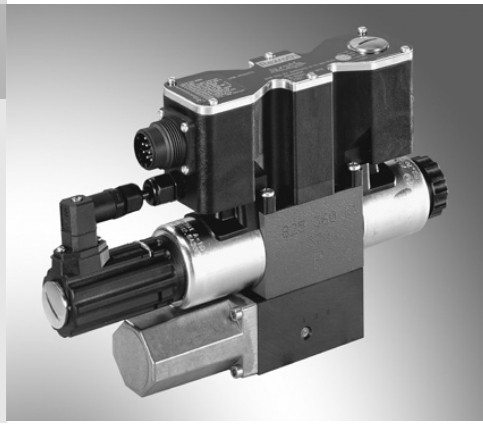
Rexroth
Bosch Group

Proportional directional valves with field bus interface, with and without Integrated axis controller (IAC-P and IFB-P)

RE 29015-B/05.11
Replaces: 02.08

English

Operating instructions



Type 4WREQ

Applies to the following types:

STW0195, STW0196 (with Integrated axis controller IAC-P)
4WREQ, size 6 und 10 (with Integrated axis controller IAC-P)
STW0240(4WREA), size 6 and 10 (with Integrated axis controller IAC-P)
4WREF, size 6 und 10 (without Integrated axis controller IFB-P)

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.

The cover page shows an example configuration. The product supplied may therefore differ from the photo shown.

The original operating instructions were prepared in German.

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1 About this document

These instructions contain important information on the safe and appropriate assembly, transport, commissioning, operation, maintenance, disassembly and simple troubleshooting of the valve with integrated IAC-P/IFB-P axis controller. These instructions contain information on the intended use of the proportional directional valves IAC-P/IFB-P with feld bus interface. For reasons of clarity, however, not all details on all possible functional combinations have been described. It is not possible either, to consider any possible case of integration or operation.

Read these instructions completely, especially chapter
"2 General safety instructions" on page 9 before working with the integrated axis controller IAC-P/IFB-P.

The target group of these operating instructions comprises all groups of persons installing, operating, servicing, and maintaining the products or systems of Bosch Rexroth.

These instructions provide information on the following:
The digital proportional valve with integrated axis controller functionality IAC-P and the digital proportional valve with field bus interface IFB-P.
The "WIN-PED 6" commissioning software.

These product-specific operating instructions apply to IAC-P and IFB-P valves with the following valve firmware:
V1.5xx (CANopen)
V1.0xx (PROFIBUS)

- You get information on the control types, the control via analog and/or digital signals as well as on the field bus connection.
- You get information on the menus and window contents of the "WIN-PED 6" commissioning software, its settings and parameters.
- In the software description, basic knowledge regarding the handling of a PC and corresponding knowledge of the user interfaces and the Windows® operating elements are assumed. If you need more related information, please read the relevant chapters in the Microsoft Windows® user manual or contact the Windows® online help.
- Before installing the digital proportional valves IAC-P or IFB-P or operating them for the first time, you must read these instructions. In this connection, you must particularly observe the safety provisions described.
- These valves may only be installed, commissioned and operated by persons having sufficient knowledge regarding their installation and operation.
- These instructions only describe the electrical installation, the parameterization as well as the commissioning and parameterization by means of the "WIN-PED 6" software. For information on the mechanical and hydraulic data, please refer to the corresponding Technical data sheets. The documentation is listed in chapter "1.1 Related documents" on page 8.

1.1 Related documents

The digital proportional valve with integrated axis controller functionality IAC-P and the digital proportional valve with field bus interface IFB-P are system components.

Also observe the instructions for the other system components.

Also observe the instructions in the following documents:

- System documentation from the system manufacturer
- Product information: IAC-P, RE 29015-P
- Technical data sheets:
  STW 0195, STW 0196, RE 29014
  4WREQ, RE 29050
  STW 0240 (4WREA), RE 29018
  4WREF 6 und 10: RD 29048
- Description of the bus protocols:
  RE 29015-01-Z (CANopen), RE 29015-02-Z (RROFIBUS-DP)
- General Information on the maintenance and commissioning of hydraulic systems and hydraulic components:
  RE 07800, RE 07900, AB 01-01.02
- Free Internet download at: www.boschrexroth.com/IAC

Also observe the generally applicable, legal or otherwise binding regulations of the European or national legislation and the rules for the prevention of accidents and for environmental protection applicable in your country.

More documents and the download for the "WIN-PED 6" commissioning software are available on the Internet at: http://www.boschrexroth.com/IAC

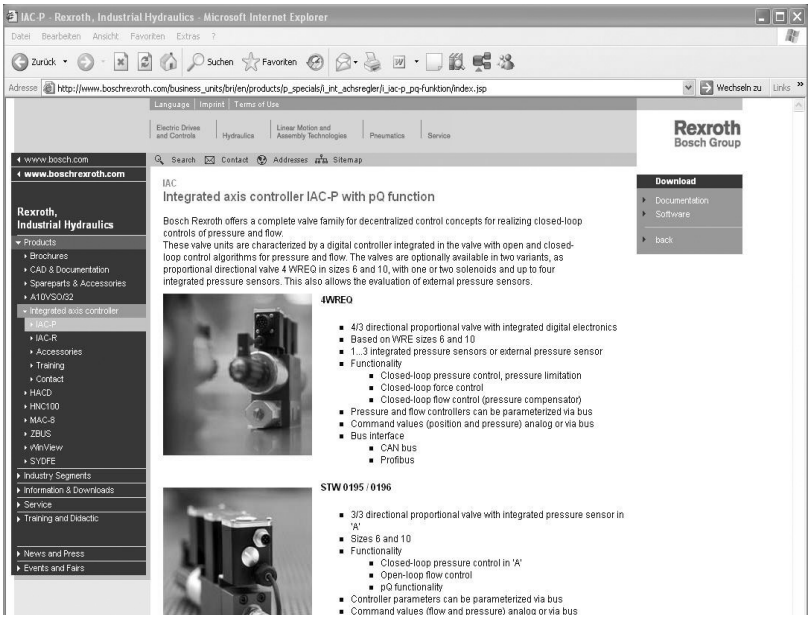

Fig. 1: Internet online support

Table 1: Issue status / version of the documentation

Document	Issue date	Replaces	Change
RE 29015-B	05.11	02.08	--

1.2 Abbreviations used

Table 2: Abbreviations

Abbreviation	Meaning
IAC-P	Integrated Axis Controller on the basis of Proportional valves (axis controller functionality)
IFB-P	Integrated Field Bus on the basis of Proportional valves (field bus interface)
OBE	On-board electronics
EMC	Electromagnetic compatibility
ESD	Electrostatic discharge
CPU	Central Processing Unit
SSI	Synchronous Serial Interface
"WIN-PED 6"	Software interface for commissioning valves

2 General safety instructions

The IAC-P/IFB-P integrated axis controllers have been manufactured according to the accepted rules of current technology. There is, however, still a risk of personal injury or damage to property if the following safety instructions and warnings before instructions contained in these operating instructions are not observed.

- Read these instructions completely and thoroughly before working with the IAC-P/IFB-P valve.
- Keep these instructions in a location where they are accessible to all users at all times.
- Always include the operating instructions when you pass the IAC-P/IFB-P valve on to third parties.
- Only operate the IAC-P/IFB-P valve in a technically immaculate condition and as intended, in a safety- and risk-conscious manner, considering these instructions.
- In case of failures impairing the safety and modifications to the operating behavior, shut down the IAC-P/IFB-P valve immediately and report the failures to the responsible personnel.
- The unobjectionable and safe operation of the valve requires the appropriate and proper transport, storage and installation as well as the careful commissioning and operation.
- The valves with IAC-P/IFB-P integrated axis controller have been manufactured according to the state-of-the-art and accepted rules of safety technology. Nevertheless, their use may cause injuries and damage to property if:
  - The valve is not used as intended.
  - The valve is not installed, commissioned and operated by corresponding specialists.
  - The valve is modified or retrofitted improperly.
- The valve with integrated axis controller IAC-P/IFB-P is intended for use in industrial areas.
- Operation is only admissible if the national EMC provisions for the present application are complied with.
- The manufacturer of the system or the machine is responsible for compliance with the limit values requested by the national regulations.
  In European countries: EC directive 89/336/EEC (EMC directive).

In the USA: National Electrical Code (NEC), National Electrical Manufacturers Association (NEMA) as well as regional building regulations. The operator must comply with all specified regulations at any time.

- For hydraulic products in general, you must moreover observe the regulations and notes described in the "General operating instructions for hydraulic systems".

2.1 Intended use

The integrated axis controllers IAC-P/IFB-P are a component in terms of the EU Machinery Directive 98/37/EC (partly completed machinery). The IAC-P/IFB-P integrated axis controllers are no ready-to-use machinery in the sense of the EU Machinery Directive. The products are intended exclusively for integration into a machine or system or to be assembled with other components to form a machine or system. The product may only be commissioned if it has been integrated into the machine/system for which it is designed and if the machine/system fully complies with the requirements of the EC Machinery Directive.

When using the products, you moreover need superordinate control logics with corresponding components that, in connection with the IAC-P/IFB-P valve are responsible for the holistic control of the machine's movement process and also its monitoring as regards safety. The products are in any case only operated as component in an overall system (e.g. machine).

The digital proportional valve with integrated axis control functionality IAC-P serves the control of the flow of a hydraulic axis by means of the analog command value (+/–10 V or 4 to 20 mA) or by means of the command value via field bus (CANopen/PROFIBUS-DP).

The digital proportional valve with field bus interface IFB-P serves the control of position, pressure and flow of a hydraulic axis by means of the analog command value (+/–10 V or 4 to 20 mA) or by means of the command value via field bus (CANopen/PROFIBUS-DP).

Observe the operating conditions and performance limits specified in the technical data.

The IAC-P and IFB-P integrated axis controllers are technical equipment and not intended for private use.

The valves are only admissible for operation in the industrial area according to DIN EN 50081-2.

The valves are only intended for use with hydraulic mediums on mineral oil basis.

The valves have been developed, produced, tested and documented complying with the safety standards. When observing the handling provisions and safety-technical instructions described for project planning, assembly and intended operation, there are normally no risks for persons or property resulting from the product.

Intended use includes having completely read and understood these instructions, especially the chapter "2 General safety instructions" on page 9 et seq.

