block Matrix Field 2

In Block Matrix Field 2 you determine the command and actual value signals used in the block matrix for control loop 2 (Loop 2).

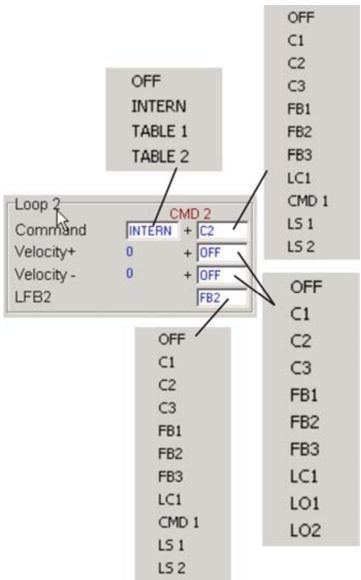


Fig. 103 "Block Matrix Field "2"

Command

Here, you can define the command value. The command value is generated from 2 parts, an internally generated value and an external signal. The resulting command value signal is termed "CMD2".

OFF	No internally generated command value is used
Intern	The internal command value from the Parameter Editor is used. See "Command Parameters Block Matrix 2
Table	The internal command value is provided by a table. See "Table"
Preset	When the block is activated, the last current command value is frozen. This command value is used for controlling when the controller is active. When the block is exited, the command value is set to the current actual value. This function prevents uncontrolled movements of a drive when a block chain is started.

Additionally, a further signal can be added to the command value.

OFF	No signal is added.
C1…C3	Signal C1, C2 or C3 from the logical input link is added to the command value.
FB1…FB3	Signal FB1, FB2 or FB3 from the logical input link is added to the command value.
LC1	The output signal of the block matrix, Loop1, is added to the command value.
CMD1	The resulting command value signal of the block matrix, Loop1, is added to the command value.
LS1, LS2	Signal LS1 or LS2 is added to the command value. See “Parameter Editor Trigger Field"

Velocity + / Velocity - The velocity of the command value change is pre-selected in the Parameter Editor, see "Command value parameter Block matrix 2". Additionally, the velocity can be controlled by an external signal.

OFF	No external signal is used.
C1…C3	Signal C1, C2 or C3 from the logical input link is added to the selected velocity.
FB1…FB3	Signal FB1, FB2 or FB3 from the logical input link is added to the selected velocity.
LC2	The output signal of block matrix, Loop1, is added to the selected velocity.
LO1, LO2	Output signal LO1 or LO2 from the Linking / Loop is added to the selected velocity.

LFB2 The actual value signal is selected here.

OFF	No external actual value signal is used. The actual value = 0.
C1…C3	Signal C1, C2 or C3 from the logical input link is used for the actual value.
FB1…FB3	Signal FB1, FB2 or FB3 from the logical input link is used for the actual value.
LC1	The output signal of block matrix, Loop1, is used for the actual value.
CMD2	The resulting command value signal of the block matrix, Loop1, is used for the actual value.
LS1, LS2	Signal LS1 or LS2 is used for the actual value. See "Parameter Editor Trigger Field"

See also: Chapter 7.2 "Define the block-specific command and feedback value signal set-up".

Linking / Loop 1

You can set the logical link of signals LC1 and LFB1. Apart from arithmetic operations, a controller can also be selected. Moreover, it is possible to select a status feedback. Output signal LO1 is passed on for output adjustment.

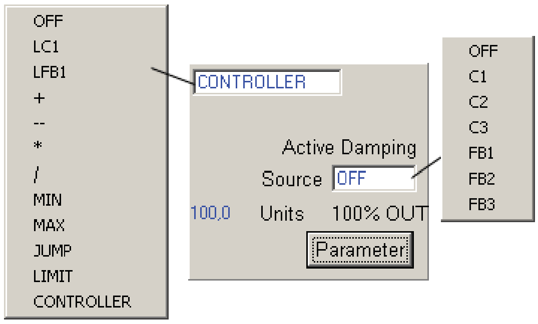


Fig. 104 Linking/Loop

Source The entry field contains arithmetic operations and a controller.

OFF	No logical link selected. LO1 = 0.
LC1	LO1 = LC1
LFB1	LO1 = LFB1
+	LO1 = LC1 + LFB1
-	LO1 = LC1 – LFB1
*****	LO1 = LC1 * LFB1 / 100
/	LO1 = LC1 / LFB1 * 100
Min	LO1 results in the mathematically smaller of the two signals LC1 and LFB1.
Max	LO1 results in the mathematically greater of the two signals LC1 und LFB1.
Limit	The function represents a signal limiter. It generates the amounts of the input signals and makes the smaller of the two input signals available without any changes. The sign of the reference signal determines the sign of the resulting signal. Calculation: LO1 = Min (|LC1| , |LFB1|) * sign(LC1)
Jump	The function represents a step generator. It generates the amounts of the input signals and makes the greater of the two input signals available without any changes. The sign of the reference signal determines the sign of the resulting signal. Calculation: LO1 = Max (|LC1| , |LFB1|) * sign(LC1)

Controller	Can be used to select a PIDT1-controller. The command value used is LC1, the actual value LFB1. LO1 is output as controller control action LO1. The controller is parameterized depending on the block, see “Loop Parameters Block Matrix 1"

Active damping To stabilize a controller, status feedback can be used. To this end, a controller must be selected under Source. The signal will be subtracted from control action LO1.

See also “Controller Structure”.

Source Here, you have to select the signal that you wish to use for active damping.

See also: Chapter 7.2 “Active Damping”.

Units 100% OUT Indicates the ratio of the input signal that you selected in the entry field "Conversion Units → %", window "Linking / Loop1" for adjusting the control action.

Parameters – Loop Matrix 1

In the “Parameter : Loop 1“ window the following parameters are set:

- The ratio between the internally used units and the output signal LO1.
- The basis for the feedforward.
- Parameters for the Active Damping signal.

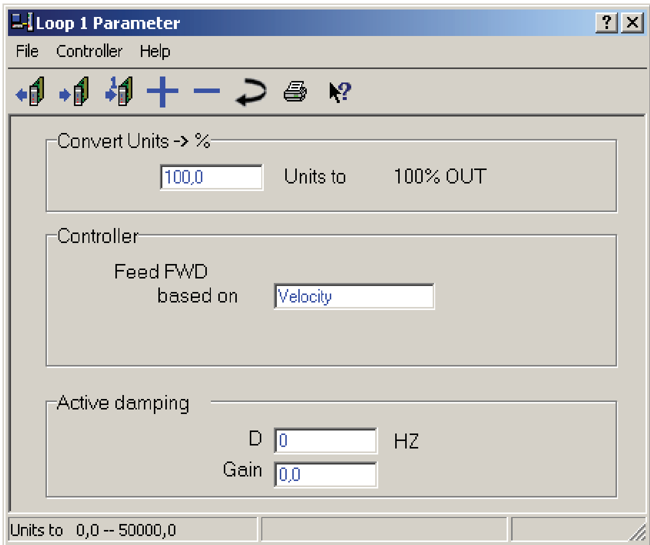


Fig. 105 Loop Matrix 1 - Parameters

Convert Units → %

Here, you can determine the conversion of the internal unit (Units) into a 100% output variable.
In the representation "Loop Matrix 1 – Parameters" 100 corresponds to 100 %, referred to the analog output. If the analog output is defined with +/- 10V, then 100 Units correspond to 10V.

Set this value to the maximum value, which the command or actual value can have in your application.

Controller

The controller structure offers the possibility of a command value feedforward. Here, you can set the basis for the calculation.

Velocity	The 1st derivative of the command value (velocity) is used as a basis for command value feedforward. This selection should be used, e.g. for closed-loop position controls.
Command value	The command value itself is used as a basis for command value feedforward. This selection should be used, e.g. for closed-loop pressure controls.

Active damping Active damping can be parameterized here.

D	D-component Active damping uses a high-pass filter (D). “Signal” (pressure) can be selected as input variable. This signal is passed via a high pass filter, and the output of the filter is multiplied by the gain and subtracted from the control action. The smaller the selected D-component is, the greater is the effect of active damping.
Gain	Factor which with active damping is weighed before it is subtracted from the controller control action.

See also: Chapter 7.2 Parameters for “Loop Matrix 1”

Linking / Loop 2

You can set the logical link of signals LC2 and LFB2. Apart from arithmetic operations, a controller can also be selected. Moreover, it is possible to select a status feedback. Output signal LO2 is passed on for output adjustment.

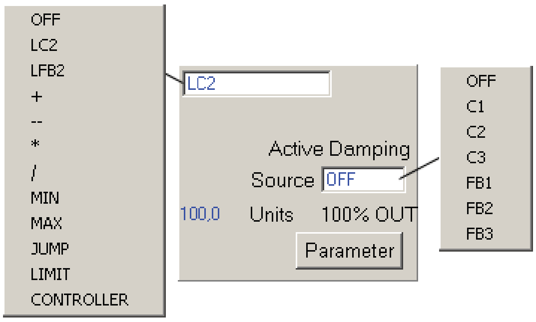


Fig. 106 Linking/Loop

Source The entry field contains arithmetic operations and a controller.

OFF	No logical link selected. LO2 = 0.
LC2	LO2 = LC2
LFB2	LO2 = LFB2
+	LO2 = LC2 + LFB2
-	LO2 = LC2 – LFB2
*****	LO2 = LC2 * LFB2 / 100
/	LO2 = LC2 / LFB2 * 100
Min	LO2 results in the mathematically smaller of the two signals LC2 and LFB2.

Max	LO2 results in the mathematically greater of the two signals LC2 und LFB2.
Limit	The function represents a signal limiter. It generates the amounts of the input signals and makes the smaller of the two input signals available without any changes. The sign of the reference signal determines the sign of the resulting signal. Calculation: LO2 = Min (|LC2| , |LFB2|) * sign(LC2)
Jump	The function represents a step generator. It generates the amounts of the input signals and makes the greater of the two input signals available. The sign of the reference signal determines the sign of the resulting signal. Calculation: LO2 = Max (|LC2| , |LFB2|) * sign(LC2)
Controller	Can be used to select a PIDT1-controller. The command value used is LC1, the actual value LFB1. LO1 is output as controller control action LO1. The controller is parameterized depending on the block, see “Loop Parameters Block Matrix 1"

Active damping

To stabilize a controller, status feedback can be used. To this end, a controller must be selected under Source. The signal will be subtracted from control action LO1.

See also “Controller Structure”.

Source

Here, you have to select the signal that you wish to use for active damping.

See also: Chapter 7.2 “Active Damping”.

Units 100% OUT

Indicates the ratio of the input signal that you selected in the entry field "Conversion Units → %", window "Linking / Loop1" for adjusting the control action.

Parameters – Loop Matrix 2

In the “Parameters - Loop Matrix 2“ window the following is done:

- Set the ratio between the internally used units and the output signal LO2,
- Specify the basis for the feedforward.
- Parameterize the Active Damping signal.

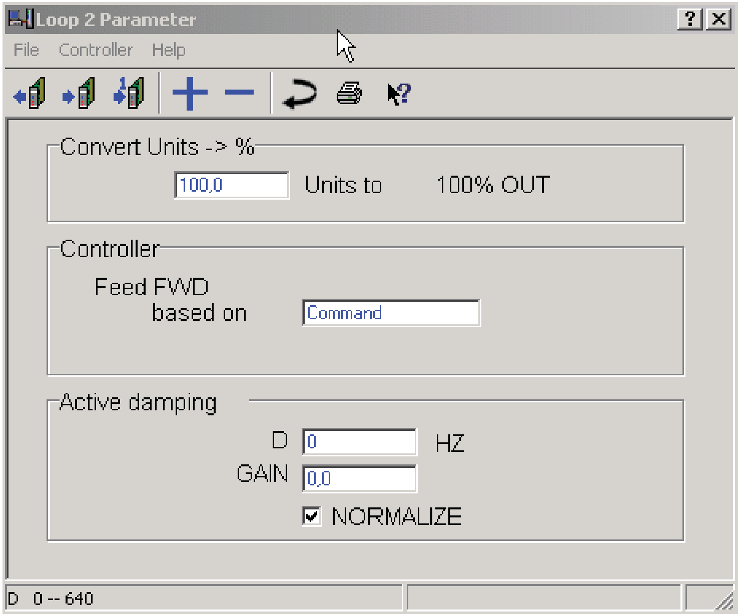


Fig. 107 Linking/Loop 2 - Parameters

Convert Units → %

In this window you can determine the conversion of the internal unit (Units) to 100% of the output variable.
In the figure, “Loop 2 Parameter”, 100 Units correspond to 100 % referred to the analog output. If the analog output is defined with +/- 10V, then 100 Units correspond to 10V.

Set this value to the maximum value that the command or actual value can take in your application.

Controller

The controller structure offers the possibility of a command value feedforward. In this entry field you can set the basis for the calculation.

Velocity	The 1st derivative of the command value (velocity) is taken as a basis for the command value feedforward. This selection should be used for, e.g. closed-loop position controls.
Command	The command value itself is used as a basis for the command value feedforward. This selection should be used for, e.g. closed-loop pressure controls.

Active damping

In this entry field you can parameterize active damping.

D	D-component Active damping uses a high-pass filter (D). “Signal” (pressure) can be selected as input variable. This signal is passed via a high pass filter, and the output of the filter is multiplied by the

	gain and subtracted from the control action. The smaller the selected D-component, the greater is the effect of active damping.
Gain	Factor which with active damping is weighed before it is subtracted from the controller control action.

See also: Chapter 7.2 “Parameters – Loop Matrix 1”

Output adjustments 1

Output adjustment offers the possibility of linking output signal LO1 with further internal signals. The result is available at i OUT1.

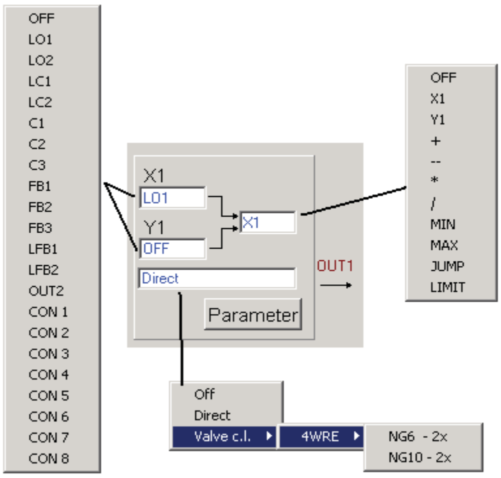


Fig. 108 Output adjustments 1

Logical linking

The entry field contains mathematical operation for the two signals X1 and Y1.

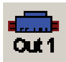
OFF	No logical operation selected. OUT1 = 0.
X1	OUT1 = "X1"
Y1	OUT1 = "Y1"
+	OUT1 = "X1" + "Y1"
-	OUT1 = "X1" – "Y1"
*	OUT1 = "X1" * "Y1"/ 100
/	OUT1 = "X1" / "Y1"* 100
Min	OUT1 provides the mathematically lesser of the two signals "X1" and "Y1".
Max	OUT1 provides the mathematically greater of the two signals "X1" und "Y1".

Limit	The function represents a signal limiter. It generates the amounts of the input signals and makes the lesser of the two input signals available without any changes. The sign of the reference signal determines the sign of the resulting signal. Calculation: OUT1 = Min (|"X1"| , |"Y1"|) * sign(X1)
Jump	The function represents a jump generator. It generates the amounts of the input signals and makes the greater of the two input signals available without any changes. The sign of the reference signal determines the sign of the resulting signal. Calculation: OUT1 = Max (|"X1"| , |"Y1"|) * sign(X1)

"X1" corresponds to the signal selected at X1, "Y1" to that at Y1.

Parameters – Output Matrix 1

Click on the “Parameters“ button to open the “Parameters – Output Matrix 1“ window. Various additional adjustments are possible here. These are customized for the various properties of the connected components.



The preceding icon, which is part of the toolbar, also opens the “Output Edit” window. A list of existing icons for the toolbar can be found in section "Toolbar".

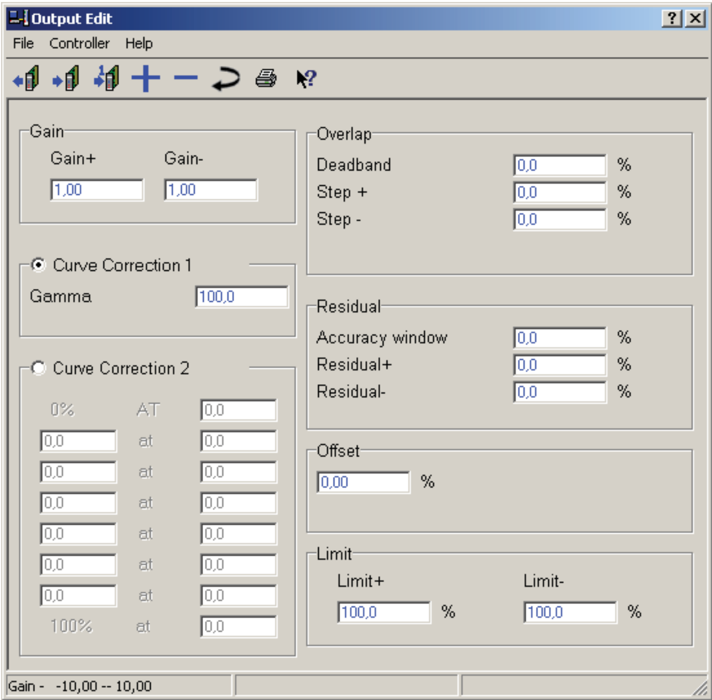


Fig. 109 Output Matrix 1 – Parameters

Output Matrix – File menu
The File menu in the Output Edit window corresponds to the BODAC main window “File Menu“.

Output Matrix – Controller menu
Contains commands for reading, writing and changing parameters.

Output Matrix – Help menu
Takes you directly to the help function for the current topic, or to the contents page of BODAC windows help.

Output Matrix – Toolbar
Buttons are provided for frequently used functions. They are described in the section “Toolbar”.

Gain

Enter here the gain factor for adjusting the variable to the properties of the connected components. The “Gain +” entry field contains the gain factor for signals having a positive sign, and the “Gain –“ field the gain factor for signals having a negative sign.

Gamma

The “Gamma” entry field is used to correct a non linear curve of the valve. The values for Gamma lie between 0 and 100, whereby a setting of 100 does not affect the variable and 0 represents the maximum adjustment.

In the following example („Plot-Gamma“), 3 curves are shown. The blue curve “LO1” represents a Gamma entered value of 100, the brown curve “OUT2” is set to the Gamma entered value 90, and the red curve “OUT1” has a Gamma value of 50.

See also: Chapter 7.2 "Linearizing using Gamma correction".

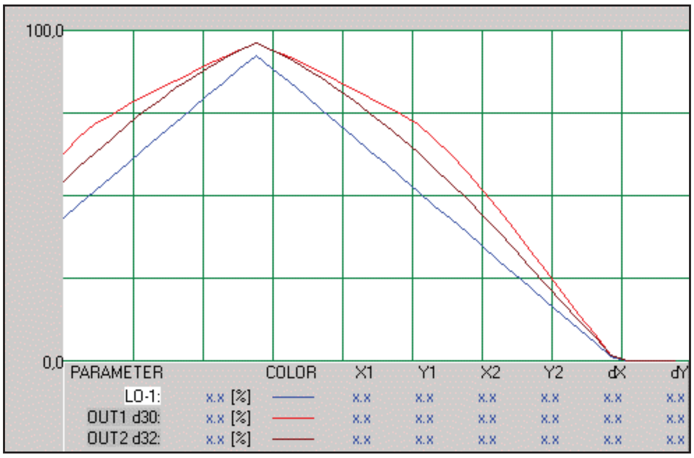


Fig. 110 Plot - Gamma

Curve correction

In the „Curve correction“ field you can achieve linearization of the valve by entering individual value pairs. This approach is useful when satisfactory results are not obtained using “Gamma”.

See also: Chapter 7.2 "Linearizing according to a table".

Overlap

Overlap compensation is used for linearizing of valves with a positive overlap. This will correct the control value (valve setpoint). The value in the entry field Step +/Step - is added to the control value. The step can be specified differently depending on the sign of the control value. If this control value lies within the “Deadband” a value is output which closes the overlapped valve in defined fashion if Step+/- has been correctly selected.

The result for the following settings is shown in the illustration below:
Step+ = 30%,
Step- = 20% and
Deadband = 10%.
The time base is set to 500ms.

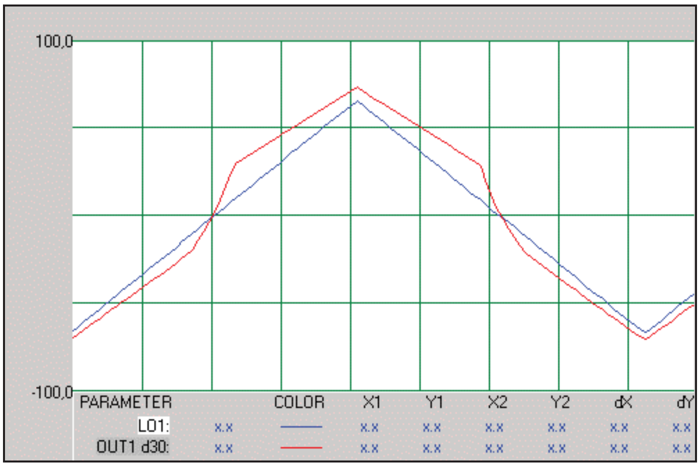


Fig. 111 Plot – Overlap

See also: Chapter 7.2 "Overlap".

Residual velocity

This principle corrects the controller output value (valve command value) in a way so that at least the set residual voltage is output. This allows a valve with positive overlap to stop at the control land until the drive has reached its target position.

If the amount of the controller output value is less than the value set in parameter Residual+ or Residual- , the axis is traversed to the target position under open loop control. The value therefore corresponds to a residual velocity. If the signal, on which residual velocity is based, is within the range of the entry field “Accuracy window”, 0 volt is output.

In "based on" you can select, on which signal residual velocity logic is to be based.

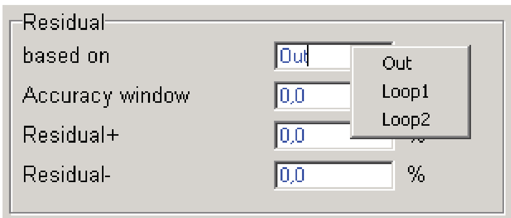


Fig. 112 Residual velocity – signal selection

Out	The signal used for controlling residual velocity is the controller output after curve correction.
Loop 1	The signal used for controlling residual velocity is the control error of control loop 1 |LC1-LFB1|.
Loop 2	The signal used for controlling residual velocity is the control error of control loop 2 |LC2-LFB2|.

Advantage when using Loop 1 or. 2:
The controller parameters (e.g. different P-gains) have no influence on the residual velocity.

The following parameters can be used to adjust the residual velocity logic to the requirements of your application:

Accuracy window	If the signal, on which the residual velocity logic is based, is within the window, 0 is output.
Residual+	Value that is added to the control action, if the signal, on which the residual velocity logic is based, is outside the window and, at the same time, positive.
Residual-	Value that is subtracted from the control action, if the signal, on which the residual velocity logic is based, is outside the window and, at the same time, negative.

The illustration below shows the results for the following settings:
based on Output
Residual+ = 30%,
Residual- = 20% und
Accuracy = 10%.
The time base is set to 500ms.

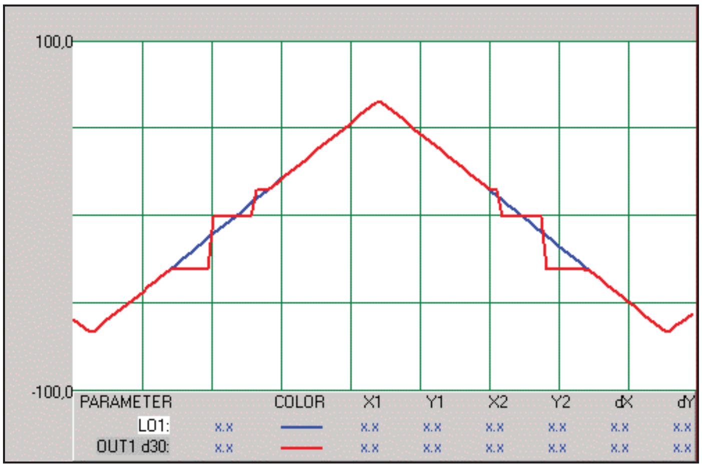


Fig. 113 Plot – Residual velocity

Offset The parameter in the „Offset“ entry field shifts the variable by the entered value.

Limit In the fields "Limit +" and "Limit –" the positive and negative maximum value allowable is specified.

See also: Chapter 7.2 "Residual velocity".

Output Matrix 2

The output matrix offers the possibility of linking output signal LO2 with further internal signals. The result is made available at OUT2.

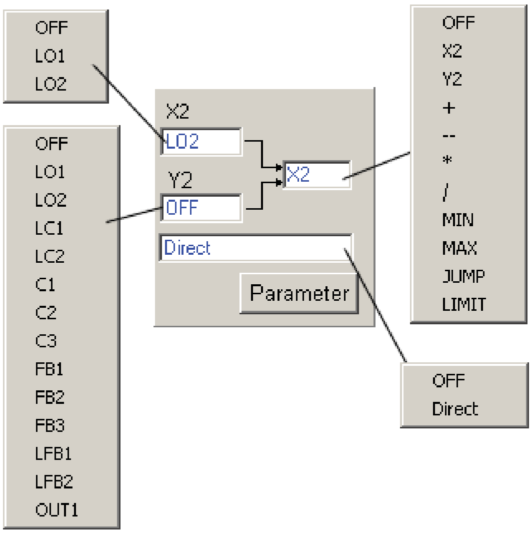


Fig. 114 Output matrix 2

Logical linking The entry field contains mathematical operations for the two signals X2 and Y2.

