Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth Bosch Group

VT-HACD-DPQ
Digital Controller for electro-hydraulic Injection Molding Machines

RE 30146-01-B/08.07
Replaces: 11.06

Start-up and Operation

Contents

1 Introduction

1.1 General

In this manual you will become familiar with:

- The VT-HACD-DPQ-1 digital controller for injection molding machines
- The BODAC (**B**osch Rexroth **O**perator interface for **D**igital **A**xis **C**ontroller) software
- Application examples

You will learn about the menus and window contents for the software, the settings and parameters.

Selected application examples will clarify the functionality, systematics and recommended procedure for starting up the "VT-HACD-DPQ - Digital controller for injection molding machines".

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

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

Information about installing and operating of the HACD-DPQ controller can be found in the manual "Installation and Operation of the HACD-DPQ Digital controller for injection molding machines".

A listing of HACD-DPQ documentation can be found in the datasheet RE 30146.

Version status of this document: 1.3

1.2 Signs and symbols used in this document

The following signs and symbols are used in this manual:

➢ Activity symbol: The text following this sign describes activities. These are to be performed from top to bottom in the order indicated.

✓ Result symbol: The text following this sign describes the result of an action.

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

After this symbol you will find references to additional documentation.

Warning signs

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

General hazard This sign is placed in front of activities which represent a potential hazard to persons and/or extensive damage to equipment.

If the source of the hazard can be exactly defined, the corresponding pictogram is used.

Shock hazard This sign is placed in front of activities which represent a potential hazard to persons and/or extensive damage to equipment due to high electrical voltage.

Equipment hazard
This sign is placed before activities which may result in damage to equipment.

2 Overview of injection control for injection molding machines

2.1 General

The injection process

The function of the injection unit on an injection molding machine is to take a granular plastic material, melt and mix it (plasticize). Then inject it under pressure into a cavity and keep the melted material under pressure while it cools to form a solid part.

Parameter changes may be individually loaded into the card, or the entire profile loaded at one time. The card maintains the last saved profile in non-volatile flash memory. A single injection motion profile is stored on the card. Multiple profiles may be stored in the machine sequential logic controller and any one selected to load into the card.

The process sequence

The process of injection molding can be described as follows:

Injection

In the injection phase the plasticized mass is injected into the mold. Depending on the material used or the nature of the mold, the injection cylinder must be controlled with a varying speed profile. This minimizes the effects such as fluid temperature, mold filling pressure or cylinder friction.

Pack and hold

In this phase the material is already in the mold and must be kept under pressure for a short time. Minimizing the effect of factors affecting the pressure curve in the mass is important for good repeatability of the injection molding process.

Pre-Decompression

To allow a nozzle shut-off valve to close after hold pressure is complete, residual material pressure can be decompressed by retracting the screw a short distance.

Back pressure

Backpressure (also known as plasticizing or recovery) is used to fill the injection unit with melted plastic. Rotating of the screw causes material to be pulled into the heated barrel where it melts while being augured towards the front of the screw. Material pressure at the screw tip forces the injection cylinder backwards and creates a hydraulic pressure - the back pressure. When the required plastic volume is accumulated rotation of the screw is stopped.

Post-Decompression

To prevent melted plastic from entering the mold area while the cooled part is removed, residual material pressure can be decompressed by retracting the screw a short distance before the mold is opened.

2.2 The system components

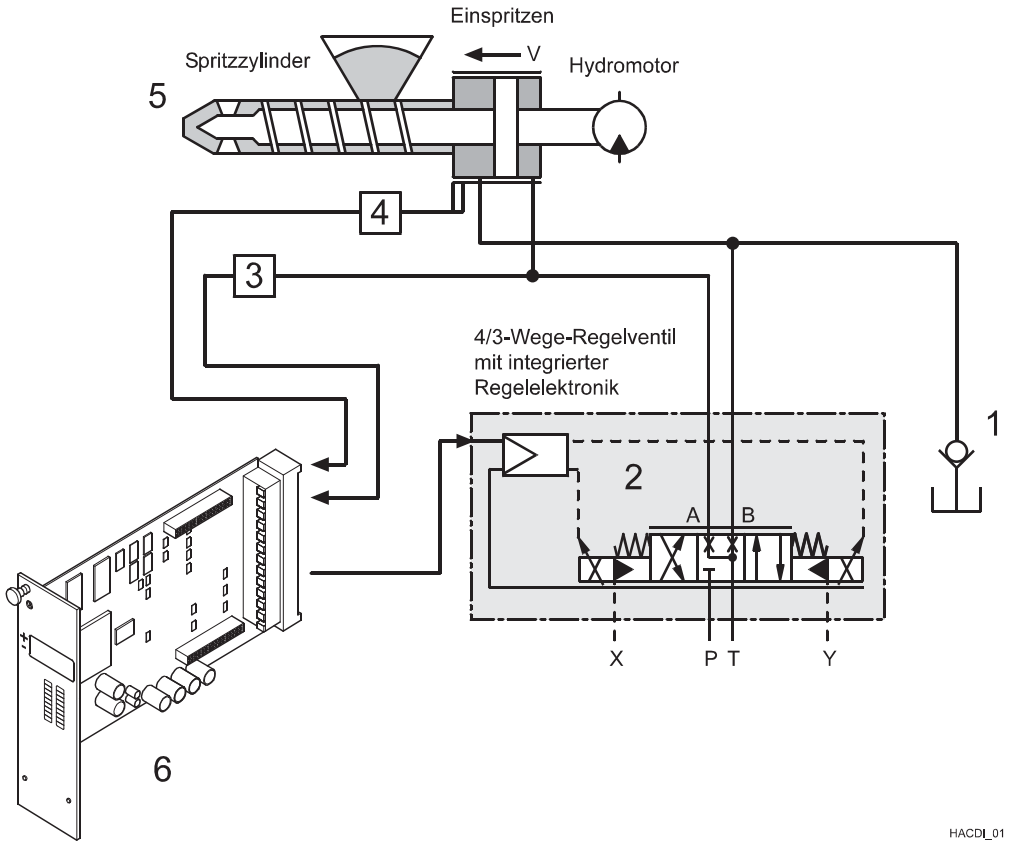

Fig. 1 System components

Required system components

1	Tank with check valve
2	4/3-directional control valve with integrated electronics and Q spool
3	Pressure transducers for voltage/current pressure inputs
4	Position transducer for position actual value
5	Injection cylinder with feed hopper, plasticizing screw and hydromotor.
6	HACD-DPQ Digital Closed-Loop Control Electronics

2.3 Electrical and hydraulic installation plan

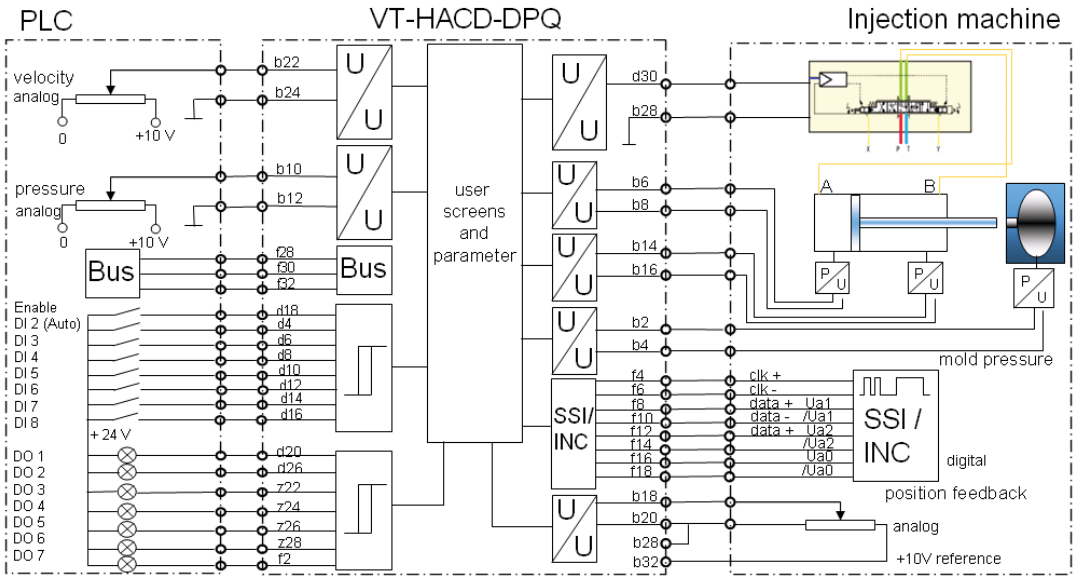

Fig. 2 Electrical and hydraulic installation plan

PLC Operation and process control

HACD-DPQ Controller for injection molding machines

Injection molding machine 4/3-directional control valve with Q-type spool, hydraulic elements (injection cylinder) and feedback (position actual value)

2.4 Sequence diagram and functional description

Intern or bus mode

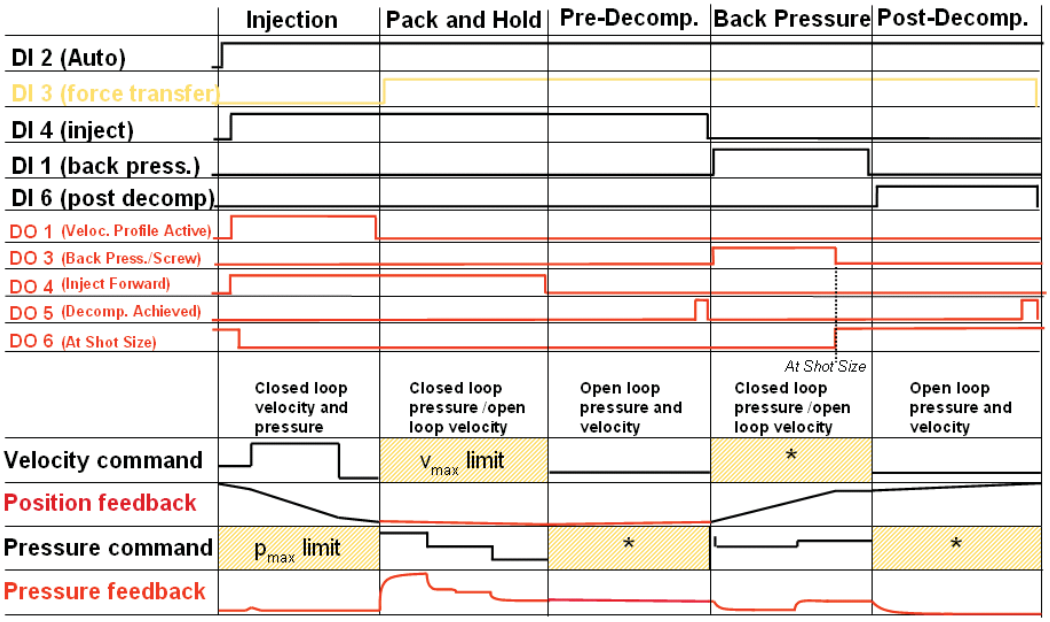

Fig. 3 Sequence diagram for intern or bus mode

* no settings necessary/possible.

Injection phase The machine control provides the signals to start injection. A rising edge on digital input DI 2 & DI 4 starts the injection phase. During this phase the velocity of the injection cylinder is regulated according to a stored profile. In addition, the pressure on the piston side of the cylinder can be limited to a maximum value.

Pack and hold phase Transfer from injection phase into Pack and Hold phase is triggered when the machine control sends a rising edge to input DI 3 or internal setpoint for position or pressure is reached. At transfer the velocity control is turned off and the hold-pressure profile is started. During this phase the pressure is regulated according to a stored profile.

Pre-Decompression phase If a value is set in the screen the “screw retract” (pre-decompression) phase will start automatically after pack and hold.

Output DO 5 turns on when Decompression position is reached.

Back pressure A rising edge on input DI 1 starts the back pressure phase. DO3 acknowledges that the HACD-DPQ is in the Back pressure phase. The machine control drives the screw-motor. Rotating of the screw causes material to be pulled into the heated barrel where it melts while being augured towards the front of the screw. Material pressure at the screw tip forces the injection cylinder backwards. A rising edge on output DO 6 (At

shot size) indicates that sufficient material is available for injecting. Also DO3 is switched when Shot Size Position is reached. The machine control then stops rotation of the screw. The back pressure phase is ended.

Post-Decompression A rising edge on input DI 6 starts the retraction of the screw to a defined position.

Output DO 5 turns on when Decompression position is reached.

Analog mode

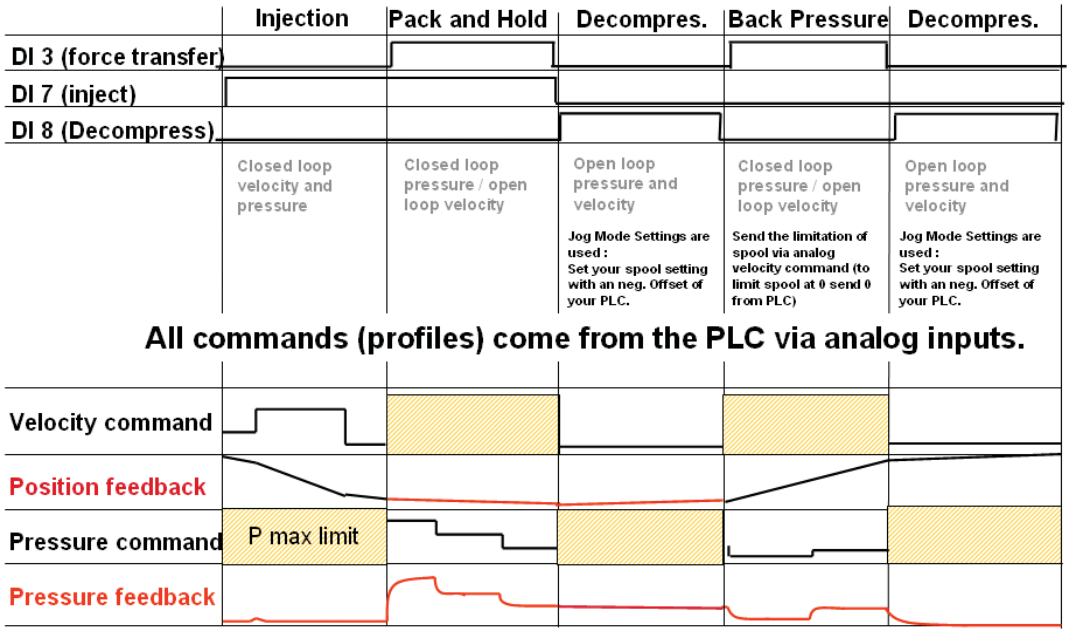

Fig. 4 Sequence diagram for analog mode

* no settings necessary/possible.

In analog mode all commands (velocity and pressure) are generated by the PLC and sent to the analog inputs of the HACD-DPQ card.

Injection phase The machine control provides a rising edge to digital input DI 7 to start the injection phase.

Pack and hold phase The machine control sends a rising edge to input DI 3 to transfer from closed loop velocity into open loop velocity. Pressure control remains active.

Pre-Decompression phase If Pre-Decompression is required the machine control sends a rising edge to DI 8. The HACD-DPQ changes to open loop velocity mode and pressure control is turned off.

Back pressure The machine control sends a rising edge to input DI 3 to start the back pressure phase. The machine control drives the screw-motor. Rotating of the screw causes material to be pulled into the heated barrel where it melts while being augured towards the front of the screw. Material pressure at the screw tip forces the injection cylinder backwards. The machine control stops rotation of the screw when it determines that shot size is reached. The back pressure phase is ended.

Post-Decompression If Post-Decompression is required the machine control sends a rising edge to DI 8. The HACD-DPQ changes to open loop velocity mode and pressure control is turned off.

2.5 Safety notes

CAUTION!

Non-observance of these safety precautions can result in damage to the equipment.

Only configure and start the application if:

- You have defined the zero point at the stop point of the screw cylinder ("0" position);
- You have checked all the entered parameters to verify they are correct. Parameterizing is done using absolute values. The values in the steps for the individual profiles are dependent on each other.

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-DPQ

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

The connection is based on RS232. A fixed baud rate of 57600 baud is set in the card.

- ➢ Connect PC to HACD-DPQ using an RS232 cable (1:1 cable)

  Connection cable:
  Type: KABELSATZ VT-HACD-1X/03,0/HACD-PC
  Part number: R900776897
  Length: 3 m
- ➢ Turn on PC and HACD-DPQ
- ➢ Install BODAC
- ➢ Start BODAC
- ✓ BODAC automatically loads the parameter set from the HACD-DPQ

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-DPQ.

If your PC doesn't have a RS 232 port you can use an USB to serial converter.
USB to serial converter:
Type: VT-ZKO-USB/S-1-1X/V0/0
Part number: R901066684

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-DPQ at any time.

Assign a file name and save the output state.

Save the working state

This allows you to easily store 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-DPQ card.
See also: "Save".
See also: "Set parameters to memory".

3.2 Main Menu

After opening the BODAC program, the BODAC main menu is shown. This contains various elements as shown in Fig. 5 BODAC Main Menu.

These include:

- The title bar
- The menu bar
- The toolbar
- The HACD-DPQ-DPQ main menu
- The status bar

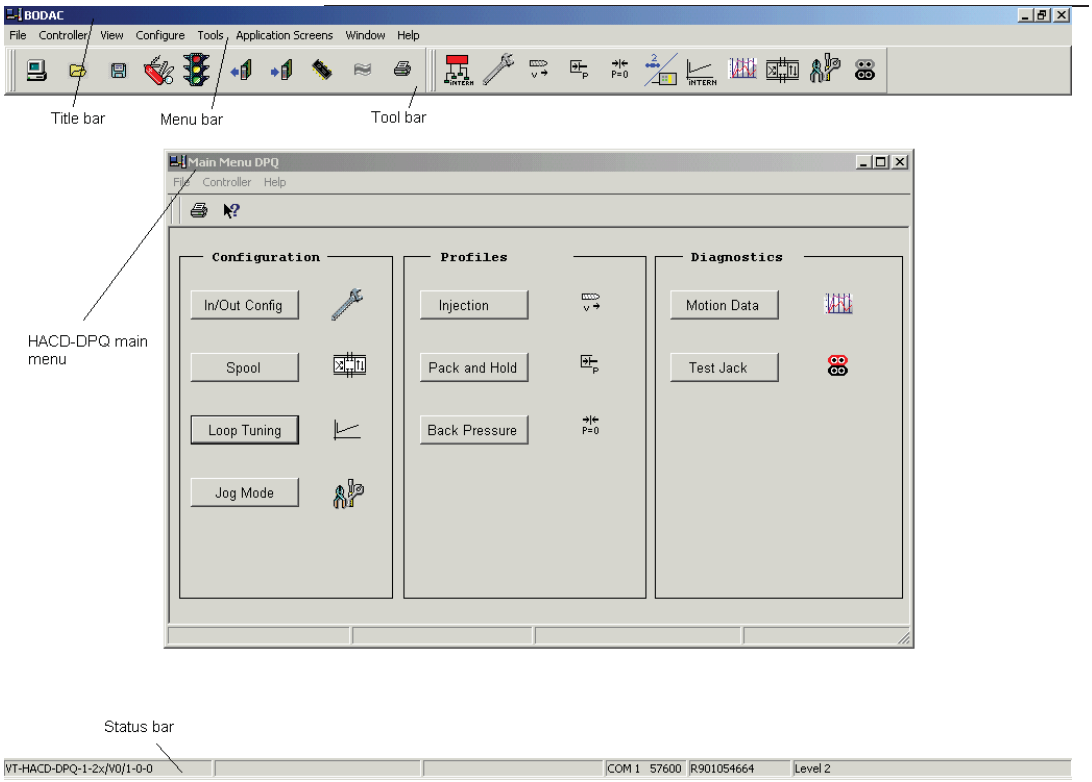

Fig. 5 BODAC main menu

Title bar

The title bar contains the name of the program or window and several 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
- Configure menu
- Tools menu
- Application Screens menu
- Window menu
- Help menu

BODAC toolbar

The toolbar contains buttons with icons. These icons execute the most commonly used functions and commands or open windows.