2.2 Improper use

Any use of the integrated axis controllers IAC-P/IFB-P other than described in chapter "2.1 Intended use" on page 10 is considered as improper.

Conversions exceeding the extent described in these operating instructions are not permitted.

In particular, the valve solenoid on valves with a single valve solenoid must not be attached to the opposite side of the valve, as the switching positions would be inverted and no unambiguous allocation of the valve functions to the type designation would be given in this case.

The valves are not suitable for being operated in explosive environments.

2.3 Qualification of personnel

Assembly, commissioning and operation, disassembly, service (including maintenance and repair) require basic mechanical, hydraulic, electrical and control knowledge as well as knowledge of the appropriate technical terms. In order to ensure operational safety, these activities may only be carried out by corresponding experts or an instructed person under the direction and supervision of an expert.

Experts are those who can recognize potential hazards and apply the appropriate safety measures due to their professional training, knowledge and experience, as well as their understanding of the relevant conditions pertaining to the work to be undertaken. An expert must observe the relevant specific professional rules.

2.4 Safety instructions in this document

In these instructions, there are safety instructions before an instruction whenever there is a risk of personal injury or damage to property. The measures described for preventing these hazards must be observed.

Safety instructions are set out as follows:

SIGNAL WORD! 	**Type of risk** Consequences ▶ Precautions

- Warning sign (warning triangle): Draws attention to the hazard
- Signal word: Identifies the degree of hazard
- Type of risk: Specifies the type or source of the hazard
- Consequences: Describes the consequences of non-compliance
- Precautions: Specifies how the hazard can be prevented

The signal words have the following meaning:

Table 3: Signal words/warning signs

Signal word	Application
DANGER! 	Indicates an imminently hazardous situation which, if not avoided, will certainly result in death or serious injury.
WARNING! 	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION! 	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury or damage to equipment.
	If this information is disregarded, the operating procedure may be impaired.

2.5 Adhere to the following instructions

2.5.1 General instructions

- Observe the regulations on accident prevention and environmental protection for the country where the product is used and at the workplace.
- Exclusively use Rexroth valves in good technical order and condition.
- Check the valves for visible defects, for example loose seat of screws, loose seat of the connecting plugs and connection lines, mechanical damage, etc.
- Do not modify or retrofit the valves.
- Only use the valves within the performance range provided in the technical data.
- Persons who assemble, operate, disassemble or maintain Rexroth valves must not consume any alcohol, drugs or pharmaceuticals that may affect their ability to react.
- Make sure that all safety devices belonging to the valve are present, have been installed properly and are fully functional. Do not displace, bypass or disable the safety devices.
- If it is necessary to disable safety devices, for example for commissioning or maintenance works, always take the appropriate measures to ensure that no hazard to a person's life or health or to property may occur. Also observe the superordinate operating instructions for the machine or system.
- Emergency stop devices must remain effective and reachable in all modes of operation of the system. Unlocking the emergency stop devices must not result in an uncontrolled system restart! Check the emergency stop chain first before switching on the system!
- Unless described otherwise, maintenance works are generally only admissible if the system has been switched off and depressurized! In this connection, the system must be protected against unauthorized and unintended re-start. If electrical measurement and test works are necessary during the system operation, they have to be carried out by specialized electricians.
- Hydraulic axes may still be pressurized after the system has been switched off! This may result in unintended axis movements. Ensure that hydraulic axes have

been depressurized before critical works are carried out.

- The valve is no safety device.
- The valve could block in an undefined position due to internal pollution – e.g. through polluted hydraulic fluid, wear debris or residual dirt. As a result, the driven actuator may no longer be under the operator's control.
- Provide for an appropriate emergency stop function to make sure that the driven actuator can be set to a safe position (e.g. immediate stop).
- Please comply with the specified cleanliness class 20/18/15 in accordance with ISO 4406 (c).

CAUTION!

Risk of burning!

The valve considerably heats up during operation. The solenoid of the valve gets so hot during operation that you may burn yourself.

- ▶ Allow the valve to cool down sufficiently before touching it.
- ▶ Wear heat-resistant protective clothing, e.g. gloves.
- ▶ Please also observe ISO 13732-1 and EN 982.

- The warranty only applies to the delivered configuration.
- Bosch Rexroth is not liable for consequential damage resulting from the regulation or control of the axes or the manual movement of the axes. Bosch Rexroth is also not liable for consequential damage that could have been avoided by corresponding PLC programming!
- The warranty expires if the product is incorrectly assembled, not used as intended and/or handled improperly.
- Do not expose the valve to any mechanical loads under any circumstances. Never use the valve as a handle or step. Do not place any objects on top of it.
- Electrically and hydraulically operated axes apply very high mechanical forces and the large dynamics allow for very fast acceleration. Consequently:
  - Never stay within the hazard area of the machine if the system is switched on!
  - Never decommission safety-relevant system functions!
  - Inform your maintenance and/or repair department about system failures immediately!
- You may only use spare parts approved of by Bosch Rexroth!
- When handling assemblies and parts, comply with all precautions for ESD protection! Avoid electrostatic discharge!
- Repair: The repaired valves will be supplied with default settings and updated firmware, if necessary. User-specific settings are not accepted. The operator will have to retransfer the corresponding user parameters

2.5.2 During transport

- Observe the transport instructions on the packaging.
- The IAC-P/IFB-P integrated axis controllers may only be transported and stored in the intact original packaging. Only remove the dust protection caps immediately before the assembly and commissioning.
- Protect the IAC-P/IFB-P integrated axis controllers against dust and humidity. Admissible temperature range –20 °C...+ 50 °C.

2.5.3 During assembly

- Make sure the relevant system component is not under pressure or voltage before assembling the valve or when connecting and disconnecting plugs. Protect the system component against being switched on.
- Lay the cables and lines so that they cannot be damaged and no one can trip over them.
- Before commissioning, make sure that all seals and plugs of the plug-in connections are installed correctly to ensure that they are leakproof and fluids and foreign bodies are prevented from penetrating the valve.
- When assembling, provide for absolute cleanness in order to prevent welding beads or metal chips from getting into the hydraulic lines and causing valve wear or malfunctions.
- The ambient air must be free from electrically conductive contamination like acids, bases, corrosive agents, salts, metal vapors, etc.
- Check the seal rings (O-rings).
- Put the integrated axis controllers IAC-P/IFB-P on the installation surface, align and attach them (tightening torques see Technical data sheets).
- Ensure a maintenance-friendly installation, i.e. simple access to the connection lines.
- Free access to the connection side must be guaranteed. Clean the installation surface!
- Before installation note down the information on the name plates. If after the installation, name plates are no longer visible or legible, this data will be quickly available to you at any time.
- Keep the largest distance possible to electric sources of interference.
- You must generally lead all electric connection lines via a pull relief.
- Power cables must not be laid in the immediate vicinity of the devices.
- Pass the sensor lines separately.
- Use low-capacitance cables. If possible, design the cable connections without intermediate terminals.
- Do not use electric signals led out of the integrated axis controller IAC-P/IFB-P (e.g. the "Ready for Operation" signal) for switching safety-relevant machine functions! (For this, also see European Standard "Safety requirements for fluid power systems and their components – Hydraulics" EN 982:1996).
- When setting up a PROFIBUS-DP bus system (according to EN 50170), you must note particularities resulting from the configuration, the selected transmission rate, the cable length, the presence of branch lines and the shield and ground guidance.

2.5.4 During commissioning

- Let the valve acclimate itself for several hours before commissioning, otherwise water may condense in the housing.
- Make sure that all electrical connections are either used or covered. Commission the valve only if it is installed completely.

2.5.5 During operation

- Only authorized staff is allowed to operate the adjustment elements at components or parts, under the proviso that the hydraulic system is used as intended.
- Only persons who have been authorized by the operator may be granted access to the immediate operating area. This also applies during machine standstill.
- In case of emergency, failure, or in case of other irregularities switch off the system and secure it against restart.

2.5.6 During cleaning

- Cover all openings with the appropriate protective devices in order to prevent cleaning agents from penetrating the system.
- Never use solvents or aggressive cleaning agents. Only clean the valve using a slightly damp, lint-free cloth. Only use water and a mild cleaning agent, if necessary, to do so.
- Do not use a pressure washer for cleaning.

2.5.7 During maintenance and repair

- Perform the prescribed maintenance works at the intervals specified in the operating instructions.
- Make sure that no lines, connections or components are disconnected as long as the system is under pressure and voltage. Protect the system against being switched on.
- The IAC-P/IFB-P integrated axis controllers can only be exchanged as entire unit. For safety reasons, modifications at the device performed to one's own authority are not admissible.
- The machine or system operation with damaged or improperly integrated IAC-P/IFB-P axis controllers (e.g. leaky hydraulic system) is dangerous and inadmissible.

2.5.8 Disposal

- Dispose of the valve in accordance with the currently applicable national regulations in your country.
- Dispose of the hydraulic fluid in accordance with the currently applicable national regulations in your country.
- Dispose of hydraulic fluid residues according to the applicable safety data sheets for hydraulic fluids.

2.6 Obligations of the operator

The operator of the Bosch Rexroth products is bound to provide for personnel training on a regular basis regarding the following subjects:

- Observation and use of the operating instructions as well as the legal stipulations.
- Intended use and operation of the Bosch Rexroth valve.
- Observation of the instructions from the factory security office as well as the operator's work instructions.
- What to do in an emergency.

Bosch Rexroth offers training support in specific fields. You can find an overview of the training contents on the Internet at http://www.boschrexroth.de/didactic.

3 Scope of delivery

The scope of delivery includes:

- IAC-P/IFB-P valve according to "Technical data sheet"
- Operating instructions

Check the scope of delivery for completeness, particularly the seal rings at the valve connection surfaces. Connection lines and connectors are not included in the scope of delivery. Recommended accessories: See Technical data sheets in chapter "1.1 Related documents" on page 8.
Check the scope of delivery for possible transport damage.
Check whether the operating instructions are suitable for the valve and complete.

4 Product description

4.1 Performance description

The advantages of distributed intelligence for the hydraulic drive technology are utilized by Bosch Rexroth by the integration of digital technology into the tried and tested proportional valves. In this connection, a microprocessor integrated in the valve electronics performs all material functionalities of the valves. The valves can be connected to machine controls via PROFIBUS-DP or CANopen. The devices can optionally be controlled analogously or by means of the field bus.