Off	No logical operation selected OUT2 = 0.
X2	OUT2 = "X2"
Y2	OUT2 = "Y2"
+	OUT2 = "X2" + "Y2"
-	OUT2 = "X2" – "Y2"
*****	OUT2 = "X2" * "Y2" / 100
/	OUT2 = "X2" / "Y2" * 100
Min	OUT2 provides the mathematically smaller of the two signals "X2" and "Y2".
Max	OUT2 provides the mathematically greater of the two signals "X2" und "Y2".

Limit	The function represents a signal limiter. It generates the amounts of the input signals and makes the lesser of the two input signals available without any changes. The sign of the reference signal determines the sign of the resulting signal. Calculation: OUT2 = Min (|"X2"| , |"Y2"|) * sign(X2)
Jump	The function represents a jump generator. It generates the amounts of the input signals and makes the greater of the two input signals available without any changes. The sign of the reference signal determines the sign of the resulting signal. Calculation: OUT2 = Max (|"X2"| , |"Y2"|)* sign(X2)

"X2" corresponds to the signals selected at X2, "Y2" to that at Y2.

Parameters – Output Matrix 2

Click on the “Parameters“ button to open the “Parameters – Output Matrix 2“ window. Various additional adjustments are possible here. These are customized for the various properties of the connected components.

The description of parameters corresponds to “Parameters – Output Matrix 1”

6.2 Parameter Editor

In the Parameter Editor you can make the required control loop settings. The parameters entered have an influence on the control loop characteristics. The movement of connected components results from the specified values.

Clicking on the preceding icon, which is part of the toolbar, also opens the window “Parameter Editor”. A list of existing shortcuts for the toolbar can be found in chapter “Toolbar”.

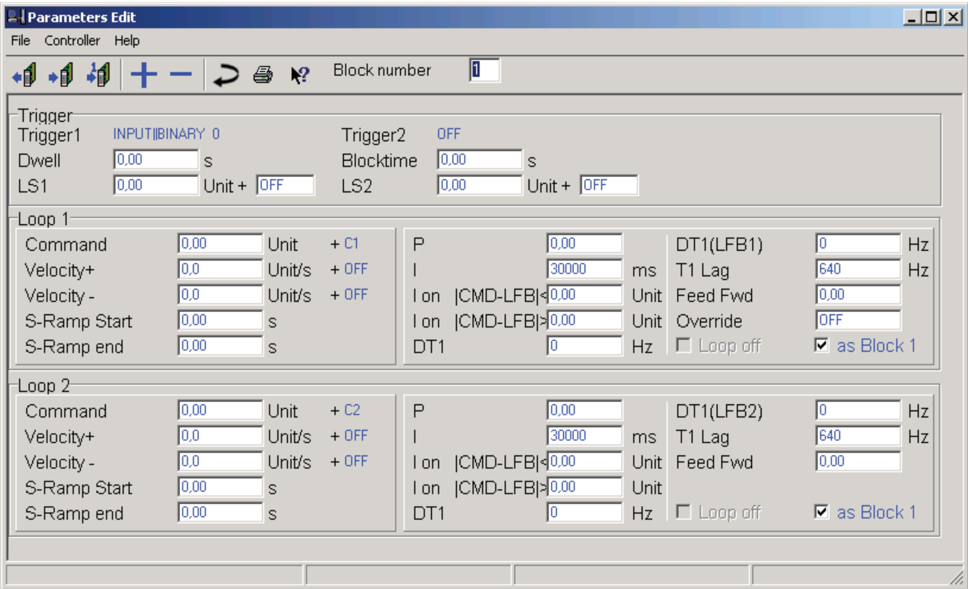


Fig. 115 "Parameter Editor" window

Parameter Editor – File menu The File menu in the Parameter Editor window corresponds to the BODAC main window “File Menu“.

Parameter Editor – Controller menu Contains commands for reading, writing and changing parameters.

Parameter Editor – Help menu Takes you directly to the help function for the current topic, or to the contents page of BODAC windows help.

Parameter Editor – Toolbar Buttons are provided for frequently used functions. They are described in section “Toolbar”.

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www.hyquip.co.uk
Rexroth Bosch Group
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Block Number

The Block Number field is a pulldown from which the “Parameter Edit” window for Blocks 1 through 32 can be selected.

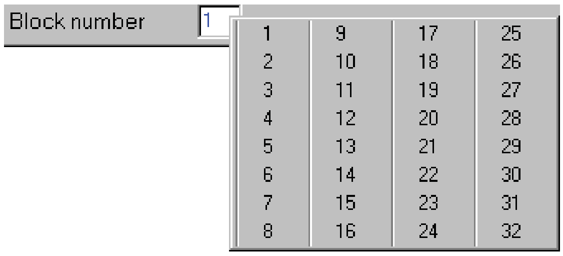

Fig. 116 "Block Number" field

Parameter Editor Trigger Field

Trigger 1/2 The “Trigger 1“ and “Trigger 2“ fields are information fields in which the trigger conditions of this specific block are displayed. The Trigger condition is entered in the block matrix of the Structure Editor. For additional information on specifying the trigger conditions, see section “Block Matrix Field Trigger”.

Dwell time In the “Dwell time“ field the user specifies the time in seconds for the selected block. This dwell time is used in the trigger conditions of the block matrix. If the trigger condition Dwell Finished is used the block with this trigger will not start until the dwell time has expired.

Block time In the “Block time“ field the time in seconds for the displayed block is entered. The block time starts when the block is activated and is used in the trigger condition Block Timeout. If the trigger condition Block Timeout is used the next operation will start as soon as the Block Time has expired.

LS1 /L S2 In the “LS1” and “LS2” fields the threshold or the window for the trigger conditions in the Block Matrix are defined.

Command Parameters – Block Matrix 1

Command The internal command is entered in the “Command“ field. An additional input signal can be added to the internal command.

Velocity + The value entered in the “Velocity +“ field sets the maximum velocity at which the setpoint is allowed to change in a positive direction.

Velocity – The value entered in the “Velocity -“ field sets the maximum velocity at which the setpoint is allowed to change in a negative direction.

S-Ramp Start The value entered in the “Velocity -“ field sets the maximum velocity at which the setpoint is allowed to change in a negative direction.

S-Ramp End The parameter in the “S-Ramp End“ field defined the rate of change from maximum velocity to zero velocity at the end of the move.

See also: Chapter 7.2 "Setpoint generation".

Loop Parameters – Block Matrix 1

The following parameters are only relevant if “Controller“ is selected in the Loop Matrix 1 area of the Structure Editor.
The controller structure is illustrated in the figure below.

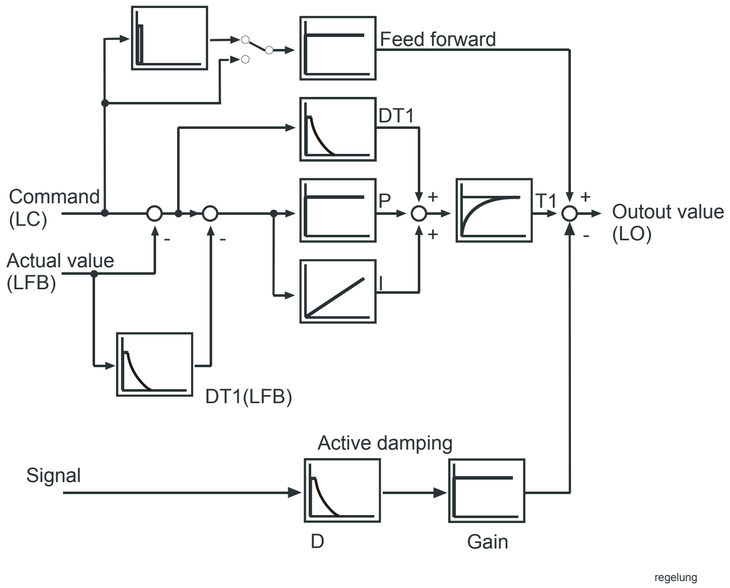

Fig. 117 Controller structure

P The parameter in the “P“ field changes the proportional component of the controller. It causes a proportional change in the output variable.
The parameter has no unit and indicates the gain of the control error.

I The parameter in the “I“ field changes the integral component of the controller. It causes a velocity change in the output signal proportional to the time integral of the input signal. A value of “0” deactivates the I-controller.
The I-component is given in milliseconds and represents the time required by the controller to change the control action from 0 to 100% in the case of a maximum control error.

I on |CMD-LFB|< The parameter in the "I on |CMD-LFB|<" field defines the threshold for the I-controller. If |CMD-LFB| is less than the threshold, the I-controller is active. Above the threshold the I-controller is set to zero.

I on |CMD-LFB|> The parameter in the "I on |CMD-LFB|>" field defines the threshold for the I-controller. If |CMD-LFB| is greater than the threshold, the I-controller is active. Below the threshold the I-controller is frozen.

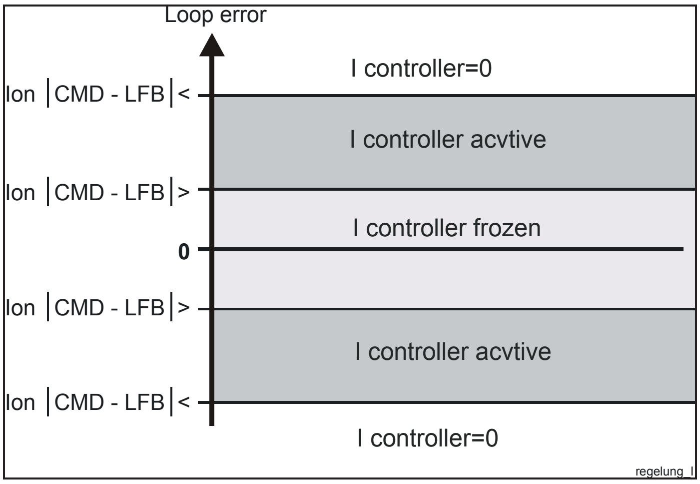

Fig. 118 Function of the fields I on |CMD-LFB|

DT1 The parameter in the „DT1“ field changes the differential component of the controller. It causes a differentiated response of the output variable corresponding to the change speed of the input signal. A value of “0” deactivates the D-controller.

Damping The parameter in the "Damping" field is used to change the D-component of the actual value. This is used for a holdback of the actual value. A value of “0” deactivates the Damping controller.

DT1 (LFB1) The parameter in the input field "DT1(LFB1)" changes the D-component of the actual value. This results in a corresponding pre-setting of the actual value.

T1 Lag The parameter in the „T1 Lag“ field implements a low-pass filter. A value of “640” deactivates the low-pass.

Feed FWD. Command value feedforward is used to feed forward either the command value or the weighted first derivative of the command value (velocity) to the controller output. See also “Parameter – Linking / Loop 1".
The parameter has no unit and indicates the weighting factor (gain).

Alternating Here, you can set the logical links of control loops 1 and 2.
If you select “OFF”, the control loops are not linked and operate independently of one another.

An alternating control can be set by means of "POSITIVE", "NEGATIVE" and "BOTH". The two controller outputs LO1 and LO2 are fed to output linking 1 via a minimum value generator, i.e. the smaller amount of the two values is output. The I-components of both controllers (if used) are corrected accordingly in order to prevent the non-active controller from advancing.

Depending on the work quadrant, one of the settings must be selected.
"POSITIVE“: Both control actions must have a positive polarity in order that alternative control is active.
"NEGATIVE“: Both control actions must have a negative polarity in order that alternative control is active.
"BOTH“: The control actions can have a positive and/or negative polarity in order that alternating control is active. However, the first loop (Loop1) must be the position control loop and the second loop (Loop2) the pressure/force control loop. The command value for the pressure/force control loop is always positive.

This allows closed-loop position control to be implemented with superimposed closed-loop pressure control.

Loop Off Placing a check mark in the “Loop OFF” box means the entered loop parameters have no effect on the control variable. The controller is deactivated (control value=Command) for this Block.

The loop parameters and entry fields are then shown in gray. If the entries are shown in gray no entries for loop parameters are possible.

As Block 1 Placing a check in the „As Block 1“ box means the controller uses the loop parameters that were entered in Block 1 for the current Block. The loop parameters and their entry fields are then shown in gray. If the entries are shown in gray no entries in the corresponding block for loop parameters are possible.

Command Parameters – Block Matrix 2

Setpoint The internal command is entered in the “Command“ field. An additional input signal can be added to the internal command.

Velocity + The value entered in the “Velocity +“ field sets the maximum velocity at which the setpoint is allowed to change in a positive direction.

Velocity – The value entered in the „Velocity -“ field sets the maximum velocity at which the setpoint is allowed to change in a negative direction.

S-Ramp Start The parameter in the “S-Ramp Start” entry field can be used for changing the motion characteristics when the movement is started. You can initiate a movement smoothly or abruptly.

S-Ramp End The parameter in the “S-Ramp Start” entry field can be used for changing the motion characteristics when the movement is completed. You can complete a movement smoothly or abruptly.

See also: Chapter 7.2 "Setpoint generation".

Loop Parameters – Block Matrix 2

The following parameters are only relevant if „Controller“ is selected in the Loop Matrix 1 area of the Structure Editor.
The controller structure is illustrated in the figure below.

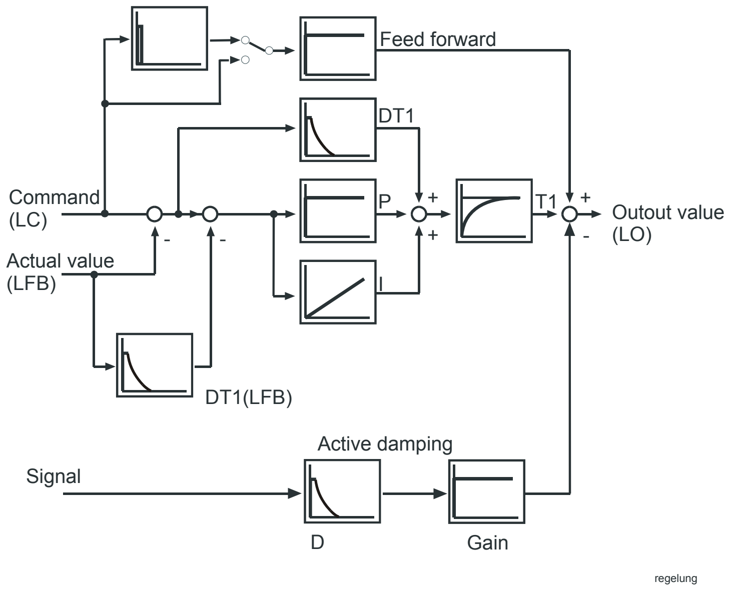

Fig. 119 Controller structure

P The parameter in the “P“ field changes the proportional component of the controller. It causes a proportional change in the output variable.
The parameter has no unit and indicates the gain of the control error.

I The parameter in the “I“ field changes the integral component of the controller. It causes a velocity change in the output signal proportional to the time integral of the input signal. A value of “0” deactivates the I-controller.
The I-component is given in milliseconds and represents the time required by the controller to change the control action from 0 to 100% in the case of a maximum control error.

I on |CMD-LFB|< The parameter in the "I on |CMD-LFB|<" field defines the threshold for the I-controller. If |CMD-LFB| is less than the threshold, the I-controller is active. Above the threshold the I-controller is set to zero.

I on |CMD-LFB|> The parameter in the "I on |CMD-LFB|>" field defines the threshold for the I-controller. If |CMD-LFB| is greater than the threshold, the I-controller is active. Below the threshold the I-controller is frozen.

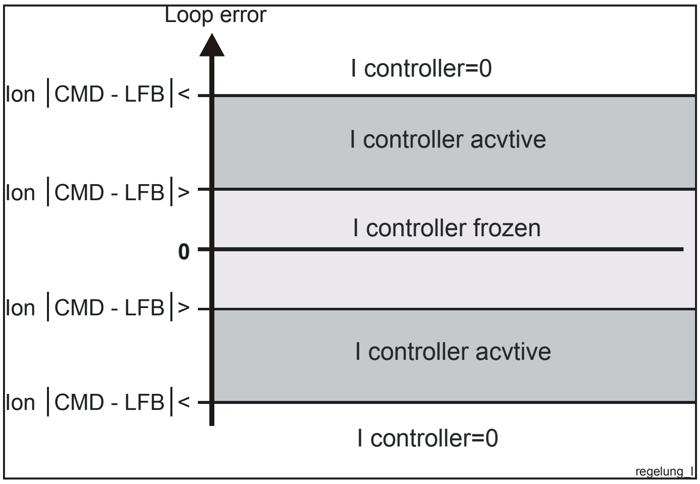

Fig. 120 Function of the fields" I on |CMD-LFB|"

DT1 The parameter in the "DT1" field changes the differential component of the controller. It causes a differentiated response of the output variable corresponding to the change speed of the input signal. A value of "0" deactivates the D-controller.

Damping The parameter in the "Damping" field is used to change the D-component of the actual value. This is used for a holdback of the actual value. A value of "0" deactivates the Damping controller.

DT1 (LFB1) The parameter in the input field "DT1(LFB1)" changes the D-component of the actual value. This results in a corresponding pre-setting of the actual value.

T1 Lag The parameter in the „T1 Lag" field implements a low-pass filter. A value of "640" deactivates the low-pass.

Feed FWD. Command value feedforward is used to feed forward either the command value or the weighted 1st derivative of the command value (velocity) to the controller output. See also "Parameter – Linking / Loop 1".
The parameter has no unit and indicates the weighting factor (gain).

Loop Off Placing a check mark in the "Loop OFF" box means the entered loop parameters have no effect on the control variable. The controller is deactivated (control value=Command) for this Block.

Placing a check mark in the "Loop OFF" box means the entered loop parameters have no effect on the control variable. The controller is deactivated (control value=Command) for this Block.

As Block 1 Placing a check in the „As Block 1" box means the controller uses the loop parameters that were entered in Block 1 for the current Block. The loop parameters and their entry fields are then shown in gray. If the entries are shown in gray no entries in the corresponding block for loop parameters are possible.

7 Application Examples

7.1 Introduction to the application examples

The emphasis in this section is on starting up example applications. We will also briefly explain the functions used with reference to the applications.

This documentation is in its section organization optimized for the needs of an online document. Therefore each section is designed as a self-contained information block.

In the illustrations contained in the following sections, user-inputs to the software are visualized by means of certain representational elements.

These symbols are explained in Section 1.3 “Characters and Symbols”.

Explanation of the application examples

HACD – Applications with a control loop

The following application examples are explained by way of example:

Analog command and analog actual value

The application of the HACD Control Card for position control of a hydraulic cylinder with analog external command, analog actual value, and a valve as actuator.

Analog command and digital actual value

The application of the HACD Control Card for position control of a hydraulic cylinder with analog external command, digital actual value (SSI), and a valve as actuator.

7.2 The HACD Control Card with one control loop and analog control signals

Features of this application

The adapt the HACD Control Card to this application, the following features are necessary:

- one control loop
- analog external command signal
- analog actual value signal
- a valve as controlled element

Structured list for proceeding with startup

The application will be explained in greater detail in three sections.
The described features are relevant for configuration and start-up of the card. The actions and explanations for startup refer to this installation.

Introducing the application

- Basic structure of the loop
- The components required
- The electrical and hydraulic installation plan

The described sequence of actions refers to the requirements and task of this application example. They serve as a template for similar applications.

Software Tool and Data Handling

An overview of the relevant steps for this application:

- The BODAC Software
- Data exchange between BODAC and the HACD
- Create a parameter file
- Save the interim settings during start-up

Configure in- and output elements

- Analog input – signal configuration elements
  - Adjust the analog input for the command value
  - Adjust the analog input for the actual value
- Digital signal input
  - Loop enable
- Analog output – signal configuration elements
  - Adjust the analog output to the physical level

Define signal structure

- Input signal structure
  - Link the command value to block-specific processing
  - Link the actual value (the feedback signal) to the controller
- Block-specific signal structure
  - Assign block numbers

  - Define triggering of Block 1
  - Define the block-specific command and feedback value signal construction
- Core function of the HACD Controller
- Output signal structure
  - Parameters for block triggering
  - Block-specific command signal generation
  - Command signal generation
  - Controller setting
  - Options for integral response of the controller

Set parameters

- Overview of grouping
- Block-specific parameters
  - Parameters for block triggering
  - Block-specific command signal generation
  - Command signal generation
  - Controller setting
  - Options for integral response of the controller
- Parameters for “Linking / Loop 1”
  - Output normalization (OUTPUT)
  - Options for Feed Forward
  - Active Damping
- Output signal generation
  - Polarity-dependent gain
  - Options for linearizing
  - Overlap
  - Residual velocity
  - Offset
  - Polarity-dependent limiting (Limit)

Basic structure of the Control loop

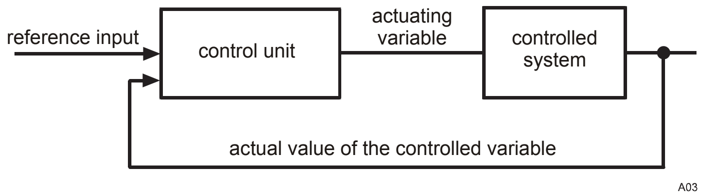

Fig. 121 Basic structure of a control loops

In the example application this basic structure contains the following elements:

- The signal for command position and command velocity is an analog signal.
- The analog command signal is adjusted for the input features of the control system.
- The actual (feedback) value of the controlled variable is detected by a linear potentiometer. The result is an analog feedback signal as a representation of the controlled variable corresponding to the position of the machine.
- The analog feedback signal is adjusted for the input features of the control system.
- The control system is in the HACD Control Card.
  The controller compares the command value with the feedback and thus obtains a control error. From this the controller generates, according to the parameterized control behavior. The output signal of the control system for compensating the deviation between command and actual signal.
- The controller output signal is adjusted to the features and control behavior of the controlled item (in our example a hydraulic valve).
- The process begins at the valve. From that point there is a hydraulic connection with the cylinder, which in turn is attached to a mechanism with the aid of which the force and motion of the cylinder piston is transferred to the machine.

The components required

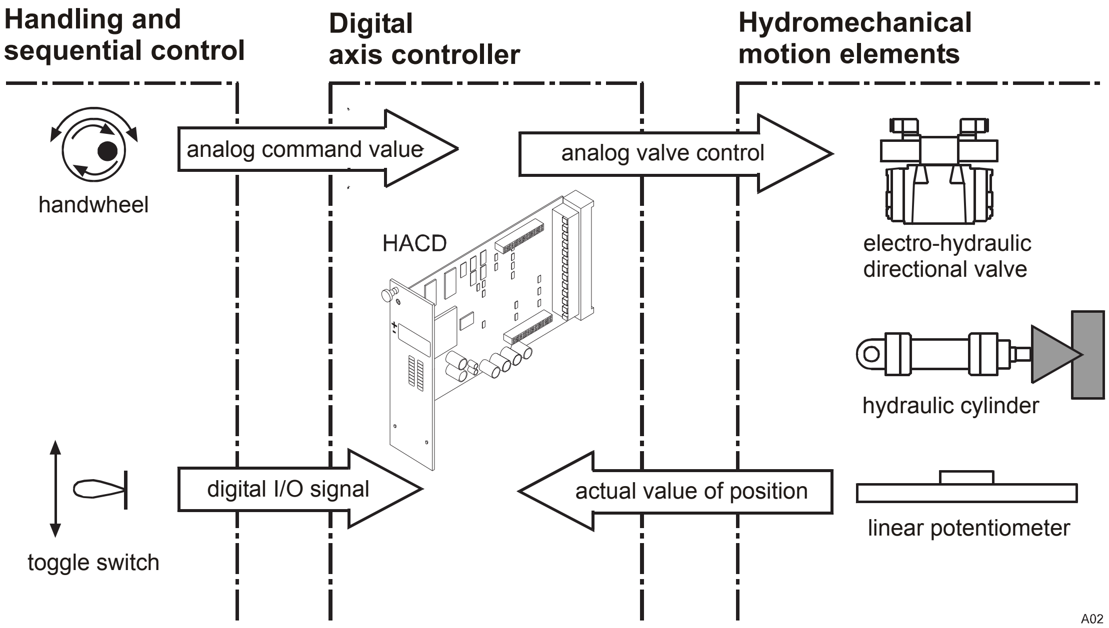

Fig. 122 The components required

In this application these components are connected to the HACD Control Card.

The electrical and hydraulic installation plan

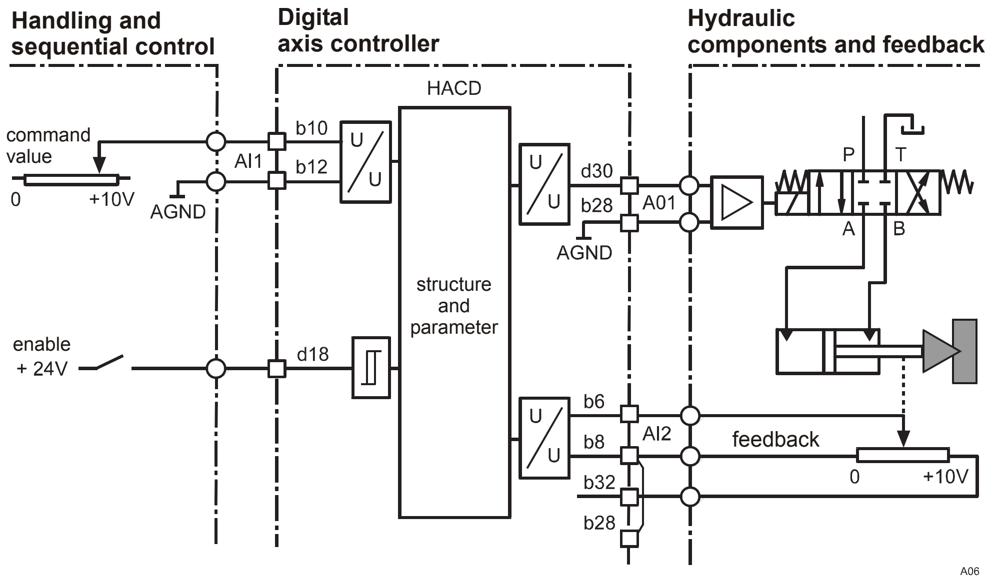

Fig. 123 Electrical connections to the HACD and the hydraulic components

Software Tool and Data Handling

The BODAC Software

BODAC is a software tool for startup. It must be installed on the PC or laptop you are using for the initial startup.