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

Generates the "Offline" command, which breaks the connection to the card. The symbol is only visible if there is no currently active connection to the card.

Generates the "Connect" command. The symbol is only visible if there is no currently active connection to the card.

Opens the "Open" window, where you can select stored BODAC data files.

Opens the "Save file as" window, in which you can save your entries.

Opens the "Analog in-/outputs" window.

The "Read parameters" command reads the data (parameter set) stored in the working memory of the HACD-DPQ and passes them to the BODAC program.

The "Write parameters" command sends the current data (parameter set) from the BODAC to the working memory of the HACD-DPQ.

The "Save parameters in memory" sends the HACD-DPQ parameter set from working memory to permanent memory.

Opens the "Language" window.

Opens the "Print forms" window.

Opens the "HACD-DPQ-DPQ main menu" window if mode is intern or bus.

Opens the "Config.Input.Velocity" window if mode is analog.

Opens the "Injection" window.

Opens the "Pack and Hold" window.

Opens the "Back Pressure" window.

Opens the "Motion Data" window.

Opens the "Test jacks" window.

Opens the "Status" window.

Opens the "Loop tuning" window for intern or bus mode.

Opens the "Loop tuning" window for analog mode.

Opens the "In/Out Configuration" window.

Opens the "2 valve/ Bus option" window.

Opens the "Spool configuration" window.

Opens the "Jog mode" window.

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 Chapter 4.2 "Read Parameters".

see Chapter 4.2 "Write Parameters".

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

3 User interface BODAC - General

The "Set parameters to memory" sends the current data from BODAC to the memory chip of the controller card.

If you are in an entry field, clicking on the symbol increments the field contents. BODAC simultaneously writes this parameter to the card.

Exception: Multiplot, see "Multiplot toolbar"

If you are in an entry field, clicking on the symbol decrements the field contents. BODAC simultaneously writes this parameter to the card.

Exception: Multiplot, see "Multiplot toolbar"

The Undo symbol in the toolbar nullifies the last entry.

Clicking on the oscilloscope symbol in the toolbar opens the BODAC "Multiplot" window.
To show signals in the multiplot window, open the Motion Data window and click on the name of the desired signal. The name of the signal is highlighted in red to indicate that it is selected for display in the multiplot window. Then click on the oscilloscope symbol in the toolbar to open the multiplot window. The signals you selected will be displayed.

Within the "Multiplot" window.

A maximum of 8 signals can be selected.

For information on the multiplot window, see section 4.3 "Multiplot".

Clicking on the printer symbol in the toolbar opens the Windows "Print" system 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.

The HACD-DPQ main menu

The HACD-DPQ main menu is automatically opened whenever the program is started depending on mode.

It contains all the required menus for the "Injection control for injection molding machines" application described in section 4.

DPQ main menu for intern or bus mode

Clicking on the preceding symbol, which is a component of the toolbar, also opens the "HACD-DPQ-DPQ main menu" window. A listing of existing shortcuts for the toolbar can be found in Section 2.1 "Toolbar".

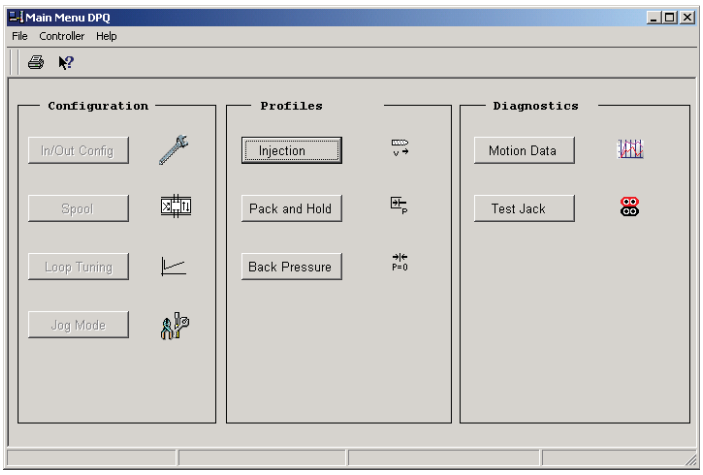

Fig. 6 The HACD-DPQ-DPQ main menu for intern or bus mode

DPQ main menu for analog mode

Clicking on the preceding symbol, which is a component of the toolbar, also opens the "HACD-DPQ-DPQ main menu" window. A listing of existing shortcuts for the toolbar can be found in Section 2.1 "Toolbar".

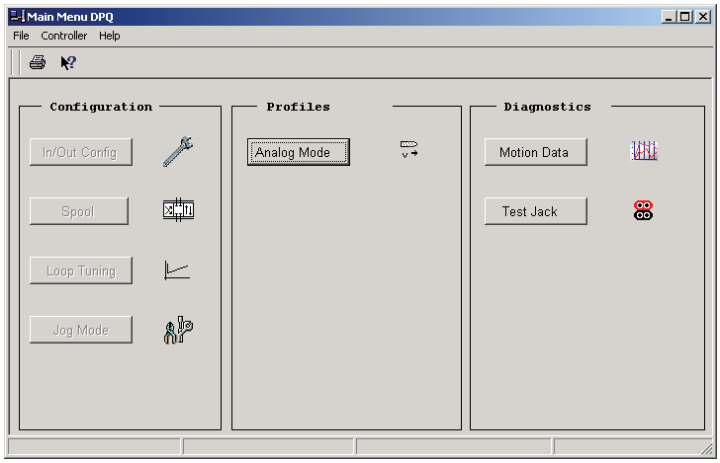

Fig. 7 The HACD-DPQ-DPQ main menu for analog mode

Configure field

This fields are accessable in security level 2 only.

In/ Out Config Opens the "In/Out Cfg" window.
You select the signals for the inputs and outputs for your application.

See also: Section 5.4 "Adjust configuration".

Spool Opens the "Spool config" window.
You can adjust the HACD-DPQ-DPQ to the flow characteristic of the injection valve

See also: Section 5.4 "Adjust configuration".

Loop Tuning Opens the "Loop tuning" window. Depending on the mode the "Loop tuning" or the "Loop tuning analog" window opens.
You can made all the necessary control loop settings with the control parameters

See also: Section 5.4 "Adjust configuration".

Jog Mode Opens the "Jog mode" window.
With the jog mode you can move the injector in open loop control.

See also: Section 5.4 "Adjust configuration".

Profiles field for intern or bus mode

Injection Opens the "Injection" window.
You can parameterize the injection phase.

See also: Section 5.5 "Configure profiles".

Pack and hold Opens the "Pack and Hold" window.
You can parameterize the pack and hold phase.

See also: Section 5.5 "Configure profiles".

Back pressure Opens the "Back Pressure" window.
You can parameterize the back pressure phase.

See also: Section 5.5 "Configure profiles".

Profiles field for analog mode

Analog mode Opens the "Analog mode" window.
You see the information how to start the analog mode.

Diagnostics

Test jack Opens the "Test jacks" window.
You can assign signals for diagnostic purposes to the diagnostic terminal "X1" and "X2".

See also: Section 5.7 "Test jacks".

Motion Data Opens the "Motion data" window.
You can see all signals of your application in real-time.

See also: Section 5.7 "Motion data"

Status bar

The status bar contains useful information about the active window. For example the main menu shows the current connection status.

Fig. 8 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")
F7	Stores the current parameter data in the memory chip on the control card. (see also "Saving parameters in memory")
F8	Pressing "F8" sends only the last changed parameter value to the control card.
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 contents. 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 menu

The "File" menu contains commands for administering and printing data.

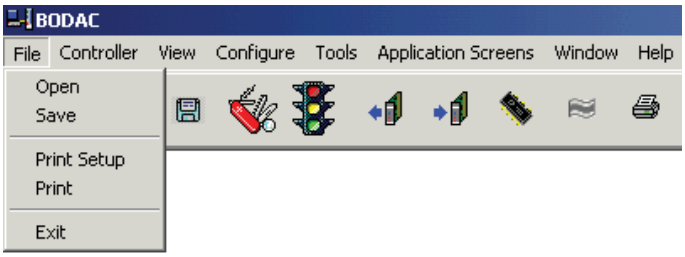

Fig. 9 File menu

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 sent to identical or similar applications.

Printer Setup

This menu point opens the standard Windows "Printer Setup" window. Information about setting up a printer can be found in your Windows online help.

Print

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

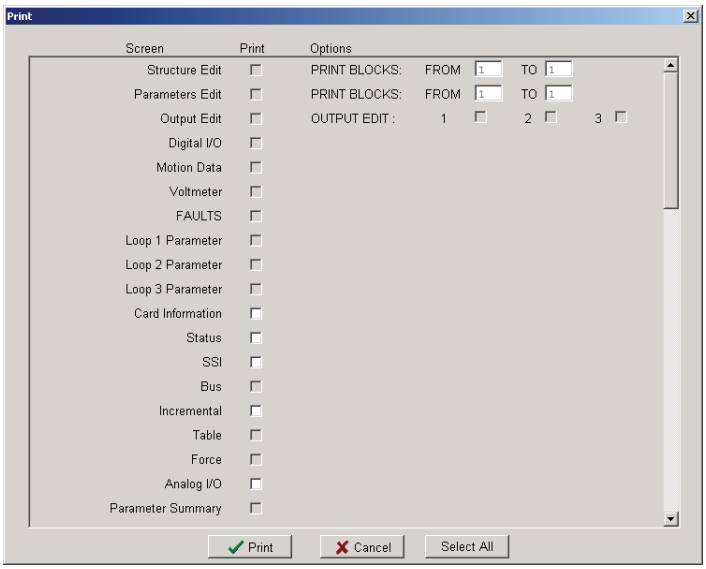

Fig. 10 "Print" window

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 preceding icon, which is part of the toolbar, also opens the "Print forms" window. A listing of icons for the toolbar can be found in Section "Toolbar".

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.

4.2 Controller menu

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

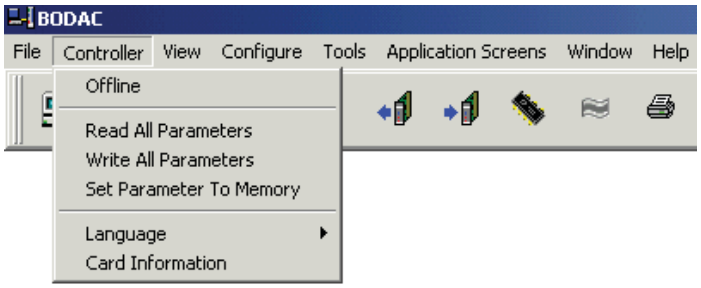

Fig. 11 "Controller" menu

Offline

Closes the connection to the controller card. The "Offline" command is only selectable if there is no 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

Opens the connection between BODAC and the HACD. The "Connect" command is only selectable if there is no currently active connection to the 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".

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.

NOTE!

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.

NOTE!

The software language selection also affects the language version of your card.

The menu tree which the buttons on the front panel of your card takes you to is also switched over to the selected language.

The language selection is stored in the card.

Card information

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

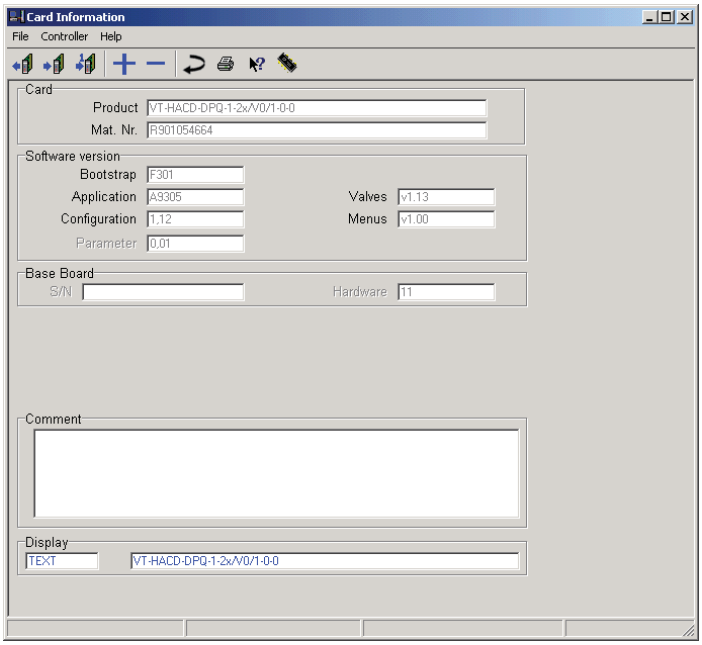

Fig. 12 "Card information" window

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 modifying parameters.

Card information – Help menu

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

In the upper section 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.)
- Mat.-Nr. (contains the material number of your controller card.)

Versions Here the hard- and software used is listed in detail.

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 user's requirements. In addition, a signal from the controller can be displayed.

Additional information: "Installation and Operation of the Controller Card", RE 30146-B.

4.3 View menu

The View menu is not available for the HACD-DPQ. All relevant information is contained in the application windows.

4.4 Configuration menu

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

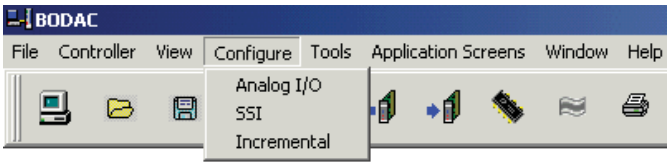

Fig. 13 Configuration menu

Analog I/O

The "Analog I/O" window is where all analog inputs 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".

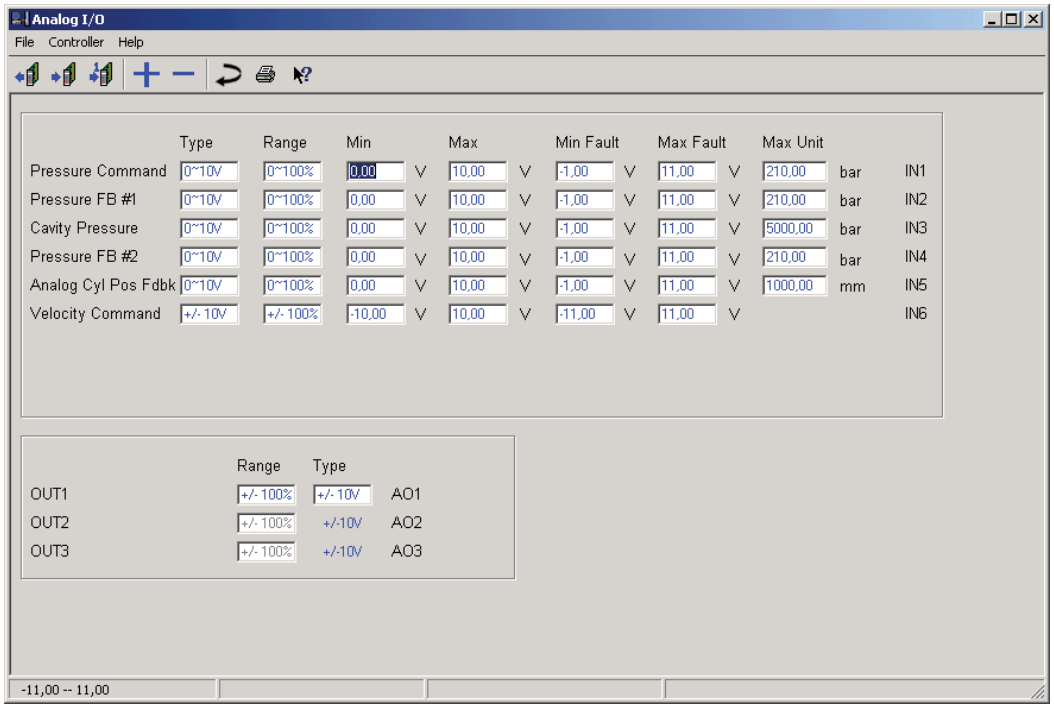

Fig. 14 "Analog I/O" window

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 modifying parameters.

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

Inputs field

The first column in the Inputs field lists the names of the analog inputs AI1 to AI6.

In the following columns in the Inputs field you specify the parameter values for the analog input signals.

Not all analog inputs can be configured as current inputs.

Type Assignments are made with the mouse button. Clicking on the "Type" entry field opens a pull down menu containing the following:

- +/-10V
  The expected input signal varies in a range of (–10V) to (+10V).
- 0~10V
  An input signal of from (0V) to (+10V) is expected.
- 0~20mA
  The current level of the input signal varies between (0mA) and (20mA).
- 4~20mA
  The current level of the input signal varies between (4mA) and (20mA).

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. For example, a value of (-5V) means the signal (-5 V) is interpreted as (-100%) range (see Fig. 15 Analog I/O - Input adjustments).

Max The "Max" setting is the opposite of "Min". For example, a value of (+9 V) means the signal (+9 V) is interpreted as (+100%) range (see Fig. 15 Analog I/O - Input adjustments).

Min Error Specifies the minimum error. When the signal falls below this entered value, BODAC uses the "Status" window to indicate that an error has occurred.

Max Error Specifies the maximum error. When the signal exceeds this entered value, BODAC uses the "Status" window to indicate that an error has occurred.

Max Units The "Max Units" setting specifies the conversion from Range [%] to Units [Unit].