The product range comprises the proportional valve versions with integrated electronics and field bus connection IFB-P (Integrated Field Bus on the basis of Proportional valves) as well as those of the proportional valve series with field bus connection, pQ or axis controller functionality IAC-P (Integrated Axis Controller on the basis of Proportional valves).

The IAC valve is a proportional valve with integrated digital control electronics for the pressure, force and flow control. The IAC-P valve is tested and calibrated ex works. Connection lines and connectors are not included in the scope of delivery. The connected valve is maintenance-free and controlled directly in the housing via supply lines.

The default parameters have been individually designed for the IAC-P valve version ex works. The control and regulation parameters can, however, be set at any time via bus or parameterization software.

The IFB-P/IAC-P valves can be used in systems with locally controlled drives. The command and actual values are transmitted depending on the present hardware version, i.e. either via the CANopen bus system or via the PROFIBUS DP bus system. In both hardware versions, command value specification and actual value output are also possible in an analog form.

Depending on the available valve ranges, only certain sensors as well as certain controller functions and field bus systems (PROFIBUS DP or CANopen) can be combined with each other.

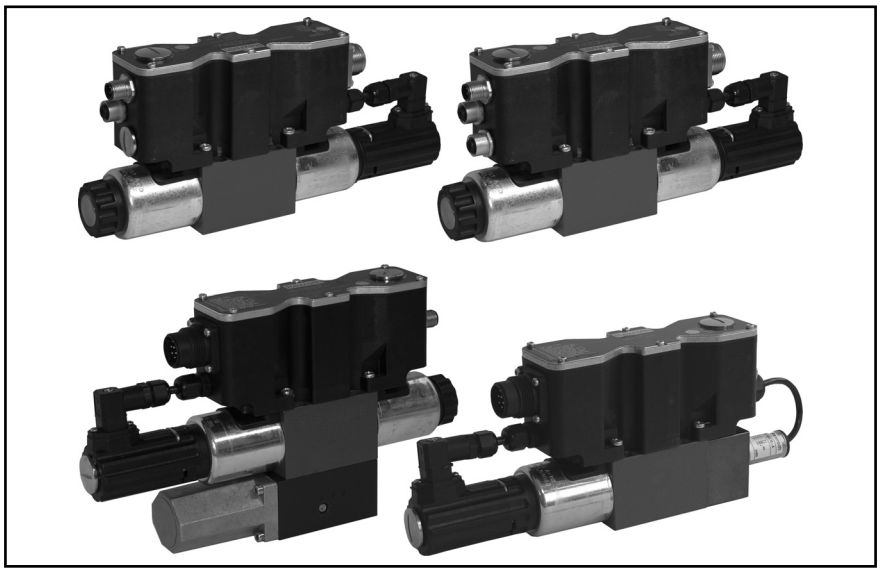

Fig. 2: Figure showing the range of integrated field bus valves and axis controllers on proportional valve basis

4.2 Device description

4.2.1 Parameterization and commissioning

For implementing the project planning task and the parameterization of the IAC-P/ IFB-P valves, the "WIN-PED 6" PC program is available to the user. Communication with the devices is made possible via a field bus connection (PROFIBUS-DP or CANopen). Optionally, the parameterization is also directly possible via the machine control and the field bus. The parameterization is determined and optimized in the First commissioning and stored as data set on the PC or the machine control.

Table 4: Parameterization and commissioning by means of a PC

The following is required for the parameterization with PC		CANopen	PROFIBUS-DB
1	Interface converter (USB)	VT-ZKO-USB/CA-1-1X/VO/0 Material number R901071963	VT-ZKO-USB/P-1-1X/VO/0 Material number R901071962
2	Commissioning software	"WIN-PED 6" Download via www.boschrexroth.com/IAC	
3	Connection cable, 3 m	D-Sub/M12, coding A Material number R900751271	D-Sub/M12, coding B Material number R901078053

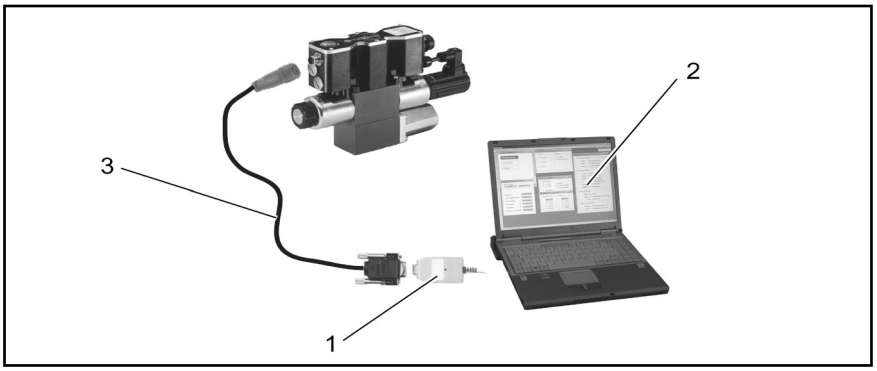

Fig. 3: Parameterization and commissioning by means of a PC

4.2.1.1 "WIN-PED 6" functionality

- Parameterization
- Commissioning and diagnosis
- Project storage on the PC

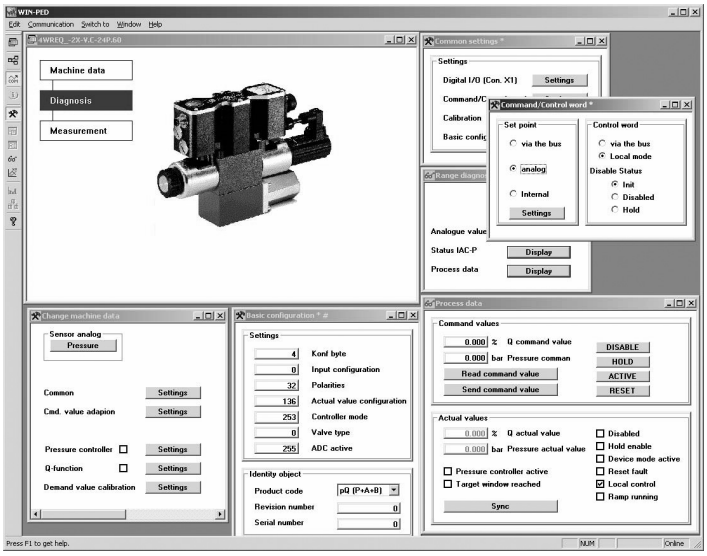

Fig. 4: Overview commissioning tool

4.2.1.2 Online support in the Internet

- Documentation
- Download commissioning tool
- www.boschrexroth.com/IAC

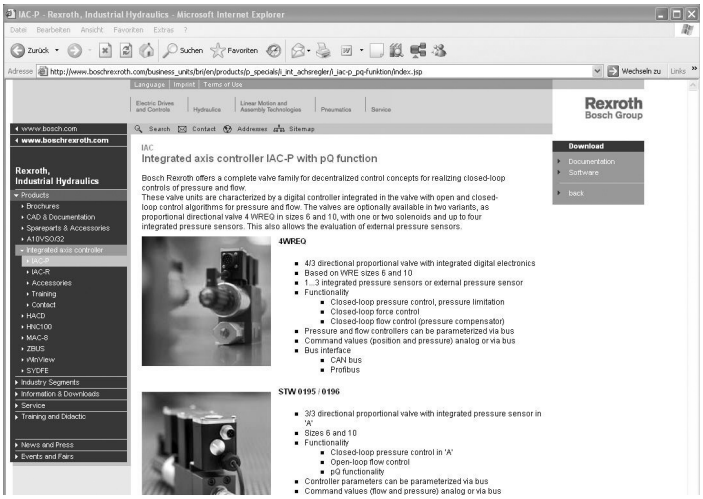

Fig. 5: Internet online support

4.2.2 IFB proportional valve with field bus interface

4.2.2.1 Features

The 4WREF continuous valve is based on the 4WRE...2X proportional directional valve series.

Thanks to the connection to a field bus system, manifold parameterization and diagnosis options result.

- Type 4WREF...2X, size 6 and 10
- Operation by means of proportional solenoids with central thread and detachable coil
- Completely adjusted unit consisting of valve, digital valve electronics and field bus connection
- Flow control
- Analog interfaces for command and actual values
- Design for CAN bus with CANopen protocol DS 408 or PROFIBUS-DP
- Control word (control of the device conditions)
- Status word (display of the device conditions)
- Quick commissioning via connected PC and commissioning software "WIN-PED 6" via field bus

The suitable parameterization is determined and optimized in the commissioning and stored as data set on the PC.

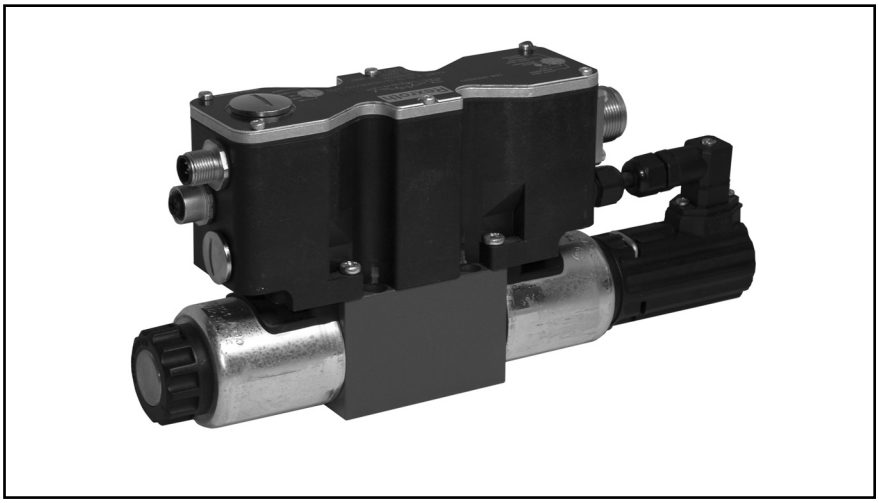

Fig. 6: 4WREF6

4.2.2.2 Functional description

The proportional directional valves serves the influencing of flow direction and size. For this purpose, the control spool position is controlled. The specified command value corresponds to a certain control spool position. The control spool command value is given to the valve electronics and compared to the actual control spool position. The control deviation is compensated by the valve electronics. The command value can optionally be provided via the analog interface or via field bus. The parameterizable actuating variable adaptation allows for the individual adaptation of the command value to different applications, e.g. by means of ramp generation, overlap compensation, zero point correction etc.