BODAC stands for:
Bosch Rexroth **O**perator interface for **D**igital **A**xis **C**ontroller used for in- and output configuration, controller structuring, parameterization, process display and diagnostics.

This software tool can be downloaded from the Internet at
www.boschrexroth.com/hacd

Data exchange between BODAC and the HACD

Establish a connection between the PC and the HACD so that the desired data can be set, saved and duplicated.

The connection is based on RS232. A fixed baud rate is set in the card.

- Connect PC to HACD using an RS232 cable (1:1 cable)
- Turn on PC and HACD
- Install BODAC
- Start BODAC (see document RE 30143-B)

Create file

The card is adapted to the application. The data for configuration and structure stored in a file.

Assign a file name and save the initial state.

Save the interim status during start-up

This allows you to easily store all parameters and structure settings during startup. If work is interrupted, this can be resumed later without any loss of data.

Note: When finished, also save the files in the permanent memory of the HACD Control Card.

See also: Section 4.1 “Save”.

See also: Section 4.2 “Set parameters to memory”.

Configuration of in- and output elements

When adapting the input signals, the physical external signal, which is a voltage or current signal, is evaluated. The polarity, Range, Limits and Fault Levels are set so a normalized internal signal is available for the control system.

In generating the output signal the internal signal is converted to an actual physical signal dependent on requirements of the control action. Units are converted into per-cent values after which the signal is converted to either a voltage or current signal with range, maximum value, minimum value and polarity.

Command value (set point) input
For the set-point we use
signal configuration element “AI1-IN1”

Actual value (feedback) input
For the actual value we use
signal configuration element “AI2-IN2”

Enable input
For the enable input a digital
signal is used.
The digital signal is connected to PIN D18. This input is always linked with the enable function of the control card.
No additional configuration is necessary.

Valve output
For the valve control output signal
configuration element “OUT1-AO1” is used.

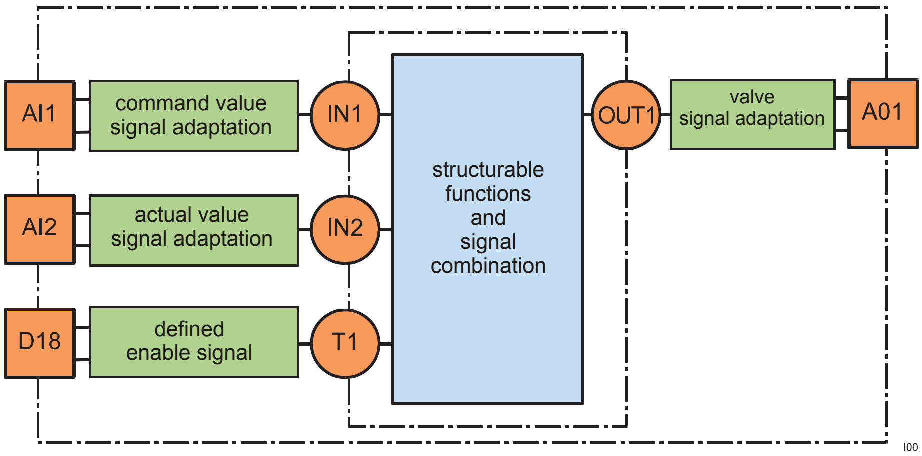

Fig. 124 The in- and output elements used for this application

Analog input – signal adapting elements

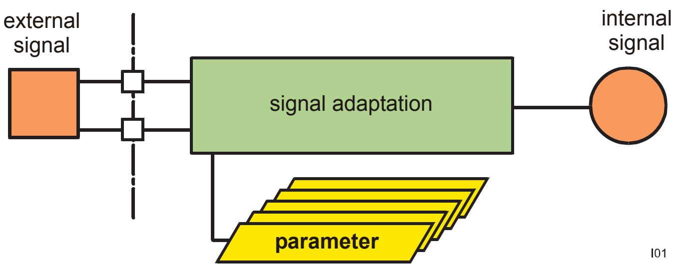

Fig. 125 Input signals – configuration elements

Configure the analog input for the command value

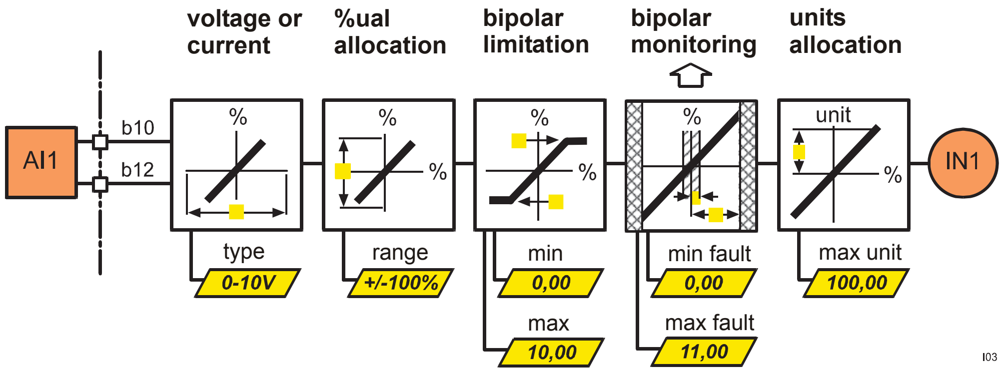

Fig. 126 Signal configuration element „AI1 -— IN1“

See also: Section 4.4 “Analog I/O”.

Configure the actual value for the analog input

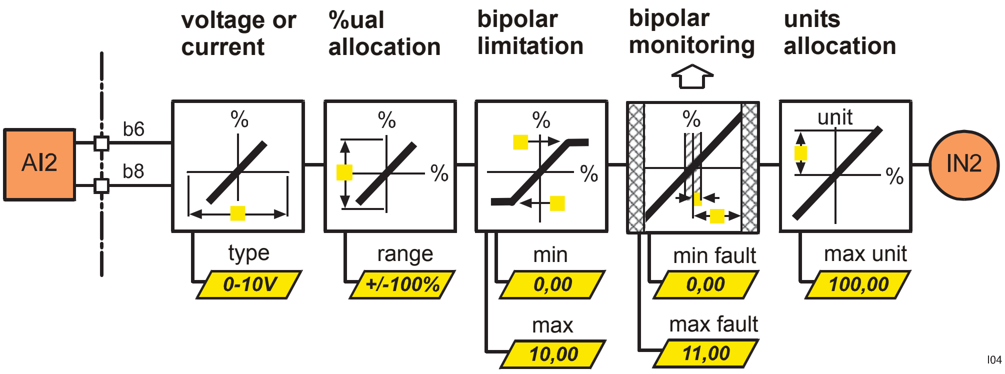

Fig. 127 Signal configuration element AI2 -— IN2“

See also: Section 4.4 “Analog I/O”.

Digital signal input

Controller enable

Use digital input D18 for the controller enable.
This input is hard-wired with the enable function of the control card and therefore eliminates the need for any additional configuration.

Without the enable signal the output value at AO1 is set to zero and the control process is stopped.

Enable starts the control loop and enables the output physically. The zero state is lifted.

The structures can be changed only when the enable is turned off.

The parameters however can be changed with an active enable signal.

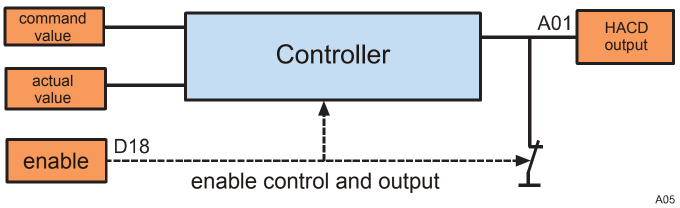

Fig. 128 Functions of the enable signal

Analog output – signal configuration elements

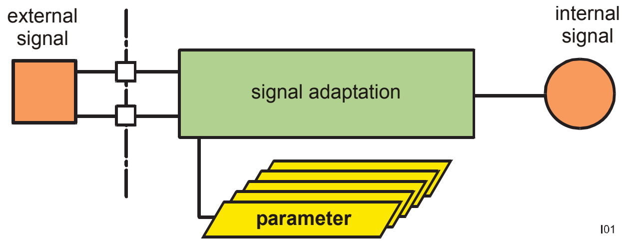

Fig. 129 Output signals – configuration elements

Configure the analog output to the physical level

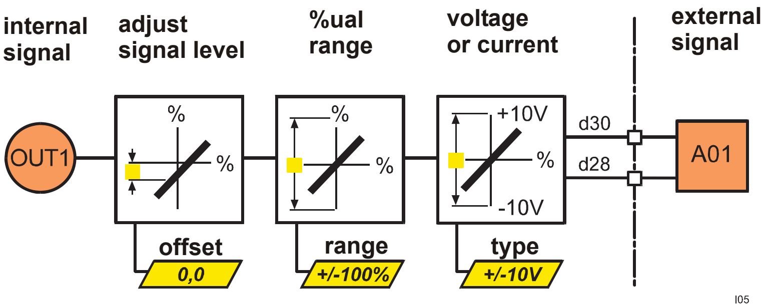

Fig. 130 Signal configuration element "OUT1 –AO1"

See also: Section 4.4 "Analog I/O".

Defining the signal structure

Due to the flexible nature of the control card it is required that the structure is adapted to the specific application. This reduces the number of parameters that need to be configured and makes the link to the actual system easily recognizable.

Adapting the structure includes signal selection, signal assignment and the selection of mathematical control algorithms for processing the signals.
Assignment is always performed using a pull-down menu.

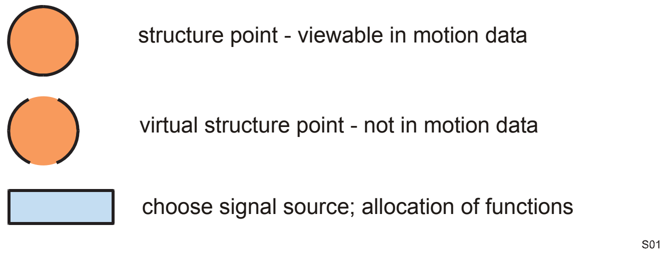

Fig. 131 Structure elements and the associated symbols

Input signal structure

The command value (set-point) for block-specific processing

Use structure element "C1-1/C1-2---C1".

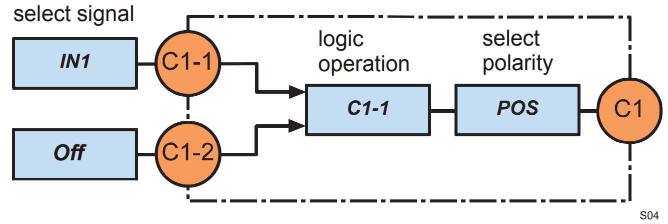

Fig. 132 Structure element for input signal generating

- ➢ Select signal IN1 for C1-1 and switch directly to C1
- ➢ Select signal OFF for C1-2
- ✓ The external command value sources are selected. The logical links are defined. The polarity of the combined signal is defined.
- ✓ This concludes the block-independent set-up of the command value(set-point)

See also: Section 6.1 "Input Matrix".

The actual value (feedback) for block specific processing

Use structure element "FB1-1/FB1-2---FB1".

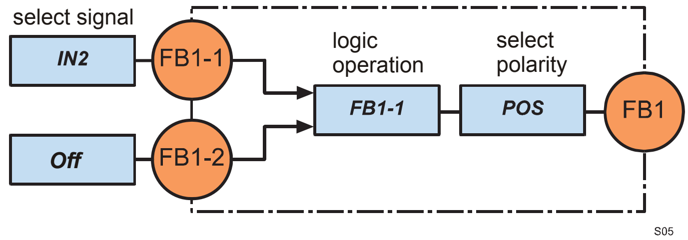

Fig. 133 Structure element for input signal generation

- ➢ Select IN2 signal for FB1-1 and switch directly to FB1
- ➢ Select OFF for signal variable FB1-2
- ✓ The controller feedback signal is selected, the logical link defined and the polarity is set.
- ✓ This concludes the configuration of the feedback signal

See also: Section 6.1 "Input Matrix".

Block-specific signal structure

32 selectable blocks are available and can be activated application-specific dependent on the goals. Each block has a unique block number. Block-specific structure elements are:

- Block triggering (Activating the block)
- Block-specific signal configuration for the main task

For this application the entire sequence control and set point generation is accomplished from an external control (the operator panel with the handwheel).

Summary: “Only one block is required for this task”.

Assign block numbers

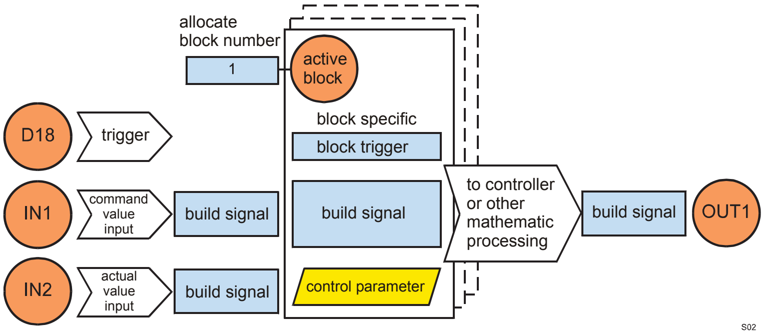

Fig. 134 The block-specific structures

➢ Use the right mouse button to assign block number “1” to the entry field.

✓ All block-specific settings refer to Block 1

See also: Section 6.1 “Block Matrix”.

Define triggering of Block 1

Use structure element “Block triggering”.

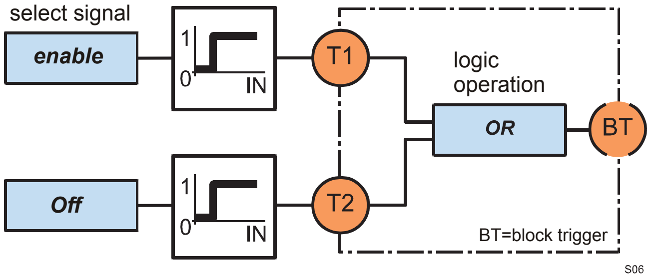

Fig. 135 Structure element “Block triggering”

- ➢ Select the enable signal (D18) for trigger condition T1
- ➢ Switch trigger condition T2 “Off”
- ➢ Assign logical operation “OR”
- ✓ This defines the conditions for triggering Block 1. Setting the “Enable” signal activates the HACD.

See also: Section 6.1 “Block Matrix Field Trigger”.

Define the block-specific command and feedback value signal set-up

Use the structure element “Block-specific” signal configuration (CMD).

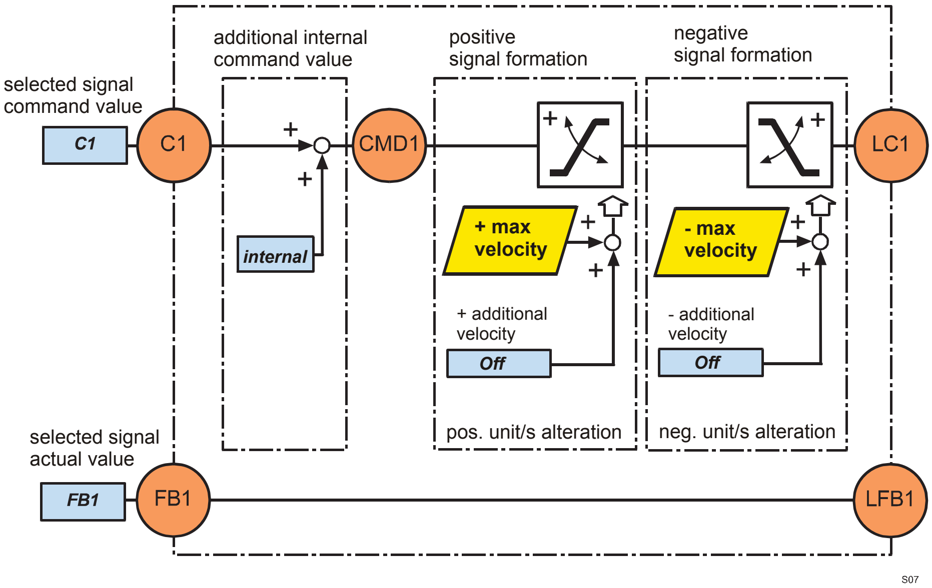

Fig. 136 Block-specific signal configuration

- ➢ Configure C1 input signal for output LC1
- ➢ Turn off (+) velocity offset
- ➢ Turn off (-) velocity offset
- ➢ Switch FB1 input signal to output LFB1
- ✓ Now the additional internal set point is possible
- ✓ The set point C1 is brought to LC1 and thus limited to a maximum signal change(velocity)
- ✓ The velocity offset in positive and negative direction is turned off
- ✓ The feedback value FB1 is brought to the structure point LFB1

See also: Section 6.1 “Block Matrix Field 1”.

Main task of the HACD Controller

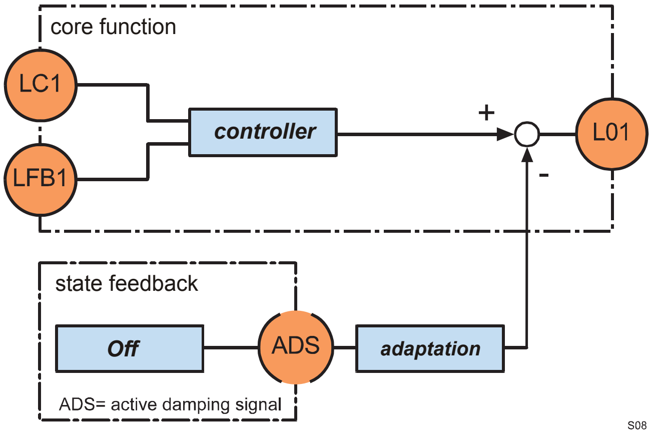

Fig. 137 Main task

- ➢ Select “Controller” as the mathematical main task
- ➢ Turn off Active Damping
- ✓ The HACD card operates as a controller without Active Damping

Note: The controller parameters are adjusted block-specifically

See also: Section 6.1 “Loop Matrix1”

Output signal structure

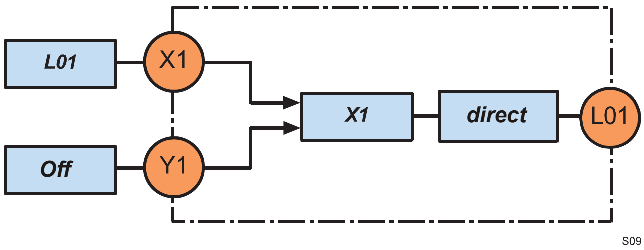

Fig. 138 Structure element: Output signal configuration "X1/Y1 --- OUT1"

- ➢ In the "X1" selection window, select signal "LO1"
- ➢ In the selection window "Y1" select the option "OFF"
- ➢ In the following link window select "X1"
- ➢ In the selection field below select the option "Direct"
- ✓ The output from Loop 1 (loop output 1) is switched to structure support point X1
- ✓ Structure support point Y1 does not accept any signals or send any
- ✓ The signal LO1 is routed directly to output "OUT1". Output adjustment is available and can be parameterized

See also: Section 6.1 „Output Matrix 1".

Parameter Set-Up

Overview of grouping

The parameters are grouped as follows:

- Parameters for each of the 32 blocks (Block-specific):
  - Trigger signals
  - Set point generation
  - Controller setting
- Parameters for Loop Matrix 1
  - Output normalization
  - Options for Feed Forward
  - Active Damping
- Parameters for output signal configuration

Block-specific parameters

Only the parameters for Block 1 need to be set. The other 31 possible blocks have no meaning in this application.

Parameters for block triggering

Define and quantify the parameters for block triggering – events for trigger signal generating

Trigger events These trigger events may be either external or internal signals. Internal signals arise while the currently active block is running. The trigger conditions for other blocks can be parameterized for the appearance of such events.

Block sequences This allows block sequences to be constructed. In sequence control the sequence is given and parameterized events are used to generate a jump or stop. Event control on the other hand has no fixed sequence. Only after the events that trigger a block have occurred a sequence is executed. By using event control it is possible that sequences are executed that not have been previously defined. The sequences are a result of events occurring during the process.

In our example the external digital “Enable” signal triggers Block 1. This function does not require any parameterization.

Additional blocks are not necessary so there is no need for parameterizing the “Block 1-specific” events used trigger signal creation.

The parameters available for this are given default values.

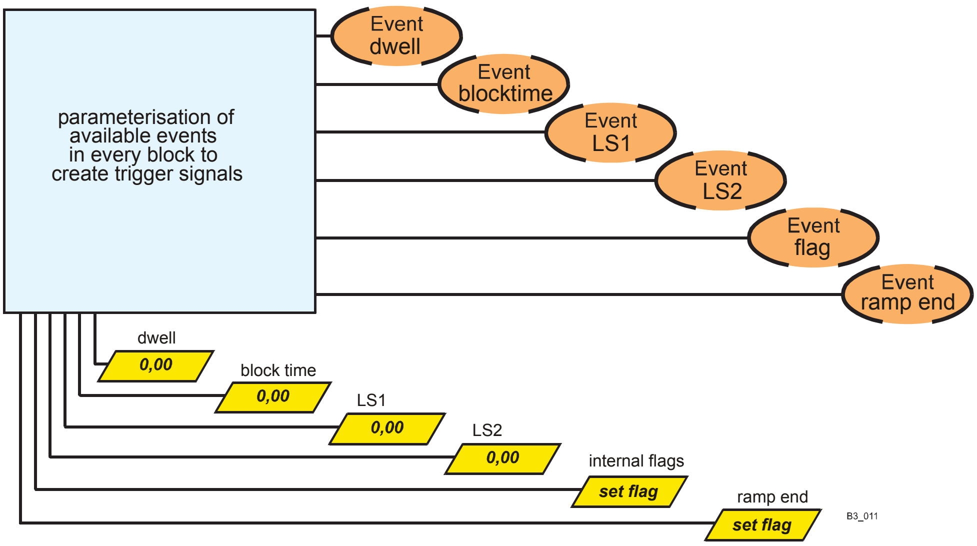

Fig. 139 Parameters for defining block triggering

- ➢ Set Dwell time to 0.00 s
- ➢ Set Block time to 0.00 s
- ➢ Set threshold for event signal 1 (LS1) to 0.00 units
- ➢ Set threshold for event signal 2 (LS2) to 0.00 units
- ✓ "Block1-specific" trigger signals that also can be used for other blocks are set to default values.

Block-specific command signal generation (CMD1)

Preceding this is the command value input configuration. This is independent of the respective active block. A block-specific internal set-point (command values) can be added to this.

In the structure definition the set-point is defined „internally“ and is given as a magnitude to be added. When parameterizing, the signal to be added receives the value "0.00".
If the external set-point (C1) is turned off, the parameterized internal set-point is left as the input for the controller.
This allows block-specific set point profiles to be constructed.

The summed command signal is passed along as "CMD1" to the block-specific set-point generation.

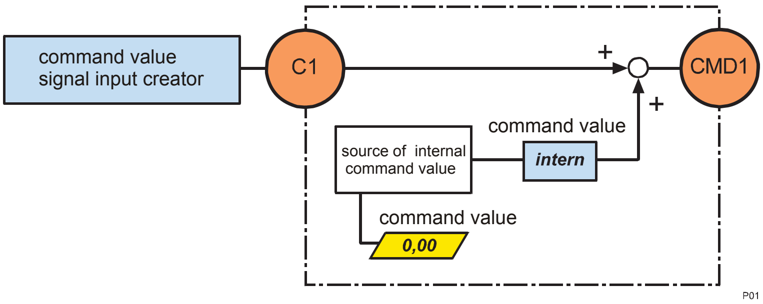

Fig. 140 Block-specific command signal generation (CMD1)

See also: Section 6.2 "Command parameters Block Matrix 1".

Block-specific set-point generation (LC1)

For stable operation of the control action, a stable set-point input is critical. Therefore the set-point signal is passed through a ramp section before it is passed to the controller as „Loop command 1“ (LC1). The rate at which the signal changes is the function of this parameter group. The time for ramping up to and ramping down from the max. signal rate results in an S-shape signal trace over time. Therefore the term S-ramp is used. In our example we enter the value 0. The signal trace over time has a trapezoidal shape if the value 0 for S-Ramp is used.

The positive and negative signal ramp can also be dynamically changed analogous to a signal. The signal is selected when the structure is formed through a pull-down menu. In our example this function is turned off.

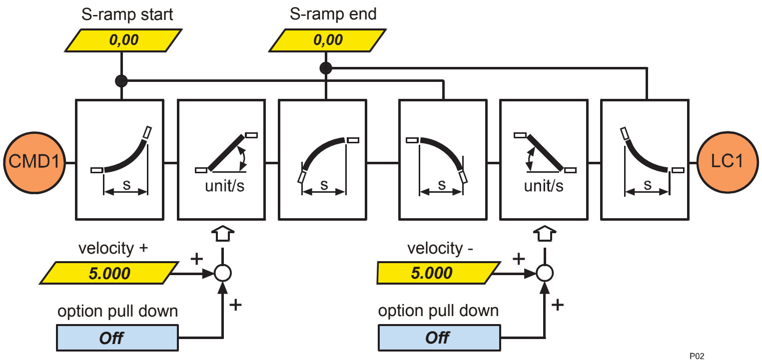

Fig. 141 Set-point generation (LC1)

- ➢ Set speed + to 5,000 Unit/s; this value turns off the positive speed limit.
- ➢ Set speed - to 5,000 Unit/s; this value turns off the negative speed limit.
- ➢ Set S-ramp Start – to 0 s. This value is the ramp-up time – from 0 Unit/s to max Unit/s
- ➢ Set S-ramp End – to 0 s. This value is the ramp-down time – from max 0 Unit/s to 0 Unit/s
- ✓ Set-point change is set to 5.000 Unit/s for both polarities and is therefore switched off. The maximum set-point change is used and as a result signal changes on CMD1 are passed through without ramping to LC1.
- ✓ The limitation is effective immediately. The time for ramping-up to and ramping-down from the selected set-point change rate is set to 0 for both directions (S-ramp is turned off).