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

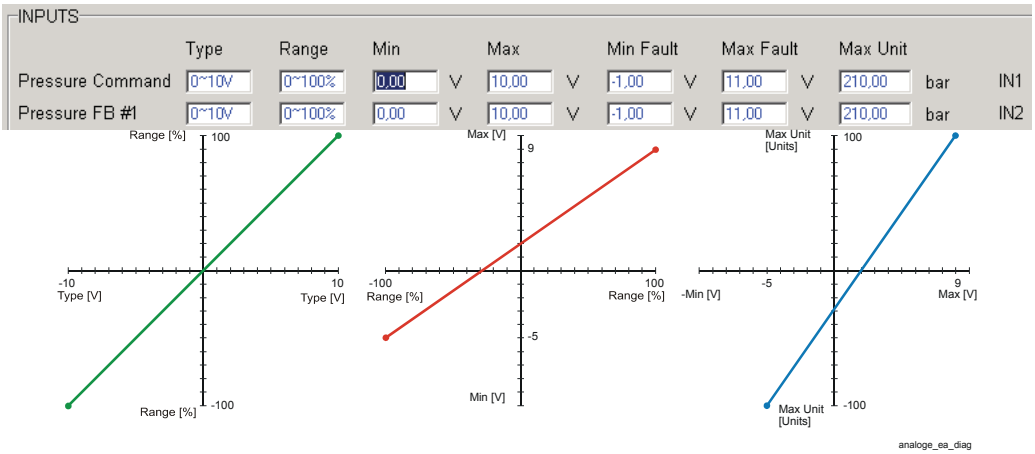

Fig. 15 Analog I/O – Input adjustments

Output field

Type Assignments are made with the mouse button. Clicking on the "Type" entry field opens a selection field containing the following:

- +/-10V
  The expected output signal varies in a range of (–10V) to (+10V).
- 0~10 V
  An output signal of from (0 V) to (+10 V) is expected.
- 4~20 mA
  The current level of the output signal varies between (4 mA) and (20 mA).

Offset The parameter in the "Offset" entry field is used to offset the manipulated variable by the entered value.

Adjust output elements

➢ Use the right mouse button to assign an entry from the selection fields to the parameters.

✓ The output signal structure of the velocity and pressure controller are defined.

➢ For configuring the Q-spool, see also section "Configure Q-spool flow curve".

✓ This concludes the output configuration.

SSI

The SSI window contains the definitions for using an appropriate encoder for measuring the actual position. With the specification for a **S**ynchronous **S**erial **I**nterface in mind position data can be read and processed.

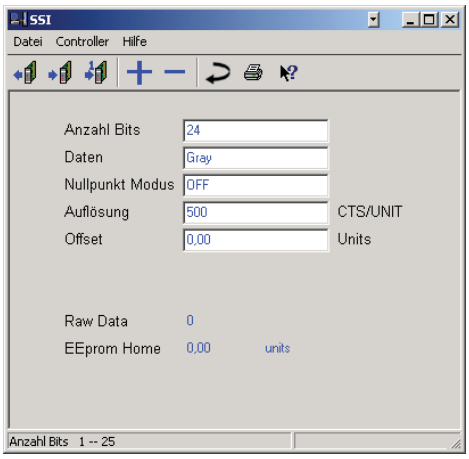

Fig. 16 "SSI" window

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

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

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

Programmable or non-programmable encoders can be used.

NB. of Bits Enter the prescribed number of bits depending on the data protocol and the encoder type used.
Number of possible bits: 1 to 24.

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

Condition	Description
BINARY	Encoder with binary code
GRAY	Encoder with gray code

Home Mode Enter the mode of adjusting the transducer offset (zero point).

Condition	Description
OFF	Offset of transducer is adjusted by changing of the parameter "Offset".
Digital Input 5	Transducer offset is set by digital input 5. The parameter "Offset" will be set automatically by this action. As long as the digital input is active the transducer offset will be re-set.
Bus	Transducer offset is set by a bus event. The parameter "Offset" will be set automatically by this action.

Resolution This parameter is used to set the scale of the position feedback device. It has a range from 0 to 32767 Count/Unit.

Offset This parameter is used to offset the position feedback from the SSI probe. For example if the zero point needed to be changed this parameter would be used to null out the offset. It has a range from 0.00 to 5000.00 units.

Incremental

The Incremental window contains the definitions for using an appropriate encoder for measuring the actual position.

NOTE!

Attention!

The conditioning electronics for the Incremental Encoder has a maximum detection frequency of 100 kHz. If this frequency is exceeded the actual position will not be decoded properly.
When using this type of encoder the user needs to choose the maximum velocity such that, keeping the resolution of the encoder in mind, the maximum frequency of 100 kHz is not exceeded.

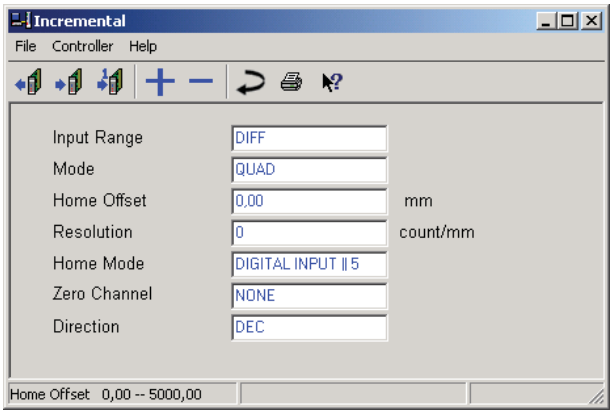

Fig. 17 "Incremental" window

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

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

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

Incremental type position feedback transducers may be used with the controller. Single ended 5Volt, Single ended 24Volt or 5 Volt differential line driver type may be used. Both single ended and quadrature types are supported. The feedback may be zeroed by using discrete input #5 or a zero bit over fieldbus. This is called the home mode. The home mode may be used along with a zero pulse from the encoder. These signals are "anded".

Input Range This selects the type of encoder being used. The Encoder Channel A and Channel B faults are only active when Diff is selected.

Condition	Description
SE 5V	Encoder type with single ended outputs with 5V signal level.
DIFF	Encoder type with differential output signals.
SE 24V	Encoder type with single ended outputs with 24V signal level.

Mode This selects whether the encoder is a quadrature or a single ended signal.

Condition	Description
QUAD	Quadrature ended encoder signal
SINGLE	Single ended encoder signal

Home Offset This parameter is used to give a home reference. The actual position could be read via the motion data screen and the value could be put in the offset. This would give a known starting point.

Resolution This parameter is set to the resolution of the encoder in CTS/Unit.

Home Mode The home mode selects whether the home input comes discrete input #5 or over fieldbus (hardware option).

Condition	Description
Digital Input # 5	Home input comes from digital input nb. 5.
Bus	Home input comes from a bit vie fieldbus. This option is available for HACD-DPQ with fieldbus interface only.

Zero Channel This will setup the type of zero pulse being used if the encoder has a Z channel. The Z channel is always "anded" with the home mode input.

Condition	Description
NON	No Z channel is used.
RISING	The rising edge of the zero pulse is used.
FALLING	The falling edge of the zero pulse is used.

Direction This will invert the sign on the position feedback.

Condition	Description
INC	Forward counting pulses will increase the feedback signal.
DEC	Forward counting pulses will decrease the feedback signal.

BUS Manager (Profibus, CANopen, DeviceNet)

In the Screen „Busmanager“ you set the parameters for the bus communication and you choose which parameters will be transmitted via bus.

Exemplary the Profibus is described.

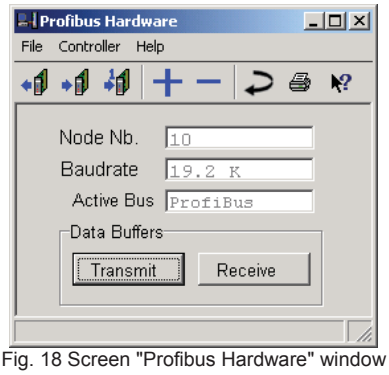

Fig. 18 Screen "Profibus Hardware" window

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

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

Profibus – Help menu Leads you directly to help on the current topic or to the index page of the BODAC Windows Help.

Profibus – icon bar Icons are provided for functions that are frequently used. They are described in “icon bars of a window ".

The window shows bus parameters, which can be changed, if applicable.

Send Determination of the parameters to be sent from the controller card to the bus master (e.g. PLC)

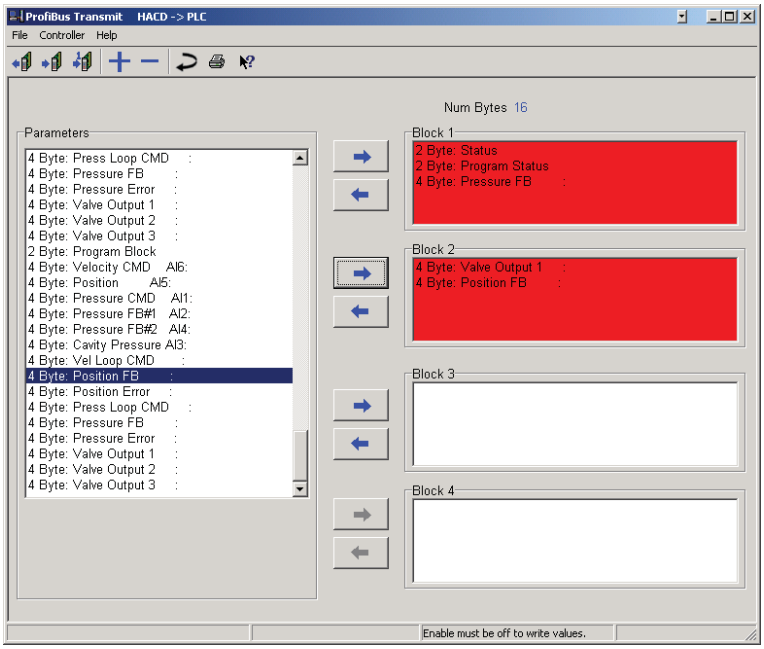

Fig. 19 "Profibus, transmit parameter HACD -> PLC" window

Send Profibus HACD->SPS – File menu The File menu in the window "Profibus" corresponds to the BODAC main window "File menu".

Send Profibus HACD->SPS - Controller menu Includes commands for reading, writing and changing of parameters.

Send Profibus HACD->SPS– Help menu Leads you directly to help on the current topic or to the index of the BODAC Windows Help.

Send Profibus HACD->SPS – Icon bar Icons are provided for functions that are frequently used. They are described in “icon bars of a window.

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

Adds parameters from the selection list for bus transmission.

Removes parameters from the bus transmission.

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

Receive Determination of the parameters to be received by the controller card (HACD) from the bus master (e.g. PLC).

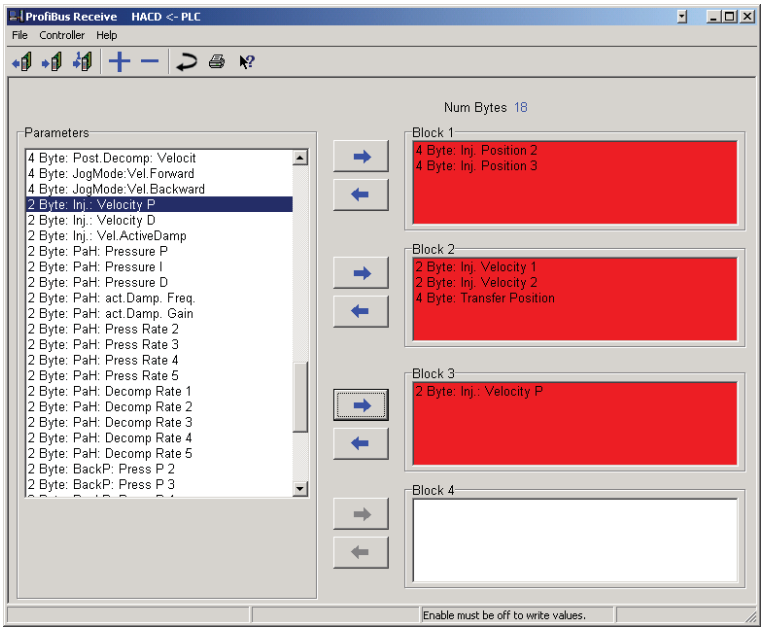

Fig. 20 "Profibus, receive parameter PLC -> HACD" window

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

Receive Profibus PLOC ->HACD – Controller menu Includes commands for reading, writing and changing of parameters.

Receive Profibus PLC ->HACD – Help menu Leads you directly to help on the current topic or to the index of the BODAC Windows Help.

Receive Profibus PLOC ->HACD – Icon bar Icons are provided for functions that are frequently used. They are described in “icon bars of a window.

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

 Adds parameters from the selection list for bus transmission.

Removes parameters from the bus transmission.

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

4.5 Tools menu

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

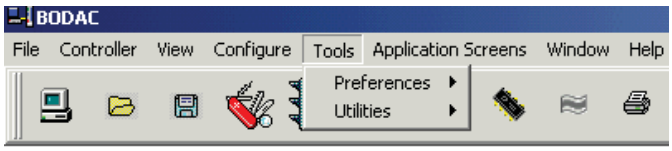

Fig. 21 Tools menu

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.

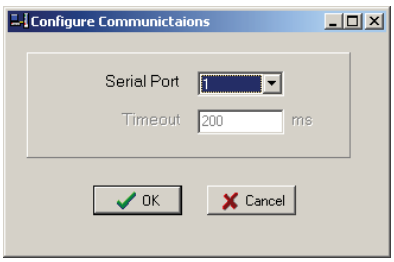

Fig. 22 "COM" window

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 In the "Timeout" field you determine how much time BODAC waits until generating the "Unable to Connect" warning.

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

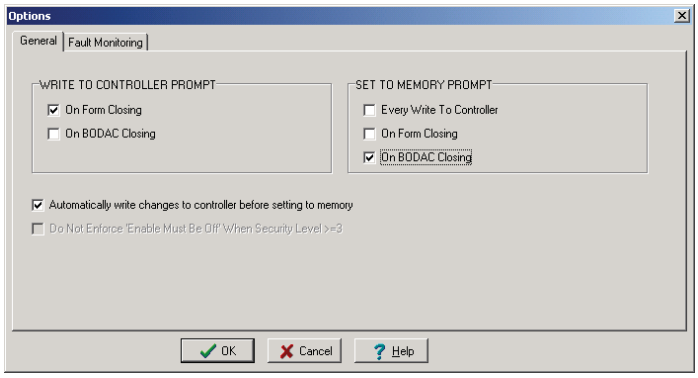

Fig. 23 "Options: General Settings" window

The user can select the desired field by placing a checkmark and the selection has to be confirmed with the "OK" button.

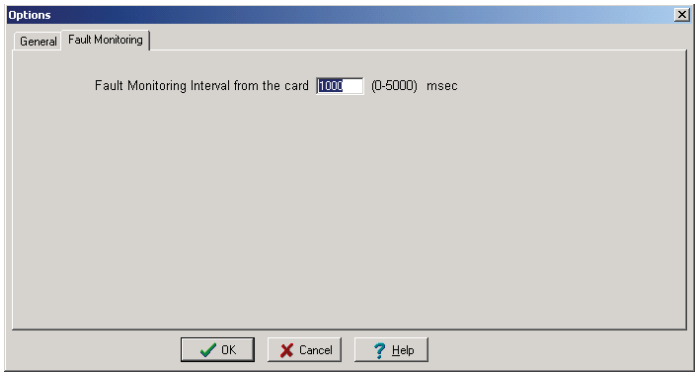

Fig. 24 "Options: Fault monitoring" window

In the "Fault Monitoring" tab the time interval can be selected for monitoring the faults that are shown in the "Status" window (see also "Status").

Example: A time of (1000 ms) means the fault status is updated every second.

Security

Five security levels are available 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 defined as follows:

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

Default for level 1 and 2 can be changed by customer.

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!

Document the Passwords for all levels (Customer and Bosch Rexroth AG).

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.

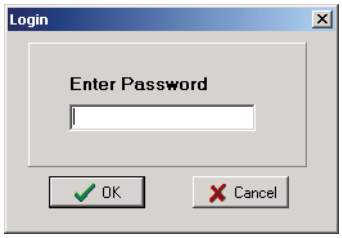

Fig. 25 "Login" window

Passwords

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

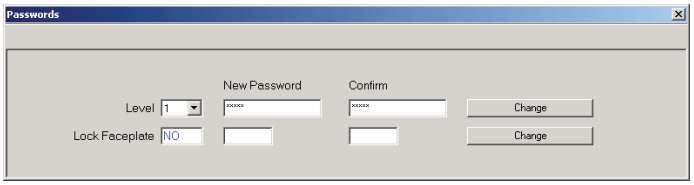

Fig. 26 "Passwords" window

Configure Screen Security

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

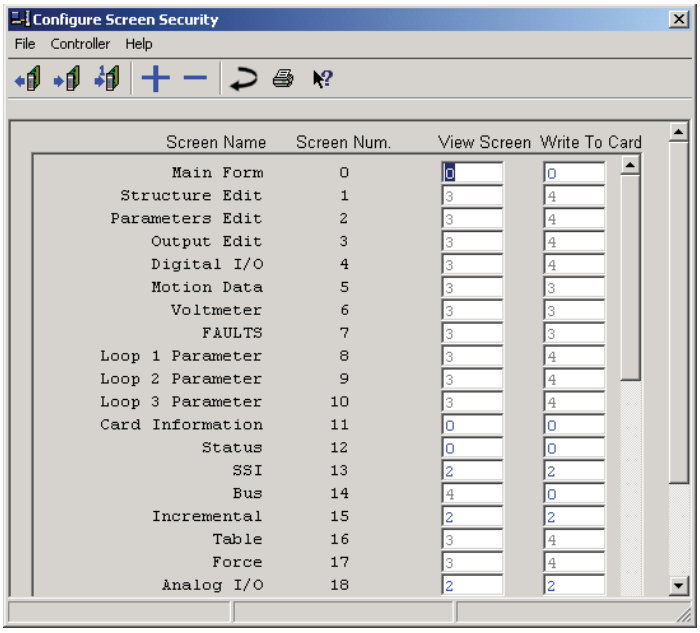

Fig. 27 "Configure Screen Security" window

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 default 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 menu

The "Application Screen" contains entry menus which are specially constructed for position-dependent braking applications.

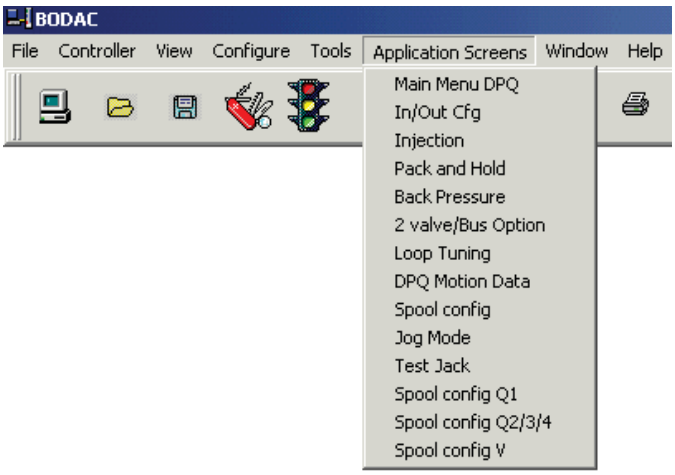

Fig. 28 Application Screens menu

The HACD-DPQ main menu

Opens the HACD-DPQ main menu, which contains all the required menus for the "Injection control for injection molding machines" application described in section 5.