4.2.3 IAC-P as pQ valve with pressure sensor, STW 195 and STW 196

IAC-P as pQ valve with an integrated pressure sensor, type STW 195 and STW 196.

4.2.3.1 Features

The STW195/196 continuous valve is based on the 4WRE...2X proportional directional valve series.

Thanks to the connection to a field bus system, manifold parameterization and diagnosis options result.

- Type STW195 size 6, STW196 size 10
- Operation by means of proportional solenoid with central thread and detachable coil
- Completely adjusted unit consisting of valve, digital valve electronics, integrated pressure sensor and field bus connection
- Analog interfaces for command and actual values
- Design for CAN bus with CANopen protocol DS 408 or PROFIBUS-DP
- Controller functionality
  Pressure control
  Flow control
  pQ functionality
- Control word (control of the device conditions)
- Status word (display of the device conditions)

Quick commissioning via connected PC and commissioning software via industrial bus.

The suitable parameterization is determined and optimized in the First commissioning and stored as data set on the PC. For the serial commissioning, the determined data set can be applied to the same valve type.

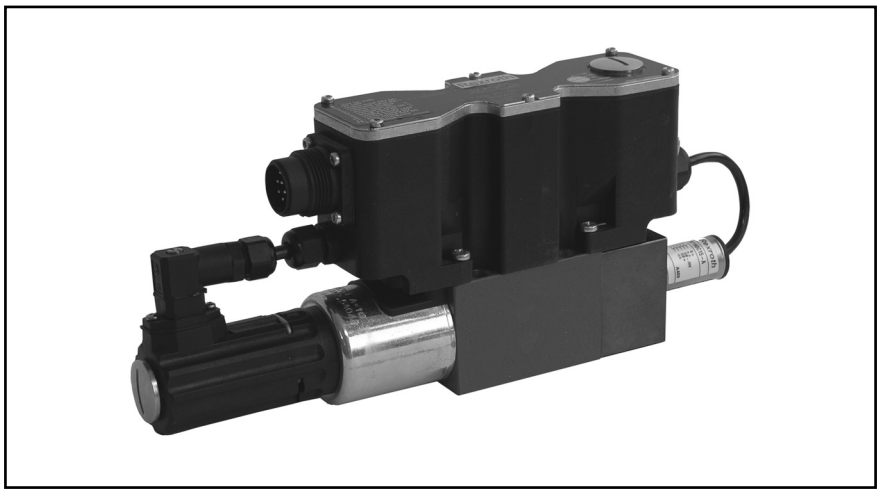

Fig. 7: STW195

4.2.3.2 Functional description

The STW195/196 proportional directional valves serves the influencing of flow size and the pressure control in port 'A'. The specified command values correspond either to a certain control spool position ('Q' command value) or a pressure in 'A' ('p' command value). The switching between the flow control and the pressure control is effected by the integrated minimum value generator. The command value can optionally be provided via the analog interface or via field bus. The parameters for the pressure controller, the flow control as well as the actuating variable adaptation allow for the individual adjustment to different applications.

4.2.4 IAC-P as pQ valve with up to 4 pressure sensors, 4WREQ

IAC-P as pQ valve with up to 4 integrated pressure sensors, 4WREQ.

4.2.4.1 Features

The 4WREQ continuous valves can be controlled via a bus system. It has been developed on the basis of the 4WRE...2X proportional directional valve series.

Thanks to the connection to a field bus system, manifold parameterization and diagnosis options result.

- Type 4WREQ, size 6 and 10
- Operation by means of proportional solenoids with central thread and detachable coil
- Completely adjusted unit consisting of valve, digital valve electronics, integrated pressure sensors and field bus connection
- Analog interfaces for command and actual values
- Optional connection of an external pressure sensor or up to 4 integrated pressure sensors
- Design for CAN bus with CANopen protocol DS 408 or PROFIBUS-DP
- Controller functionality
  Pressure control
  Flow control
  Flow regulation
  pQ functionality
- Control word (control of the device conditions)
- Status word (display of the device conditions)

Quick commissioning via connected PC and commissioning software via industrial bus.

The suitable parameterization is determined and optimized in the First commissioning and stored as data set on the PC. For the serial commissioning, the determined data set can be applied to the same valve type.

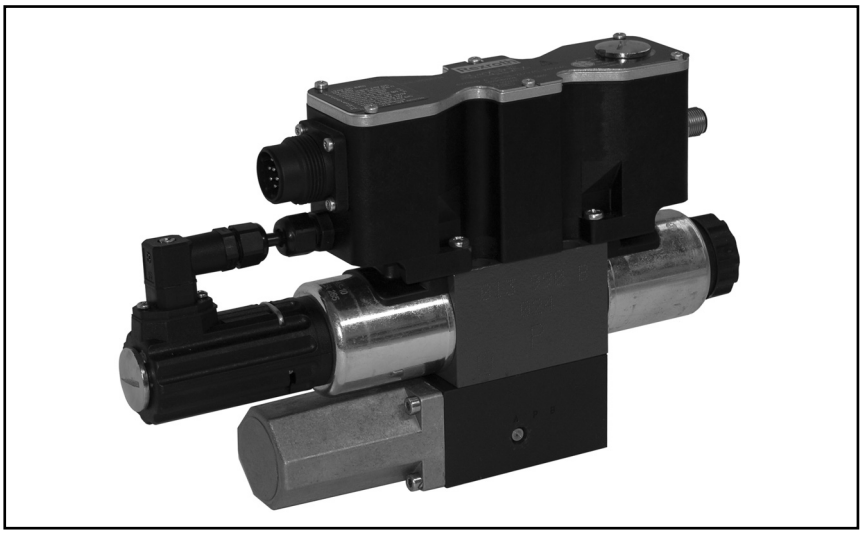

Fig. 8: 4WREQ6

4.2.4.2 Functional description

Depending on the device version, the 4WREQ proportional directional valve serves the flow control, flow regulation, pressure control or pressure differential control. The specified command values correspond either to a certain control spool position or flow quantity ('Q' command value) or a pressure or pressure differential ('p' command value).

The switching between the flow control and/or regulation and the pressure control and/or force control is effected by the integrated minimum value generator. The command value can optionally be provided via the analog interface or via field bus. The parameters for the controllers as well as the actuating variable adaptation allow for the individual adjustment to different applications.

4.2.5 IAC-P with position controller functionality, STW0240 (4WREA)

IAC-P with position controller functionality of the STW0240.

4.2.5.1 Features

The STW0240 (4WREA) continuous valve is based on the 4WRE...2X proportional directional valve series.

Thanks to the connection to a field bus system, manifold parameterization and diagnosis options result.

- Type STW0240 (4WREA), size 6 and 10
- Operation by means of proportional solenoids with central thread and detachable coil
- Completely adjusted unit consisting of valve, digital valve electronics and field bus connection
- Analog interfaces for command and actual value
- Design for CAN bus with CANopen protocol DS 408 or PROFIBUS-DP
- Controller functionality, flow control, position control
- Control word (control of the device conditions)
- Status word (display of the device conditions)
- Quick commissioning via connected PC and commissioning software via industrial bus

The suitable parameterization is determined and optimized in the First commissioning and stored as data set on the PC. For the serial commissioning, the determined data set can be applied to the same valve type.

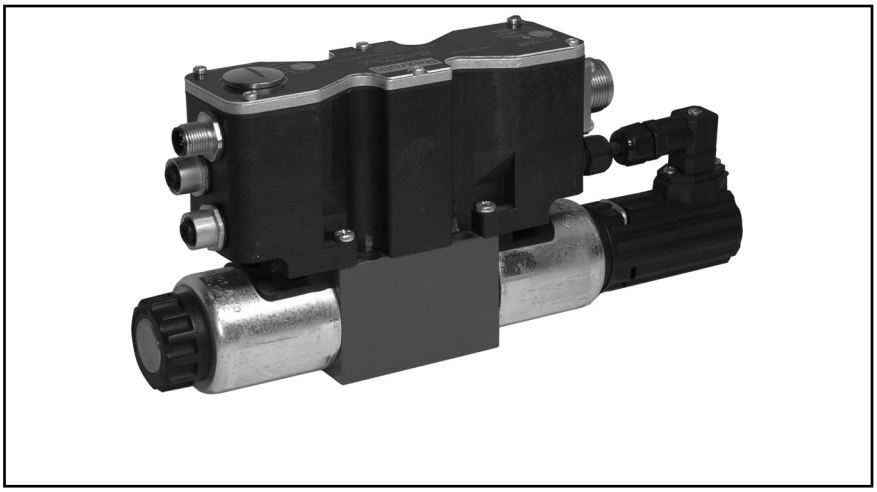

Fig. 9: STW0240 (4WREA6)

4.2.5.2 Functional description

The STW0240 (4WREA) proportional directional valve serves the control of a cylinder position. The specified command value corresponds to a certain cylinder position ('Q' command value). The command value can optionally be provided via the analog interface or via field bus. The parameters for the controller as well as the actuating variable adaptation allow for the individual adjustment to different applications.

4.2.6 Principle and system of IAC-P/IFB-P

4.2.6.1 Overview

The IAC-R valve has different important features:

- Mode of operation:
  The IAC-P valve can be operated with analog command values (analog mode of operation), expects its command values via the bus interface (digital mode of operation) or receives its command values internally, from a command value generator. All settings at the IAC-P valve are in any case made via the bus interface. Even if you want to operate the IAC-P valve in the system with analog command values, it has to be configured for the concrete application via the bus interface, e.g. using the "WIN-PED 6" commissioning software.
  If you want to operate the IAC-P valve in the system with command values via the bus interface, the IAC-P valve can also be parameterized by means of the superior control system, using suitable procedures. In this case, the commissioning software can be omitted.