See also: Section 6.2 “Command parameters Block Matrix 1”.

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Controller setting

You must enter the block-specific parameters in order to tune the behavior of the controller for the control circuit.

The objective of tuning is to maintain the controlled variable as close to the set point and as independent of disturbing factors as possible.
For this purpose the controller has four parameters which can be used to tune the control circuit successfully to the properties of the actual system.
How the controller responds to the control deviation and as a result generates a signal on the output is called the control behavior. The proportional, integral and derivative terms of the control behavior can be parameterized (PID controller).

Proportional term

Error multiplied by a gain, Kp. (proportional control response)

Integral term I

The Integral-component correct for any offset between the set point and the process variable by automatically resetting or shifting the proportioning band. The controller's output is proportional to the amount of time the error is present. (integrating control response)

Derivative term

The Derivative determines the rate at which the controller reacts to changes in the process variable. The controller's output is proportional to the rate of change of the error. (derivative control response)

Options for control response

The integrating control response in the HACD Control Card has 3 options. These depend on the magnitude of the control error:

I-component frozen
The current value of the I-component is held constant when the error signal is smaller then the parameterized threshold.

I-component active
The value of the I-component changes corresponding to the set parameters.

I-component turned off
The value of the I-component is switched to zero when the error signal is smaller then the parameterized threshold.

The different control responses are added and passed through a low-pass filter. The filter will dampen signal oscillations that would only lead to inefficient energy consumption rather than have an actual effect on the control action.

Block-specific options

Block-specific turning off of the controller is also provided as an option.

To obtain stronger and faster response of the controller to changes in the feedback value, the latter can be differentiated. The resulting derivative quotient is added to the control error, which acts as an input for the proportional and integral control response.

To make the parameterizing work easier an option switch is available to use the controller settings of Block1 in other blocks.

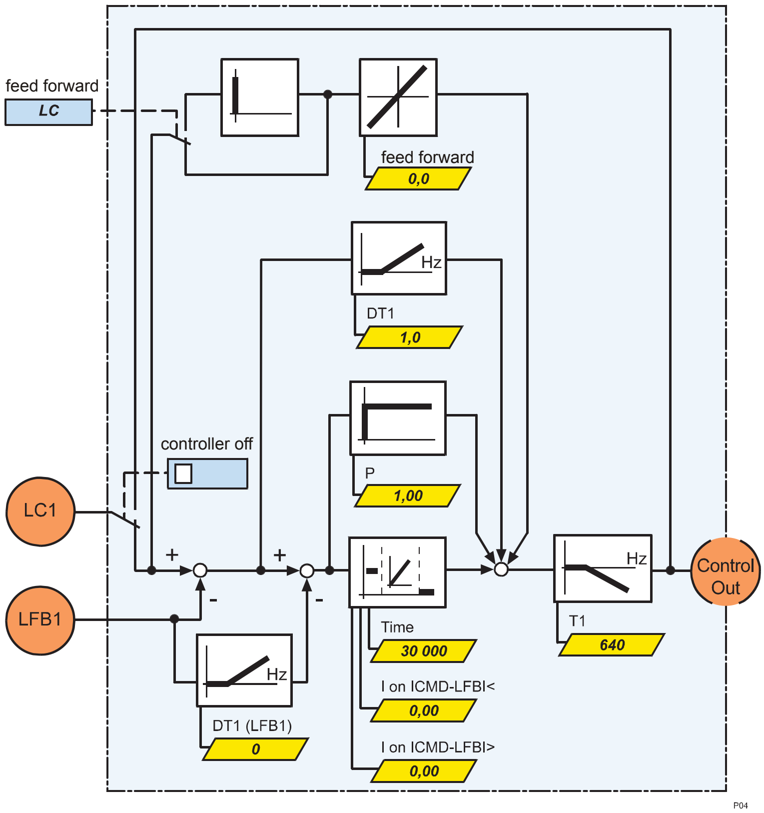

Fig. 142 Controller setting

Settings for our example

- The control error is applied to the output summing point with a gain factor of 1
  The P-term is given a value of “1”
- The control error is not amplified as a function of time (in the configured Integrator time the control error would be amplified up to the maximum value)
  The integration time as part of the I-term is given a value of “30 000” ms. This is done for safety reasons. If the value entered was 0 and the user by accident increments this time it would jump to the fastest integration time of 1 ms.
- The integral term of the controller is turned off. The threshold of the control error for turning off the integral term is given the smallest possible value.
  “I on I CMD-LFB I<” is given the value “0” Unit
- Freezing of a value resulting from the integral term of the controller is turned off. The threshold of the control error for freezing the integral term is given the smallest possible value.
  “I on I CMD-LFB I >” is given the value “0” Unit
- The rate of change in the control error will not be amplified.
  The D-term and the reset time are combined in only one parameter the DT1-component.
  In our example, the frequency component of the control error in the signal will not be amplified. The DT1-component is given the parameter value “0” Hz
- The rate of change in the feedback signal will not be subtracted from the control error. The D-term and the reset time are set with only one parameter a DT1-

component.
In our example, the frequency component in the feedback signal will not reduce the control error.
The DT1(LFB1) member is given the parameter value “0” Hz

- High frequency components of the controller signal will be reduced. Frequency components of 640Hz are reduced by 3dB, and higher frequency components are reduced to a correspondingly greater degree.
  T1 is given the value “640” Hz
- The Feed Forward function will have no effect. Set the gain factor for Feed Forward to zero.
  Command value setting is given the value “0”
- There is no additional controller for overriding the influence of this controller in its effect on the controlled variable.
  In order to switch off the override function choose “OFF” from the pull-down selection.
- The controller in this block should be turned on.
  Do not select the option “LOOP OFF”
- Do not copy the settings from a previous block.
  Do not select the option “as Block 1”

See also: Section 6.2 “Loop parameters Block Matrix 1”.

Options for integral response of the controller

The integral component is, dependent on the amount of control error (the command – feedback difference, abbreviated as ICMD-LFBI), either active, frozen or turned off.

This allows disturbing side-effects of a control system with an integral component to be suppressed.

Zero point drift

The integral portion is held constant at a minimum value if the control error drops below the defined threshold (quasi frozen). Only when the amount of control error exceeds this threshold does the integral component become active again.

Winding up of the control output

The integral component of the controller is constantly increasing the output value, even when the control error remains the same. The speed at which this increasing of the output signal takes place can be parameterized using the “Integration time” parameter. The “Integration time” is the amount of time it takes for the output value to reach the maximum value (100%) at a control error of 1 Unit.
If the control error remains the output value will remain at the maximum value of 100%. If an external factor prevents the machine from correcting according to the control-output (I.e. physical block of an actuator) the control-output will wind up due to the integrator. If the external factor disappears the system will react according to the wound up control-output and might result in unexpected movement of the controlled axis.
To prevent this, the integral component is set to zero if the control error exceeds the configurable threshold of control error Ion |CMD-LFB|<.

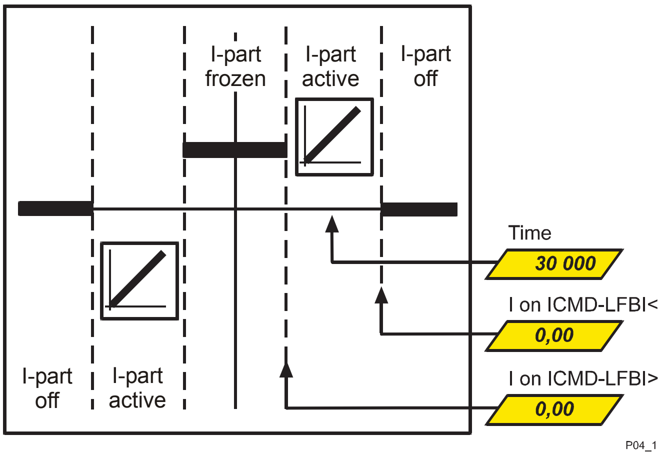

Fig. 143 Options in the integral component – detail

Parameters for “Loop Matrix 1”

These parameters are not block-specific. The settings apply to all blocks. They are organized into three groups:

Output normalization (OUTPUT)

The conversion of the values from the internal calculated unit in Units to a normalized output value in %.

Options for Feed Forward (controller)

The direct or derivative quotient of the Feed Forward signal selected can be applied.

Active Damping Active Damping can be selected for suppressing oscillations that can contribute to hysteresis or instability of the system.

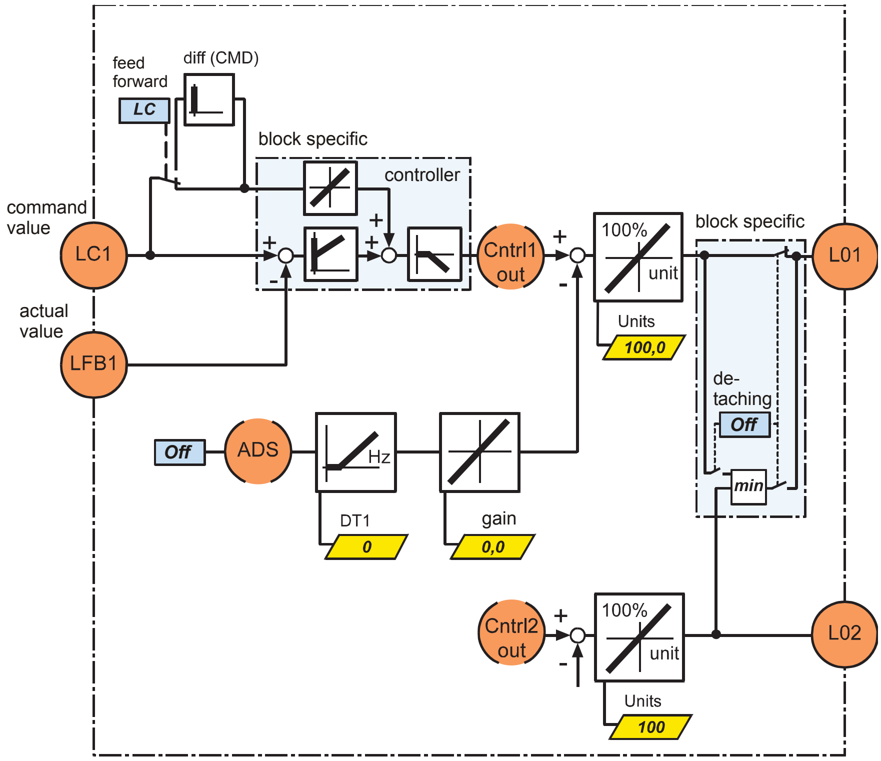

Fig. 144 Block diagram shows parameters for „Loop Matrix 1“

See also: Section 6.2 "Loop parameters Block Matrix 1".

Output normalization (OUTPUT)

Adjusting the controller output signal to a normalized percentual signal creates the conditions for further use of the signal.
This is relevant for:
1. Maximum use of the range available for the control action.
2. The override function with a second control circuit.

Note:

In overriding control, the second controller, according to the rules of a minimum value generator, has an effect on the control action. This function can be selected block-specific.

➢ The units coming from the controller should cause a swing of 100%. The controller is parameterized to max. 100 units. (It is recommended that you use the max. Unit-value of the feedback signal).
Therefore, enter the numerical value 100.

✓ 100 Units on the controller output (Cntrl1 out) result in 100% on the loop output (LO1).

Options for Feed Forward

To relieve the control response, the command value – regardless of the control error – can also be added directly to a summing point following the controller regardless of the control error.

This so-called Feed Forward has two options:
1. Apply the command value directly, multiply with a gain factor and add at the summing point.
2. Generate the derivative quotient of the command value, multiply with a gain factor and add at the summing point.

➢ Feed Forward at LC

✓ The command value is passed to the controller unchanged for block-specific evaluation with a gain factor

See also: Section 6.1 “Loop Matrix 1”

Active Damping

In the structure screen, the Active Damping was already turned “Off”.

In the first attempt at control circuit optimizing you should always work without Active Damping.

The following explanations should clarify this. The parameters are given default values.

The loop-internal ADS value (active damping signal) is obtained according to the structure specification from a signal listed in the pull-down menu.

The signal is differentiated and then multiplied by a gain factor. In this way both the changes in the Active Damping variable as well as the Active Damping variable itself are subtracted as a damping variable from the controller output.

➢ Set the differentiating frequency of the Active Damping signals to 0 Hz.

✓ The derivative effect of the Active Damping is turned off.

➢ Set the gain for the Active Damping variable to 0.00

✓ Active Damping has no effect (even if it is turned on in the structure screen).

See also: Section 6.1 “Loop Matrix 1”

Output signal configuration

This parameter group is independent of the control. The group is used for adjusting the loop output signal to the characteristic response of the control action.
Output signal adjustment always calculates with reference to 100% and no longer in Units.

Polarity-dependent gain This is relevant to compensate for different piston surface areas with double-acting cylinders. On one side with, on the other side without the area of the piston rod

Linearity curves There are two options for linearizing the non-linear response of the control action. Either with Gamma correction or according to a table with a maximum of 8 stages.

Overlap To obtain a stronger response (higher gain) in the center position of the valve.

Residual velocity To assure that the control signal is sufficiently large in the small signal level range. To increase the stability and to reduce ineffective signals around the zero position of the valve (reduce wear and heating without compromising controllability).

Offset To compensate signal level shifts in the valve actuation or to compensate undesired offsets in the valve.

Polarity-dependent signal limiting For preventing overdriving the valve.
Limiting the output independent of the control.

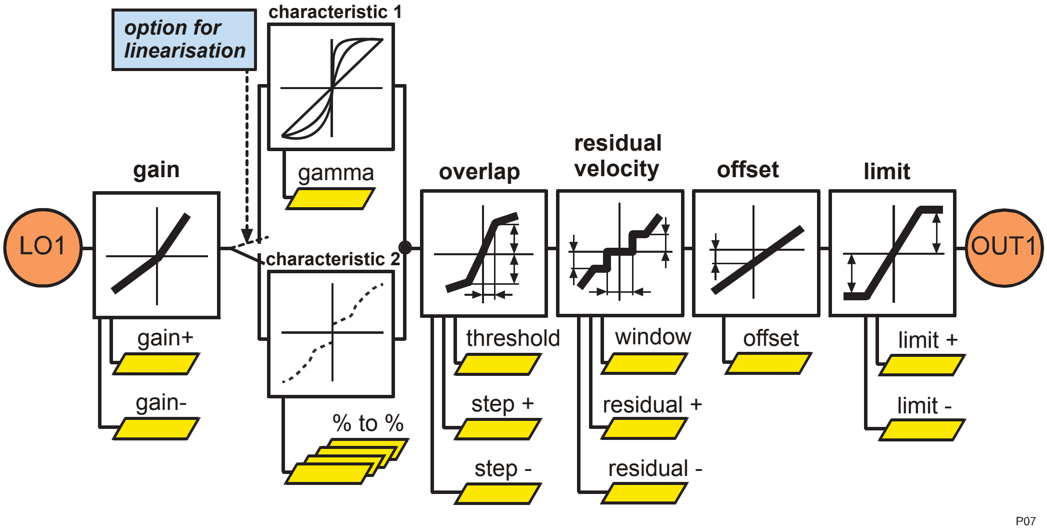

Fig. 145 Overview of the parameters of output signal configuration

See also: Section 6.1 “Parameters – Output Matrix 1”.

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Polarity-dependent gain

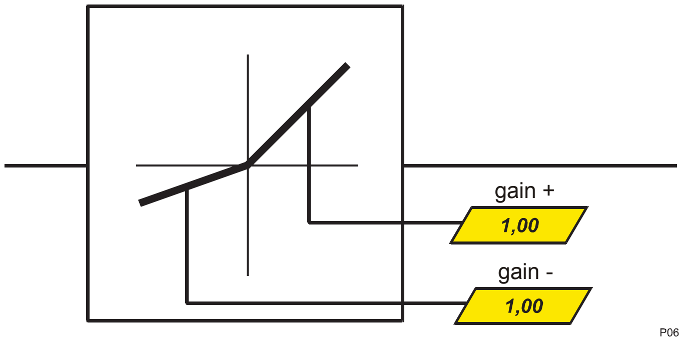


Fig. 146 Polarity-dependent gain

Tuning can be accomplished using the characteristic data for the control action (the valve) and by evaluating the measured results after a test run.

Enter the same gain as the output setting for positive and negative output signals.

- ➢ Set Gain + to “1.00”
- ➢ Set Gain – to “1.00”
- ✓ The same gain is applied in both movement and force direction.

See also: Section 6.1 “Parameters – Output Matrix 1 / Gain”.

Options for linearizing

Linearizing using Gamma correction

Gamma correction is a way of linearizing a constantly non-linear response using just one parameter for the positive and negative movements.
The characteristic feature of this type of correction is the higher gain for smaller signals and a smaller gain at maximum signals as can be seen in the figure below.
In the middle of the range the gain-factor is 1.

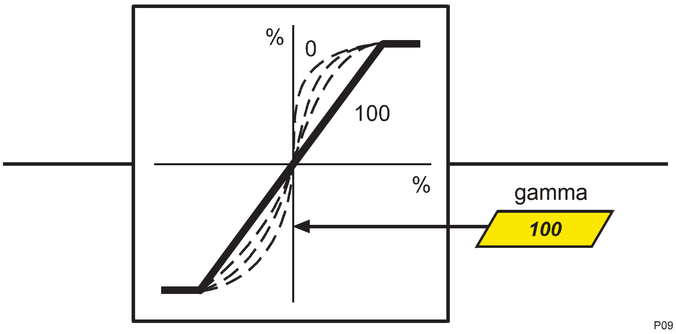


Fig. 147 Gamma correction

- ➢ Select the linearization option Curve Correction 1
- ➢ Set a value of 100 for the Gamma parameter
- ✓ Linear transfer is set. The actual Gamma correction function has no effect.

See also: Section 6.1 “Parameters – Output Matrix 1 / Gamma”.

Linearizing according to a table

If correction using the Gamma curve does not produce satisfactory results, linearization according to a table can be used.
This allows user-specific linearization with a maximum of 8 steps for both positive and negative direction. Especially for non-constant, jumping non-linearity’s in the control action this is an effective linearization.
Since the correction table always refers to the amount, the result is a point-symmetrical correction curve.

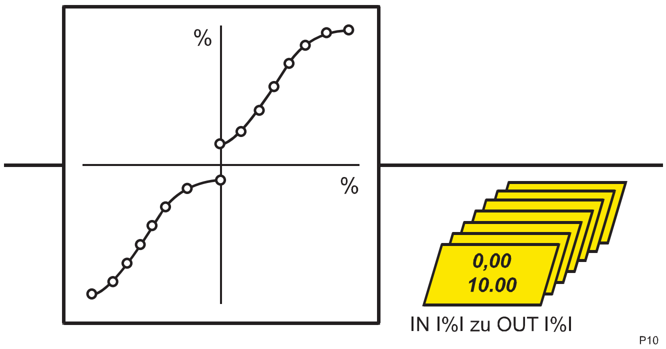


Fig. 148 Transfer function for linearizing according to value pairs from a table

- ➢ Do not select the option according to Curve Correction 2
- ✓ Gamma correction is activated. The table values are disabled.

See also: Section 6.1 “Parameters – Output Matrix 1 / Curve correction”.

Overlap

This is a method for optimum valve control in the small signal range.
This allows valves with E-spools to be controlled directly at the control edge. This also enables fast valve response, even with small changes from the controller output. Control is active immediately and, with optimized setting of the overlap, has an immediate effect on the control action with no deadband.

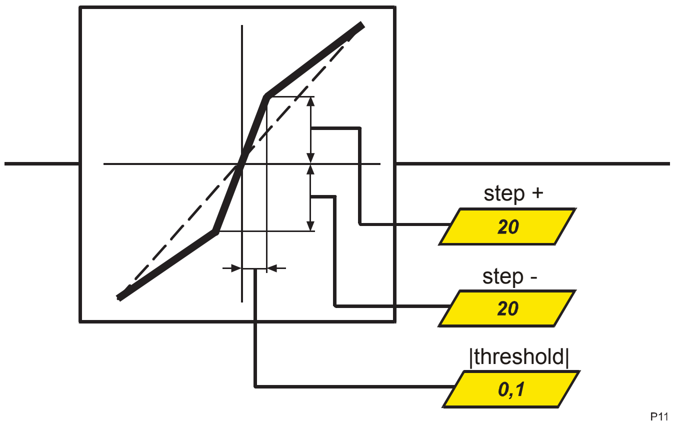


Fig. 149 Parameters for “Overlap "

The optimum values for the 3 parameters defining the overlap in valve control are generally determined through practical measurements.

Select the following values as a basic setting:

- ➢ For the deadband at which an overlap jump takes effect, enter “0”
- ➢ Enter “0” as the magnitude of Step+
- ➢ Enter “0” as the magnitude of Step-
- ✓ With this basic setting the overlap function is not in effect. The function acts like a linear signal transfer.

See also: Section 6.1 “Parameters – Output Matrix 1 / Overlap”.

Residual velocity

Assumption for purposes of explanation

"decreasing positive input signal at the control section."
If a positive input variable falls below the parameter value of "Residual+", this parameterized value will become the output.
If the input variable continues to fall, the level falls below the amount of the accuracy window value. Below this value the output is zero.

Assumption for purposes of explanation

"increasing positive input signal at the control section."
If a negative input variable exceeds the parameter value of "Residual-", this parameterized value becomes the output.
If the input variable continues to rise, the level exceeds the amount of the accuracy window value. Above this value the output is zero.

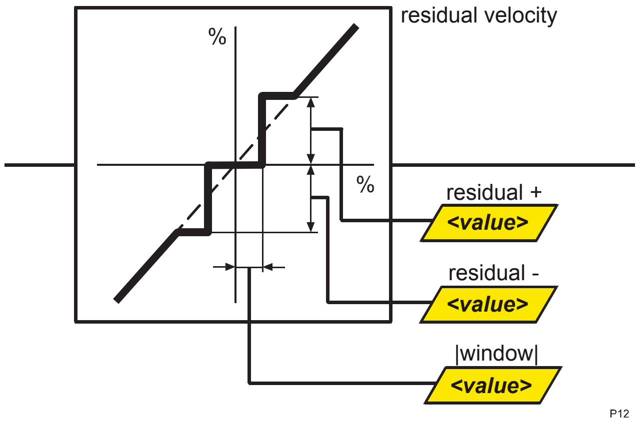


Fig. 150 Parameters for the section "Residual velocity""

The optimum values for the 3 parameters of the residual velocity section are generally determined through practical measurements of the valve response.

Select the following initial setting:

- ➢ Enter the parameter “0” for the “accuracy window” within which the value zero should be output.
- ➢ Assign a value of “0” for the “Residual+” parameter as a positive residual value above the “accuracy window”.
- ➢ Assign a value of “0” for the “Residual-” parameter as a negative residual value below the “accuracy window”.
- ✓ With these parameters as an initial setting, the „Residual velocity“ function is disabled. The function acts like a linear transfer.

See also: Section 6.1 “Parameters – Output Matrix1 / Residual velocity”.

Offset

The control action can already have an offset even when the controller output signal is zero.
In order to compensate this independent of the control, an offset function is provided in the output signal generator.

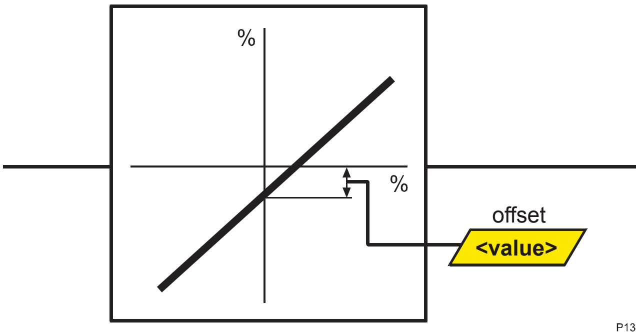


Fig. 151 Offset in output signal generation

Determine the parameter value on site by means of practical tests.

- ➢ Set a value of “0” for the initial setting
- ✓ The offset function will not effect the signal.
  The signal becomes linear and is passed through without any change.

See also: Section 6.1 “Parameters – Output Matrix 1 / Offset”.

Polarity-dependent limiting (Limit)

With this section the positive and negative value of the control action can be limited independently of each other. Machine processes or system conditions may require such a limit regardless of and with precedence to the control.

The practical optimum value must be determined from the specifications of the machine on site.

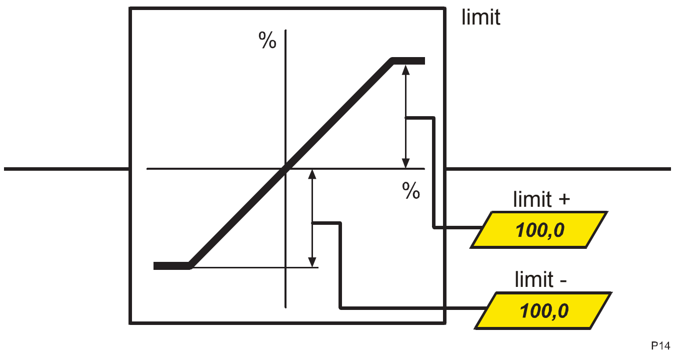


Fig. 152 Polarity-independent limiting in output signal generation

Use the full value range as the basic setting:

➢ Set the parameter Limit+ to 100%

➢ Set the parameter Limit- to 100%

✓ Limiting is not applied and the function acts as a linear pass through.

See also:

Section 6.1 “Parameters – Output Matrix 1 / Limit”.

7.3 Application of the HACD with internal profile generation and digital actual value

The task

Shifting of a workpiece

A workpiece is to be shifted with the help of a hydraulic cylinder to a position A or position B. The target position can optionally be approached directly from maximum velocity (rapid speed) or at a velocity reduced before (creep speed). The process is to be automated using signals from the operator panel or a simple PLC.