Clicking on the preceding icon, which is a component of the toolbar, also opens the "Main menu DPQ" window. A listing of existing short-cuts for the toolbar can be found in Section "Toolbar".

or

Clicking on the preceding icon, which is a component of the toolbar, also opens the "Main menu DPQ analog" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

See also: Section "HACD-DPQ Main menu"

IN/ OUT Config

Opens the "In/Out configuration" window for configuration the analog and digital I/Os.

Clicking on the preceding icon, which is a component of the toolbar, also opens the "In/Out cfg" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

See also: Section 5.4 "Configure inputs and outputs".

Injection

Opens the "Injection" window for parameterizing the injection phase.

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

See also: Section 5.5 "Configure profiles for injection".

Pack and hold

Opens the "Pack and hold" window for parameterizing the pack and hold phase.

Clicking on the preceding icon, which is a component of the toolbar, also opens the "Pack and hold" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

See also: Section 5.5 "Configure profiles for pack and hold".

Back pressure

Opens the "Back pressure" window for parameterizing the back pressure phase.

Clicking on the preceding icon, which is a component of the toolbar, also opens the "Back pressure" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

See also: Section 5.5 "Configure profiles for back pressure including pre- and post-decompression".

Loop Tuning

Opens the "Loop Tuning" window.

Clicking on the preceding icon, which is a component of the toolbar, also opens the "Loop Tuning" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

or

Clicking on the preceding icon, which is a component of the toolbar, also opens the "Loop Tuning analog" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

See also: Section 5.4 "Adjust controller parameter for velocity and pressure for internal mode" or "Adjust controller parameter for velocity and pressure for analog mode".

Spool config

Opens the "Spool config" window for parameterizing the flow characteristic of the Q-spool.

Clicking on the preceding icon, which is a component of the toolbar, also opens the "Spool Config" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

See also: Section 5.4 "Configure spool flow curve".

2 valve / Bus option

Opens the "2 valve / Bus option" window for further options.

Clicking on the preceding icon, which is a component of the toolbar, also opens the "2 valve / Bus option" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

See also: Section 5.4 "2 valve / Bus option".

Motion Data

Opens the "Motion data" window for monitoring all signals in real-time.

Clicking on the preceding icon, 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".
Different screens will be opened depending if Analog Mode or Internal/Bus Mode was choosen.

See also: Section 4.6 "Motion data".

Jog Mode

Opens the "Jog mode" window for parameterizing the open loop jog mode.

Clicking on the preceding icon, which is a component of the toolbar, also opens the "Jog mode" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

See also: Section 5.4 "Configure velocity for jog mode".

Bus Trigger

Opens the "Bus Trigger" window for checking the settings of the triggers set via bus system.

Clicking on the preceding icon, which is a component of the toolbar, also opens the "Bus Trigger" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

See also: Section 4.6 "Bus Trigger".

Controller Structure

Opens the "Controller Structure" window for checking the values of controller settings.

Clicking on the preceding icon, which is a component of the toolbar, also opens the "Controller Structure" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

See also: Section 4.6 "Controller Structure".

Test jacks

In the "Test jacks" window the signals can be assigned which you can measure for diagnostic purposes on diagnostics terminal "X2" on the front panel of the HACD.

The "Valve command" signal is permanently assigned to test jack "X1".

You can assign a signal corresponding to the selection menu to test jack "X2" (see Fig. 29 "Test jacks" window).

The tabular window shows the signal flow from left to right with the necessary entry fields.

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".

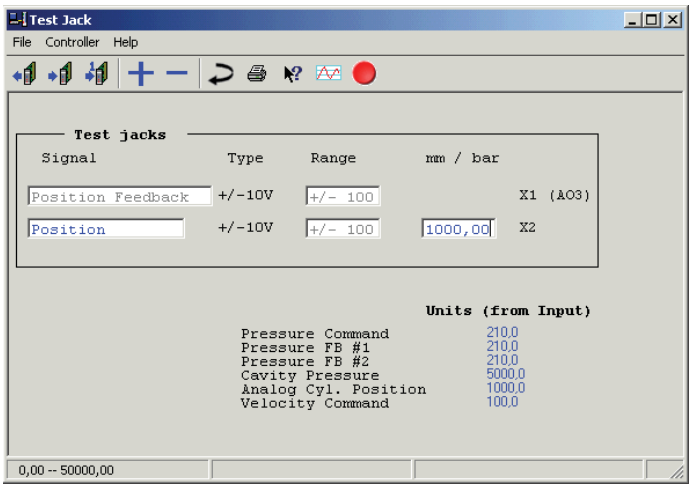

Fig. 29 "Test jacks" window

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

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

Unit Test jack "X1" has a pre-assigned value of 100 units, but you can adjust the size of the unit [Unit] for "X2".

For additional information on the test jacks of the card, see Technical Bulletin RE 30146-B "Installation and Operation of the Controller Card".

4 BODAC – Menu Description

Motion Data

The "Motion Data" window shows the entire signal sequence for the controller card in real-time.

Clicking on the preceding icon, 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".
Different screens will be shown, depending if Analog Mode or Internal/Bus Mode is choosen.

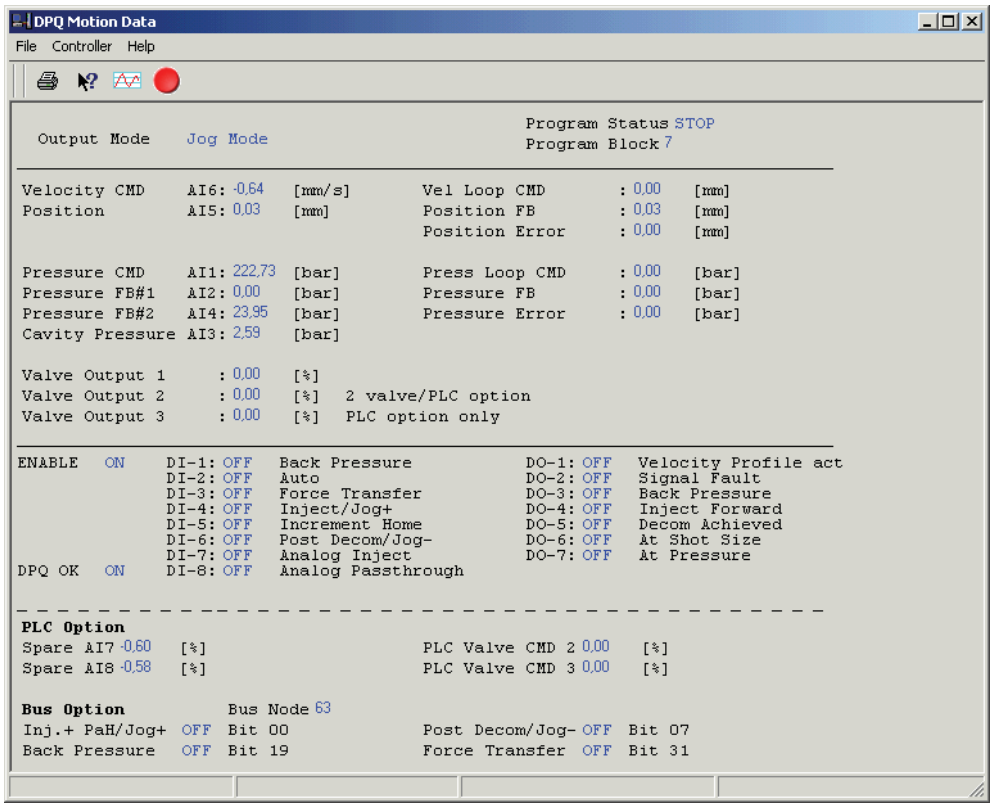

Fig. 30 "Motion Data" window for Internal/Bus Mode

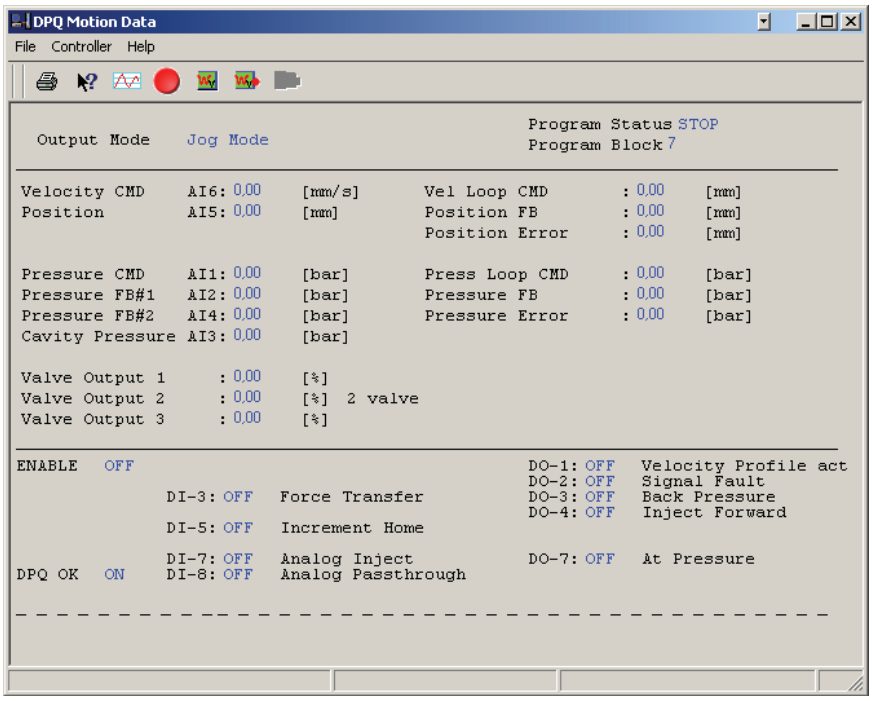

Fig. 31 "Motion Data" window for analog Mode

Depending which Mode is chosen the accordant Motion Data screen appear.

Clicking on the preceding icon, which is also a component of the tool-bar, opens the window "Multiplot".

Clicking on the preceding icon, which is also a component of the tool-bar, starts the recording of all signals shown in the multiplot window with every Block change.

Clicking on the preceding icon, which is also a component of the tool-bar, opens the window "WinView recording“

The upper third displays the current operating status of the HACD-DPQ control elec-tronics.

Below that is an overview of all necessary parameters for the input and output variables.

The lower third of the window shows the digital in-/outputs with their current state on / off.

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

Description of the signals:

Output Mode Represents active phase of injection control (Injection, Jog mode, Back pres, Decompress).

Program Status Represents the internal state of the controller card (Stop, Pause, Active).

Program Block Represents the active block of the internal structure. Following is a complete lsit what is done in every block. This can also be used on the PLC to determine in what state the card will be.

Block Nb	Analog Mode	Internal Mode
1	-	Inject Profile Step 1
2	-	Start Inject / Jog +
3	-	Inject Profile Step 2
4	-	Inject Profile Step 3
5	-	Inject Profile Step 4
6	-	Inject Profile Step 5
7	Analog Passthrough / Start/Stop	Analog Passthrough / Start/Stop
8	-	Start Post Decompress / Jog -
9	Start Analog Inject	Transfer Optimisation
10	Analog Inject	-
11	-	Transfer Hydraulic Pressure
12	-	Transfer Cylinder Position
13	-	Holding Pressure Step 1
14	-	Holding Pressure Step 2
15	-	Holding Pressure Step 3
16	-	Holding Pressure Step 4
17	-	Holding Pressure Step 5
18	-	Jog Forward
19	-	Jog Retract
20	-	Back Pressure Step 1
21	-	Back Pressure Step 2
22	Analog Transfer for Holding Pressure	-
23	-	Pre Decompress
24	-	Back Pressure Step 3
25	Analog Transfer for Back Pressure	Decompress Complete / Fault
26	-	Inject Profile Step 6
27	-	Inject Profile Step 7
28	-	Inject Profile Step 8
29	-	Inject Profile Step 9
30	-	Inject Profile Step 10
31	-	Post Decompress

32	-	Transfer External Signal

Mode 1:	Inject	white
Mode 2:	Jog Mode	green
Mode 3:	Pack and Hold / Back Pressure	yellow
Mode 4:	Decompression	red

In Analog Mode the Decompression settings are not used. For decompression the Passthrough function is used in the Analog Mode.

Velocity CMD Represents the analog command value of the velocity. This value is valid in analog mode only.

Position Represents the analog position feedback signal.

Vel Loop CMD Represents the internal command value of the velocity.

Position FB Represents the SSI position feedback signal.

Position Error Represents the loop error of the position controller.

Pressure CMD Represents the analog command value of the velocity. This value is valid in analog mode only.

Pressure FB#1 Represents the pressure feedback signal of pressure transducer #1.

Pressure FB#2 Represents the pressure feedback signal of pressure transducer #2.

Cavity Pressure Represents the pressure feedback signal of pressure transducer inside the mold (actual cavity pressure)

Press Loop CMD Represents the internal command value of the pressure

Pressure FB Represents the internal pressure feedback which is used for the pressure controller

Pressure Error Represents the loop error of the pressure controller.

Valve Output 1 Represents the output to the control valve.

Valve Output 2 Represents the value at output 2. See 2 valve / Bus option.

Valve Output 3 Represents the value at output 3. See also 2 valve / Bus option.

Digital I/O Represent the digital inputs and outputs.

PLC Option Represents the values at spare inputs and outputs if used as analog I/O via bus communication. See also valve/ Bus option

Bus Option Represent the control bits via bus.

Multiplot

In the multiplot window the signal trace of selected signals are represented in graphical form.

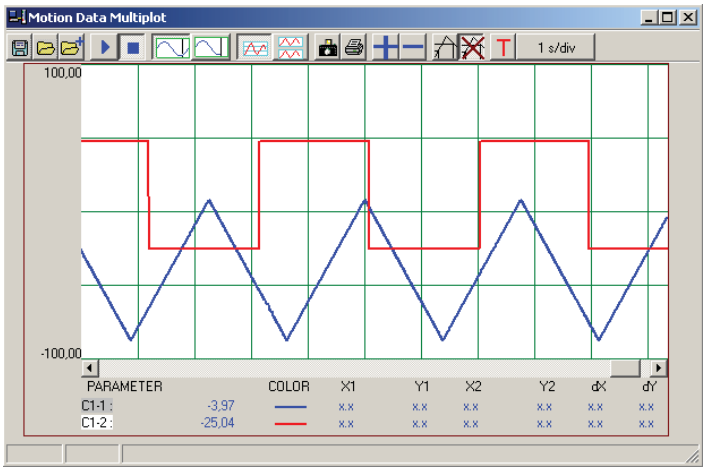

Fig. 32 "Multiplot" window

The window is a convenient software representation of an oscilloscope.

You can get to the "Multiplot" window from any submenu in the "Application Screens" menu.

The real-time oscilloscope is used mainly in the "Motion Data" window (see section "Motion Data").

Multiplot toolbar

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

Fig. 33 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 "**W**indows **M**eta **F**ile".

4 BODAC – Menu Description

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".

Increase the in the time base set value one step up. With the actual setting of 1 s/div the x-axis will increase to 500 ms/div.

Decrese the time base value for one step. With the actual setting of 1 s/div the x-axis will decrease to 2 s/div.

The with the mouse cursor framed area will be increased to the whole area of the process indication.

Decrease the signal setting to the original frame/size.

Multiplot Display

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

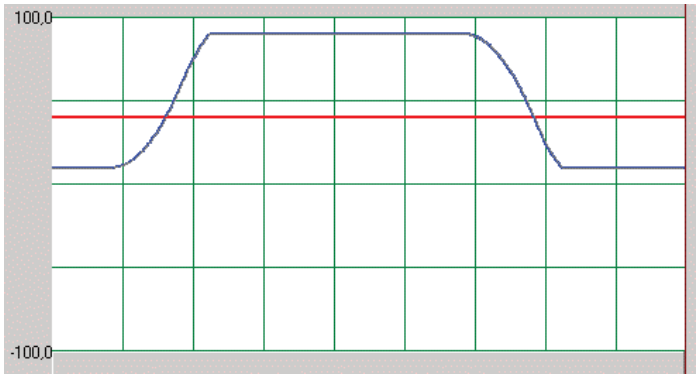

Fig. 34 Multiplot – signal display

The distance is shown in the Y-direction. The unit for the displayed velocity is units per second. The X-direction is represented as a time axis.

The representation 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
velocity command : x.x		0,000	0,0	0,000	0,0	0,000	0,0
position feedback : x.x		0,000	0,0	0,000	0,0	0,000	0,0
pressure command x.x bar		0,000	0,0	0,000	0,0	0,000	0,0
actual pressure : x.x bar		0,000	0,0	0,000	0,0	0,000	0,0

Fig. 35 Multiplot – Signal display – Legend

Parameters In the Parameters column the signals are shown with their names. Clicking 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.

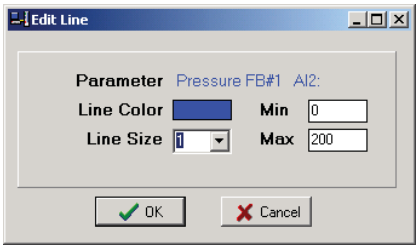

Fig. 36 "Adjust graphs" window

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 changing 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

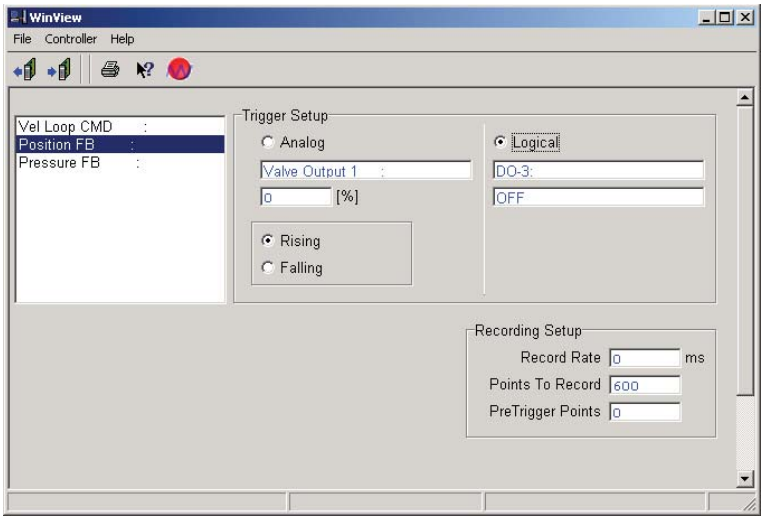

Abb. 1 “Winview Recording” window

Winview Recording – File menu

The File Menu in the „Winview Recording“ window corresponds to the BODAC main window „File menu“.

Winview Recording – Help menu

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

Winview recording – Toolbar

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

The signals listed in this screen are the same signals used in the BODAC Structure Editor. The Structure Editor screen layout is used to categorize the different signals that can be recorded in an easy to understand representation

Further information regarding the signals used in BODAC that can be selected for recording can be found in the chapter Motion Data.

Trigger Setup

This setup allows the user to select the condition that will trigger the start of the recording.

Recording Setup

This setup is used for configuring the recording parameters. The number of recording points for all signals combined is limited to 16384.
The rate of recording can be set between 2ms and 32766ms. Since the smallest available time step for recording is 2ms the number entered here should be a multiple of 2.
The Pretrigger points have a range of 0 – 16384 ms.