- Sensor interfaces:
  The IAC-P valve with pQ function is preferably equipped with integrated pressure sensors. Alternatively, this device is also available for an external sensor (default with STW 0240/4WREA).
- Internal state machine:
  The state machine is the basis for the control and state monitoring of the IAC-P valve. In case of parameter changes, certain states must e.g. be taken so that they can take effect.
- Parameter:
  The digital structure of the IAC-P valve makes sure that the settings necessary for the commissioning can be made in a comfortable way, using parameters. This is only possible via the bus interface. Each IAC-P valve of one series is delivered with identical default parameters. The implemented system controllers are also pre-configured with typical dynamic settings. These parameters must, however, mostly be adjusted to the application. All control settings are stored in the IAC-P valve in a non-volatile form.

4.2.6.2 Commissioning tool and aids

If the commissioning is not effected directly via the control, the "WIN-PED 6" commissioning software must be available allowing for the setting and transfer of parameters via the bus:

The "WIN-PED 6" software can be executed on any IBM-compatible PC with Microsoft Windows® NT/2000/XP as independent program.

Existence of a corresponding interface (CANopen and/or PROFIBUS-DP interface) at the PC is a prerequisite.

For the complete list of the supported interfaces and the description of the "WIN-PED 6" program refer to the help function and/or the Technical data sheets.

4.2.6.3 Hardware prerequisites for the commissioning

For the First commissioning, you need the following hardware equipment:

- PC/laptop
- "WIN-PED 6" commissioning software
- Bus interface for CANopen and/or PROFIBUS-DP incl. connection cable
- IFB-P and/or IAC-P valve
- Voltage supply for valve

Table 5: Hardware requirements

The following is required for the parameterization with PC		CANopen	PROFIBUS-DB
1	Interface converter (USB)	VT-ZKO-USB/CA-1-1X/VO/0 Material number R901071963	VT-ZKO-USB/P-1-1X/VO/0 Material number R901071962
2	Commissioning software	"WIN-PED 6" Download via www.boschrexroth.com/IAC	
3	Connection cable, 3 m	D-Sub/M12, coding A Material number R900751271	D-Sub/M12, coding B Material number R901078053

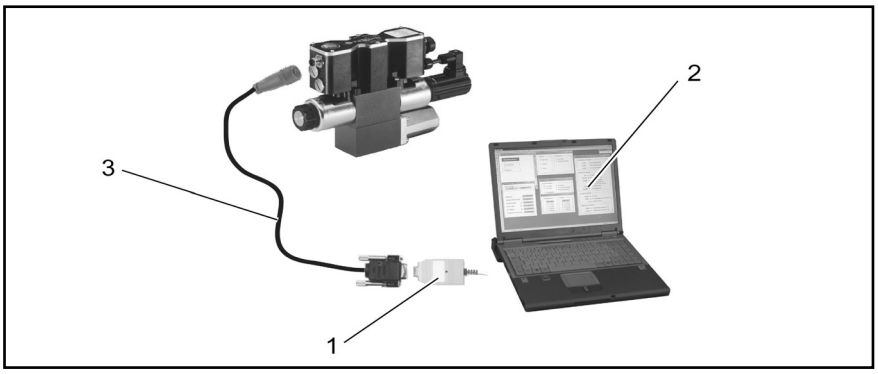

Fig. 10: Example parameterization test set-up

By connecting the bus interface, the PC is equipped with a CAN bus and/or PROFIBUS DP interface. After starting the "WIN-PED 6" program, communication with the valve can be established. Afterwards, parameters can be changed in a targeted form or complete parameter sets can be read or written.

If the sensors necessary for the subsequent mode of operation are connected to the IAC-P valve, their configuration can also be set.

An oscilloscope may be necessary if the commissioning is carried out while the system is in operation. The "WIN-PED 6" commissioning tool supports the commissioning by the online visualization of the process variables.

4.2.6.4 Bus, node, baud rate

Data transmission via bus assumes a functional field bus connection. For the documentation of the bus-specific settings refer to the description of the CANopen communication RE 29015-01-Z or the description of the PROFIBUS-DP communication RE 29015-02-Z.

4.2.7 Analog/digital operation with state machine, device function

The following functions determine the processes and states in the IAC-P valve. They can be used by the user to influence the operation. It is therefore necessary to understand the connections of the following functions.

- Control:
  The control can be operated digitally via bus and/or also analogously with restrictions. It decides how and to which extent the user can use the IAC-P device functions, device states and device control.
- Device function:
  Device functions are general application settings (e.g. mode of operation, controller mode) under which the IAC-P valve is operated. They require the IAC-P valve to take certain states before a device function can be changed.
- Device control:
  The device control determines the conditions and possibilities under which the IAC-P valve can change from one state into another one. The IAC-R valve can be operated with digital or analog device control.
- Device state:
  The device state of the IAC-P valve is mapped via the "digital or analog state machine". Every state of the IAC-P valve corresponds to information that can be output via the "status word".

4.2.7.1 Control

The control type usually also determines the way in which the command values reach the IAC-P valve. With analog control, this is the analog command value provision via X1. With analog control, this is the analog command value provision via X1.

- Full functionality of the IAC-P valve is only given with digital control via bus.
- Control and status functions are different for the digital and analog control.
- In the commissioning, you can switch between analog and digital control using the "Local switching" and "Mode of operation" parameters.
- In the condition as supplied, the device is set to analog control.

4.2.7.1.1 Digital control

Control word and status word are transmitted via the bus. In this way, information on states and commands for changes in state can be transmitted.

Command values and actual values are transmitted via the bus.

During operation, complete access to all parameters of the IAC-P valve is possible and the device behavior can partially be changed by the control via the bus during ongoing operation.

For IAC-P valves, the following signals are available at the X1 interface:

- 1 digital input for the release
- 1 digital output for the error message
- Max. 2 analog inputs at the 12-pin connector for command values
- Max. 2 analog outputs at the 12-pin connector for actual values

For IFB-P valves, there is in each case only one analog input and one analog output available at the X1 interface (no digital inputs and outputs). During operation, the device behavior cannot be changed via the analog interface. You can only change the controller parameter (machine data) of the IAC-P valve.

4.2.7.2 Device function

The IAC-P valve behavior is determined by the following device functions:

- Mode of operation (command value provision)
- Local switching (release behavior)
- Controller mode

4.2.7.2.1 Device function: Mode of operation

By means of the mode of operation, you specify the source of the command values for the IAC-P valve.

The following table explains the variants:

Table 6: Device function mode of operation

Value	Command value origin	Reaction depending on the device control
1	The command values are transmitted via the bus.	Command values will only become active if DEVICE MODE ACTIVE has been selected as state.
2	The command values are specified in an analog form and the command values specified via the bus are ignored.	Command values will only become active if DEVICE MODE ACTIVE has been selected as state.
3	A time-controlled profile stored on the IAC-P valve is started and its command values are processed.	DEVICE MODE ACTIVE state must be active and/or be set

CAUTION!

Danger due to unwanted tool or axis movement.

Electrically and hydraulically operated axes apply very high dynamic forces and may therefore move very fast.

- ▶ Switching between the modes of operation is only admissible in the INIT, DISABLED and HOLD state.

4.2.7.2.2 Device function: Local switching

The device control also comprises the local switching. It determines whether the "Control word" and "Status word" parameters are transmitted analogously via the X1 interface or digitally, via the bus.

Table 7: Device function local switching

Value	Description
0	Control word generated in the superior control system (e.g. PLC).
1	Internally generated local control word with analog device control (as result of the release input to X1). By means of the release input, the IAC-P valve itself generates an internal, local control word. The control word coming from the bus is ignored. Thus, the IAC-P valve is in the Local mode.

CAUTION!

Danger due to unwanted tool or axis movement.

Electrically and hydraulically operated axes apply very high dynamic forces and may therefore move very fast.

- Switching between the modes of operation is only admissible in the INIT, DISABLED and HOLD state.

The status is formed irrespective of the local switching. In the condition as supplied, the local control word specification is active. Bit 4 in the status word indicates whether the local control is active.

4.2.7.2.3 Device function: Controller mode

The controller mode is the control type by means of which the IAC-P valve is operated. This parameter can only be read.

Table 8: Device function controller mode

Controller mode	Description
1	Bus valve without valve spool position control
2	Bus valve with valve spool position control
5	pQ function
-9	Position controller
-3	pQ function with flow controller

4.2.7.3 Device control

States and processes of the IAC-P valve can be influenced via the device control using the "Control word" parameter.

The "Control word" parameter set the IAC-P valve into a certain state.

4.2.7.3.1 Device control: Control word

The control word is transmitted via the field bus. The control word is organized bit-by-bit:

Table 9: Control word

Byte	1								0							
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Condition								p					R	M	H	D

Every bit has a certain meaning and can only be set under certain conditions (e.g. mode of operation, controller mode).

The first 4 bits (0,1,2,3) are responsible for the device control commands Disabled (D), Hold Enable (H), Device Mode Active Enable (M), Reset Fault (R). For the meaning of the remaining bits, refer to the following table.

Table 10: Control word

Bit	Control word	Meaning
0	Disabled (D)	This bit controls the device state of the IAC-P valve.
1	Hold Enable (H)	This bit controls the device state of the IAC-P valve.
2	Device Mode Active Enable (M)	This bit controls the device state of the IAC-P valve.
3	Reset Fault (R)	This bit controls the device state of the IAC-P valve.
4...7	No function (reserved)	
8	Activation of the pressure controller (only with PROFIBUS!)	pQ function: Bit = 0: Deactivate pressure controller Bit = 1: Activate pressure controller
9	No function (reserved)	
10	No function (reserved)	
11	No function (reserved)	
12	No function (reserved)	
13	No function (reserved)	
14	No function (reserved)	
15	No function (reserved)	

4.2.7.3.2 Selecting the state transition

A state describes a certain behavior of the IAC-P valve and can only be quit via certain events. If the state transition is completed, the system changes from the current state into the following state. in the state machine, a state can also be selected via several states (e.g. DEVICE MODE ACTIVE directly from INIT).

The following table provides information about the "value" to be set in the control word "Parameter" if the IAC-P valve is to be brought into a new state:

Table 11: Selecting the state transition

Initial state	Target state	Control word coding			
		R	M	H	D
Init	Disabled	X	0	0	1
Init	Hold	X	0	1	1
Init	Active	X	1	1	1
Disabled	Hold	X	0	1	1
Disabled	Active	X	1	1	1
Disabled	Init	X	0	0	0
Hold	Active	X	1	1	1
Hold	Disabled	X	0	0	1
Hold	Init	X	0	0	0
Active	Hold	X	0	1	1
Active	Disabled	X	0	0	1
Active	Init	X	0	0	0
Fault	"Quit Fault"	0	0	0	0
"Quit Fault"	Disabled	1	0	0	1

4.2.7.4 Device state

During start-up, operation and in case of failures, the IAC-P valve takes different states that always reflect a certain behavior.