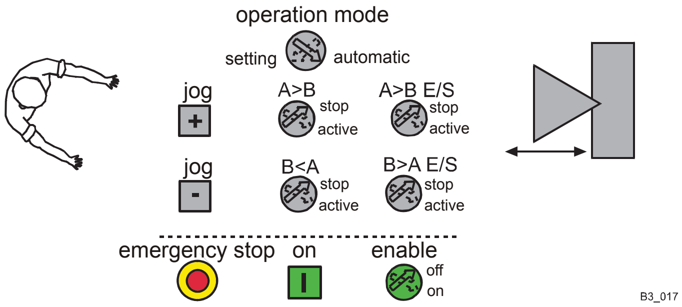


Fig. 153 Man produces with a machine

Operating modes

Setup mode

The hydraulic cylinder moves in the open-loop control mode. The movement is initiated by means of keys (e. g. "Jog+" or "Jog–"). When the key is pressed, the valve opens, whereas releasing of the key causes the valve to close.

Automatic operating mode with one velocity

The hydraulic cylinder moves in the closed-loop control mode at one velocity. The movement is initiated by a steady-state switching signal (e. g. switch "A>B"; for moving to position B). If switch position “active” is selected, the cylinder moves to the target position irregardless of its current position. Before reaching the target point, it decelerates so that it comes to a standstill exactly at the target point. With switch position "stop" the cylinder stops and maintains its position under closed-loop control.

Automatic operating mode with rapid and creep

The hydraulic cylinder moves in the closed-loop control mode; over the first distance at rapid speed, then at creep speed.
The movement is initiated by a steady-state switching signal (e. g. switch "A>B – R/C"; for moving to position B). When the switch position is selected, the cylinder moves to the target position irrespectively of its current position. Before reaching the target position, it decelerates from rapid speed to creep speed depending on its position. It continues to approach the target position at creep speed and then comes to a standstill at the target position. With switch position "stop" the cylinder stops and maintains its position under closed-loop control.

Procedure for editing the application

This compilation was drafted in the form of a structured checklist. Detailed information can be found in the associated sections.

Planning of the solution

The solution method is explained in three sections.
The aspects described are relevant for the adjustment and commissioning of the card. The activities and explanations with regard to commissioning refer to this installation. The electro-hydraulic installation is of an exemplary character. In the following, the explanations of activities refer to this example.

The order of the activities described here refer to the requirements and the task of this exemplary application. They can be applied by analogy to similar applications.

- The general solution method
- The required components
- The electrical and hydraulic schematic diagram for the installation

Software tool and data handling

The software and data handling are independent of the application. The work steps have proven in practice.

- The commissioning software BODAC
- Data exchange between BODAC and the HACD
- Creating a settings file
- Saving the current status

Adjusting the input and output elements

- Data input for actual position values and command value
- “Enable” input
- Inputs for freely assignable functions
- Output “OK” (ready for operation)
- Outputs for freely assignable functions
- Analog output for controlling valves

Defining the signal structure

- Signal structure referred to the inputs
  - Providing the command value for block-specific processing
  - Directing the actual value (feedback signal) to the controller
- Signal structure referred to blocks
  - Assigning block numbers
  - Defining the triggering of blocks for the operating modes
  - Defining signal conditioning of command and actual values referred to blocks
  - Defining the internal signal generation for the command value
- Core function of the HACD controller
- Output signal structure

Setting parameters

- Overview of setup of groups
- Block-related parameters
  – Parameters for triggering blocks
  – Block-specific generation of command values
  – Command value creation
  – Controller adjustment
  – Options in the integral action of the controller
- Parameters for “Logical operation / Controller 1”
  – Output normalization (OUTPUT)
  – Options for command value feedforward
  – State feedback
- Generation of the output signal
  – Polarity-dependent gain
  – Characteristic curves for linearization
  – Overlap
  – Residual velocity
  – Offset, zero point drift
  – Limit, polarity-dependent signal limitation

Planning of the solution

The general solution method

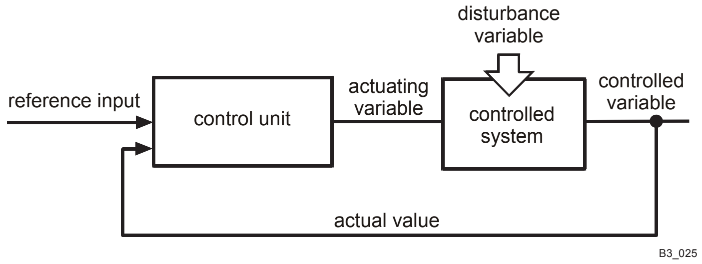


Fig. 154 The basic structure of control loops

In the exemplary application the basic structure is set up with the following elements:

Reference input The reference inputs for the setpoint position and setpoint velocity are parameterized within the HACD card. Digital input signals are used to call up pre-defined motion profiles.

Actual value The actual value of the controlled variable, the actual position of the machine part, is acquired by a digital absolute measuring system. The digital signals are transmitted to the HACD card in the SSI format. The digital actual value is adjusted to the input characteristics of the control unit

Control unit The control unit is included in the HACD card.
The controller subtracts the actual value from the command value and thus provides the control error. This is used by the controller to generate the output signal of the

control unit according to the parameterized control characteristics to correct the control error.

Actuating variable

The output signal of the control unit is adjusted to the data for actuation and the control characteristics of the actuating variable. In our example, the valve is a hydraulic valve with a +/- 10V input voltage and linear control characteristics.

Controlled system

In our example, the controlled system starts at the valve. It has a hydraulic connection to the cylinder, which, in turn, is connected to a mechanism. This mechanism transmits the force and movement of the cylinder piston to the machine.

Disturbance variable

Variables, which are not output as actuating variable by the control unit, but have an effect on the controlled variable, are disturbing variables. In our example, these can be friction forces, process forces or vibrations on the machine part.

Controlled variable

The controlled variable is the essential element of the entire closed-loop control. In our example it is the actual position of the machine part. The task of closed-loop control is to adjust the controlled variable with a tolerance that is adequate for the machine process at hand and meets the relevant time requirements (dynamic control response) taking into account the maximum disturbance variables that have to be expected.

Command value inputs and operating modes

The cylinder control with the HACD is subordinate to the machine control.
Data and signals are exchanged between the machine control and the movement of the machine part controlled by the HACD card. (Signal level, zero reference, rising edge, time overlaps, safety functions, …). The sequence is controlled through queries and logical operations of events and signals.

Typical task for the internal generation of profiles in the automatic operating mode

In order to integrate the motion steps of a cyclical motion sequence with unchanged positions via a logic control (sequence control, PLC) into the machine process, an internal profile generator with closed-loop position control is utilized.
For each of the positions to be approached with a defined traversing profile, the PLC provides a digital signal.
The velocities for rapid traverse and creep speed are saved in the HACD in the form of parameters. In the HACD, events (e. g. position switching points) are set, which initiate a changeover to various velocities without requiring a PLC signal.
The motion sequence is subordinate to the machine process at any time.

Typical task for the internal signal input in the setup mode

To approach positions in the manual operating mode, internal signal input without closed-loop position control is to be utilized.
The PLC provides a digital signal each for Jog + and Jog -. These signals are used for closing and opening the valve. The velocity for opening and closing the valve is defined in the HACD.

The required components

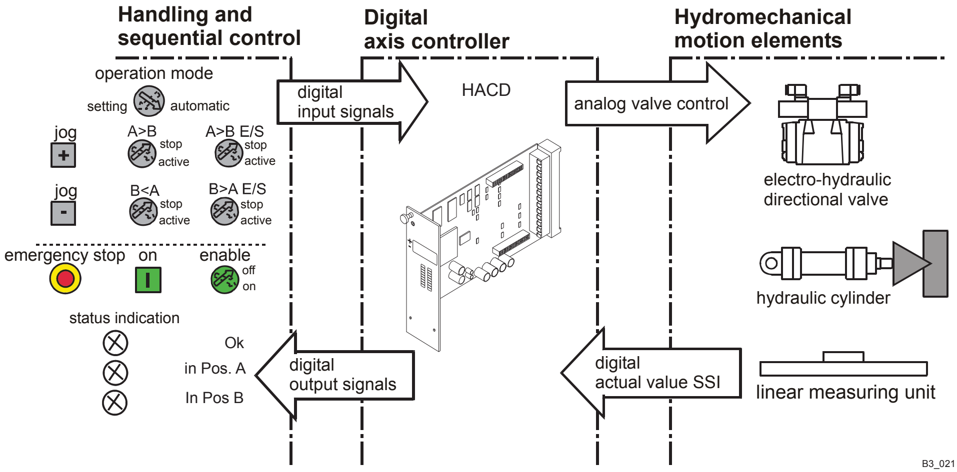


Fig. 155 Required components

The components required for the example described here are shown together with the relevant technical data required for their adjustment.

Excerpt of technical data of the linear measuring unit:

Data format in Gray code,
word length 24 bits,
measurement resolution 5μm per count

Excerpt of technical data of the valve:

Valve input voltage +/- 10V

Electrical and hydraulic installation diagram

Although every system is different, there are common features and common function groups. In the diagram below we distinguished between the handling and the sequential control, the digital axis controller and the hydro-electrical-mechanical motion elements. The functions of the digital axis controller are called through signals from the PLC. In the case described here, the signals are generated directly by keys and switches.

The installation diagram forms the basis for structuring in the card. The designation of the inputs in capital letters is the same as the designation of signals in the Structure Editor. The designations in lowercase letters refer to the terminal assignments on the Euro-format plug-in card.

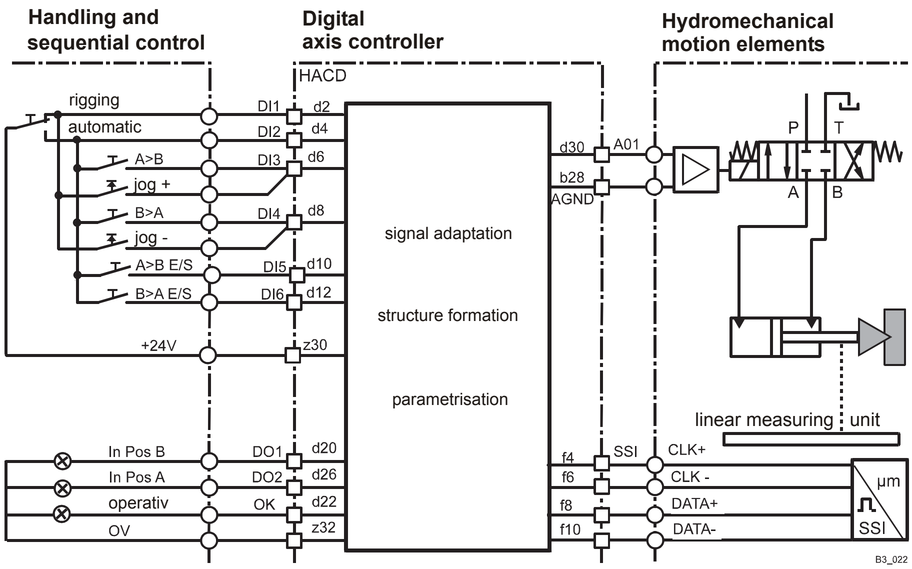


Fig. 156 Schematic illustration of an electrical and hydraulic installation diagram

The wiring shown is of an exemplary, descriptive character. It symbolizes PLC functions. Contradicting signals are not ruled out. Wiring, the generation of signals, the selection and design of operator elements must be planned according to the system requirements.

Safety note:
From a safety point of view, malfunction must be taken into account. For this reason, higher-level and system-specific protective functions must be an integral part of planning.

Startup software and data handling

The BODAC software

BODAC is a software tool for startup. It must be installed on the PC (laptop) that is used for the initial startup.

The designation BODAC stands for
Bosch Rexroth **O**perator Interface for **D**igital **A**xis **C**ontrol.

BODAC is used for

- adjusting input and output signals,
- defining the controller structure,
- entering parameters,
- displaying process data and diagnosis.

The software tool can be downloaded on the Internet at www.boschrexroth.com/hacd

Data exchange between BODAC and the HACD

Establish a connection between the PC and the HACD in order that you can quickly, reliably and properly adjust, save, protect and duplicate the required data for your controller card. The connection is based on RS232. A fixed baud rate is set on the card.

- Connect your PC with the HACD by means of an RS232 cable (1:1 cable)
  e.g. Cable set VT-HACD-1X/03.0/HACD-PC
- Switch on your PC and the HACD
- Install BODAC
- Start BODAC (see documentation RE 30143-B)

Creating a file

The card is to be adjusted to the task at hand and the solution method. The data for adjustment and structuring are saved in a file.

➢ Determine a file name and save the initial status.

Saving the working state

All parameters and structural determinations can easily be saved in a buffer during commissioning. If the work has to be interrupted, it can be resumed without loss of data.

Note: To finalize your work, save the data also permanently in the flash of the HACD card.
See also: Chapter 4.1 “Save”.
See also: Chapter 4.2 "Save parameters to memory".

Adjusting the input and output elements

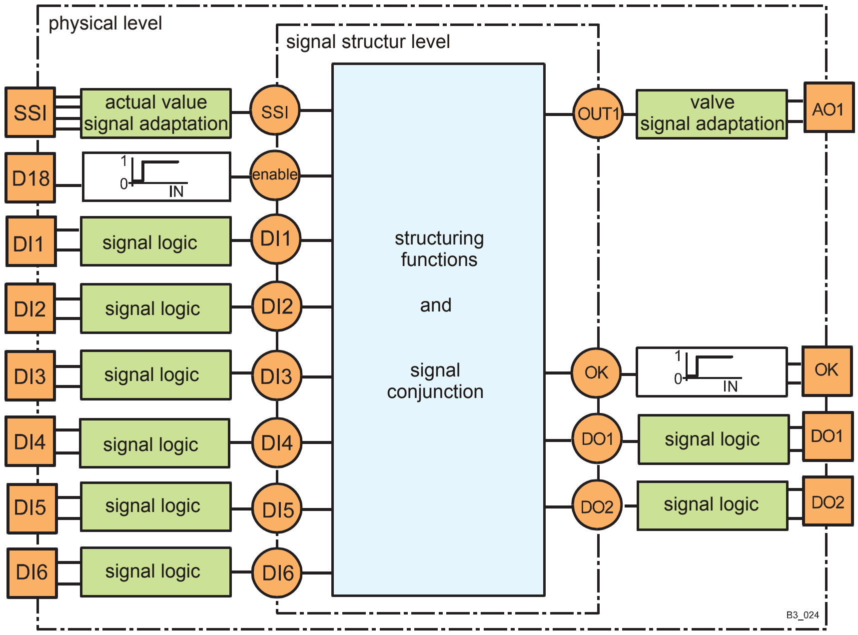


Fig. 157 The input and output elements used for this application

Data input for actual position values

The actual position value is acquired as absolute, digital numerical value on the linear scale. Each position is assigned numerical value. These numerical values are transmitted via the synchronous serial interface (SSI). The control requests data via the clock line from the evaluation electronics on the linear scale. The measuring electronics transmits the actual position value via the data cable to the control.

If several cylinders are required and each cylinder is provided with its own control with an HACD, it is possible to utilize the linear scale also as actual position value for cylinders operating in parallel. A card (the master) determines the read cycle, the other cards receive data within the determined cycle. In our present example, the HACD queries data as the master.

The data are generated in the linear scale in the form of a parallel bit pattern, the data word. The word length (number of bits) depends on the type of linear scale. For the reconversion on the receiver side, the identical word length must be queried. The data are converted into a serial data format, controlled by the clock line. Depending on the type, the value is either Gray-coded or binary-coded.

The linear scale breaks the distance to be measured down into short sections (counts = CTS). The closed-loop control in the HACD operates internally also with short sections, that is, units. A unit represents a physical variable, e.g. 1 Units = 1mm or 1 Units = 1/25 inch. The parameter "CTS/Unit" is required for adjusting the measurement resolution to a useful dimensional unit. The internal command value input is always by a factor of 100 finer than the defined dimensional unit.
Note: The internal control resolution is independent of this.

The offset parameter is subtracted from the numerical value from the scale in order to provide, for example, a numerical value of zero at the starting point.

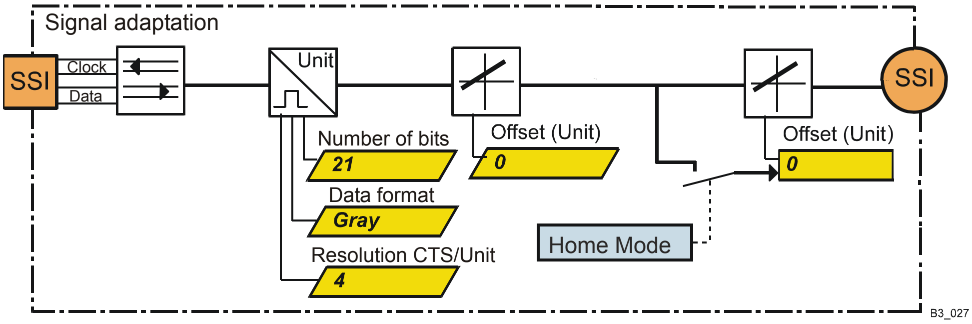


Fig. 158 The parameters for the digital actual position value

- ➢ Enter the parameters shown on the diagram.
- ✓ The data input for actual position values in the SSI format is adapted to the application.

“Enable” input

Without the enable signal, the current values are set to zero, the inputs are not read and the outputs are set to the parameterized idle state. The control process is stopped.

When the enable signal is present, the processor on the HACD is active. The actual values are read in, the inputs queried, the outputs set according to the currently applied logical operations, and the closed-loop control is active. This state is acknowledged through the output signal "OK".

Connection terminal d18

The digital "enable" input must always be connected to terminal d18. The internal enable function is firmly connected to a signal at this terminal.

The structures of signal processing can only be changed while the enable is switched off.
The parameters can also be changed while the enable is applied.

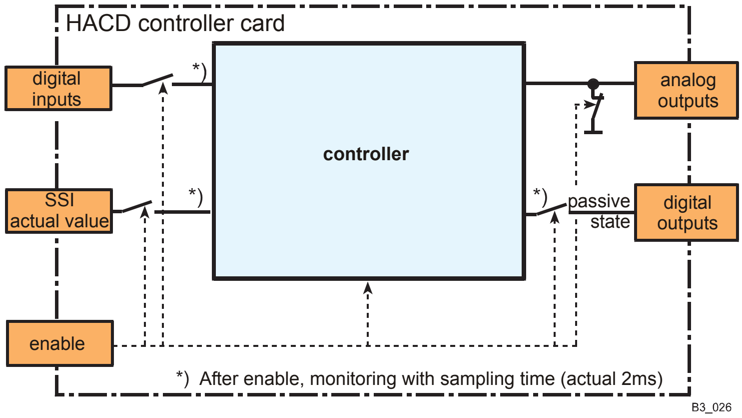


Fig. 159 Functions of the enable signal

✓ The "enable" input can be utilized without any adjustments, a “high” signal enables the control of the HACD card

Inputs with freely assignable functions

Depending on the application, specific functions can be assigned to these inputs. The assignment is made when structures are created. The machine operator applies signals to these inputs via the operator interface, thus initiating functions.

(In this application, these are as follows:
Setup mode, automatic operating mode, Jog +, Jog –, moving to position A, moving to position B; moving to position A at rapid and creep speed, moving to position B at rapid and creep speed)

Signal level

The voltage levels for "0" signal and "1" signal are determined. As "0" signal, voltages of (0 to 5)Volt are evaluated,
as "1" signal, voltages of (15 to UB)Volt are evaluated.
(UB = operating voltage).

Signal logic

Signal logic can optionally be selected, that is, whether the inputs are "low active" or "high active". For functions, which are to initiate a desired reaction also in the event of a cable break, the “low active“ signal logic is to be used (braking inputs, stop inputs, start-up blocking).

The inputs are pre-assigned to the "high active" signal logic.
If required, click the inputs with required “low active logic” in the entry field “low active” in the menu: Configuration / Digital I/O.

✓ The inputs can be used without requiring any adjustments; "high" signals activate the function.

“OK” Output

The output is set when the processor is active and no internal faults are present. The actual values were read in, the inputs queried, the outputs set according to the currently applied logic operations and the closed-loop control operates properly.

Connection terminal d22 The "OK" output is firmly assigned to terminal d22.

Option Enable sets OK Optionally, the enable signal can be used us additional condition. The internal state and the enable signal are then acknowledged with "OK". To this end, select the option "Enable sets OK" in the menu Configuration / Digital I/O.

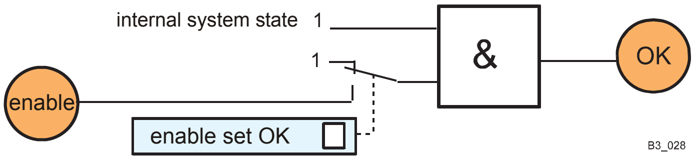


Fig. 160 Options for the “OK” message:

✓ The "OK" output can be used without requiring any adjustments.
"HACD ready for operation" is signaled by a "high" signal.

Outputs with freely assignable functions

Depending on the application, specific functions can be assigned to these outputs. The assignment is made when structures are created. These signals are typically evaluated for acknowledging, for displaying the status or as condition for the machine sequence.
The voltage levels for the "0" signal and "1" signal are determined. As "0" signal, voltages of (0 to 5) Volt are output,
as "1" signal, voltages of (15 to UB) Volt are output.
(UB = operating voltage). Each output can be loaded up to a maximum of 30mA.

You can optionally select, whether the outputs are to operate "low active" or "high active". For functions, which must initiate a desired reaction also in the event of a cable break, the “low active“ signal logic is to be used (for instance for braking, locking, …).
The outputs are pre-assigned in the "high active" signal logic.
If required, click the outputs with required “low active logic” in the entry field “low active” in the menu: Configuration / Digital I/O.

✓ The outputs can be used without requiring any adjustments.
An active function is signaled by a "high" signal.

Analog output for controlling valves

During the adjustment of the analog output signal, the internal signal is converted into a real physical signal according to the requirements of the hydraulic valve. The input variable for signal adjustment is a percentage value, which can be shifted and defined in terms of its range. Then, the percentage value is converted into a physical variable, either as voltage or current value, with assigned range, maximum value, minimum value and polarity.

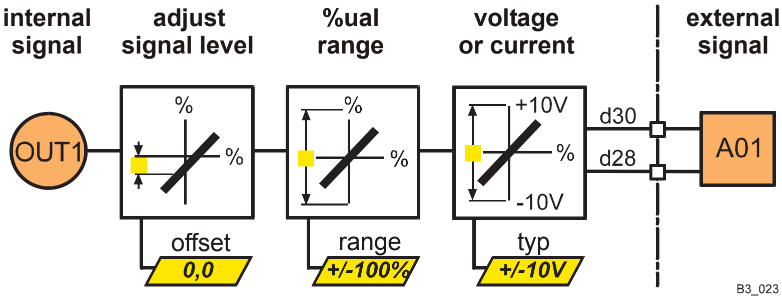


Fig. 161 Signal adjustment element for the analog output for valve controlling

➢ Enter the parameters shown on the diagram.

✓ The output is adjusted to the control input of the valve.

Defining the structure

The control card allows a structural adjustment to the application at hand. This includes signal selection, signal assignment and the selection of arithmetical closed-loop control algorithms for processing the signals.
Thanks to the creation of structures with concrete reference to the real system, the universal control card becomes an application-specific control card. (This also results in a reduction in the relevant parameters for optimizing the control unit.)
The assignment is always made by selecting prepared functions from pull-down menus.

Block-specific structure

32, individually selectable, block-specific structures can be defined. Each block is identified by a block number. Block-related structure elements are:

- Activation of the block (block triggering)
- Block-specific signal generation
- Setting of events

The diagram below shows the inputs and outputs used in this example, and the block-specific and block-neutral elements for structuring.

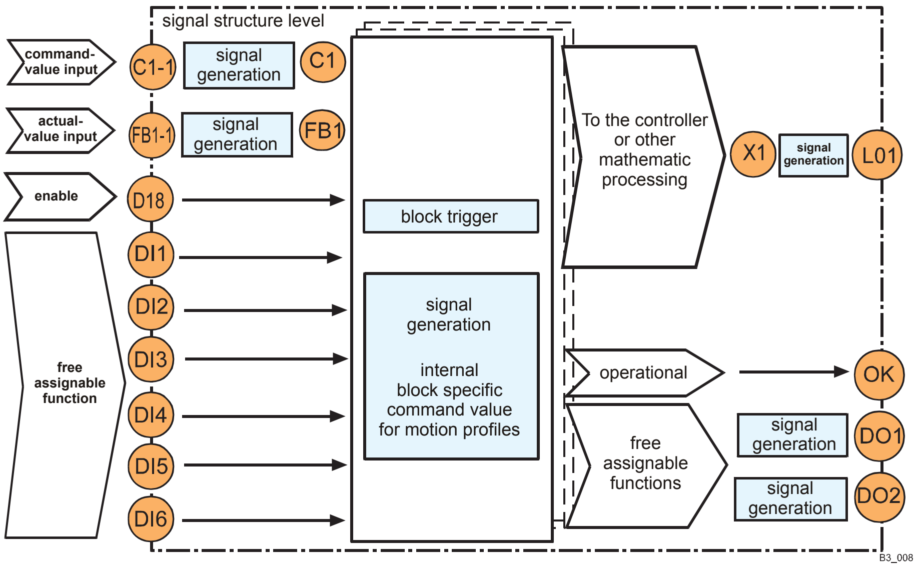


Fig. 162 Overview of the definition of structure elements

The structure elements

The structure elements comprise static parts, the structure supporting points, and dynamic parts, the signal generation. The structure supporting points can be selected in the motion data window during operation, e. g. for diagnosis purposes. The virtual structure supporting points are useful for delimiting and describing the individual structure elements. In signal generation, the signal sources are selected and logically linked.