Status

The "Status" window provides an overview of the current faults which were detected while the HACD-DPQ was operating.

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

Fig. 37 "Status" window

OK Remains green as long as no fault has been detected.

Marker Remains yellow when a fault has been detected. If a signal you want to monitor is set to "Flag" in the "Faults" window, operation of the card is not interrupted. The fault is recognized, saved and processing continues.

Stop Comes on red when a fault has been detected. The controller card stops the process. Set the monitored signal in the "Faults" window to "Stop".

AI 1 to 6 Fault scheme for analog inputs 1 through 6.

SSI SSI encoder error. The settings for the SSI are made in the "SSI" window (See section "SSI").

Encoder Channel A The Incremental encoder has a fault at channel A.

Encoder Channel B The Incremental encoder has a fault at channel B.

Max. Freq. Fault If the frequency is too high for the incremental encoder an error occurred (See chapter 4.4 Incremental).

Checksum flash	The checksum for the memory chip shows a deviation from the currently stored data in the chip.
Memory	Error indication, that the RAM chip in the controller card is defective.
24 V Power	An error is indicated if the supply voltage is absent or incorrect. (short circuit or effect of other connected consumers)
+/-10V / 5V Source	A fault is indicated if the reference voltage +/-10 on the edge connector deviates by 0.5 %.
Short circuit DO1 to DO7	Error indication for digital outputs 1 through 7 when there is a short circuit on one of the outputs.
Bus Fault	Error indication for a bus fault. In general it mean that the bus has left the operaional communication state. But depending of the Bus System it has different meanings. Profibus: The slave has left condition “DATA_EXCHANGE”. CANopen: The node has left the condition “OPERATIONAL”. DeviceNet: The node has left the condition “ONLINE”.
Status – Help menu	Takes you directly to the help for the current topic or to the contents page of the BO-DAC windows help.

Bus Trigger

The Bus Trigger screen will only be visible if the Bus Mode is chosen. It shows the actual status of the bus triggers. With it you can see and control what bit is set via the bus for the triggers because every block has its own bit. Please check this screen when you are having trouble to set the triggers via bus from the PLC.

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".

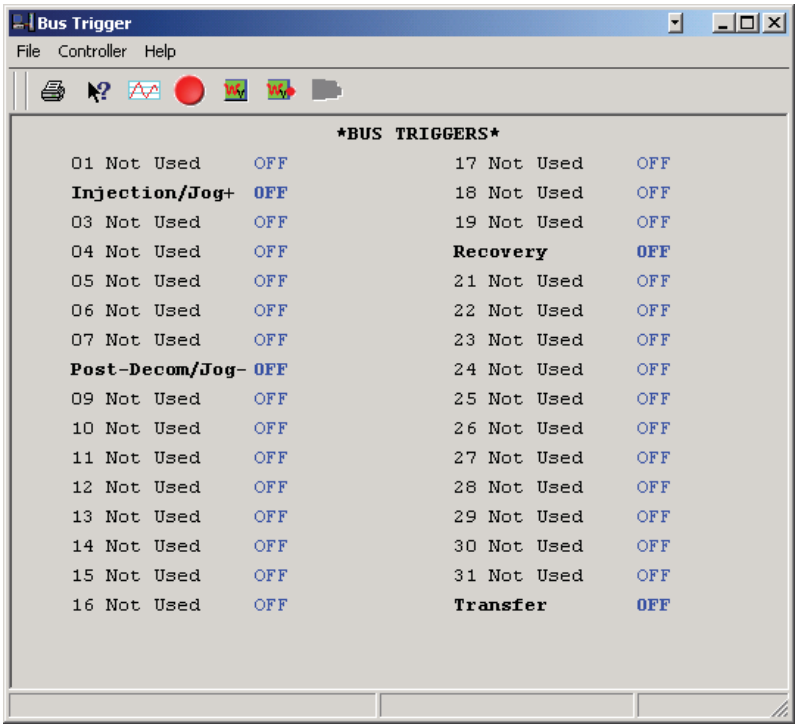

Fig. 38 "Bus Trigger" window

Only visible in security level 2 and is Bus Mode is chosen in In/Out Config screen.

Controller Structure

The Controller Structure screen will show the actual status of the controller values inside the card. With it you can see what value each controller part has. This will help to do the controller settings for the DPQ.

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

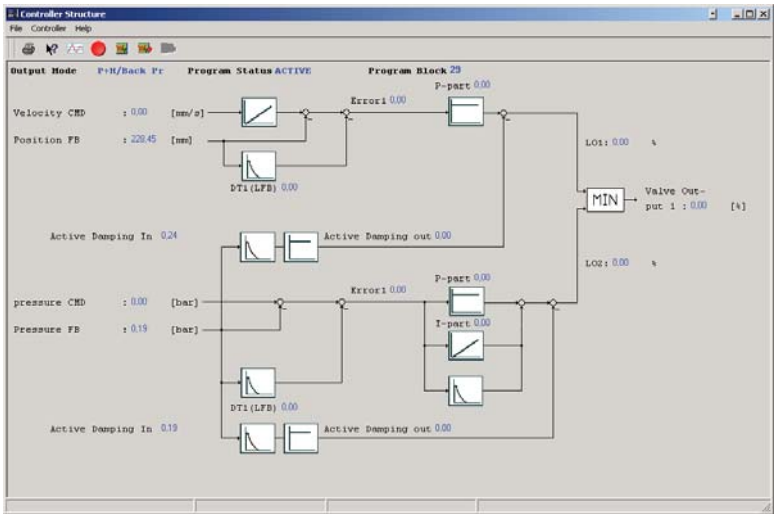

Fig. 39 "Controller Structure" window

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.

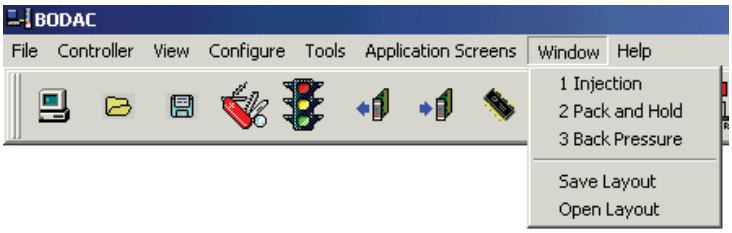

Fig. 40 Window menu

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 window Already opened windows (e.g., Analog I/O, see Fig. 40 Windows menu) can be selected by a simple mouse click. This allows you to navigate quickly through opened windows.

Save layout The "Save layout" function saves the current layout 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.

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 the Topics menu in the Help menu

or

- Click on the Help button in the active window

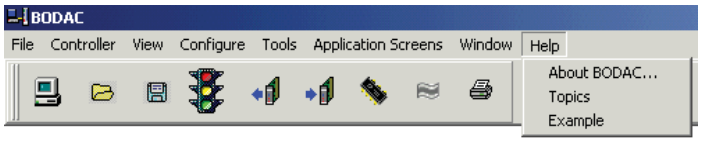

Fig. 41 Help menu

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.

Example

Opens online help for the application (see section 5 "Injection control for injection molding machines").

5 Application: Controller for injection molding machines

5.1 Startup reference list

Using software for startup
- The BODAC Software.
- Data exchange between the BODAC software and the HACD-DPQ closed-loop controller electronics.
- Open or create parameter file.
- Save the working state.

Select mode
- Choose mode of the controller card (intern, analog or bus)

Adjust configuration
- Configure inputs and outputs:
  - Choose maximum values
  - Choose position feedback signal
  - Choose pressure transducers and pressure controller mode
  - Adjust digital outputs
- Configure Q-spool flow curve.
- Adjust controller parameter for velocity and pressure:
  - for internal or bus mode or
  - for analog mode
- Configure velocity for jog mode.

Check wiring
- Check wiring with jog mode. Double check if valve and feedback signals are correct.

Define profiles for internal or bus mode
- Configure profiles for injection.
- Configure profiles for pack and hold.
- Configure profiles for back pressure including pre- and post-decompression.

Save the working state
- Save parameter file

Process settings
- Check your actual values
  - Motion Data
  - Test jacks
  - Status overview

Starting the application
- Start application

5.2 Establish communication

Data exchange between the BODAC software and the HACD-DPQ closed-loop controller electronics

Establish an RS-232 connection between the PC and the HACD-DPQ so the desired data can be set, saved and duplicated.

A fixed baud rate is set in the card.

- Connect PC to HACD-DPQ using an RS-232 cable (1:1 cable).
  Required cable set: VT-HACD-1x/03.0/HACD-PC
- Turn on PC and HACD-DPQ.
- Install BODAC.
- Start BODAC (see section 3 "BODAC user interface").

Open or create parameter file

The card is set up for an application. The data for adapting and structuring the application are saved in a file (FILENAME.PARAM) and stored in the predefined directory **\user**.

Assign a file name and save the current application state.

If there are no parameter files, the user is prompted after program start to open a default file.

Open parameter file

See section "Open".

Create parameter file

See section "Save".

5.3 Select mode

Mit dem Mode erfolgt die Umschaltung der Betriebsarten der HACD_DPQ.

Access to this screen is allowed at security level 2 only.

Choose Mode

INTERN	The injection phases (Injection, Pack and Hold and Back Pressure) are defined in the subsequent HACD-DPQ profiles. The selecton of the profiles is realized through Digital Inputs as well as through internal trigger events. Auto (DI2) has to be active (Active High) to start this Mode.
BUS	The injection phases (Injection, Pack and Hold and Back Pressure) are defined in the subsequent HACD-DPQ profiles. The selecton of the profiles is realized through BUS triggers as well as through internal trigger events. Auto (DI2) has to be active (Active High) to start this Mode.
ANALOG	The setpoint is an analog signal connected to an analog input. Digital inputs start the separate phases (Injection, Pack and Hold and Back Pressure and Screw Decompress). Auto (DI2) has to be inactive (Active Low) to start this Mode.

Transfer Trigger This pulldown is only visible, if in “Choose Mode” Bus is set.

DI3	The transfer from Injection to Pack and Hold is triggered via the discrete input DI3.
BUS	The Transfer from Injection to Pack and Hold is triggered via bus system.

5.4 Adjust configuration

Configure inputs and outputs

In the "Configure inputs and outputs" menu you select the signals for the inputs and outputs for your application.

Access to this screen is allowed at security level 2 only.

In/Out Cfg

Clicking on the preceding icon, which is a component of the toolbar, also opens the "In/Out Cfg" window. A listing of existing shortcuts for the toolbar can be found in Section "Toolbar".

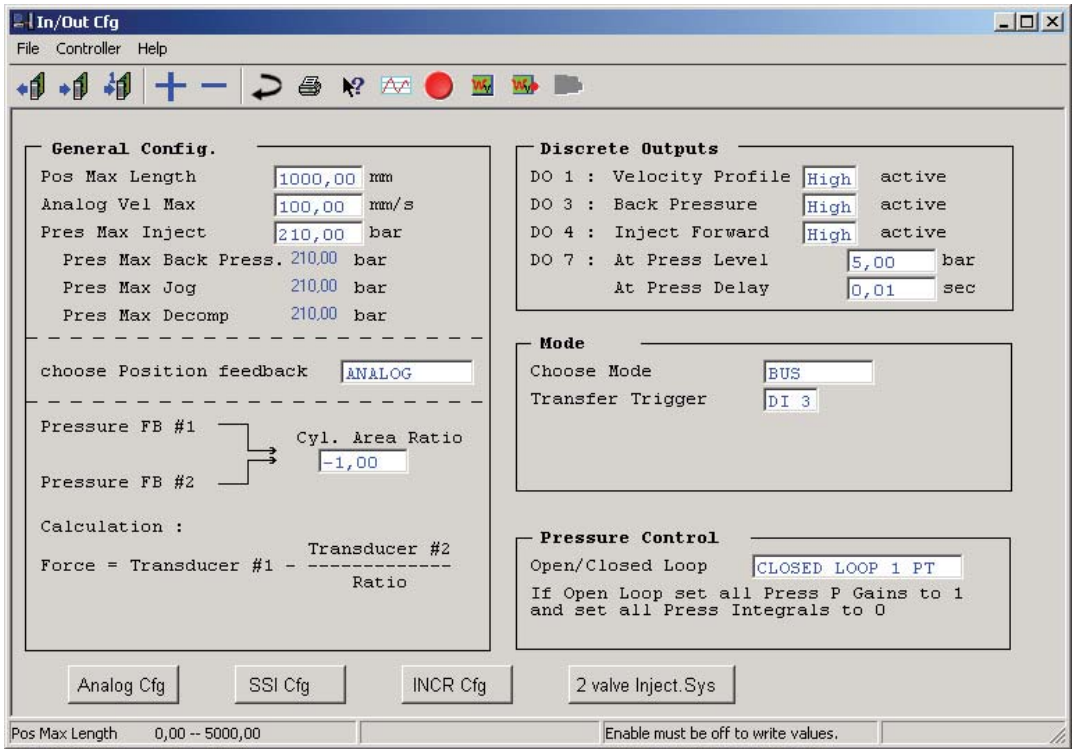

Fig. 42 "Configure inputs and outputs" window

In/Out Cfg – File menu

The File menu in the "Config.Input.Velocity" window corresponds to the BODAC main window "File menu".

In/Out Cfg – Controller menu

Contains commands for reading, writing and modifying parameters.

In/Out Cfg – Help menu

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

General Config.

Pos Max Length Set to the maximum length of the position feedback transducer.

Analog Vel Max In Analog Mode the velocity command is presented to the controller as an analog signal. This value corresponds to the maximum velocity related to a 100% command.

Pres Max Inject Set to the maximum value of the pressure feeback transducer(s).

Pres Max Back Press
Pres Max Jog
Pres Max Decomp The value Pres Max Inject is copied tor all these parameters if BODAC is used. If a BUS is used to set Pres Max inject then all 4 values have to be set seperately. These values are displayed for information.

Choose Position Feedback Defines the position feedback type.

ANALOG	Select ANALOG if you are using an analog positon transducer with voltage or current interface connected to IN 5
SSI	Select SSI if you are using a SSI digital position transducer.
INCR	Select INCR if you are using an incremental positon transducer.

Attention!

The conditioning electronics for the Incremental Encoder has a maximum detection frequency of 100 kHz. If this frequency is exceeded the actual position will not be decoded properly.

When using this type of encoder the user needs to choose the maximum velocity such that, keeping the resolution of the encoder in mind, the maximum frequency of 100 kHz is not exceeded.

Cyl. Area Ratio For force control instead of pressure control this value determines the ratio of the cylinder areas. Two pressure transducers are necessary.

For pressure control with one pressure transducer this value is irrelevant.
This factor compensates for different areas in the extend/retract directions of the injection hydraulic cylinder. This allows the DPQ to limit the actual force of the cylinder, allowing for area differences.
The default is –1.0.

Ratio >= 1 OR -1 < Ratio < 0	Force = (Transducer#1 * Ratio) – Transducer#2
Ratio <= -1 OR 0 < Ratio < 1	Force = Transducer#1 – (Transducer#2 / Ratio)

This parameter is only useful in a hydraulic system that uses a proportional directional type flow valve with a non-injection type spool to control both velocity and pressure. If the hydraulic system uses an injection valve or seperate valves for flow and pressure then set this parameter to –1.0.

Discrete Outputs

DO 1 This output indicates if injection or pack and hold mode is active. Choose between high or low active.

DO 3 This output indicates if back pressure mode is active. Choose between high or low active.

DO 4 This output indicates if injection mode is active. Choose between high or low active.

DO 7 This output indicates if the actual pressure has reached a certain pressure level (At Press Level). This level has to be reach for a minimum of time (At Press Delay).

Pressure Control

Open/Closed Loop

OPEN LOOP	Open loop pressure controller. Please set all P gains to 1 and all integrals to 0. The closed loop control may be turned off for initial setup and troubleshooting purposes. If the DPQ is controlling the pressure profile using a pressure type proportional valve connected to valve output 2 then the pressure loop may be left in open loop. PID tuning is not required in open loop control and the resultant control may be acceptable depending on the type of pressure control valve and the system configuration.
CLOSED LOOP 1 PT	Closed loop pressure controller with 1 pressure transducer
CLOSED LOOP 2 PT	Closed loop pressure (force) controller with 2 pressure transducers. Cyl. Area Ratio has to be set.

Buttons

These buttons give the user a fast and comfortable way to access several windows directly from the current window.

Analog Cfg Opens the "Analog I/O" window for configuring the analog inputs.
See also: Section "Analog I/O".

SSI Cfg Opens the "SSI" window for configuring the SSI input.
See also: Section "SSI".

INCR Cfg Opens the "Incremental" window for configuring the incremental input.
See also: Section "Incremental".

2 valve Inject.Sys Opens the "2 valve / Bus option" window for configuring the 2-valve mode and som options.
See also: Section "2 valve / Bus option".

Configure spool flow curve

A proportional valve with integrated electronics and Q-type spool is recommended for injection control. This allows for implementing pressure control by using a single pressure transducer.

Access to this screen is allowed at security level 2 only.

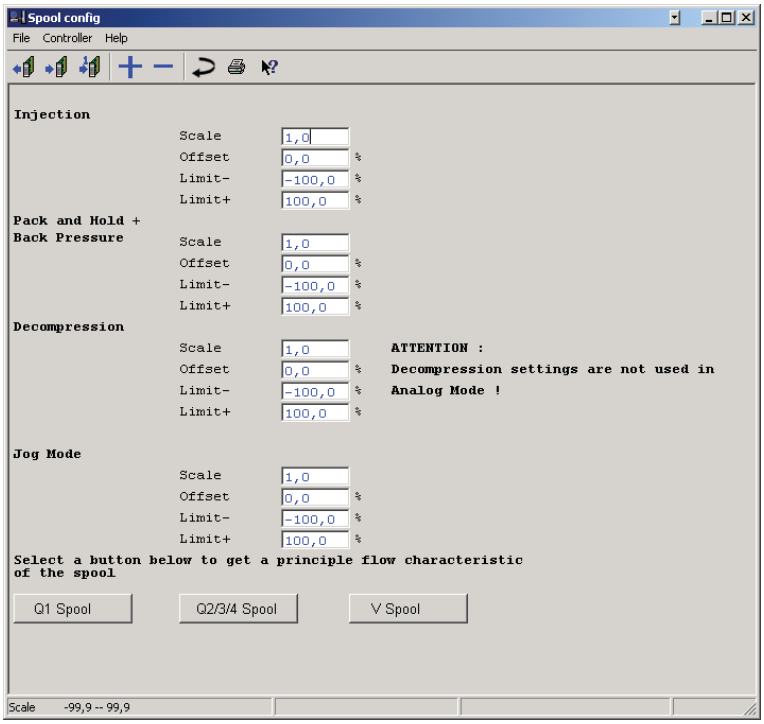

Fig. 43 "Spool configuration" window

Spool config – File menu The File menu in the "Q-spool Config" window corresponds to the BODAC main window "File menu".

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

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

Compensates for the flow curve of the spool during different modes of operation.