The so-called state machine describes this behavior of the IAC-P valve. All states and changes in state as well as their links are shown.

The state machine is simultaneously the IAC-P valve control center. The status word indicates the current device state of the IAC-P valve.

The state machine is, for example, visually recorded in the "WIN-PED 6" configuration tool and always displays the current state of the connected valve.

4.2.7.4.1 Device state: Digital state machine

In the digital state machine, states and state transitions with control and status words are processed digitally, via bus. Due to this digital transmission option, all information and settings of the control and status words are transparent, due to their bit coding.

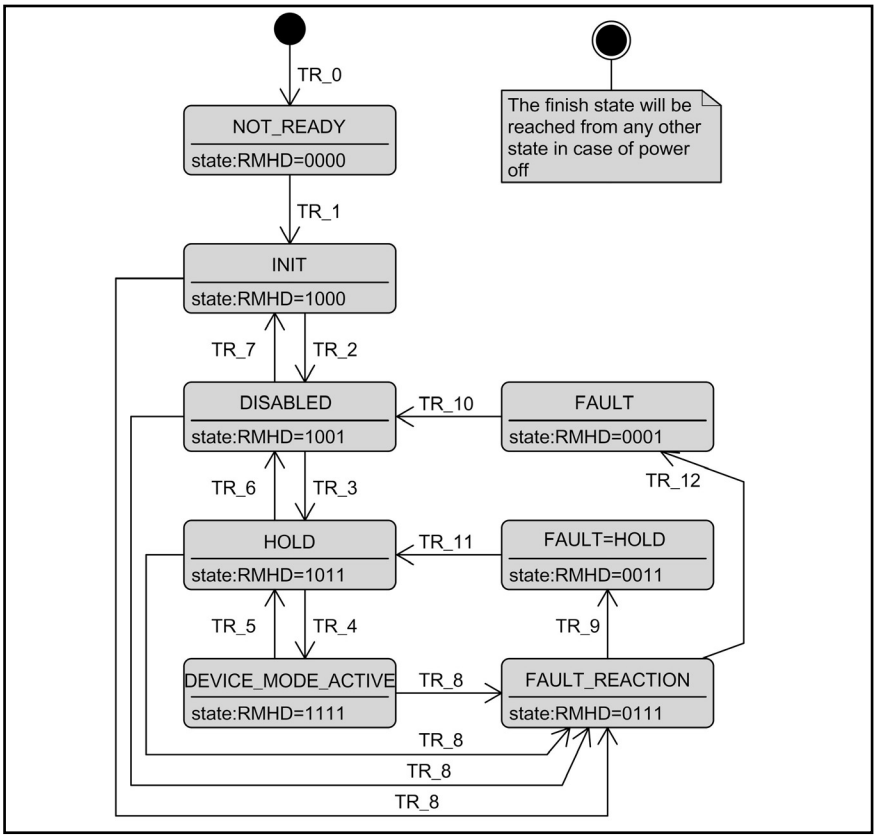

Fig. 11: Digital state machine

The following table explains the states and their function within the IAC-P valve:

Table 12: States and function within the IAC-P valve

State		Selectable	Device function	IAC-P valve system components	Comment
NOT READY	Not ready for initialization	No	Blocked		The electronic system is supplied with voltage. Self-test is running, device initialization is running (communication interface, hardware, software,...).
INIT	Initialization	Yes	Blocked	Valve controller: OFF Power stage: OFF Valve command value: 0 System controller: OFF System controller command value: 0	Initialization of the device parameters with the values stored in the device (if available).
DISABLED (D)	Blocked	Yes	Blocked	Valve controller: OFF Power stage: OFF Valve command value: 0 System controller: OFF System controller command value: 0	See FAULT state.
HOLD (H)	Hold	Yes	Released	Valve controller: ON Power stage: ON Valve command value: System controller output System controller: ON System controller command value: System controller hold command value	The set hold command value becomes effective. The command value generated in the DEVICE MODE ACTIVE state and/or the command value via bus or the analog command value is not effective.
DEVICE MODE ACTIVE (M)	Mode of operation active	Yes	Released	Valve controller: ON Power stage: ON Valve command value: System controller output System controller: ON System controller command value: According to the selected mode of operation	The mode of operation defined by the Mode of operation parameter is activated. In this state, change in the mode of operation is not admissible (write access to the Mode of operation parameter is acknowledged negatively).
FAULT HOLD	Fault hold	Function is not used in IAC-P valves			
FAULT	Fault	No	Blocked	Valve controller: OFF Power stage: OFF Valve command value: 0 System controller: OFF System controller command value: 0	The system controller is not active. The valve moves into the fail safe position.
FAULT REACTION	Fault reaction	No			This state is only run through and not taken.

4.2.7.4.2 Device state: Analog state machine

As no bit-coded control and status words are available in analog operation, states and statuses are transmitted by means of release and error signals via the X1 interface in an analog form (voltage/current).

As compared to the digital state machine, only the following states are known to the analog state machine:

- DISABLED or HOLD (parameterizable)
- DEVICE MODE ACTIVE
- FAULT

All others are also run through during start-up or in case of errors; access as with digital control words/status words is, however, not possible with the analog control word/status word.

In the analog state machine of the IAC-P valve, the analog input (pin 3, release) of interface X1 is used for the device control. A control word that might be available via BUS is ignored.

The release signal input switches between the DEVICE MODE ACTIVE and DISABLED/ HOLD states.

With the IFB-P valve, release is always active if the analog state machine is used.

4.2.7.4.3 Device state: Status word

The status word is transmitted digitally, via field bus (CAN bus/PROFIBUS-DP) and shows the device state in a detailed form.

Table 13: Status word

Byte	**1**								**0**							
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Condition				Z			R	p				L	R	M	H	D

The first 4 bits (0, 1, 2, 3) determine the device state: Disabled (D), Hold (H), Device Mode Active (M), Ready (R). The remaining bits have different meanings, depending on the "controller mode".

Table 14: Status word

Bit	Control word	Meaning
0	Disabled (D)	Initialization completed
1	Hold Enable (H)	Hold mode activated
2	Device Mode Active Enable (M)	Release activated
3	Reset Fault (R)	No error displayed
4	Local control	Analog release activated
5...7	No function (reserved)	-
8	Pressure controller active	Shows that the pressure controller will take action, if necessary
9	Ramp is running	Ramp has not reached the command value yet
10	No function (reserved)	-
11	No function (reserved)	-
12	Monitoring window reached (position, pressure, flow or external cylinder position)	Depending on valve type and parameterization
13	No function (reserved)	-
14	No function (reserved)	-
15	No function (reserved)	-

4.2.8 "WIN-PED 6" – first steps

4.2.8.1 Accessories

In order to be able to work with "WIN-PED 6", the following accessories are required:

Table 15: Hardware requirements

The following is required for the parameterization with PC		CANopen	PROFIBUS-DB
1	Interface converter (USB) [1)]	VT-ZKO-USB/CA-1-1X/VO/0 Material number R901071963	VT-ZKO-USB/P-1-1X/VO/0 Material number R901071962
2	Commissioning software	"WIN-PED 6" Download via www.boschrexroth.com/IAC	
3	Connection cable, 3 m	D-Sub/M12, coding A Material number R900751271	D-Sub/M12, coding B Material number R901078053

[1)] The related drivers are included in the scope of delivery of the interface converters.

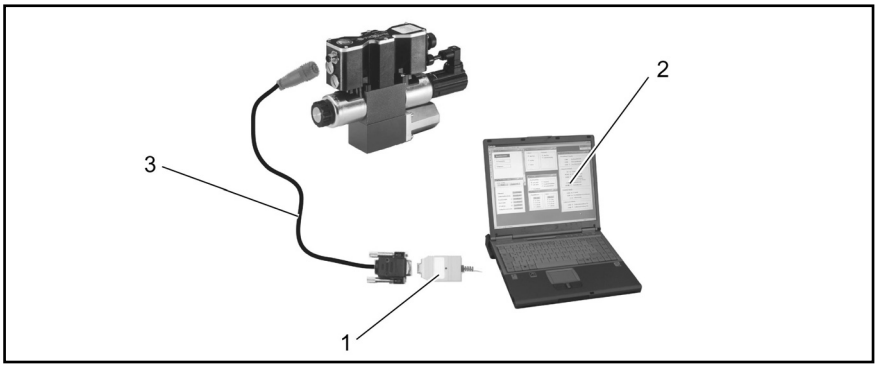

Fig. 12: Parameterization and commissioning by means of a PC

4.2.8.2 Driver installation

The USB interface converters may only be connected after the drivers have been installed successfully.

The installation instructions for the interface converters have to be observed!

4.2.8.2.1 Interface converter USB-CAN

Ordering information: VT-ZKO-USB/CA-1-1X/V0/0

Material number: R901071963

Work steps for installing the interface converter:

- The driver software must be installed before connection of the interface converter. Observe the installation steps of the set-up program.
- Restart the PC.
- Connect the interface converter to the PC.
- The PC finds the new USB device and asks for the path to the file PCAN_USB.SYS.
- Indicate the previously defined path and open the file.

The driver is now installed and the USB interface converter can be used.

If the interface converter is to be operated at different USB interfaces of one PC, it might be necessary to repeat the process described above from point three.

The USB driver only finds one interface converter at a time even if several are connected to the PC at the same time.

4.2.8.2.2 Interface converter USB-PROFIBUS

Ordering information: VT-ZKO-USB/P-1-1X/V0/0

Material number: R901071962

Work steps for installing the interface converter:

- The driver software must be installed before connection of the interface converter. Observe the installation steps of the set-up program.
- Restart the PC.
- Connect the interface converter to the PC.
- The PC finds the new USB device.
- Driver configuration in the Windows® menu
  Start/Ifak-System/is Pro Multidriver/is Pro Configurator
  Add a device using the 'Add' button, select "Device 0" and enter or search the serial number of the USB device.

Fig. 13: Driver configuration

The driver is now installed and the USB interface converter can be used.

If the interface converter is to be operated at different USB interfaces of one PC, it might be necessary to repeat the process described above from point three.