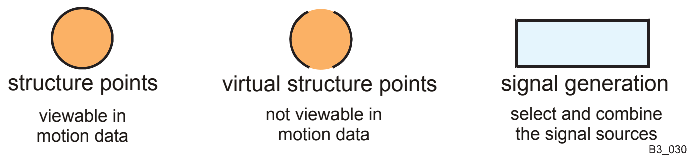


Fig. 163 Structure elements and symbols used

Signal structure referred to the inputs

Signal processing for command value inputs

In this application, the command values for closed-loop controlling are provided through internal, parameterized signal inputs. The card is not to evaluate external command value signals at the inputs.

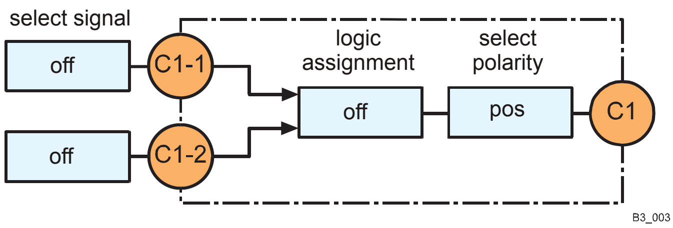


Fig. 164 Structure element for command value inputs

- ➢ Turn signal selection to "OFF" at C1-1.
- ➢ Turn signal selection to "OFF" at C1-2.
- ➢ Switch logic operations to "OFF".
- ✓ External command value sources and signal processing are switched off.

Signal processing for actual value inputs

The actual value of the controlled variable is digitally acquired and transferred using the standard transmission protocol SSI (serial synchronous interface). This data take-over is already configured in the input adjustment. In the structure definition, it is to be determined that the data are fed as actual value via feedback input "FB1" to the control unit.

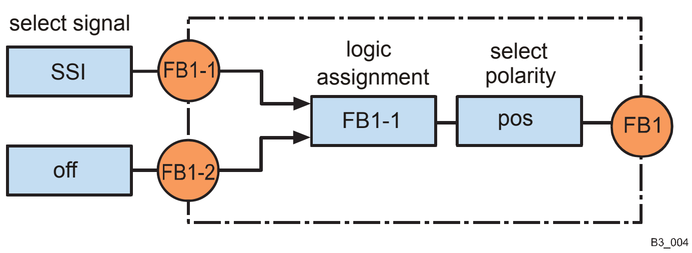


Fig. 165 Structure element for actual value inputs

- ➢ Assign the SSI signal to structure supporting point FB1-1 and pass it on with positive polarity to structure supporting point FB1 without any further logic operations.
- ➢ Turn signal selection to "OFF" at FB1-2.
- ✓ The actual value signal for closed-loop controlling is selected and fed to the controller with positive polarity.
  The second actual value source is switched off.

Signal structures related to blocks

Block-related signal structures can be used to create traversing profiles.
The internal profile generation supersedes the external command value provision, like it is output by a motion control. In conjunction with internal profile generation even

simple logic controls can be used to solve automation tasks.
The logic control (PLC) can control a hydraulic cylinder the help of digital command signals and digital acknowledgement signals.

Advancing from one motion block to the next needs not necessarily to be defined in the program, but can be initiated by external events or internal trigger conditions.
In every motion sequence, events are to be defined that are useful for the sequence. Also unexpected events in exceptional situations such as emergency stop activation, power failure or device failure can be handled according to the same method.

A special feature of this control is that dwell times and process times for the sequence are not specified. A block sequence is generated exclusively through events in the machine process.

Various blocks are available in the control for structuring the traversing profile. To structure this traversing profile, individual movements must be subdivided into blocks.

The signal structures, which are related to blocks, comprise the definition of the trigger logic for starting the block, signal generation within the block, linking of events (events that can be called up in the HACD) and the identification of internal operational states.

Trigger condition

Trigger conditions are logically linked trigger events. Trigger events can be external signals, internal operational states related to blocks, or internal signals not related to blocks. Internal operational states are generated while the currently active block is being processed.

Block sequences

Block sequences can be generated by combining trigger conditions and setting internal events. Here, the difference between an event control and a sequence control becomes apparent. In a sequence control, the sequence is firmly determined; parameterized, logic queries initiate prepared branching or a stop. In contrast to this, the event control does not follow a firmly defined sequence. A sequence is generated exclusively by the occurrence of cyclically queried events. In this way, sequences are possible, which were not programmed before, but result exclusively from a sequence of events in the machine process and the operation.

Distinction between structuring and parameterization

Structuring defines the signal generation, events and logic queries for the trigger conditions.

The parameterization quantifies defined structures. For most of the parameters, this is feasible during operation (online).

Events

In our example we use the events "Dwell", "Flag" and "LS1".

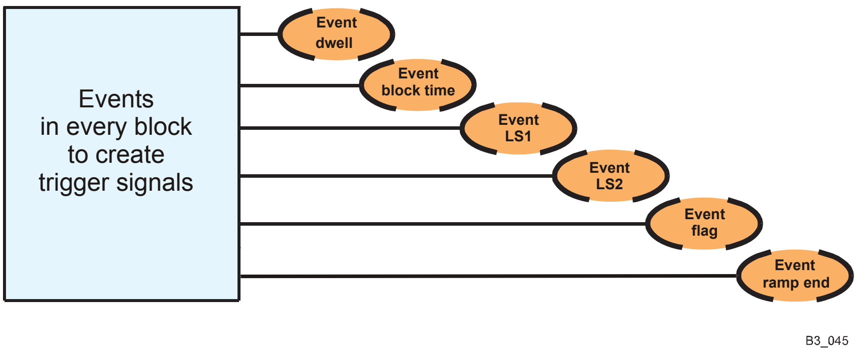


Fig. 166 Events for defining the logic for block triggering

The event “flag”

The flag is an internal signal for creating a definable signal state within the HACD as callable event. It can be used for block triggering. The internal flags can be set in the menu "Configuration/internal flags".

In this application flag 2 is used to signal the activation of the relevant block.

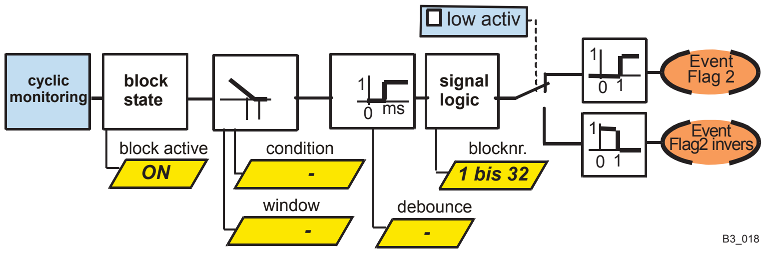


Fig. 167 Parameters for the definition of flag 2

The event "dwell" The event "dwell" is a freely definable timing element. Its start time can be linked to various states, and at the end of the dwell time, various actions can be initiated. In this application, subsequent blocks are triggered at the end of dwell times.

The event "LS1" The event "LS1 - loop threshold 1 –" queries states of the control loop.

Signals and block sequences for changing over to the automatic operating mode

For the automatic operating mode, the motion profile given for the task at hand is subdivided into motion segments. These can be called from the machine sequence control. Within the HACD, stepping to subsequent blocks takes place without any additional external signals.

The functional sequence

First, the position control loop is closed, and the variable actual position, which is not yet controlled, is read in as setpoint position (block 3). Then, a firm setpoint position is fed to the closed position control loop (block 2).

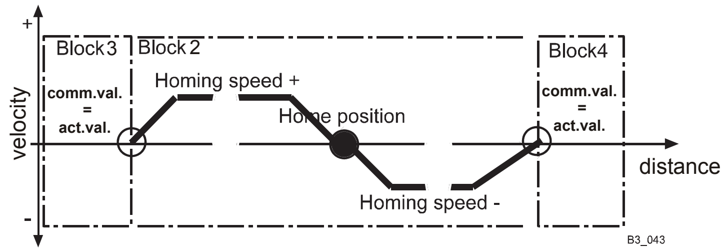


Fig. 168 Sequences for transition into the automatic operating mode

Signal structure in block 3 for closing the position control loop

In block 3 the position control loop is closed. In order that this takes place without any movements, the actual position of the cylinder is read in and taken over as setpoint position (setpoint=LFB). If the actual value changes at that operating stage, the command value changes as well. The position control is active, but a certain position is not yet maintained. The duration of this operating stage can be parameterized to include a dwell time. The end of the dwell time is the event that triggers the subsequent block.

Note on the parameterization:
In our example we set the dwell time to a value of zero in order to leave this operating stage as quickly as possible.

Signal structure in block 2 for controlling in position

In block 2 the last command value (block 3) is used for controlling. The triggering event for this block is "End of dwell time of block 3".

Signal structure in block 2 for approaching the home position

In block 2 a home position, which is useful for the relevant machine, is approached and maintained with the help of the position control. The triggering event for this block is "Digital input DI1 is active".

This first positioning process at the home position is not yet part of the automated motion sequence, i.e. the callable traversing profile, but a typical procedure for transition into the automatic operating mode. In any case, a fixed command value must be fed to the position control in order that the position can be maintained. As block 2 is activated, flag 2 is set immediately. It indicates that block 2 is active.

Note on the parameterization:
In our example we set the parking position to plus 20 Unit and the velocity for approaching the parking position in the positive direction (V+) and negative direction (V-) to 250 Unit/s.

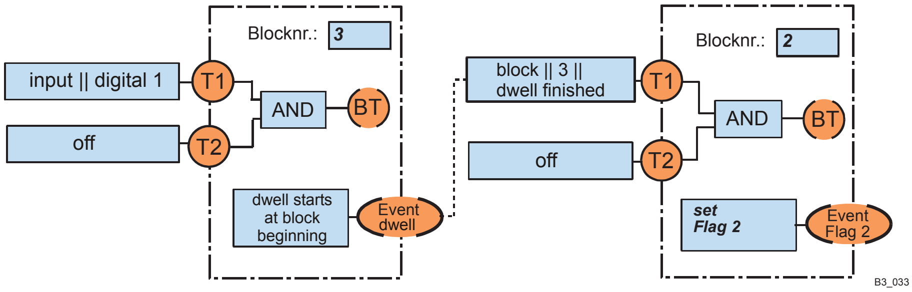


Fig. 169 Block-specific signal structure for block 3 and block 2; "Changing over to automatic operating mode".

Signal processing in block 3 and 2

A signal at digital input "DI 1" activates block 3. It starts a dwell time at the beginning of the block.
Block 2 triggers upon the condition "dwell of block 3 finished". Block 2 queries the conditions for flag 2 and sets it, if required. The condition is fulfilled as soon as block 2 is active.

Signals and block sequences for moving to position B in the automatic operating mode

The functional sequence

The operator actuates a switch in order to approach position B. The control brings the machine part to position B (block 4) independently of the actual position. A light signal indicates to the operator that the position has been reached (output DO1).

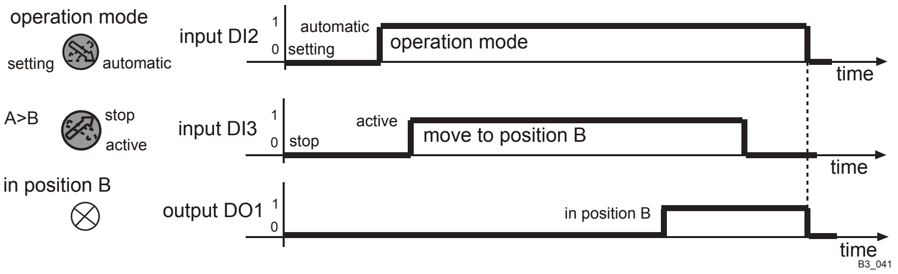


Fig. 170 Signals from the operator panel for moving to position B.

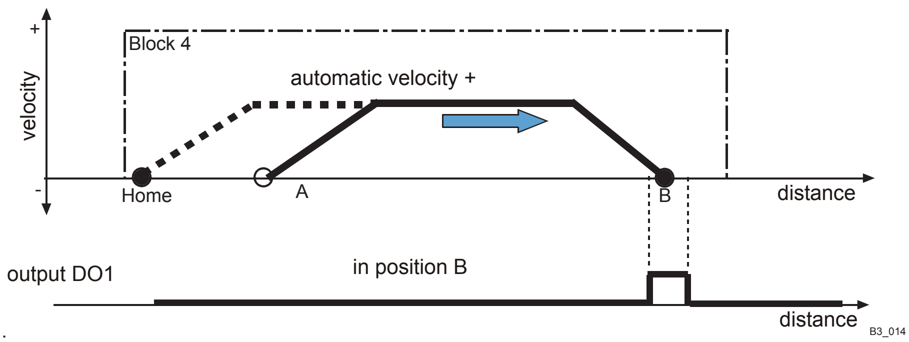


Fig. 171 Velocity profile for moving to position B in the automatic operating mode.

Signal structure in block 4 for moving to position B

Position B is approached in block 4.
Two trigger conditions are queried to this end.
Firstly, the automatic mode is set up, which is signaled by flag 2.
Secondly, the operator wants to approach position B, which is indicated by the signal at input DI3.

Block 4 executes the parameterized instructions. Position B is maintained in the closed-loop control mode.

Note on the operation:
Once activated, the traversing movement towards position B can be stopped by deactivating the traversing signal at input DI3.

Note on the parameterization:
In our example we set position B to Unit 16000 and select +/- 1000 Unit /s as velocity for approaching position B.

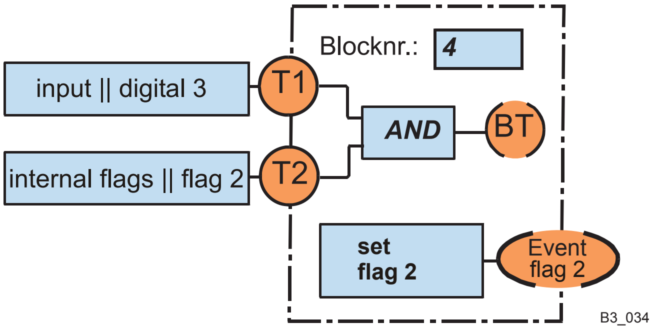


Fig. 172 Block-specific signal structure for block 4 "Moving to position B"

Signal processing in block 4

A signal at digital input "DI 3" and "flag 2" trigger block 4. The conditions for flag 2 are cyclically queried. They are fulfilled as soon as block 4 is active.

Signals and block sequences for moving to position A in the automatic operating mode

The functional sequence

The operator actuates a switch in order to approach position A. The control brings the machine part to position A (block 3) independently of the actual position. A light signal indicates to the operator that the position has been reached (output DO2)

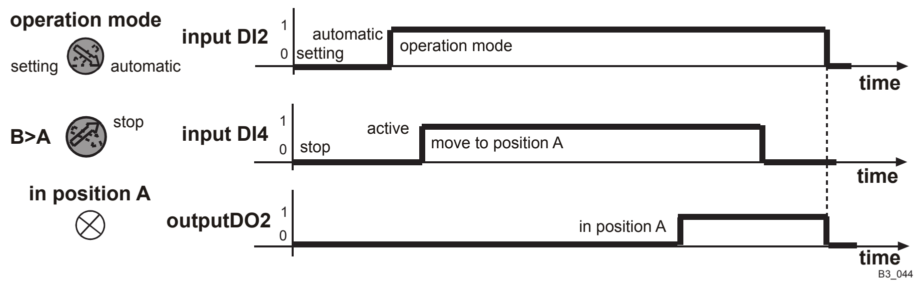


Fig. 173 Signals from the operator panel for moving to position A.

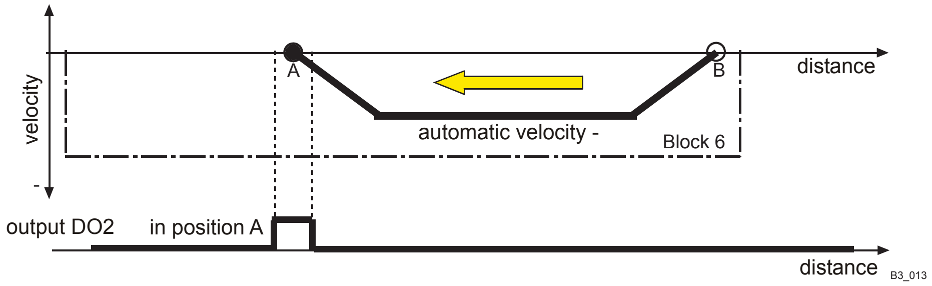


Fig. 174 Velocity profile for moving to position A in the automatic operating mode.

Signal structure in block 6 for moving to position A

Position A is approached in block 6.
Two trigger conditions are queried to this end.
Firstly, the automatic mode is set up, which is signaled by flag 2.
Secondly, the operator wants to approach position A, which is indicated by the signal at input DI4.

Block 6 executes the parameterized instructions. Position A is maintained in the closed-loop control mode.

Note on the operation:
Once activated, the traversing movement towards position A can be stopped by deactivating the traversing signal at input DI4.

Note on the parameterization:
In our example we set position A to Unit 5000 and select +/- 1000 Unit /s as velocity for approaching position A.

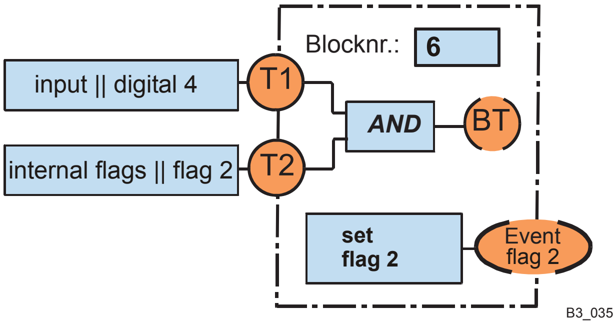


Fig. 175 Block-specific signal structure for block 6 “Moving to position A”

Signal processing in block 6

A signal at digital input “DI4” and flag 2 trigger block 6. The conditions for flag 2 are cyclically queried. They are fulfilled as soon as block 6 is active.

Signals and block sequences for approaching position B at rapid and creep speed

Functional sequence

By switching the switch "A>B R/C" to position "active" an internally saved traversing profile is called. The velocity is increased to rapid speed and kept constant. The axis moves towards A until the rapid speed limit is reached. The velocity is reduced to creep speed and corrected to ensure proper positioning at the target position. A light signal indicates to the operator that target position B is reached (output DO1).

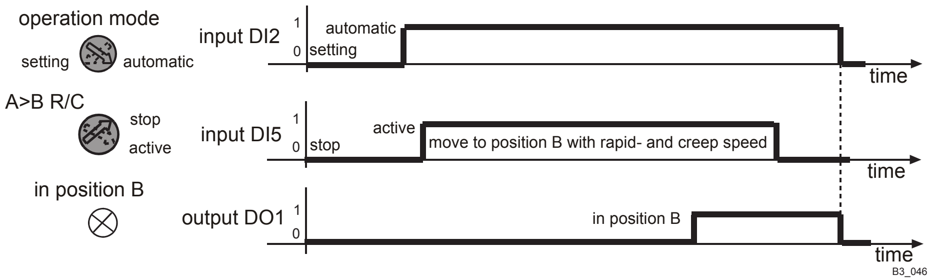


Fig. 176 Signals from the operator panel for moving to position B at rapid and creep speed.

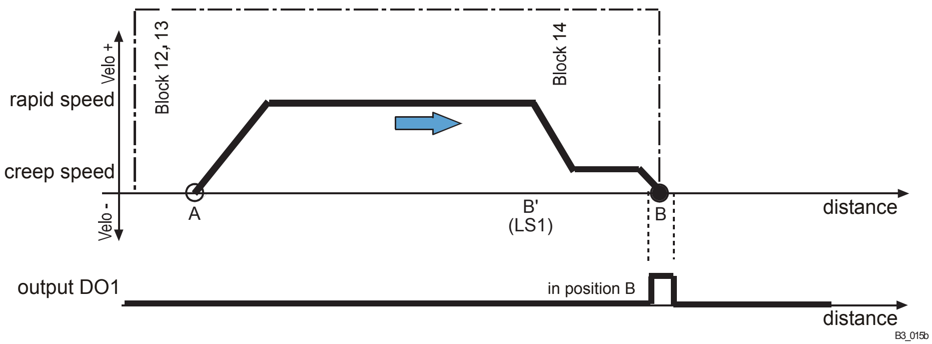


Fig. 177 Velocity profile for moving to position B at rapid and creep speed in the automatic operating mode.

Signal structure in blocks 12, 13, 14 for moving at rapid/creep speed to position B

Position B is approached with block sequence 12, 13, 14.
Two trigger conditions are queried to this end.
Firstly, the automatic mode is set up, which is signaled by flag 2.
Secondly, the operator wants to approach position B at rapid and creep speed, which is indicated by the signal at input DI5.

Block 12

Block 12 is used as intermediate block. It is used, if the profile is extended to form a rapid/creep speed profile.

Block 13

Status "block || 12 || dwell finished" triggers block 13. Block 13 increases the velocity to rapid speed and keeps it constant until the end of the command value ramp is reached.
At the limit, block 14 is triggered.

Block 14

The status "Block || 13 || dwell finished" triggers block 14 for decelerating to and continuing the movement at creep speed until the velocity is corrected for positioning at the target position.

If the automatic operating mode continues to remain active, the closed position control loop maintains position B.

A light signal indicates to the operator that target position B has been reached (output DO1).

Note on the operation:
Once activated, the traversing movement towards position B can be stopped by deactivating the traversing signal DI5.

Note on the parameterization:
In our example, position B is set to Unit 16000. The selected rapid speed is 2000 Unit /s, the creep speed 250 Unit/s. At Unit 15000 changing over to creep speed takes place.

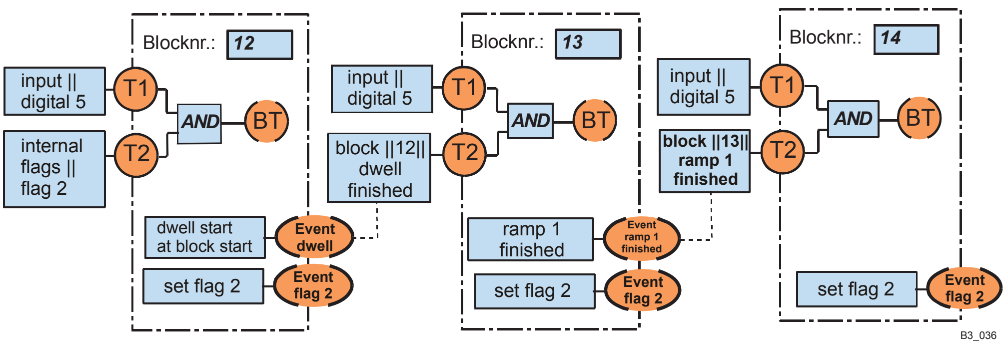


Fig. 178 Block-specific signal structure for blocks 12, 13, 14 "Moving to position B at rapid and creep speed"

Signal processing in blocks 12, 13, 14

A signal at digital input "DI 5" and flag 2 trigger block 12, which has a minimum dwell time of 0sec. Status “Block ||12|| dwell finished“ triggers block 13. This initiates the movement at rapid speed towards B. When the command value ramp has reached the changeover point (ramp finished), block 14 becomes active.
Status "Block||13|| ramp finished" triggers block 14 for decelerating the movement to creep speed and continuing it towards B until the point of positioning. All blocks query the conditions for flag 2. The condition is fulfilled as soon as the relevant block is active.

Signals and block sequences for approaching position A at rapid and creep speed in the automatic operating mode

Functional sequence

By pressing the key from B to A at rapid/creep speed (B>A/RC) an internally saved traversing profile is called. The velocity is increased to rapid speed and kept constant. The axis moves towards A until the rapid speed limit is reached. The velocity is then reduced to creep speed and corrected for positioning at the target position. A light signal indicates to the operator that target position A has been reached (output DO2).

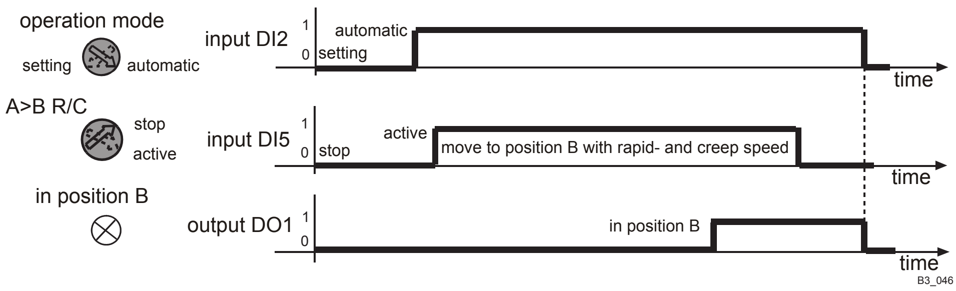


Fig. 179 Signals from the operator panel for moving to position A at rapid and creep speed.

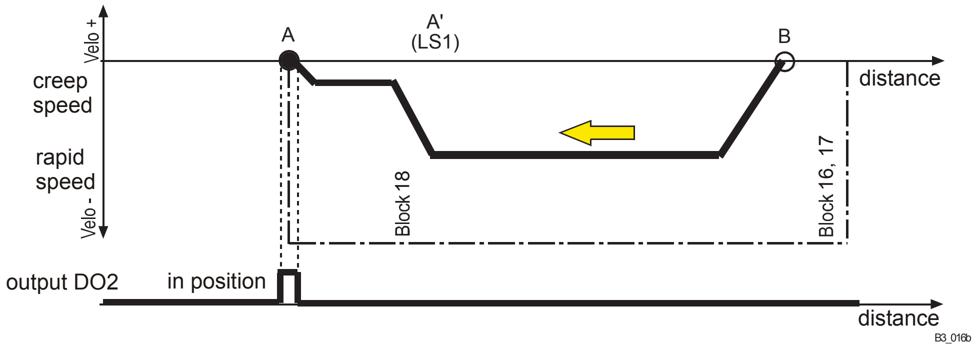


Fig. 180 Velocity profile for approaching position A at rapid and creep speed

Signal structure in blocks 16, 17, 18 for moving at rapid/creep speed to position A

Position A is approached with block sequence 16, 17, 18.
Two trigger conditions are queried to this end.
Firstly, the automatic mode is set up, which is signaled by flag 2.
Secondly, the operator wants to approach position A at rapid and creep speed, which is indicated by the signal at input DI6.