Scale Enter the required gain factor for the controller output value to the valve. This parameter is used to rescale the control loop output range for improved resolution when offsets and limits are applied. The scale factor is applied anytime a corresponding segment is selected. This parameter is direction dependent.
The standard setting is 1.0. This parameter shoul be adjusted so that the full range of the valve output is 100% of the control loop. For example, if the valve offset is set to 10%, the valve output will reach 100% with only 90% loop output, effectively increasing the loop gain. In this example, the remaining 90% of valve output can be scaled to 100% loop output by applying a multiplication factor of 0.9. This parameter value should normally be set to 1.0 or lower.

Offset Offset to valve output#1, in percent of full scale. This parameter is used to improve the response of the control loop when using overlapped or injection type valve spools.
The offset is applied anytime a corresponding segment is selected. This parameter is direction dependent.
This parameter should be adjusted to closely match the valve spool flow characteristic. Set the offset value to be slightly less than the overlap of the spool, so the injection cylinder does not drift when the machine is idle.

Limit + Enter the maximum value to limit the controller output value to the valve.
This parameter can be adjusted to limit the direction of the valve output in the forward direction.
Jog Mode and Decompression should be set to +100%, so over center operation is possible in these modes.

Limit – Enter the minimum value to limit the controller output value to the valve.

When using an injection type valve set this value to prevent the pressure integrator from shifting the valve into the decompression range of operation during Mold fill, Pack and Hold and Back Pressure.
Jog Mode and Decompression should be set to –100%, so over center operation is possible in these modes

Buttons for **Q1 Spool** **Q2/3/4 Spool** **V Spool** These buttons will give the user an overview of the flow charateristics of the most commonly used spools.

The exact data used for Scale, Offset and Limit can be found in the actual RE datasheet of the corresponding valve.

In Back Pressure the Limit + parameter is automatically set to zero to prevent the injection cylinder from actively advancing

In Analog Mode the Decompression settings are not used. For decompression the Passthrough function is used in the Analog Mode.

5 Application: Controller for injection molding machines

Example: Q2/3/4 Spool

The following example shows the flow characteristic of a Q2, Q3 and Q4 spool.

The values for Scale, Offset, Limit+ and Limit- are displayed for the different Injection phases. It is not unlikely that these values need to be fine-tuned during commissioning.

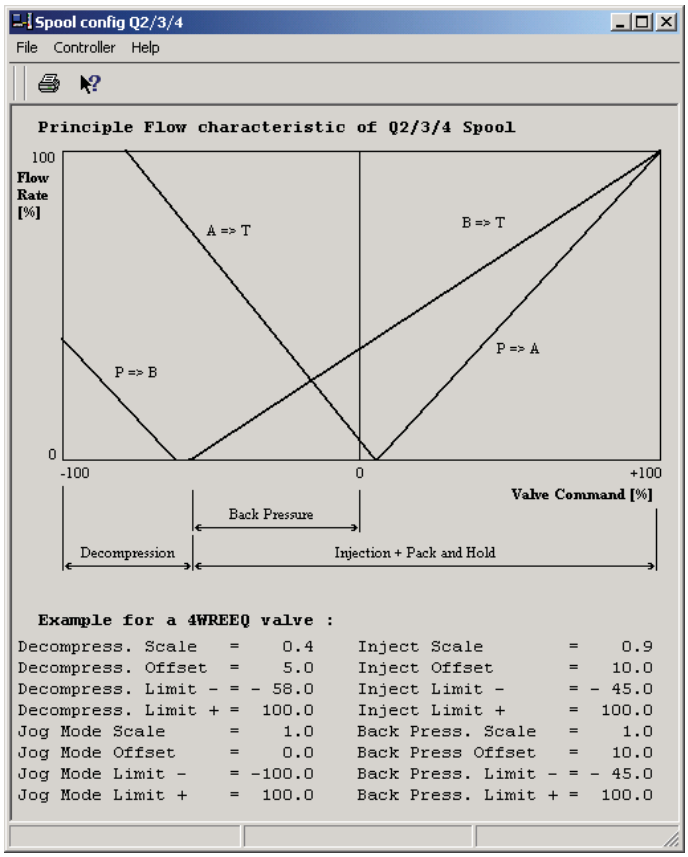

Fig. 44 Q-type spool settings

Adjust controller parameter for velocity and pressure for internal mode

All the necessary control loop settings can be made with the control parameters. The values entered affect the loop behavior.

Access to this screen is allowed at security level 1 only.

Loop Tuning

Clicking on the preceding symbol, which is a component of the toolbar, also opens the "Loop Tuning" window. A list of existing shortcuts for the toolbar can be found in Section 2.1 "Toolbar".

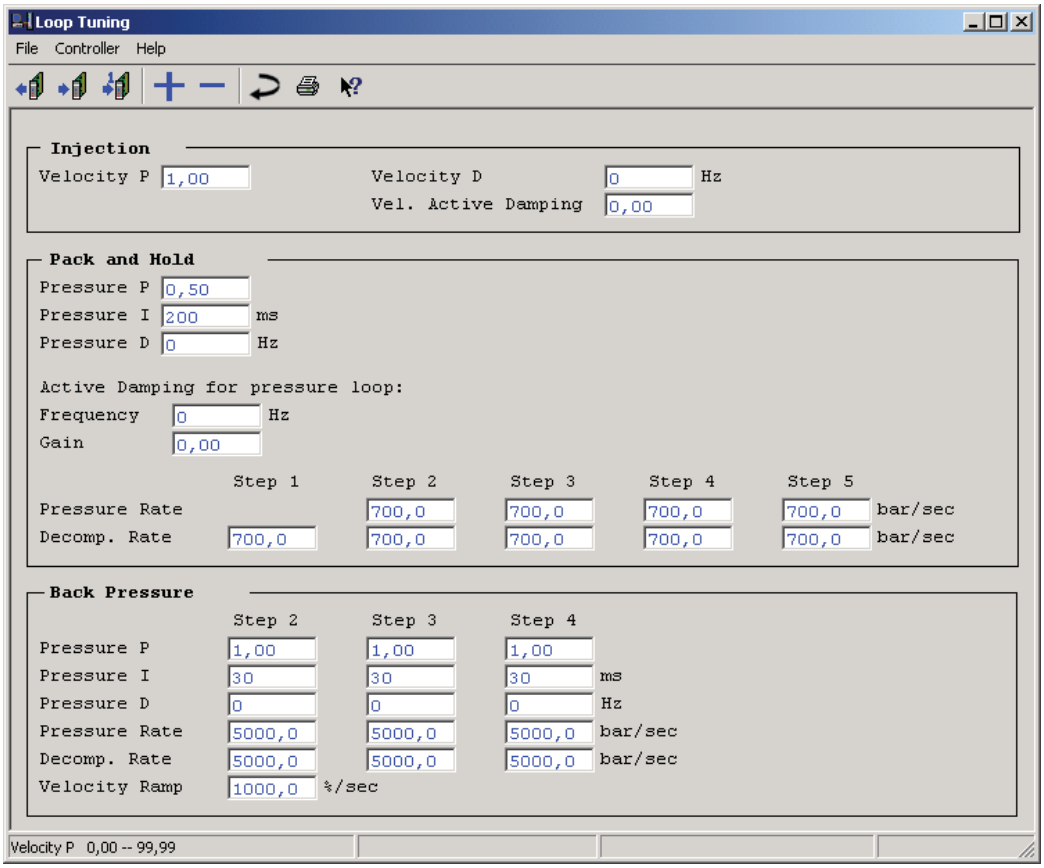

Fig. 45 "Loop Tuning" window for internal and bus mode

Loop Tuning – File menu

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

Loop Tuning – Controller menu

Contains commands for reading, writing and modifying parameters.

5 Application: Controller for injection molding machines

Loop Tuning – Help menu

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

Injection

Controller parameters for the velocity controller during injection.

Velocity P	This parameter changes the proportional component of the velocity controller. It causes a proportional change in the output component. See also "Controller structure".
Velocity D	This parameter changes the derivative component of the velocity controller. It causes a differentiated response of the output signal corresponding to the rate of change of the input signal. See also "Controller structure".
Vel. Active Damping	This parameter changes the gain of the active damping path. See also "Controller structure".

Pack and Hold

Parameters for the pressure controller and the pressure rates during pack and hold. The Pressure PID parameters are also active during the injection velocity profile.

Pressure P	This parameter changes the proportional component of the pressure controller. It causes a proportional change in the output component. See also "Controller structure".
Pressure I	This parameter changes the integral component of the pressure controller. It causes a velocity change in the output signal proportional to the time integral of the input signal. See also "Controller structure".
Pressure D	This parameter changes the derivative component of the pressure controller. It causes a differentiated response of the output signal corresponding to the rate of change of the input signal. See also "Controller structure".

Active damping for pressure loop

Frequency	This parameter changes the frequency of the filter of the active damping path. See also "Controller structure".
Gain	This parameter changes the gain of the active damping path. See also "Controller structure".

Pressure rate	This parameter defines the Ramp time for an increase in pressure command. See also "Creating command values with ramps".
Decomp. rate	This parameter defines the ramp time for a decrease in pressure command. See also "Creating command values with ramps".

Back Pressure Controller parameters for the pressure controller, pressure rates and velocity ramp during back pressure.

Pressure P	This parameter changes the proportional component of the pressure controller. It causes a proportional change in the output component. See also "Controller structure".
Pressure I	This parameter changes the integral component of the pressure controller. It causes a velocity change in the output signal proportional to the time integral of the input signal. See also "Controller structure".
Pressure D	This parameter changes the derivative component of the pressure controller. It causes a differentiated response of the output signal corresponding to the rate of change of the input signal. See also "Controller structure".
Pressure rate	This parameter defines the Ramp time for an increase in pressure command. See also "Creating command values with ramps".
Decomp. rate	This parameter defines the ramp time for a decrease in pressure command. See also "Creating command values with ramps".
Velocity ramp	This parameter defines the Ramp rate for the open loop maximum valve output at the start of back pressure control. See also "Creating command values with ramps".

Adjust controller parameter for velocity and pressure for analog mode

All the necessary control loop settings can be made with the control parameters. The values entered affect the loop behavior.

Access to this screen is allowed at security level 1 only.

Loop Tuning analog

Clicking on the preceding symbol, which is a component of the toolbar, also opens the "Loop Tuning" window. A list of existing shortcuts for the toolbar can be found in Section 2.1 "Toolbar".

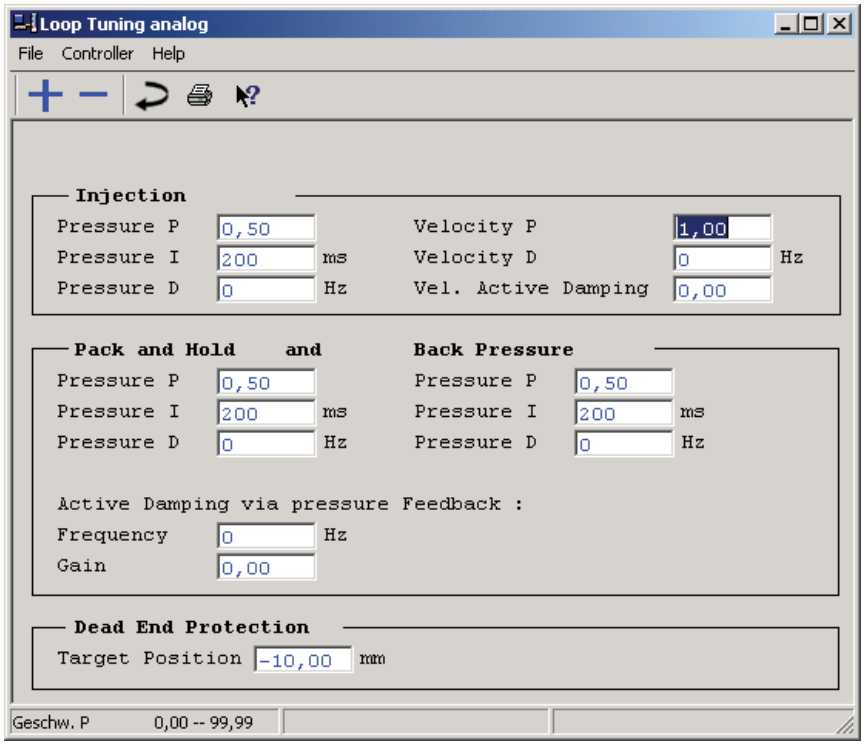

Fig. 46 "Loop Tuning analog" window for analog mode

Loop Tuning analog – File menu

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

Loop Tuning analog – Controller menu

Contains commands for reading, writing and modifying parameters.

Loop Tuning analog – Help menu

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

Injection

Controller parameters for the velocity controller during injection.

Velocity P	This parameter changes the proportional component of the velocity controller. It causes a proportional change in the output component. See also "Controller structure".
Velocity D	This parameter changes the derivative component of the velocity controller. It causes a differentiated response of the output signal corresponding to the rate of change of the input signal. See also "Controller structure".
Vel. Active Damping	This parameter changes the gain of the active damping path. See also "Controller structure".

Controller parameters for the pressure controller during injection.

Pressure P	This parameter changes the proportional component of the pressure controller. It causes a proportional change in the output component. See also "Controller structure".
Pressure I	This parameter changes the integral component of the pressure controller. It causes a velocity change in the output signal proportional to the time integral of the input signal. See also "Controller structure".
Pressure D	This parameter changes the derivative component of the pressure controller. It causes a differentiated response of the output signal corresponding to the rate of change of the input signal. See also "Controller structure".

Pack and hold and back pressure

Controller parameters for the pressure controller during pack and hold and back pressure.

Pressure P	This parameter changes the proportional component of the pressure controller. It causes a proportional change in the output component. See also "Controller structure".
Pressure I	This parameter changes the integral component of the pressure controller. It causes a velocity change in the output signal proportional to the time integral of the input signal. See also "Controller structure".
Pressure D	This parameter changes the derivative component of the pressure controller. It causes a differentiated response of the output signal corresponding to the rate of change of the input signal. See also "Controller structure".

Active damping for pressure loop

Frequency	This parameter changes the frequency of the filter of the active damping path. See also "Controller structure".
Gain	This parameter changes the gain of the active damping path. See also "Controller structure".

Dead end protection This parameter is used for protection of the Injection Axis in case of a failure in the analog command value.

Target position This parameter defines the position at which the axis will stop regardless of the velocity command value.

To de-activate this function enter a negative value.

2 Valve / Bus option

This window offers additional options for configuring this controller.

Access to this screen is allowed at security level 2 only.

2valve / Bus option

Clicking on the preceding symbol, which is a component of the toolbar, also opens the "2valve / Bus option" window. A list of existing shortcuts for the toolbar can be found in Section 2.1 "Toolbar".

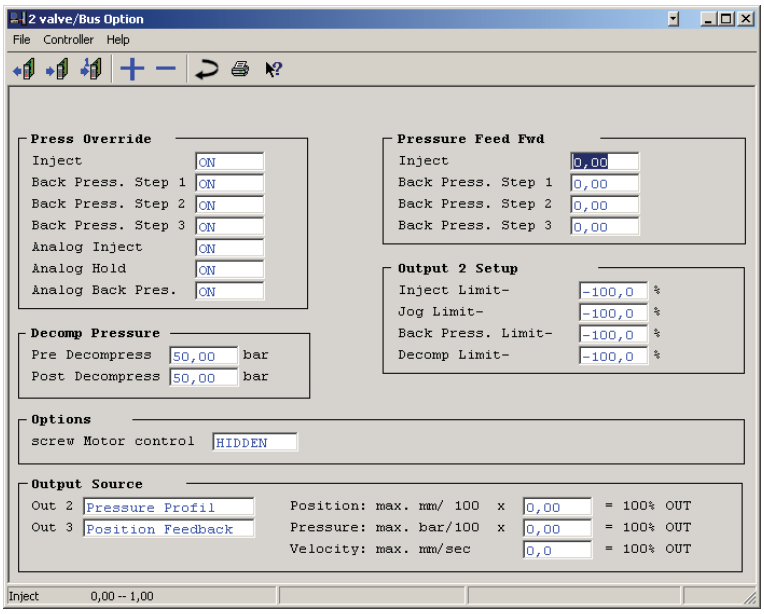

Fig. 47 "2 Valve / Bus option" window

2valve / Bus option – File menu

The File menu in the "Q-spool Config" window corresponds to the BODAC main window "File menu".

2valve / Bus option – Controller menu

Contains commands for reading, writing and modifying parameters.

2valve / Bus option – Help menu

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

Press Override

Inject	The pressure override option allows the pressure loop to override the flow control during the inject profile. In a system that uses one injection proportional valve for both velocity and pressure control the pressure override must be turned on. In a system that uses separate valves for velocity and pressure control the pressure override must be turned off.
Back Press. Step 1	see Inject
Back Press. Step 2	see Inject
Back Press. Step 3	see Inject
Analog Inject	see Inject
Analog Hold	see Inject
Analog Back Pres.	see Inject

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Pressure Feed Fwd	Inject	Pressure loop feed forward multiplication factor. This parameter is necessary when the DPQ is controlling the pressure profile and a pressure control type proportional valve is connected to valve output 2. The pressure command set point for closed loop pressure control is multiplied by this value and added to the pressure control loop output. If the DPQ is controlling pressure using a pressure type proportional control valve connected to valve output 2 then this parameter should be set to 1.00. The percentage of the proportional valve command at output 2 will be equal to the pressure command. The closed loop pressure controller will add or substract to that value as required to maintain the pressure set point. If the DPQ is controlling pressure using a single directional type proportional flow control valve connected to output 1 then this parameter must be set to 0.00. The feed forward function is disabled with a value of 0.00.
	Back Press. Step 1	see Inject
	Back Press. Step 2	see Inject
	Back Press. Step 3	see Inject
Decomp. Pressure	Pre Decompress	Open loop pressure command in percent of valve output 2. This command is only used to drive a proportional pressure control type valve that is connected to Valve Output 2 during screw decompress. If there is no proportional pressure control valve in the hydraulic system then these parameters have no influence.
	Post Decompress	see Pre Decompress
Output 2 Setup	Inject Limit -	Negative limits to valve output 2, in percent of full scale. This parameter is used to limit the direction of the valve output to a positive polarity when the DPQ is controlling the pressure. The limit is applied anytime a corresponding segment is selected. The negative limits should be set to 0.0% when a pressure type proportional valve is connected to output 2. If the PLC is controlling output 2 directly and a bi-directional type output is required then the negative limits should be set to -100.0%. Also if output 2 is used as an analog output for position or pressure indication the negative limits should be –100.0%.
	Jog Limit -	see Inject Limit -
	Back Press. Limit -	see Inject Limit -
	Decomp Limit -	see Inject Limit -

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Options	Screw Motor Control	With this option it is possible to use output 1 to control hydraulic screw motor speed during back pressure control if the hydraulic circuit is configured to allow this function. Hidden: The screw motor is not controlled by the DPQ card. Visible: The screw motor is controlled by the DPQ via output 1 during back pressure control. The flow settings will be visible on the Back Pressure screen.
Output Source	Out 2	Select type of output : - PLC controlled: the PLC will send commands via a bus and OUT2 acts as an analog PLC ouput – Pressure Profile: OUT 2 is used for a second valve for pressure control in a different hydraulic setup – Position Feedback: the position feedback is available at the connector side of the card – Pressure Feedback: the pressure feedback is available at the connector side of the card. - Velocity Feedback: the velocity feedback signal is available at the connector side of the card
	Out 3	Select type of output : - PLC controlled: the PLC will send commands via a bus and OUT3 acts as an analog PLC ouput - Position Feedback: the position feedback is available at the connector side of the card - Pressure Feedback: the pressure feedback is available at the rear connector side of the card - Velocity Feedback: the velocity feedback signal is available at the connector side of the card

Calculation of the conversion factor from units to % is done by the following mathematical relationship:

(Max Engineering Units / 100) * Conversion factor = 100%.