4.2.8.3 Installing "WIN-PED 6"

Work steps for installing "WIN-PED 6":

- Download of the current "WIN-PED 6" version at www.boschrexroth.com/iac
- Download of the necessary control types (setup) at www.boschrexroth.com/iac

CAN bus

Valve types WREF, WREQ, STW0195, STW0196:

IAC-P_Can_Bus_pQ.exe

Valve type WREA / STW0240:

IAC-P_Can_STW240.exe.

PROFIBUS

Valve types WREF, WREQ, STW0195, STW0196:

IAC-P_Profi_Bus_pQ.exe

Valve type WREA / STW0240:

IAC-P_Profi_STW240.exe.

- Installation of "WIN-PED 6" by executing the corresponding setup file.
- Installation of the necessary control types by executing the corresponding setup files

"WIN-PED 6" has now been properly installed.

4.2.9 Working with "WIN-PED 6"

4.2.9.1 Creating a new project

In order to be able to work with "WIN-PED 6", a valve-specific project has to be created. You can also integrate several control types into one project.

Work steps:

- Using "Edit/New", a new project is created.

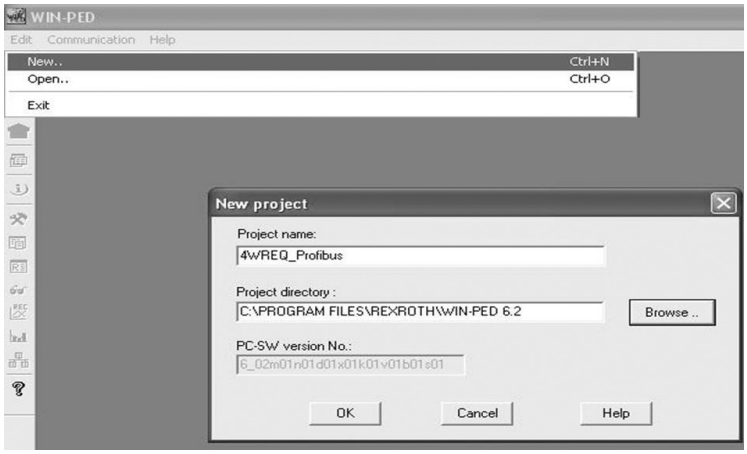

Fig. 14: Creating a project

- Selecting the control type belonging to the valve

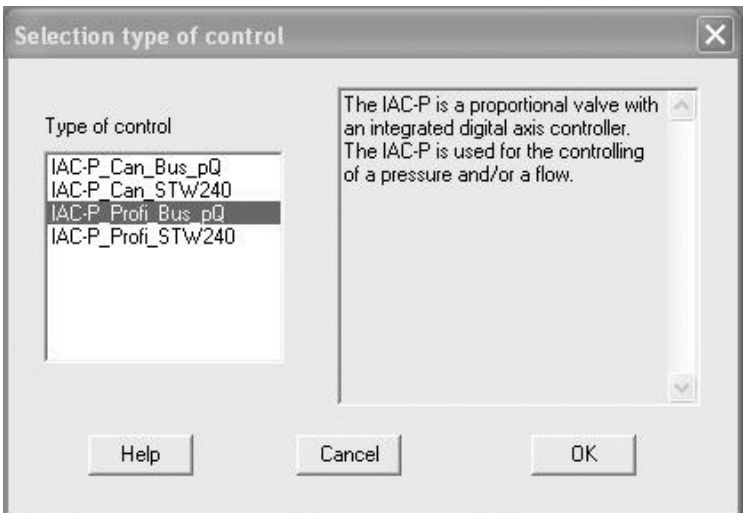

Fig. 15: Control type selection

- Assignment of a control name to be defined independently and selection of the control and firmware version suitable for the valve. (For more information on the control version, please refer to the valve ordering code in the Technical data sheet.)

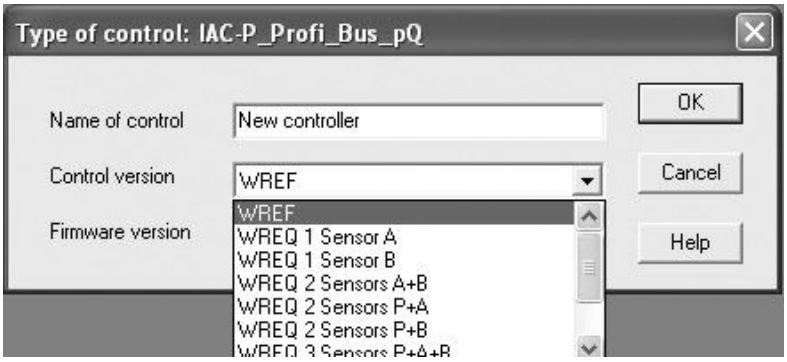

Fig. 16: Control type insertion

- Setting the address pre-selected at the valve (must comply with the hardware address).

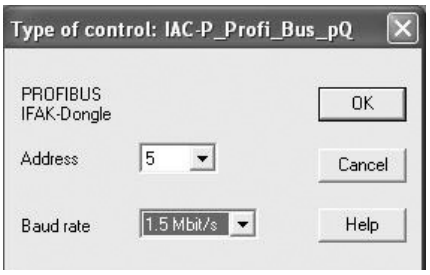

Fig. 17: Address selection

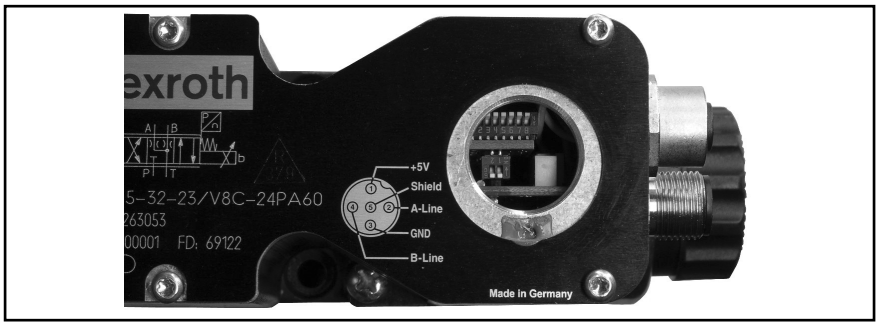

Fig. 18: DIL switch

Setting the valve address

At upper DIL switch row:
Switch top = 0
Switch bottom = 1

Bus terminal activation

Only with PROFIBUS:
Both top = active
Both bottom = inactive

If the PG fitting is sealed, the sealing may be broken. The baud rate for the CAN bus can also be set at the valve. Recommended baud rates for test purposes: CAN bus: 250 kB/s, PROFIBUS: 500 kB/s. When setting the address, you have to observe the values. Switch in rightmost position corresponds to 2^0; the 2nd from right 2^1; the 3rd 2^2 etc.
If, for example, the first and third switch are in bottom position, this corresponds to address 5. After the address and/or baud rate have been changed at the valve, a reset is necessary. The baud rate set in "WIN-PED 6" must comply with the baud rate of the control (PLC).

- Open the project by double-clicking on "New control" or by clicking on "Overview" in the menu bar.

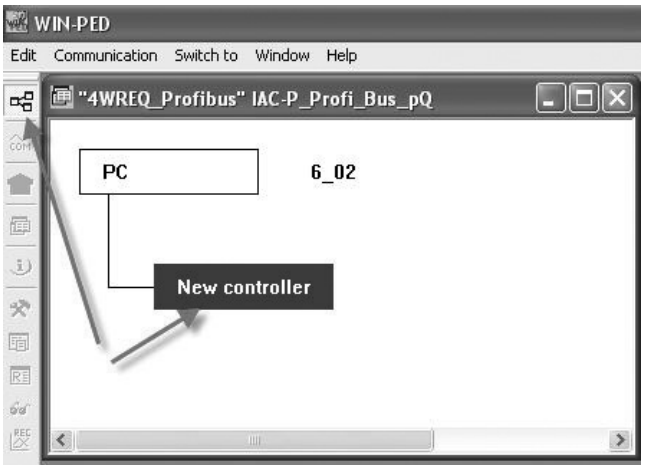

Fig. 19: Opening a project

- Establish the connection with the valve (online)

.

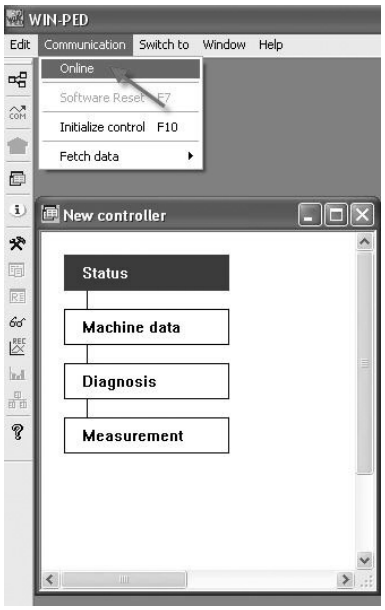

Fig. 20: Establishing the online connection

In the first-time connection with a new device, the parameters have to be obtained from the valve and stored. Otherwise, there is the risk of overwriting the device-specific setting for the pressure sensors.

The new project has now been created properly and can be edited.

4.2.9.2 Deleting, changing and extending projects

Using the "Edit/Configure" menu, new controls can be added, edited or deleted in an existing project.

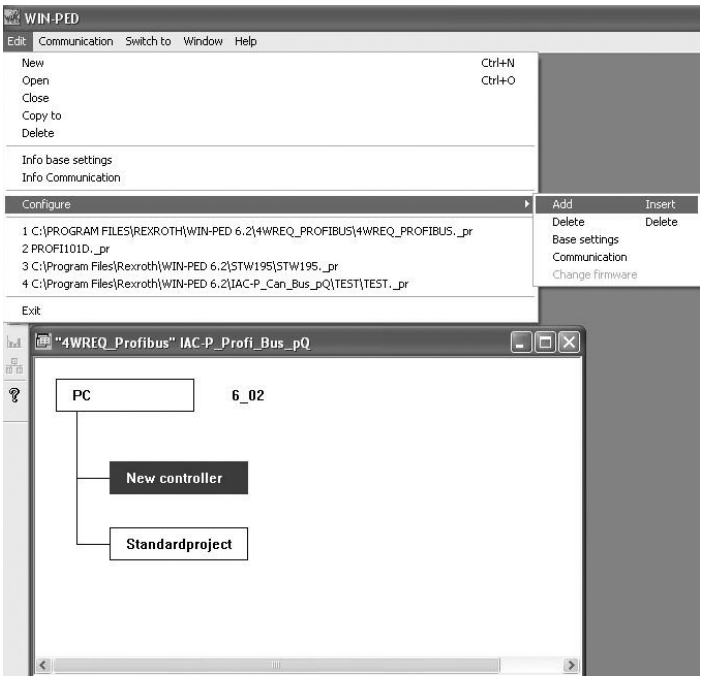

Fig. 21: Editing a project

4.2.9.3 Firmware update

Before the firmware update, the current settings have to be stored. In order to do so, call the control, establish an online connection, retrieve the data, edit the data and save the data.