Block 16

Block 16 serves as intermediate block. It is used, if the profile is extended to form a rapid/creep speed profile.

Block 17

The status “Block ||16|| dwell finished” triggers block 17. Block 17 increases the velocity to rapid speed and maintains it constant until the end of the command value ramp is reached.
At the limit, block 18 is triggered.

Block 18

The status “Block ||17|| dwell finished” triggers block 18 for decelerating to and continuing the movement at creep speed until the velocity is corrected for positioning at the target position.
If the automatic operating mode continues to remain active, the closed position control loop maintains position A.
A light signal indicates to the operator that target position A has been reached (output DO2).

Note on the operation:
Once activated, the traversing movement towards position A can be stopped by deactivating the traversing signal DI6.

Note on the parameterization:
In our example we set position A to Unit 5000. The rapid speed is 2000 Unit /s, the creep speed 250 Unit/s. At Unit 6000 changing over to creep speed takes place.

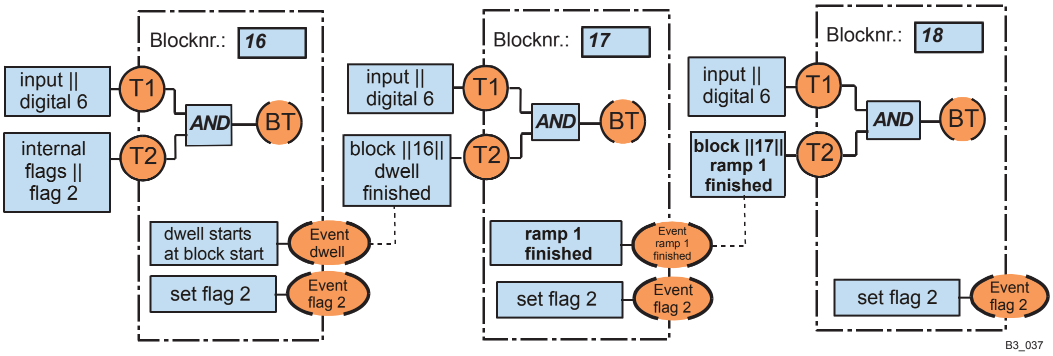


Fig. 181 Block-specific signal structure for blocks 16, 17, 18 "Moving to position A at rapid and creep speed"

Signal processing in blocks 16, 17, 18

A signal at digital input "DI 5" and flag 2 trigger block 16, which has a minimum dwell time of 0sec. Status "Block ||16|| dwell finished" triggers block 17. This initiates the movement at rapid speed towards A. When the command value ramp has reached the changeover point (ramp finished), block 18 becomes active.
Status "Block ||17|| ramp finished" triggers block 18 for decelerating the movement to creep speed and continuing it towards A until the point of positioning.

All blocks query the conditions for flag 2. These conditions are fulfilled as soon as the relevant block is active.

Signals and block sequences for operation with jog + and jog – in the set-up mode

The traversing signal in the selected direction opens the hydraulic valve in the assigned direction at the parameterized valve opening velocity. (“Opening“ means shifting from the central position.) A corresponding oil flow will be obtained, which moves the cylinder in the desired direction in dependence upon friction and process forces. When the traversing signal is withdrawn, the valve closes at the parameterized valve closing velocity.

Functional sequence Jog+

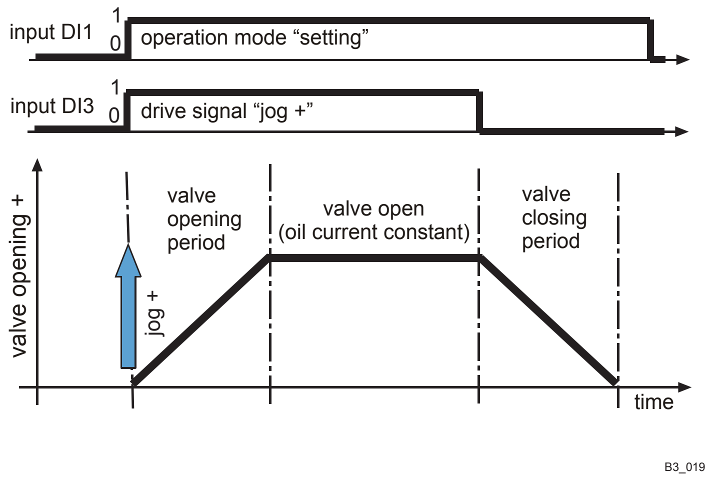


Fig. 182 Traversing in the set-up mode "Jog +" (tip +)

The “Setup“ operating mode is pre-selected on the control panel (input DI1).
The operation of pushbutton A>B results in a traversing signal (input DI3). The HACD then moves the valve from the central position (valve closed) and an oil flow builds up for traversing in the direction "Jog +". The cylinder moves according to the oil flow and the cylinder area.
When the pushbutton is no longer actuated, the valve closes. The oil flow is reduced, and hence the velocity of the cylinder. The movement is completed when the valve is again in its central position. The cylinder drifts further at a small positive or negative velocity.

Note:
In the setup mode, the position is not closed-loop controlled.

Note on the parameterization:
In our example the traversing limit for Jog + is set to Unit 20000. The jog velocity is 500 Unit /s. The controller is switched off in this block.

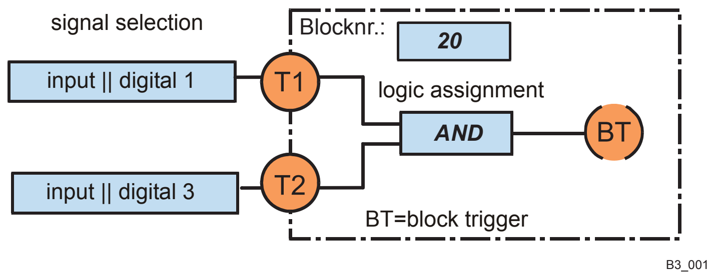


Fig. 183 Block-specific signal structure for block 20 (Jog+)

Signal processing in block 20

The signals that are simultaneously applied at digital input "DI 1" and “DI 3” activate block 20.

Functional sequence Jog-

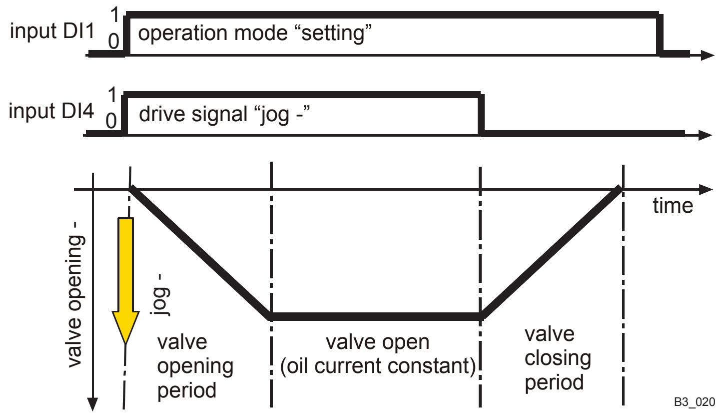


Fig. 184 Traversing in the set-up mode "Jog -" (tip-)

The “Setup“ operating mode is pre-selected on the control panel (Input DI1).
The operation of pushbutton A>B results in a traversing signal (input DI3). The HACD then moves the valve from the central position (valve closed) and an oil flow builds up for traversing in the direction "Jog -". The cylinder moves according to the oil flow and the cylinder area.
When the pushbutton is no longer actuated, the valve closes. The oil flow is reduced, and hence the velocity of the cylinder.The movement is completed when the valve is again in its central position. The cylinder drifts further at a small positive or negative velocity.

Note:
In the setup mode, the position is not closed-loop controlled.

Note on the parameterization:
In our example the traversing limit for Jog - was set to Unit 0. The jog velocity is 500 Unit /s. The controller is switched off in this block.

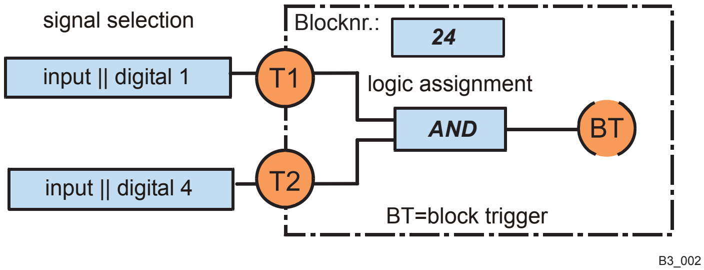


Fig. 185 Block-specific signal structure for block 24 (Jog-)

Signal processing in block 24

The signals that are simultaneously applied at digital input “DI 1” and digital input “DI 4” activate block 24.

Signal generation for command and actual values for all operating variants available

The signal generation for the command value and the actual values are to be defined in each block. This application of the HACD does not require different signal processing in the blocks. The same setting must be entered in all blocks.

Signal generation that can be used for all blocks

The external command value is switched off.

The feedforward of an internal command value is activated.

Signal forming for positive and negative signals is required in all blocks.

An "additional velocity feedforward by means of a signal" is switched off for both, positive and negative signal forming.

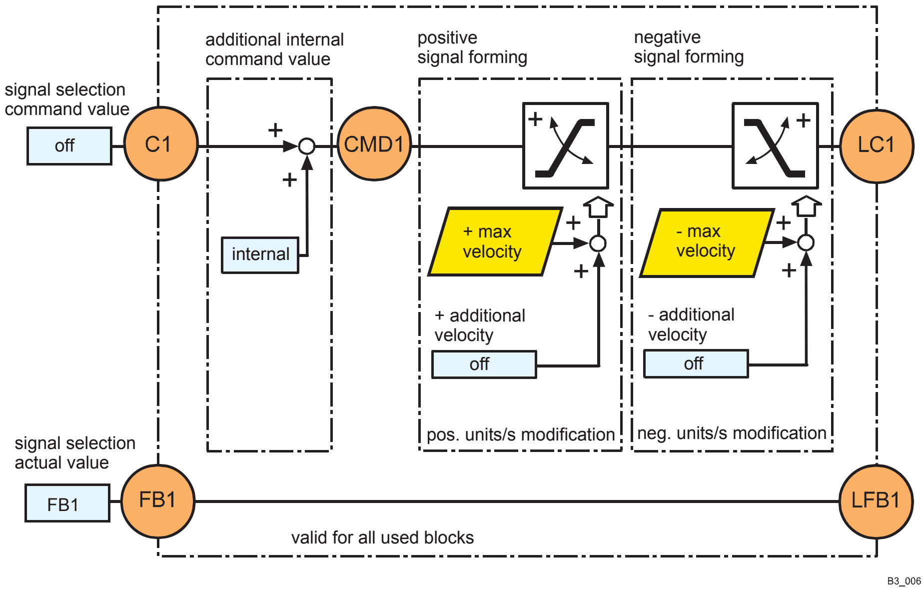


Fig. 186 Block-related signal generation for command and actual values in all blocks.

Entries in the individual blocks according to the following list:

- Signal selection at C1 to “OFF”
- Set the additional internal command value to “ON”.
- Turn + additional velocity by means of signal to “OFF”.
- Turn - additional velocity by means of signal to “OFF”.
- Pass FB1 input signal to output LFB1 without any changes.

Structure of the core function

The core function (controller) of the HACD is available in a selection menu. Upstream of the controller, there are the input structure and block-specific structuring. Downstream of it are output structures that branch to the outputs.

Required core functionality

In this application a “controller” is required as core function of the HACD card. Command and actual values are cyclically read in, and the output is changed according to the controller setting. The possibility of feeding additionally state signals to the controller output is not required.
For the movement in the set-up mode, the cylinder is not closed, but open-loop controlled. For such operating mode variants the controller can be switched off in the block-specific parameterization.

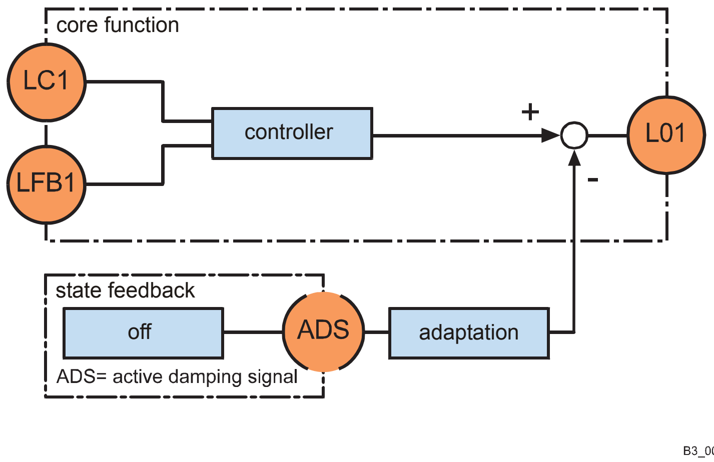


Fig. 187 Core function of the HACD card.

- ➢ Select "Controller" as arithmetic core function.
- ➢ Switch the state feedback (active damping signal) "OFF", enable signal adaptation.
- ✓ The HACD card generally operates as controller without active damping.

Note: The parameters of the controller must be set block-specifically.

For the set-up mode the controller must be switched off block-specifically in block 20 and block 24.

Output signal structure

The output of the core function can also be linked with other signals, before the signals are physically set up for controlling the actuating variable.

Required output structure No additional signal logic required.

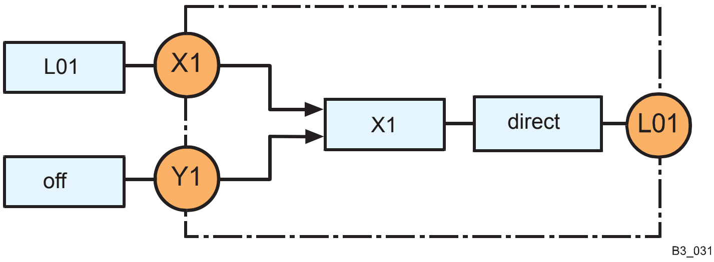


Fig. 188 Structure element of output signal generation "X1/Y1 --- OUT1"

- ➢ Assign the "LO1" signal to structure supporting point "X1" and pass it on to structure supporting point "L01" without any further logic operations.
- ➢ Pass the signal assignment "OFF" on to structure supporting point "Y1".
- ✓ Controller output 1 is connected to structure supporting point X1.
- ✓ Structure supporting point Y1 does not accept or issue any signals.
- ✓ The direct passing on of the signal to output "OUT1" is activated. Output adjustment is active and can be parameterized.

Setting parameters

Overview of setup of groups

The parameters are grouped as follows:

- Parameters for the 32 blocks
  - For the generation of the trigger signal
  - For the command value generation
  - For the controller setting
- Parameters for the active damping function
  - State feedback
  - Disturbance variable feedforward
- Parameters for the output signal generation

Parameters for the 32 blocks

Parameters for block triggering

The parameters for block triggering quantify the events for the generation of the trigger signal.

These events were explained in the section of block structuring. The following elements are used:

- Dwell at the beginning of the block
- Loop threshold 1
- Internal flag 2

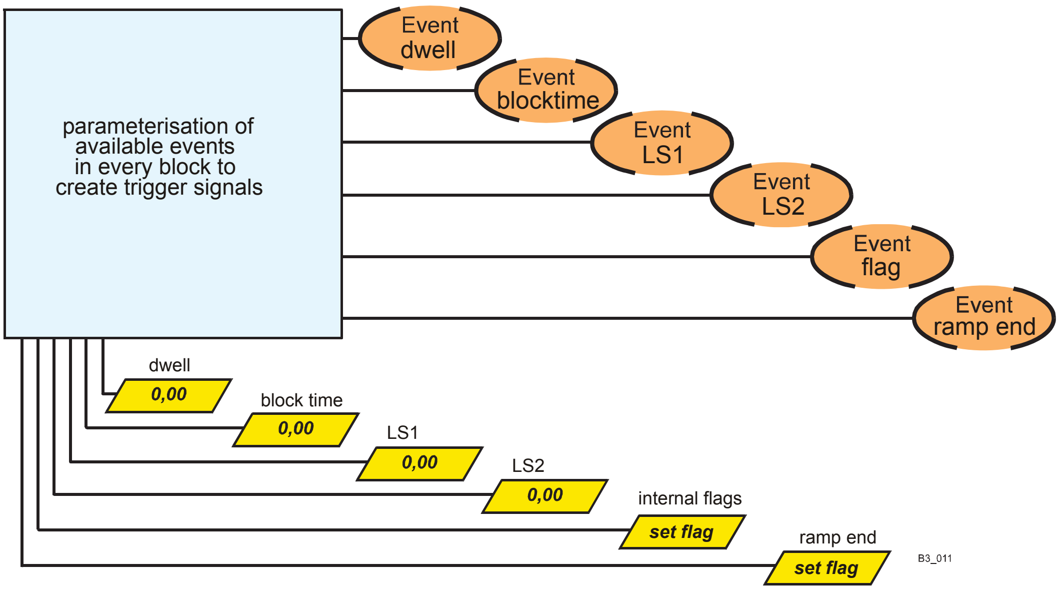


Fig. 189 Parameters for quantifying events for block triggering

Parameters for the block-specific generation of command values

This is preceded by the input command value generation. The latter is independent of the currently active block. Based on this, block-specific, internal command values can be added to the input command value.

Adding internal command value signals

In the structure definition, command value "internal" is defined and selected as variable to be added. During the parameterization, the value "0.00" is assigned to the variable to be added. When the external command value is switched off, the controller can still use the parameterized internal command value. This is useful for creating block-specific command value profiles.

The summated command value is fed as "CMD1" to block-specific command value forming.

In the example, no internal command value source is used. The command values are entered directly as parameter values.

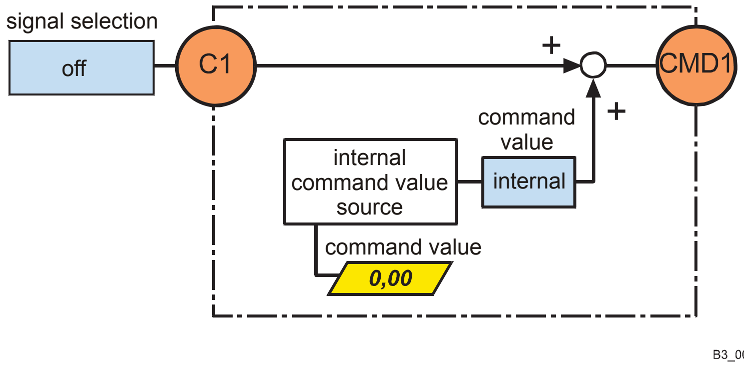


Fig. 190 Block-specific command value signal generation

Command value forming

An essential precondition for steady characteristics of the control variable is the continuous provision of a command value. For this reason, the signal is formed by transfer elements before it is passed on as "loop command 1" (LC1) to the controller. The change rate of the signal is the object of this parameter group. The time required for building up and reducing the max. signal change rate provides an S-shape in the signal curve as a function of time. We therefore use the term S-ramp.

The positive and negative signal change rate can also be dynamically changed analogously to a signal. The signal is selected when the structure is determined. This function is deactivated in the example.

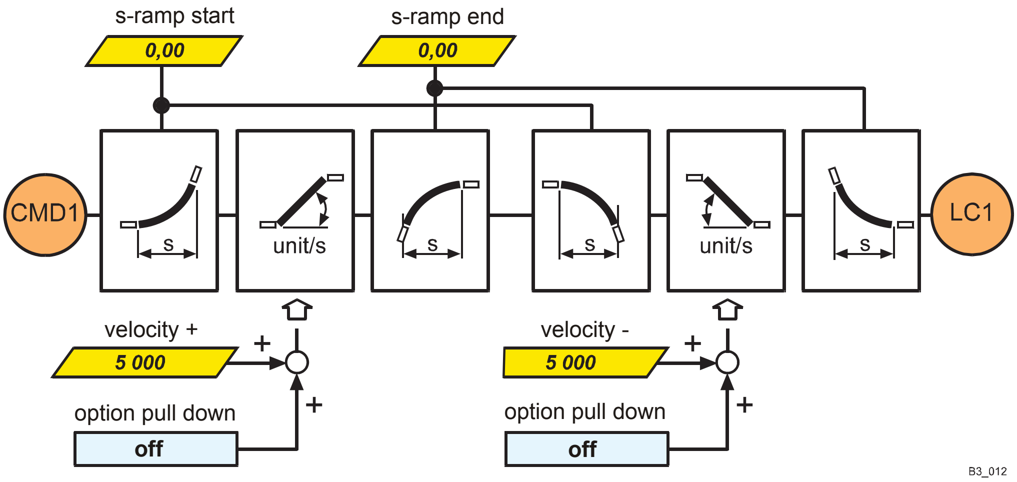


Fig. 191 Command value forming for all blocks

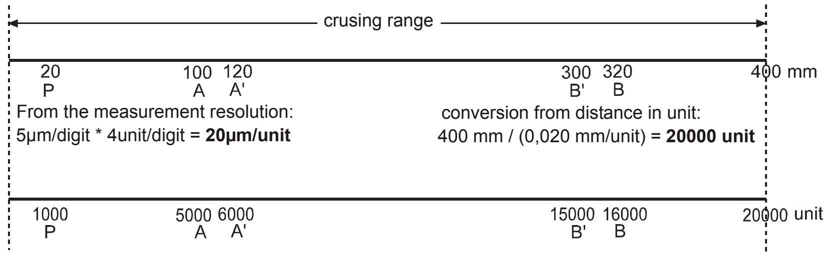
Command value forming and physical variables

In this application, the input and output signal of command value forming is an image of the distance in Units.
(1 Unit corresponds to 0.020mm)

The change rate of 1 Units/s thus results in a velocity of 0.02mm/s.

If a time of 1s is parameterized as build-up and reduction time of the change rate (S-ramp time indication), this results in an acceleration of (0.02 mm/s)/ 1s = 0.020mm/s².

These values are used in the table for representing the motion profile for the task.



motion	blocknr.	position	position parameter	velocity	velocity parameter	acceleration ACC and DEC	s-ramp start (sart acceleration)	s-ramp end (slow down acceleration)	controller	c-adjustment like in block 1
		mm	unit	mm/s	unit/s	mm/s²	s	s		
without	1	0	0	100	500	500	1,0	1,0	on	-
home	2	20	1000	50	250	250	1,0	1,0	on	yes
A>B	4	320	16000	200	1000	500	2,0	2,0	on	yes
B>A	6	100	5000	200	1000	500	2,0	2,0	on	yes
										yes
A>B R/C	12	300	15000	400	2000	500	4,0	4,0	on	yes
A>B R/C	13	300	15000	400	2000	500	4,0	4,0	on	yes
A>B R/C	14	320	16000	50	250	250	1,0	1,0	on	yes
										yes
B>A R/C	16	120	6000	400	2000	500	4,0	4,0	on	yes
B>A R/C	17	120	6000	400	2000	500	4,0	4,0	on	yes
B>A R/C	18	100	5000	50	250	250	1,0	1,0	on	yes
jog+	20	400	20000	100	500	500	1,0	1,0	off	-
jog-	24	0	0	100	500	500	1,0	1,0	off	-

B3_048

Fig. 192 Parameter list with the following assignment. Motion – Block number – Traversing profile – Controller setting

Parameters for the controller setting

The structure of the system determines the stiffness, the mechanical resonant frequency of the controlled system and damping within the controlled system. The control parameters must be adjusted accordingly. Derived from this, the same control settings can be used for all blocks.
In exceptional cases, it may be useful to change the control parameters for special operating states.

Parameterization of the controller with block 1

The HACD meets these requirements in that the control setting of block 1 can be taken over by all the other blocks by means of an option switch. This offers the advantage that the closed control loop has to be parameterized only once for all blocks, but is still flexible enough for deviations in special cases.

In our example, block 1 is not used for the traversing profile. It is reserved for the controller settings.

Objective of the parameterization

Ideally, the controlled variable is to change like the command value independently of any disturbing variables.
For this purpose, the controller is provided with setting options in order that the closed control loop can be successfully matched to the features of the real system.
How the controller responds to a control error for creating a signal at the output is called control behavior. The proportional, the integral and the derivative-action components of the control behavior can be parameterized (PID-controller).

Proportional component

The P-component of the controller proportionally amplifies the control error (proportional control behavior).

Integral-action component

The I-component of the controller proportionally amplifies the control error and the duration of the deviation. (Integral-action control behavior)

Derivative-action component

The D-component of the controller proportionally amplifies the change rate of the control error (derivative-action control behavior)

Options for the system behavior

The integral-action control characteristics of the HACD offers 3 options. These depend on the magnitude of the control error:

I-component frozen
The current value of the I-component is kept constant when the error falls below a parameterized threshold.

I-component active
The value of the I-component changes according to the set parameters.

I-component switched off
The value of the I-component is switched over to zero when the error exceeds a parameterized threshold.

The summated components of the various reactions to the control behavior are fed through a low-pass filter. In this way, signal oscillations can be dampened, which would anyway not result in a change of the controlled variable, but only in an ineffective energy consumption due to the initiated actuating processes, without having an actual influence on the actuating variable.

Block-specific options

Deactivation of the controller.
The controller can also optionally be deactivated block-specifically.
(We used this option in blocks 20 and 24 in order to move the cylinder without closed-loop position control in the setup mode).

Differentiation of the actual value.
In order to obtain a stronger and faster reaction of the control in the case of changes in the actual value, the actual value can be differentiated. The currently obtained differential quotient is added to the control error, which acts as input for the proportional and integral-action control behavior.