Example for position:

Max Engineering Units: 2000 mm
Conversion factor = (100% *100) / 2000 mm = 5 [%/mm]

So if you are at an actual position of 500 mm the output will be:
500 / 100 * 5 = 25 % = 2,5 V.

Example for pressure:

max 315 bar pressure transducer
10000 / 315 = 31,75
The value in this example is 31,75. So if you have an actual pressure of 120 bar so the output will be:

120 / 100 * 31,75 = 38,1% = 3,81 V.

Configure velocity for jog mode

With the jog mode you can move the injector in open loop control.

Access to this screen is allowed at security level 1 only.

Jog Mode

Clicking on the preceding symbol, which is a component of the toolbar, also opens the "Jog Mode" window. A list of existing shortcuts for the toolbar can be found in Section 2.1 "Toolbar".

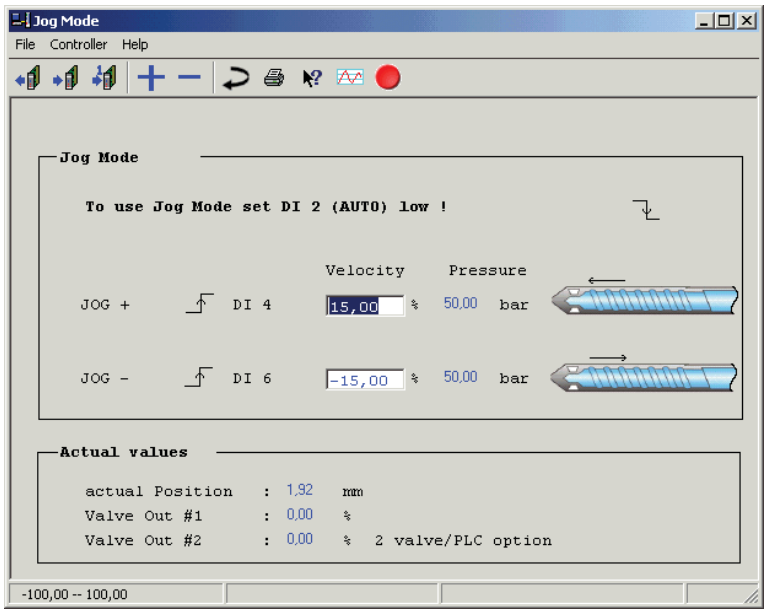

Fig. 48 "Jog Mode" window

Jog Mode – File menu

The File menu in the "Jog Mode" window corresponds to the BODAC main window "File menu".

Jog Mode – Controller menu

Contains commands for reading, writing and modifying parameters.

Jog Mode – Help menu

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

Velocity (Jog +)

This parameter defines the valve opening in Open Loop in the Inject forward direction. The position feedback should move towards „0“ in the inject forward direction.

Velocity (Jog -) This parameter defines the valve opening in Open Loop in the Inject retract direction. The position feedback should move towards „100%“ in the inject retract direction.

When using a Q-type spool retract motion (JOG-) requires a large value.

Controller structure

The complete controller structure of the HACD-DPQ is shown in Fig. 49. It consists of a position controller and a pressure controller followed by a minimum value generator. The minimum value generator defines what controller is active and ensures a bumpless transfer between the two.

Velocity controller Velocity control is achieved by a position controller. The velocity command is the ramp rate for an internal position command. Position command and position feedback are used by the position controller which is configured as a P control.Damping of the actual position can be achieved by using the available Derivative (DT1) in the actual position branch.

Pressure controller The Pressure controller is a PI controller. Damping of the actual pressure with a Derivative action in the feedback line can be configured.

Active damping Active Damping is available as an enhancement for extremely demanding installations. Active Damping uses the actual pressure which is fed into a Highpass filter(D) multiplied by a factor (Gain) and can be added to either controller output.
Active Damping can be used to stabilize the position control loop during the velocity profile. Active damping can be used to enhance the derivative action in the pressure control loop.

Minimum value generator Also referred to as pressure override function. The minimum value generator ensures that the transfer between multiple controller loops is bumpless.

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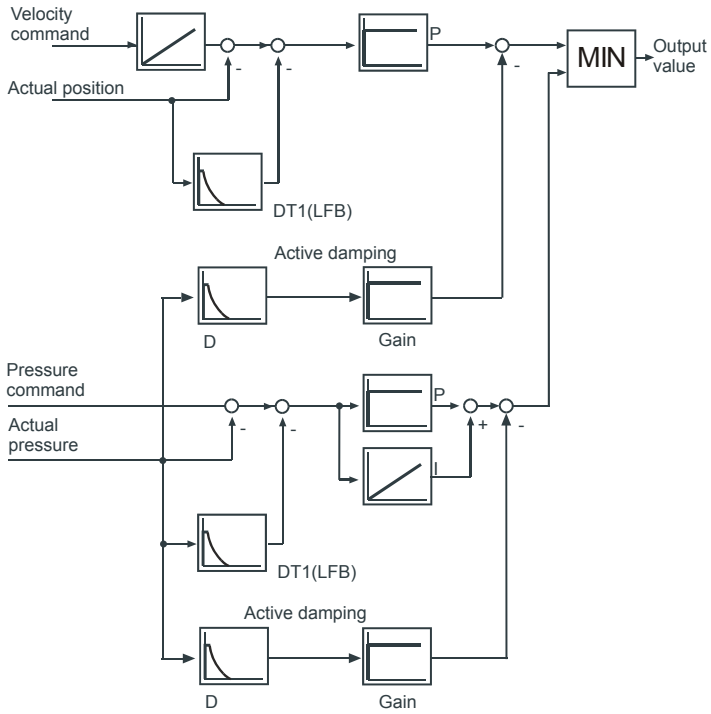

Fig. 49 Controller structure

5.5 Define profiles for internal or bus mode

Configure profiles for injection

Enter parameters for the injection velocity profile. The injection cylinder moves the screw according to the steps that define the velocity profile (see "0" position in Fig. 50 "Injection" window).

Injection

Clicking on the preceding symbol, which is a component of the toolbar, also opens the "Injection" window. A listing of existing shortcuts for the toolbar can be found in Section 2.1 "Toolbar".

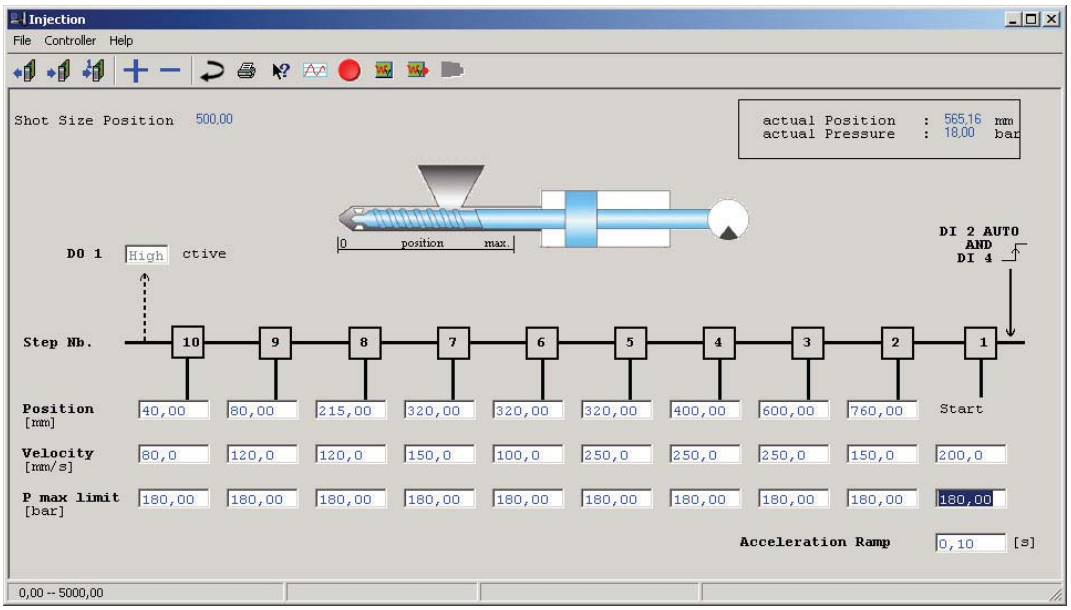

Fig. 50 "Injection" window

Injection – File menu

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

Injection – Controller menu

Contains commands for reading, writing and modifying parameters.

Injection – Help menu

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

Fig. 51 shows the velocity change of the injection phase as a function position.

See also: "Sequence diagram and function description", Injection.

5 Application: Controller for injection molding machines

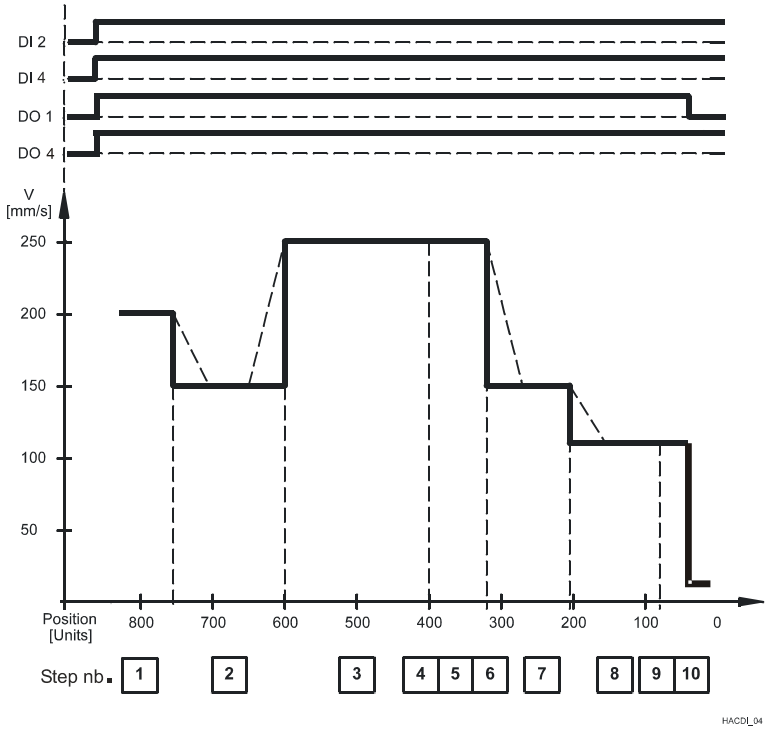

Fig. 51 Sequence diagram "Injection"

Position Segment start positions. The next corresponding Injection segment (step) begins when the internal position command is equal to or less than the value in that step.

Not all ten positions for the profile are necessary: The start position of any unused steps are set to zero.

Velocity Segment travel velocity. The internal position command will ramp towards the next segments' (step) start position at a rate determined by this value.

The Injection velocity should be limited to slightly lower than the maximum speed that the hydraulic system is capable of producing. If a velocity set point much higher than the capability of the machine is used, then the DPQ will not be able to accurately control the injection profile.

P max limiting Maximum segment pressure limit. This command is used to either drive a proportional pressure control type valve which is connected to valve output 2, or to limit pressure with the proportional directional valve which is connected to valve output 1. The pressure limit should be set high enough so it does not interfere with the velocity control in the segment.

Acceleration Ramp Acceleration rate at the start of the velocity profile. This parameter defines the time to accelerate to the velocity setpoint in the first segment.

See also: section "Command value forming with ramps and S-ramps".

Configure profiles for pack and hold

Enter parameters for the Pack and Hold pressure profile. In the pack and hold phase the closed loop position controller is turned off and the hold pressure profile is turned on.

Pack and hold  Clicking on the preceding symbol, which is a component of the toolbar, also opens the "Pack and hold" window. A list of existing shortcuts for the toolbar can be found in Section 2.1 "Toolbar".

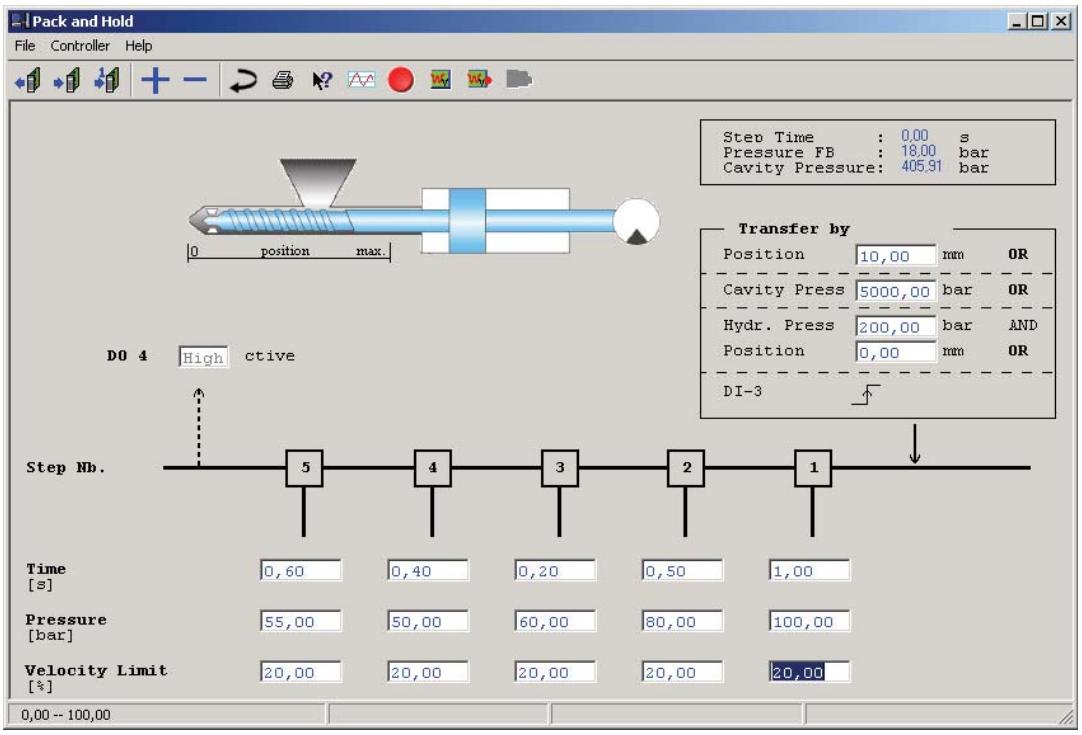

Fig. 52 "Pack and hold" window

Pack and hold – File menu The File menu in the "Pack and Hold" window corresponds to the BODAC main window "File menu".

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

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

Fig. 53 shows the pressure change during the pack and hold phase as a function of time t.

See also: "Sequence diagram and function description", Pack and Hold.

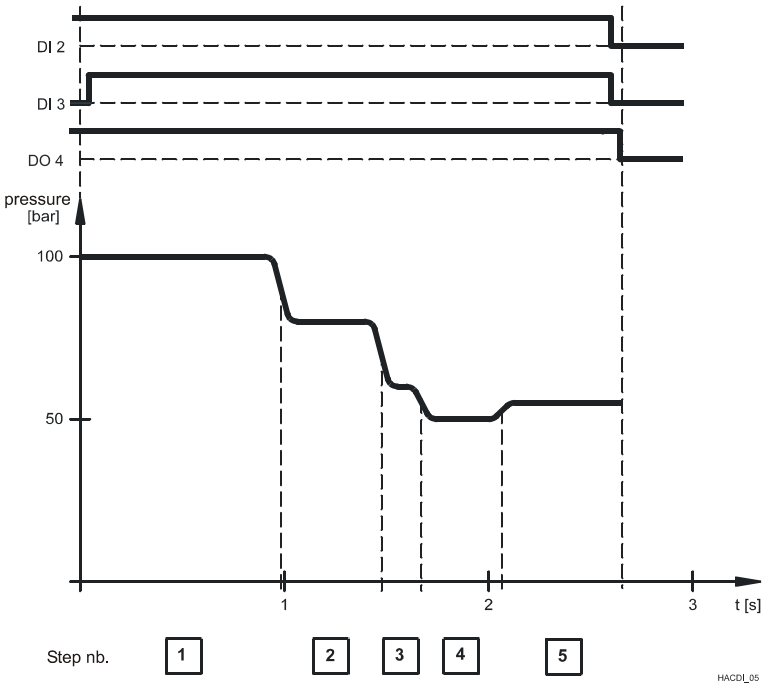

Fig. 53 Sequence diagram "Pack and Hold"

NOTE!

The internal command values in the profiles are absolute values. Check your entries after you have made them.

Transfer by

Select the start condition for the pack and hold phase.

- at a certain position
- at a certain pressure (hydraulic or cavity)
- using a rising edge on input DI-3

Transfer by position

- Position: Enter the desired cylinder position to begin Pack and Hold
- Cavity Press: Enter a maximum value for the pressure (corresponds to max. units for the pressure transducer)
- Hydr. Press: Enter a maximum value for the pressure (corresponds to max. units for the pressure transducer.
- Position: Enter “0” value
- DI-3: OFF

✓ When the position setpoint is reached there is a transfer from the velocity profile to the Pack and Hold pressure profile.

Transfer by hydraulic pressure

- ➢ Position: Enter “0” value
- ➢ Cavity Press: Enter a maximum value for the pressure (corresponds to max. units for the pressure transducer).
- ➢ Hydr. Press: Enter the desired hydraulic pressure to begin the pack and hold profile
- ➢ Position: Enter a position at which a change-over to the pack and hold profile is permitted. A higher actual pressure before this point will not force a transfer.
- ➢ DI-3: OFF
- ✓ When the hydraulic pressure setpoint is reached there is a transfer from the velocity profile to the Pack and Hold pressure profile.

Transfer by mold cavity pressure

- ➢ Position: Enter “0” value
- ➢ Cavity Press: Enter the desired mold cavity pressure to begin the pack and hold profile.
- ➢ Hydr. Press: Enter a maximum value for the pressure (corresponds to max. units for the pressure transducer).
- ➢ Position: Enter “0” value
- ➢ DI-3: OFF
- ✓ When the mold cavity pressure setpoint is reached there is a transfer from the velocity profile to the Pack and Hold pressure profile.