Takeover of block 1.
To simplify work during parameterization, it is possible to take the controller settings of block 1 over by means of an option switch.
(We use this option to adjust the parameter setting in block 1 and then call it up by the blocks used. Block 1 is not used directly for the machine sequence).

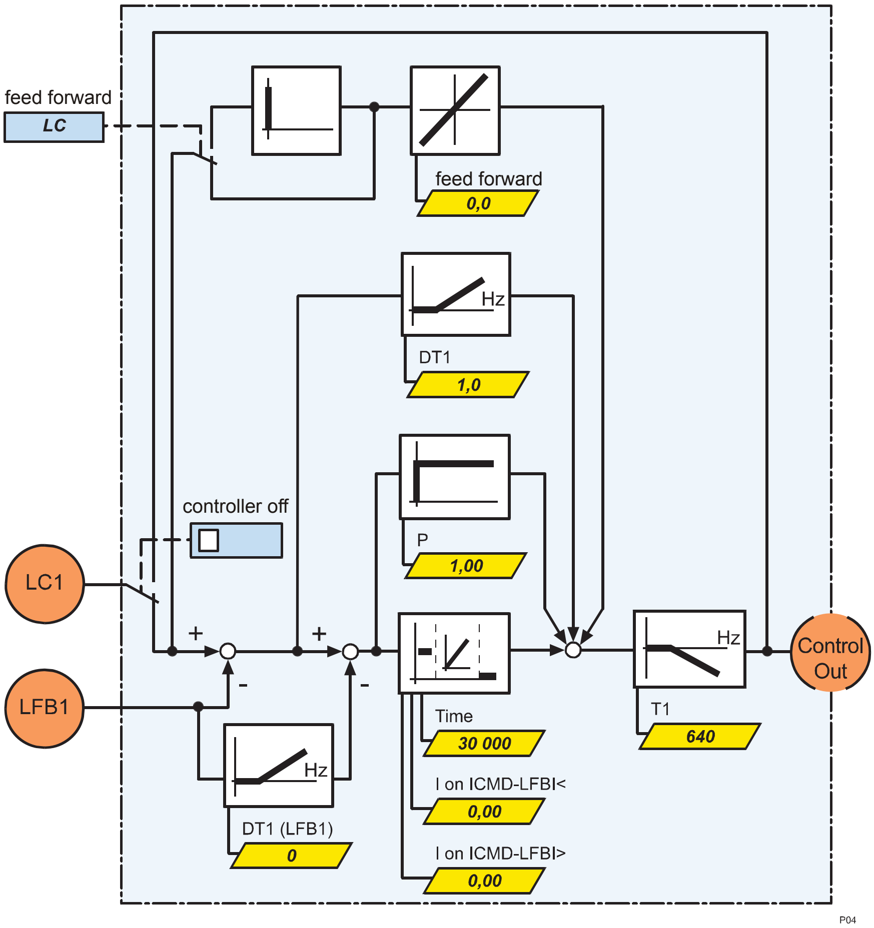


Fig. 193 Controller setting for block 1, taken over by means of the option for the blocks used in the automatic operating mode

Settings for block 1

- The control error is to be fed to the output summation point with a gain factor of 1. The value “1” is assigned to the P-component.
- The control error is not to be subjected to a time-related gain. (Within the parameterized time, the control error would be amplified to the maximum value) The integral-action time for the I-component is "30 000" ms.
- Zeroing of a value from the integral-action component of the controller is switched off. The threshold of the control error, at which the integral-action component is deactivated, is assigned the greatest value possible. The value “0” Unit is assigned to "I on I CMD-LFB I <".
- Freezing of a value that results from the integral-action component of the controller is switched off. The control deviation threshold, at which the integral-action component is activated, is assigned the smallest value possible. The value “0” Unit is assigned to "I on I CMD-LFB I >".
- The change rate in the control deviation is not to be amplified. Only one parameter is used to set the D-component and the integral-action time with a DT1-element.

In the present example, the frequency component in the signal of the control erro is not to be amplified. The parameter value assigned to the DT1-element is "0" Hz.

- The change rate in the actual value signal is not to be subtracted from the control error. Only one parameter is used to set the D-component and the integral-action time with a DT1-element.
  In the present example, the frequency component in the actual value signal is not to result in a reduction in the control error.
  The parameter value assigned to the DT1 (LFB1) element is “0“ Hz.
- High frequency components of the controller signal are to be reduced. Frequency components of 640Hz are reduced by 3dB, higher frequency components by a correspondingly higher rate.
  T1 is assigned a value of "640" Hz.
- The function of command value feedforward should not have any influence. Set the gain factor for command value feedforward to zero.
  The value for command value feedforward is “0”.
- There is no further controller, which is to have alternately an effect on the controlled variable.
  “Alternating“ is to be set to “OFF“ in the pull-down selection.
- The controller is to be switched on in this block.
  Do not select the option "Deactivate controller".
- Any settings from a preceding block are not to be taken over.
  Do not select the option "As block 1".

Options in the integral action of the controller

The integral-action component is either active, frozen or switched off depending on the amount of the control deviation (difference between setpoint and actual value, abbreviated as ICMD-LFBI.

It serves to suppress any disturbing by-effects of a control unit with an integral-action component.

Freezing

Below a minimum value the integral-action component is maintained at the currently active value (frozen). Only when the amount of the control deviation exceeds this threshold again is the integral-action component re-activated.

I-controller characteristics

The integral-action component of the controller constantly increases the output value, even in the case of a constant control deviation. The rate, at which the output signal is increased, can be parameterized with the parameter "integral-action time". During this time, the output value increases to the maximum output value with a control error of 1 Unit and weighting of 100% Output.
If the control deviation continues to persist, the maximum value remains saved. If the reasons for the "non-correction" of the controlled variable are then eliminated on the system side, the saved value will have an unexpectedly sudden effect on the controlled variable.
To prevent this, the integral-action component is set to zero at a parameterizable threshold of the control deviation.

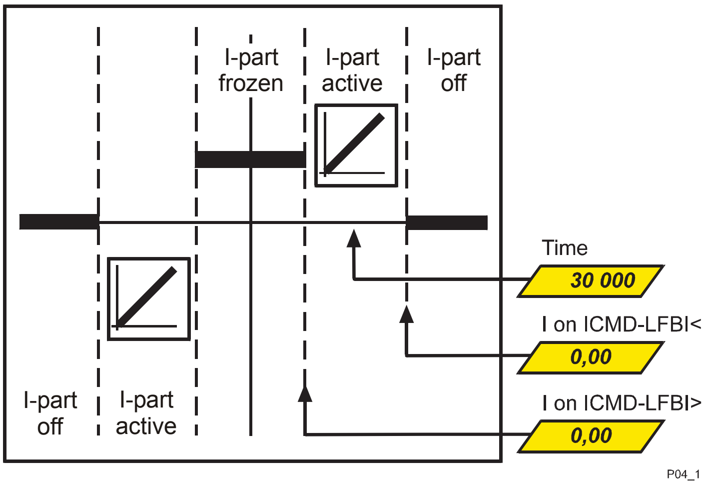


Fig. 194 Options in the integral-action component – detailed.

Parameters for "logical operation / Controller 1"

These parameters are not block-specific. The settings are valid for all blocks They are subdivided into three groups:

Output normalization (OUTPUT) Conversion of the units of the internal computing unit in Unit into a normalized output variable in %.

Options for the command value feedforward (controller) Either the command value can be fed forward directly or its differential quotient.

State feedback Additional active damping measure for suppressing control oscillations, which can be traced back to, for example, t hysteresis or instability of the controlled system.

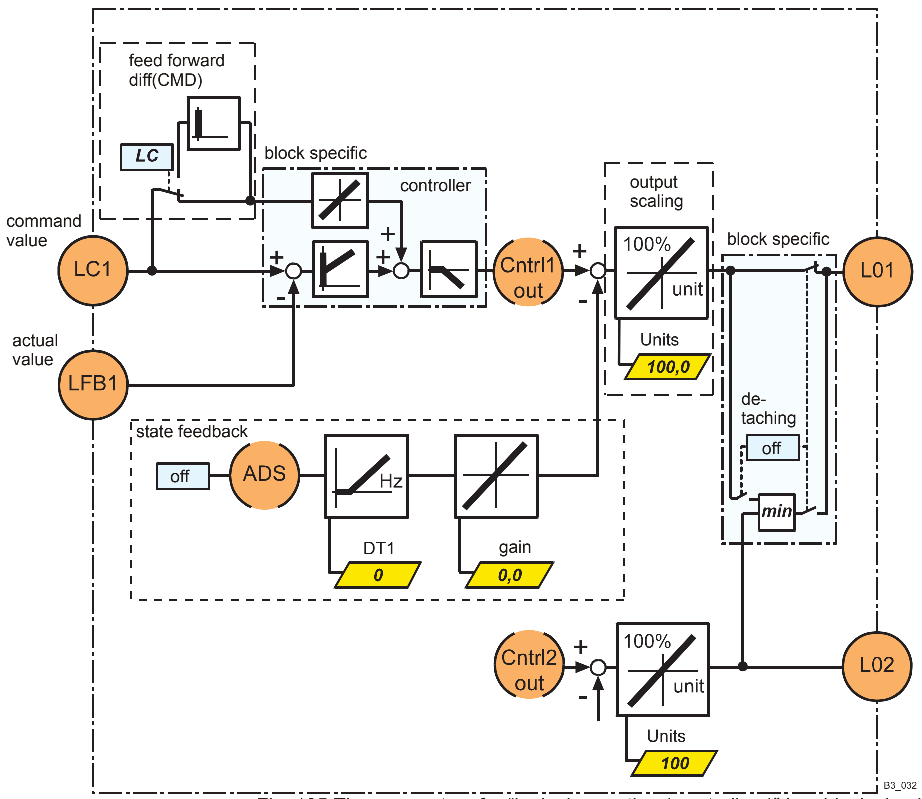


Fig. 195 The parameters for "logical operation / controller 1" in a block circuit diagram

Output normalization (OUTPUT)

Adjusting the controller output signal to a normalized percentage output signal provides the precondition for further use of the signal.
This is relevant for:
1. Maximum use of the range available for the control action.
2. The smooth transition in the case of alternation with a second closed control loop.

In the case of alternating controls, the second controller has an influences on the control action according to the rules of a minimum value generator. This function can be selected block-specific.

➢ The Units coming from the controller are to cause a 100% activation. The controller is parameterized to max. 100 Units. (It is recommended that you use the max. Unit value of the feedback signal). Therefore, enter the numerical value 100.

✓ 100 Units on the controller output (Cntrl1 out) result in 100% on the loop output (LO1)

Options for the command value feedforward

To relieve the control response, the command value can also be added directly to a summation point following the controller – regardless of the control deviation.

This so-called command value feedforward offers two options:
1. Direct application of the command value, multiplication by a gain factor and addition at the summation point.
2. Generation of the differential quotient of the command value, multiplication by a gain factor and addition at the summation point.

➢ Set the command value feedforward to LC

✓ The command value is fed unchanged to the controller for block-specific weighting with a gain factor.

Active damping

In the structure adjustment, active damping was already turned "OFF".

In the first attempt at control loop optimization it is generally recommendable to work without active damping.

The following explanations should clarify this. Default values are to be assigned to the parameters.

The loop-internal ADS value (active damping signal) is taken from a signal listed in the pull-down menu.

The signal is differentiated and then multilplied by a gain factor. In this way, both, the changes in the active damping variable and the active damping variable itself are subtracted as a damping variable from the controller output.

- ➢ Set the differentiating frequency of the active damping signal to 0 Hz.
- ✓ The derivative effect of active damping is switched off.
- ➢ Set the gain for the active damping variable to 0.00.
- ✓ Active damping has no effective (even if it was activated in the structure adjustment).

Generation of the output signal

This parameter group is independent of the closed-loop control. These parameters are used to adjust the loop output signal of the closed-loop control to the characteristic response of the control action.
The output signal adjustment always calculates with reference to 100% and no longer in Units.

Polarity-dependent gain Is relevant to compensate for different piston areas of double-acting cylinders. On one side with, on the other side without the area of the piston rod.

Characteristic curve linearization There are two options for linearizing the non-linear response of the control action. Either according to the rules of gamma correction or according to a table with a maximum of 8 stages.

Overlap To achieve a stronger response (higher gain) in the control characteristics of the valve in the central position of the control spool.

Residual velocity To obtain a clear, sufficiently large signal for controlling the valve also in the small signal range.
To increase the stiffness and reduce ineffective signals in the minimum control range of the valve (reduction in wear and heating without useful effect).

Offset, zero point drift To compensate for signal level offsets in the valve actuation or undesirable offsets in the valve.

Polarity-dependent signal limitation Is used for preventing overdriving the valve. This function refers to a limitation of the actuation and is independent of and superordinate to the closed-loop control.

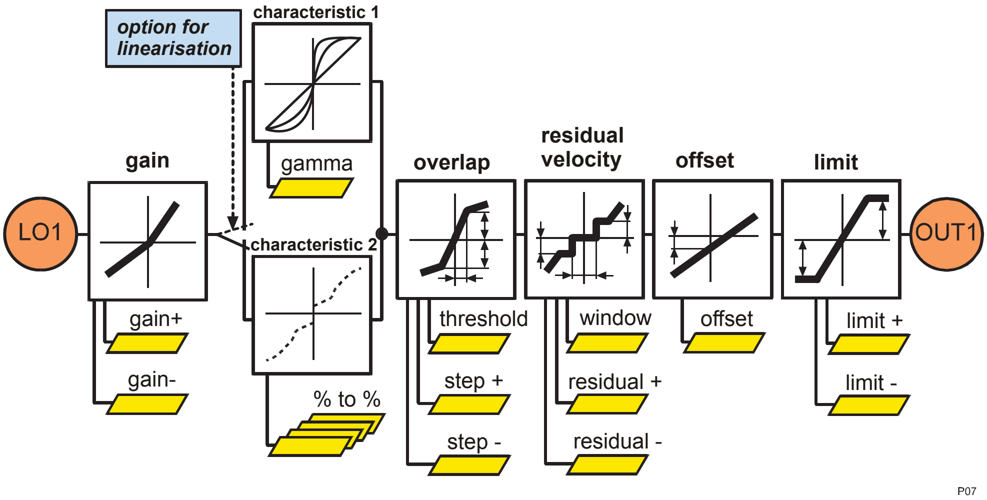


Fig. 196 Overview of parameters and transfer elements of output signal generation

Polarity-dependent gain

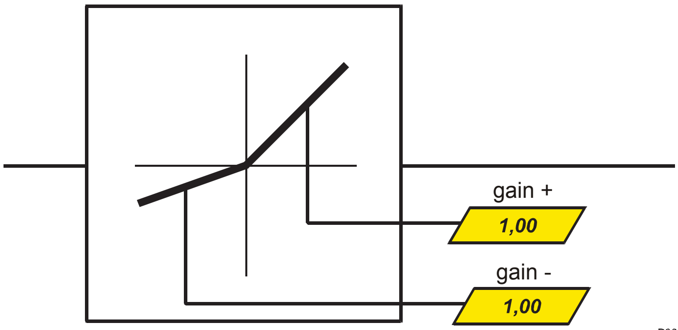


Fig. 197 Polarity-dependent gain

Tuning can be accomplished on the basis of characteristic data of the control action (of the valve) and an evaluation of measurement results obtained during a test run.

Enter the same gain as output setting for positive and negative output signals.

- ➢ Set gain + to "1.00".
- ➢ Set the gain - to "1.00".
- ✓ The same gain is effective in both directions of movement and force.

Options for linearization

Linearization according to the gamma correction

Gamma correction is a possibility of linearizing a constantly non-linear response using just one parameter for the positive and negative actuating movements.
This type of correction is characterized by a higher gain for smaller control signals and, with the same relationship, a smaller gain in the maximum control range.
In the middle range of the characteristic curve, the transfer has a gain factor of 1.

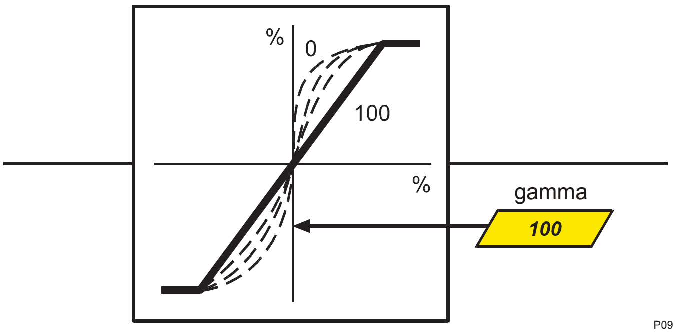


Fig. 198 Gamma correction

- ➢ St the option of linearization to curve correction 1.
- ➢ Set a value 100 for the gamma parameter.
- ✓ Linear transfer is set. The actual function of gamma correction has no effect.

Linearization according to a table

If correction using the gamma curve does not produce satisfactory results, lineariza-tion according to a table can be used.
This allows user-specific linearization with a maximum of 8 steps for both, the positive

and negative direction, especially for non-constant, almost jumping non-linearities in the control action.
Since the correction table always refers to the amount, the result is a point-symmetrical correction curve.

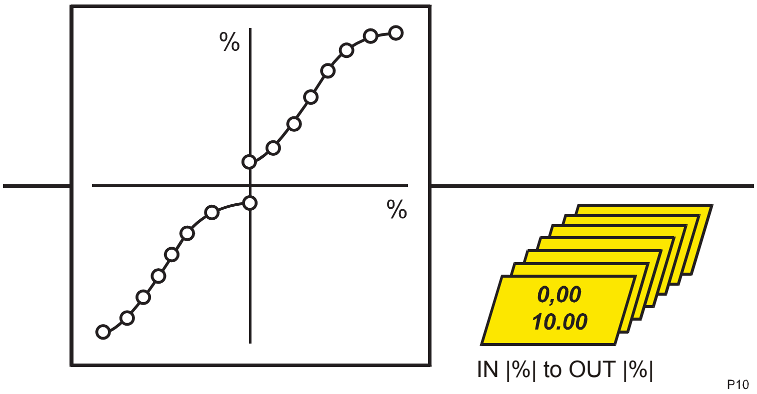


Fig. 199 Transfer function for linearizing according to value pairs from a table

- ➢ Do not select the option according to curve correction 2.
- ✓ Gamma correction is activated. The table values are irrelevant.

Overlap

This is a method for optimum valve control in the small signal range.
It allows valves with E-spools to be controlled directly at the control edge. This also enables fast valve response, even with small changes at the controller output. The control is active immediately and, with optimized setting of the overlap, has an immediate effect on the control action without any delays.

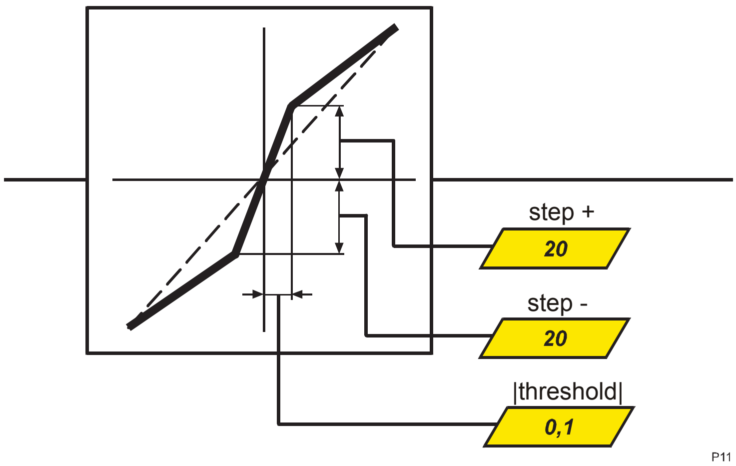


Fig. 200 Parameters of the transfer element " Overlap"

The optimum values for the 3 parameters defining the overlap in the valve control are usually determined through practical measurements.

Select the following values as basic setting:

- ➢ For the threshold, from which an overlap jump takes effect, enter "0".
- ➢ Enter "0" as magnitude of Step +.
- ➢ Enter "0" as magnitude of Step -.
- ✓ With this basic setting, the overlap function is not effective. The function acts like a linear signal transfer.

Residual velocity

Positive signal

A decreasing, positive signal is applied at the input of the transfer element:
If a positive input variable falls below the parameter value of "Residual+", this parameterized value will be output.
If the input value continues to fall and falls below the parameter "Window", zero will be output.

Negative signal

An increasing, negative signal is applied at the input of the transfer element:
If a negative input variable exceeds the parameter value of "Residual-", this parameterized value will be output.
If the input value continues to rise and exceeds the value of the parameter "Window", zero will be output.

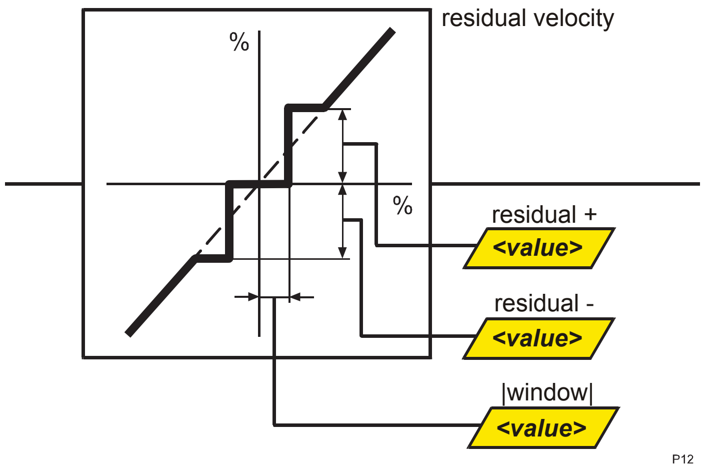


Fig. 201 Parameters of the transfer element " Residual velocity"

The optimum values for the 3 parameters defining the residual velocity are usually determined through practical measurements on the valve control.

Select the following initial setting:

- ➢ Enter the parameter "0" for the "amount window" within which the value zero should be output.
- ➢ Assign a value of "0" to the "Residual+" parameter as positive residual value above the "zero window".
- ➢ Assign a value of “0” to the “Residual-“ parameter as negative residual value below the “zero window”.
- ✓ With these parameters as initial setting, the "Residual velocity" function is disabled. The function acts like a linear signal transfer.

Offset

The control action can have an offset even when the controller output signal is zero. In order to compensate for this independently of the control, an offset function is provided in the output signal generator.

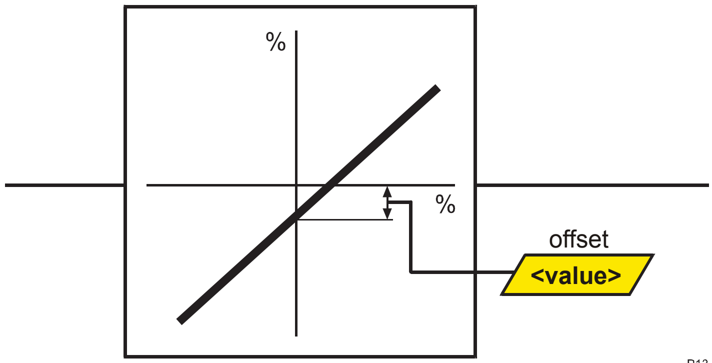


Fig. 202 Offset in output signal generation

Determine the parameter value on site by means of practical tests.

➢ Set a value of "0" for the initial setting.

✓ The offset function will then be disabled.
The signal becomes linear and is transferred without any changes.

Polarity-dependent limiting (Limit)

This transfer element can be used to limit the positive and the negative value of the control action independently of each other. Machine processes or system conditions may require such a limit regardless of and with precedence to the control.

The practical optimum value must be determined from the specifications of the machine on site.

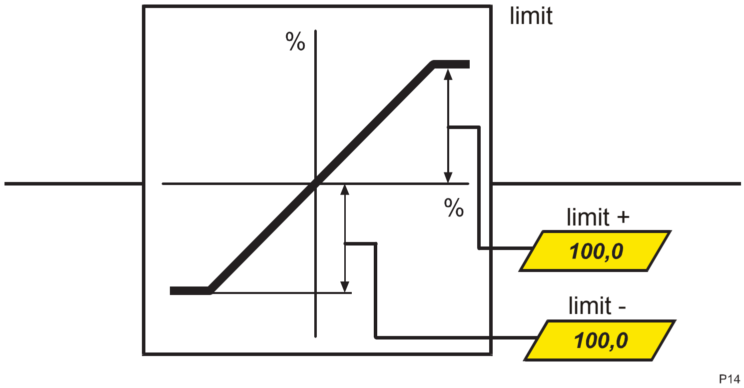


Fig. 203 Polarity-dependent limiting in output signal generation.

Use the full value range as the basic setting:

➢ Set the parameter Limit+ to 100%.

➢ Set the parameter Limit- to 100%.

✓ The limitation is not effective, the operating principle corresponds to a linear transfer element.

Glossary

Gamma

Characteristic curve adjustment for valves with non-linear characteristics. This correction can be used to adjust the characteristics so that linear valve characteristics are obtained.

Characteristic curve

A characteristic curve is the representation of a motion sequence in the form of a graph. It shows the characteristics of the connected components.

Limiter

A limiter, also referred to as limit, defines the positive or negative maximum value that a control action must not exceed due to the limitation.

Offset

Value that corrects the deviation from the zero point of the system.

Parameter set

The entirety of all parameters of the HACD is termed parameter set. This parameter set can be read from or written to the HACD or opened or saved as a file.

Control parameters

The controller functionality of the HACD is implemented as PIDT1-controller. Additionally, a command value feedforward – based on the command value or the 1st derivation of the command value (velocity) – as well as a D-component to the actual value are possible. Each controller component can be activated separately.

Residual velocity

Residual velocity is the given movement of a drive component that takes a corresponding velocity within a defined monitored window.

Unit

Measure in closed-loop control technology, which is used as operand for process data in the BODAC program.

Overlap

Overlap compensation can be used for valves with positive overlap. It corrects the controller actuating value (valve command value)

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Logic operation

Two or more logic blocks are interconnected.

Gain

Gain is the factor by which a value or signal is multiplied.

I

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