Transfer by DI-3

- ➢ Position: Enter “0” value
- ➢ Cavity Press: Enter a maximum value for the pressure (corresponds to max. units for the pressure transducer).
- ➢ Hydr. Press: Enter a maximum value for the pressure (corresponds to max. units for the pressure transducer).
- ➢ Position: Enter “0” value
- ➢ DI-3: ON
- ✓ When DI3 is turned ON (rising edge) there is a transfer from the velocity profile to the Pack and Hold pressure profile.

All transfer conditions are active. Muliple conditions to start the pack and hold profile may be used, such as position and pressure.

Time

Enter values for the time (internal command values). The Pack and Hold Step 1 timer begins when one of the transfer functions has been satisfied. The next timer begins at the end of the preceding timer.

If not all five steps of the profile are needed:
“0” is entered in the time for any unused steps.

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Pressure

Enter values for the pressure setpoint for each step of the pack and hold profile. The value of the Pack and Hold pressure is maintained in each step until the corresponding time has expired.

Velocity

Enter values for the velocity limit for each step of the pack and hold profile. It is an open loop flow command to the valve output 1. These parameters may be used to limit the maximum opening of the flow control valve during Pack and Hold pressure changes. It is possible to set a value that is too low to build the pressure that is required for the corresponding pack and hold step.

Define structure of the pack and hold phase

➢ Enter the corresponding values in the entry fields.

✓ This concludes configuration of the pack and hold phase.

Configure profiles for back pressure including pre- and post-decompression

Enter parameters for back pressure control and screw decompression. As the screw turns, melted plastic material is augered to the front of the screw tip until a sufficient volume for injection is accumulated. Residual pressure in the melted plastic may be relieved using either pre- or post-decompression.

Back pressure

Clicking on the preceding symbol, which is a component of the toolbar, also opens the "Back pressure" window. A list of existing shortcuts for the toolbar can be found in Section 2.1 "Toolbar".

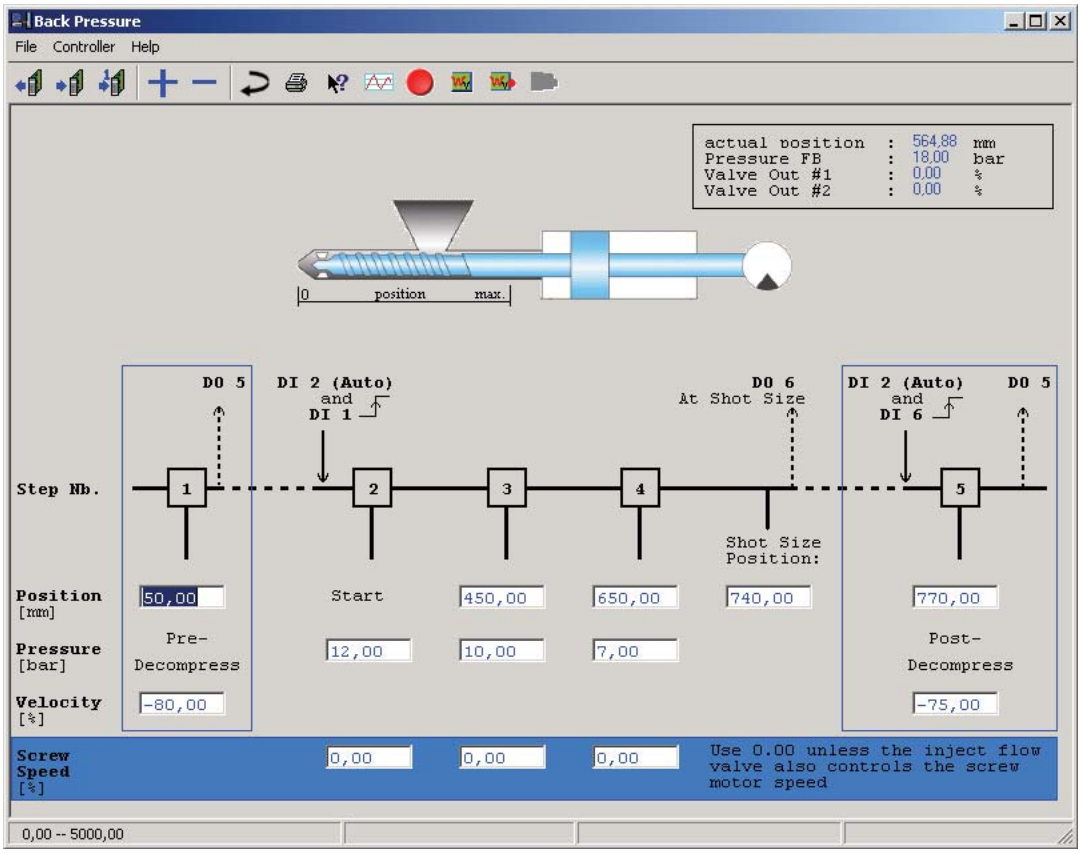

Fig. 54 "Back Pressure" window

Back Pressure – File menu

The File menu in the "Back pressure" window corresponds to the BODAC main window "File menu".

Back Pressure – Controller menu

Contains commands for reading, writing and modifying parameters.

Back Pressure – Help menu

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

Pre-Decompression

The Pre Decompress function is automatically enabled at the end of the Pack and Hold profile. It does not need an extra discrete input which saves cycle time.

Fig. 55 shows the position change during the pre-decompression phase.

See also: "Sequence diagram and function description", Pre-Decompression.

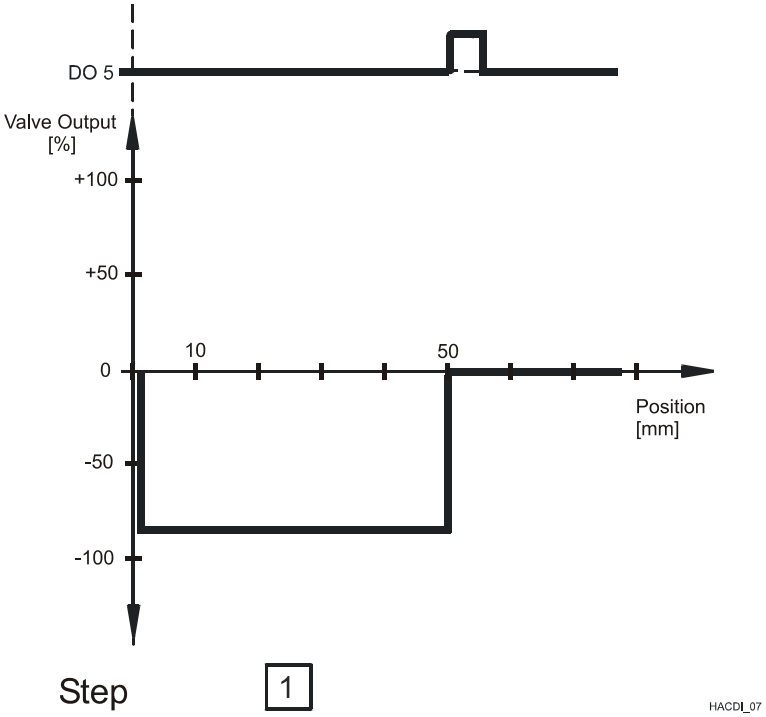

Fig. 55 Sequence diagram "Pre-decompression phase"

NOTE!

The internal command values in the profiles are absolute values. Check your entries after you have made them.

Position Enter values for the pre-decompress stop position.
If Pre Decompression is not required then enter a value less than the minimum cushion position into this parameter (Typically “0”). Discrete Output DO5 is set when the value of the injection cylinder position feedback is equal to or greater than the value in the Pre Decompression Position parameter.

Velocity Enter values for the pre-decompress velocity. It is an open loop flow command to valve output 1. When Pre Decompression is completed (DO5 “ON”), valve output 1 is set to zero.

Define structure of the pre-decompression phase

- ➢ Enter the corresponding values in the entry fields.
- ✓ This concludes configuration of the pre-decompression phase.

If the phase Pre-Decompression is not used enter a Position "0".

Back Pressure

The Back Pressure profile may use up to 3 pressure control steps. This mode is triggered when the screw is turning.

Fig. 56 shows the pressure change of the back pressure phase as a function of position.

See also: "Sequence diagram and function description", Back pressure.

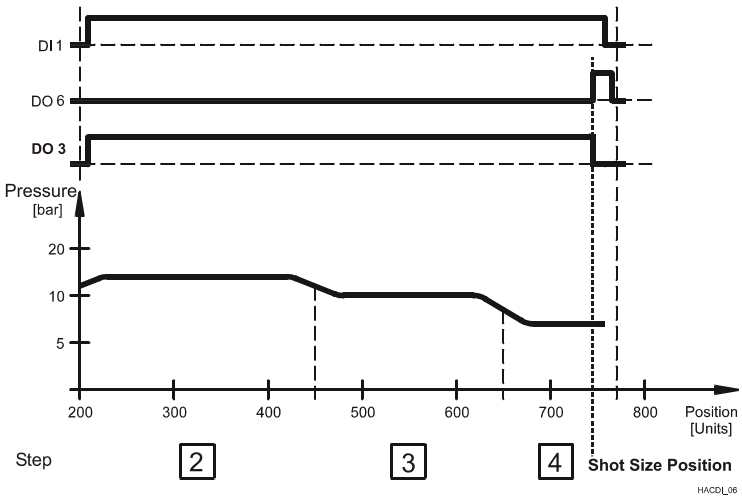

Fig. 56 "Back pressure" sequence diagram

NOTE!

The internal command values in the profiles are absolute values. Check your entries after you have made them.

Position Enter values for step 2 and step 3 start position if used.

If not all steps are needed for the profile: The start position for the unused steps should be set to maximum stroke length.

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Shot Size Position

Enter values for the Shot Size Position. Discrete output DO6 “At Shot Size” is turned on whenever the value of the injection cylinder position feedback is equal to or greater than the value in the Shot Size parameter. Also discrete output DO3 “Back Pressure” is turned of, when Shot size Position is reached.

Screw Speed

Open loop flow command to the valve output 1. This parameter is used to control the valve opening to be used during the corresponding recovery segment.
Normally this parameter is hidden and can be made visible in the Option screen with Screw Motor Control -> VISIBLE.
It’s set per default to zero. This will allow the valve output 1 only to reach negativ limits during Back Pressure. This will block the P->A curve for Back Pressure. Depending of the spool setup these values might be changed by user.
If the hydraulic system is installed that way, these parameters can be used to set the screw speed.
Valve output 1 is set to zero when the Back Pressure trigger is lowered.

Pressure

Enter values for the Back Pressure profile steps. This command is used to either drive a proportional pressure control type valve which is connected to valve output 2, or used to limit pressure with the proportional directional valve which is connected to valve output 1. The value of the Back Pressure parameter is maintained in each Back Pressure step until the next segment is reached or the Back Pressure trigger is lowered.

Define structure of the back pressure phase

➢ Enter the corresponding values in the entry fields.

✓ This concludes configuration of the back pressure phase.

Post-Decompression

Enter the parameters for Post-decompression, if used. Post-Decompression must be triggered. When triggered by DI6 (rising edge) the screw retracts to a defined stopping position.

Fig. 57 shows the position change of the screw during retraction after the back pressure phase.

See also: "Sequence diagram and function description", Post-decompression

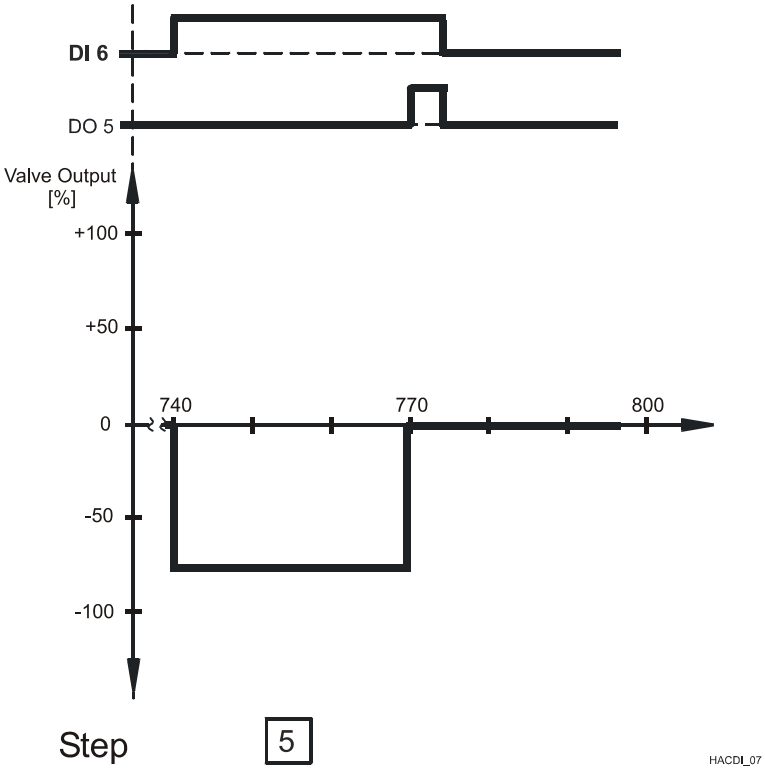

Fig. 57 "Screw retraction after back pressure" sequence diagram

NOTE!

The internal command values in the profiles are absolute values (Relative positions are NOT supported). Check your entries after you have made them.

Position Enter the value for Post -Decompress stop position. Post Decompression is complete when the value of the injection cylinder position feedback is equal to or greater than the value in the Post Decompression Position parameter. If Post Decompression is not required then do not raise the Post Decompression trigger.
Post Decompression may be triggered to pull the injection cylinder back to the Post Decompression Position at any time by raising the Post Decompression trigger discrete input DI6.
Discrete Output DO5 is on when the Post Decompression function is triggered and the value of the injection cylinder position feedback is equal to or greater than the value in the Post Decompression Position parameter.

Velocity Enter the value for the Post-Decompress velocity. It is an open loop flow command to valve output 1. When Post-Decompression is completed (DO5 “ON”), valve output 1 is set to zero.

Define structure of the post-decompression phase

➢ Enter the corresponding values in the entry fields.

✓ This concludes configuration of the post-decompression phase.

Creating command values with ramps

Ramps are necessary for parameterizing velocity and pressure commands.

Stable control requires a command profile that can be achieved by the hydraulic system. Step changes of command values must be avoided. Therefore, after a profile command value has been triggered, the current command is passed through ramps towards the profile command. The ramped value is sent to the loop controller as the loop command.

Ramp

The ramps are configured in seconds (s).

Fig. 58 shows the ramp function using a number example.

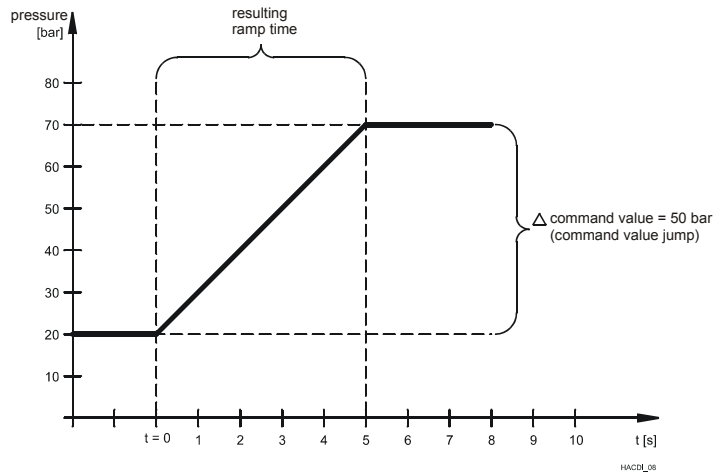

Fig. 58 Command value forming using the "Ramp" transfer function

Pre-defined settings

- Command value at 20 bar
- Max. pressure = 200 bar
- Ramp time = 20 s
- New command value = 70 bar => command value difference = 50 bar

Result

- The ramp time of 20 s refers to the equation 100 % = 200. The command value change is 50 bar with a resulting ramp time of 5 s.

Velocity

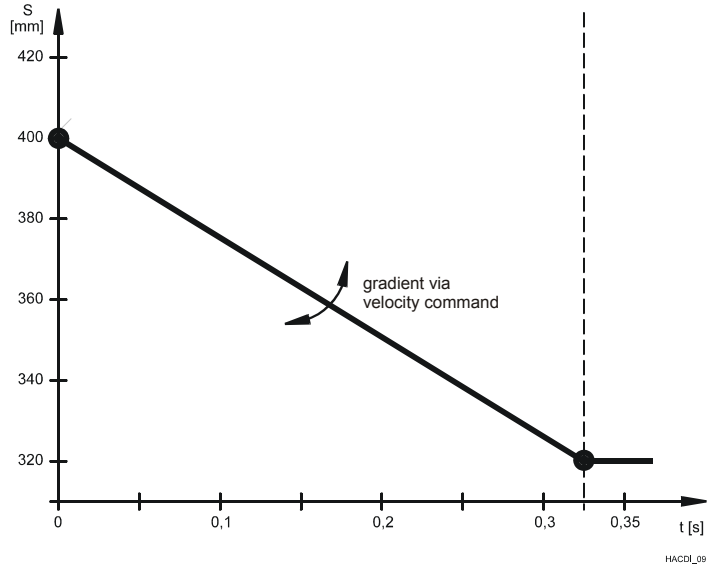

Fig. 59 Velocity

Pre-defined settings

- Travel difference: s = 80 mm
- Velocity: v = 250 mm/s

Result

- Travels

  t = s/v follows

  t = (80 mm) / (250 mm/s)

  time t = 0.32 s

See also: section "Injection phase".

5.6 Save parameter file

➢ All necessary functions have been parameterized.

✓ Save the data record in a parameter file (FILENAME.PARAM). The parameter file is stored in the predetermined directory **user**\.

See section "Save".

5.7 Process settings

This will give the user a quick overview of:

- the current parameters
- the current data structure
- the signals which are present
- the status of the card

Motion data

The entire signal sequence of your application can be monitored in real-time.

Process display

Clicking on the preceding symbol, which is a component of the toolbar, also opens the "Motion data" window. A list of existing shortcuts for the toolbar can be found in Section 2.1 "Toolbar".

See section "Motion data".

Test jacks

For diagnostic purposes signals can be assigned to the "X2" test jack on the front panel of the card.

Test jacks

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 2.1 "Toolbar".

See Section "Test jacks".

Status overview

The "Status overview" window provides an overview of the current faults which were detected while the HACD-DPQ was operating.

Status overview

Clicking on the preceding symbol, which is a component of the toolbar, also opens the "Status overview" window. A list of existing shortcuts for the toolbar can be found in Section 2.1 "Toolbar".

See section "Status overview".

5.8 Start application

Starting up

The application is started after setting:

- digital input "D18". This input is always linked with the ENABLE function of the controller card.

and

- digital input "DI 2" (AUTO) for internal closed loop profiles.

and

- Mode dependant DI x or Bus Trigger.

See also chapter 2.4 “Sequence diagram and functional description”.

Rexroth
Bosch Group

The data specified above only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.

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