In order to update the firmware, select "Communication" "Initialize control" in the menu. The firmware supplied with the control type is transmitted to the valve.

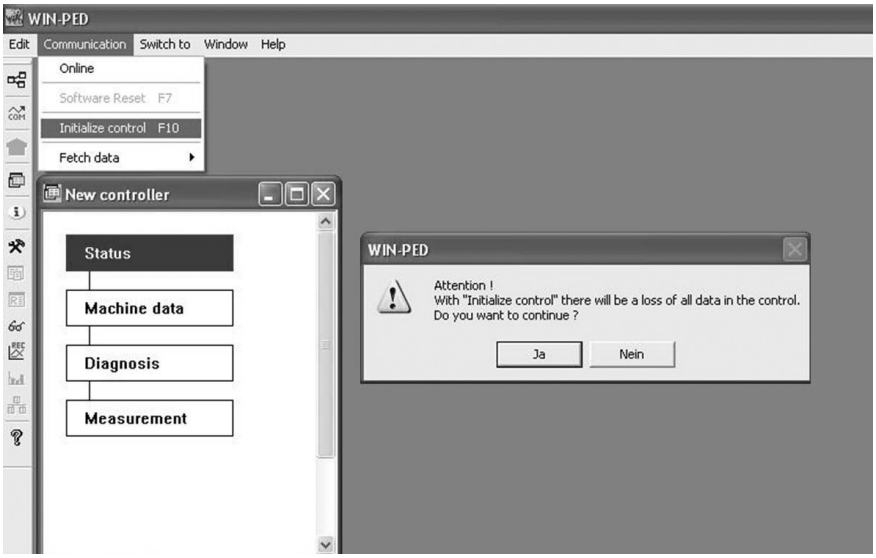

Fig. 22: Changing the firmware

4.2.10 Bus valve control type

4.2.10.1 Overview

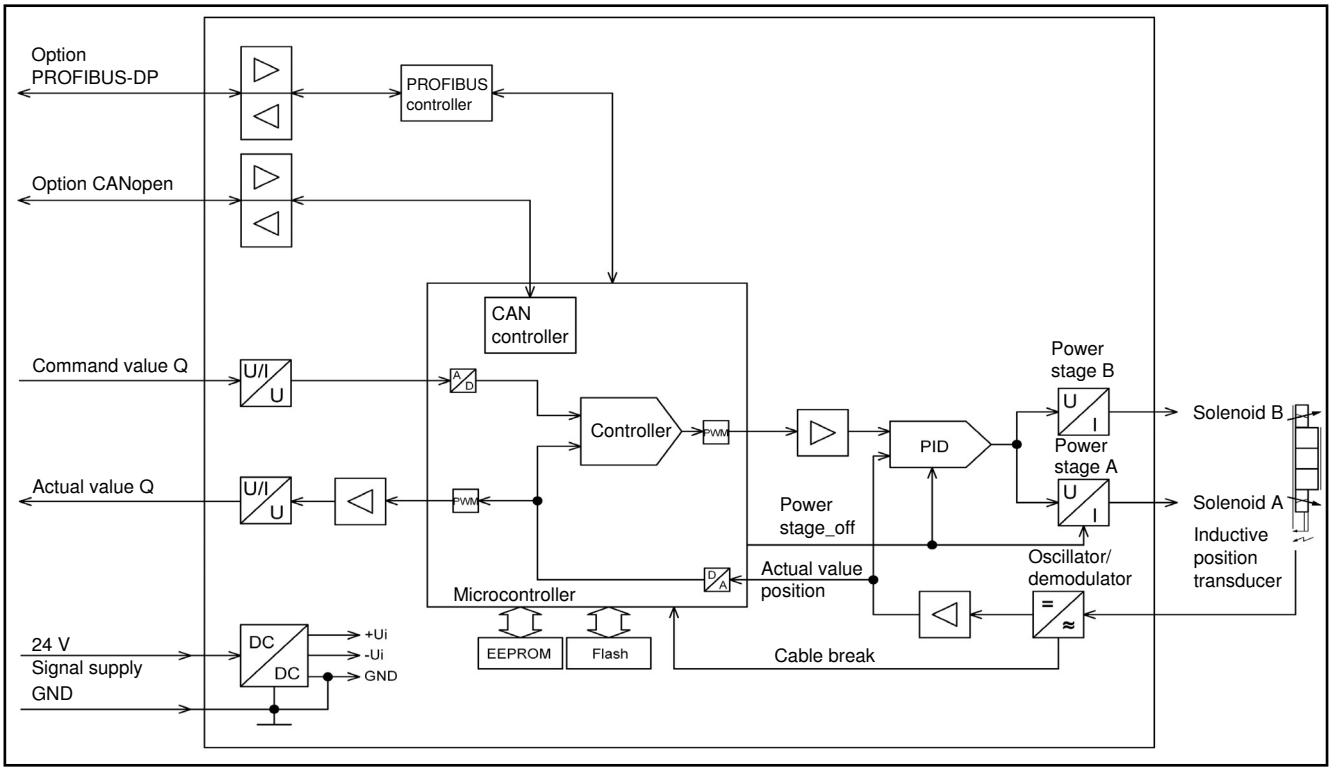

Fig. 23: IFB-P block diagram with all functions

The block diagram also shows the optional functions of the IFB-P valve. Not all functions can be combined. A device supports either CANopen or PROFIBUS-DP.

4.2.10.2 Project window

Fig. 24: Project window

The project window gives an overview of the possible functions for operating a device; in this case for a project with the exemplary name "4WREF10".

4.2.10.3 Status

The status window gives an overview of basic valve settings. It is updated once after the connection to the valve has been established.

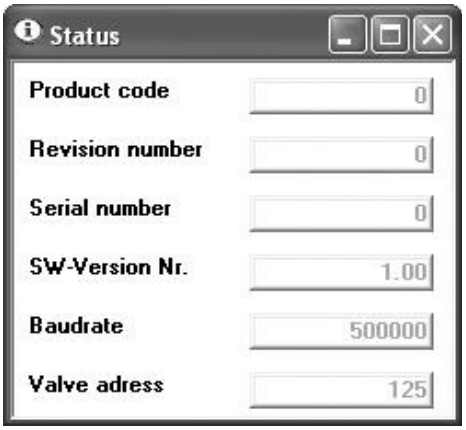

Fig. 25: Status window

Product code The product code corresponds to a "Basic valve type" as it is also differentiated when creating a new "WIN-PED 6" project. E.g. "Bus valve" or "pQ with 2 sensors in ZP (A and B)".

Revision number Not used.

Serial number Not used.

SW version no. Valve software version.

Baud rate Display shown in baud, in the example 500000 for 500 kBaud.

Valve address Active valve address.

4.2.10.4 Machine data

In the machine data window, the basic device settings are made. These are general settings as well as settings for the command value preparation, Q function and actuating variable adaptation.

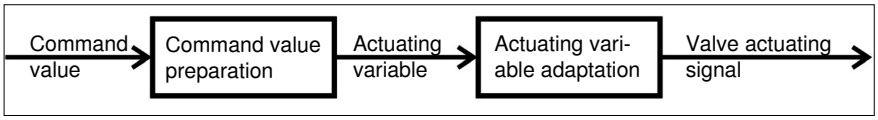

Fig. 26: Block diagram controller structure

Fig. 27: Machine data window

4.2.10.4.1 General

The general settings refer to the specification type of command value and control word.

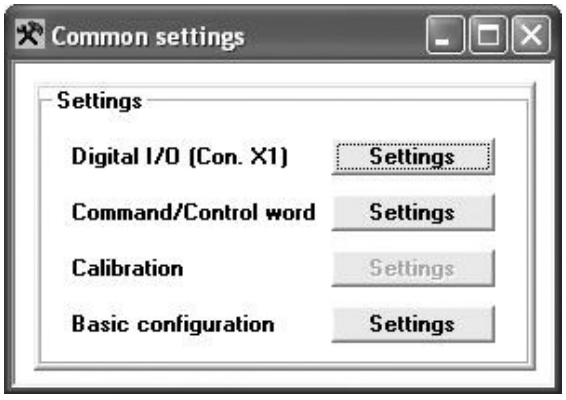

Fig. 28: General settings

Digital I/O (Con. X1) Not used.

Command/Control word

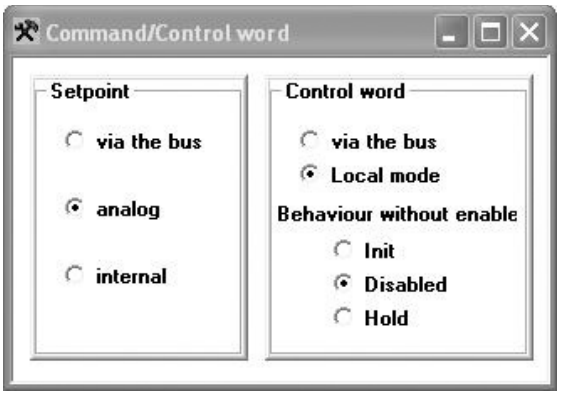

Fig. 29: Settings regarding command value and control word

Setpoint:

For the command value specification, there are the following options (M429):

- Command value "via the bus"
- Command value "analog" via connector X1.
  The interface version (voltage or current interface) can be seen from the device type key.
- Command value "internal"

Control word setting:

The control word can be specified as follows (M431):

- Control word "via the bus"
- Control word via “Local mode” (release is always active)

Setting "Behavior without enable": Not used.

Calibration Not used.

Basic configuration Not used.

4.2.10.4.2 Software preparation

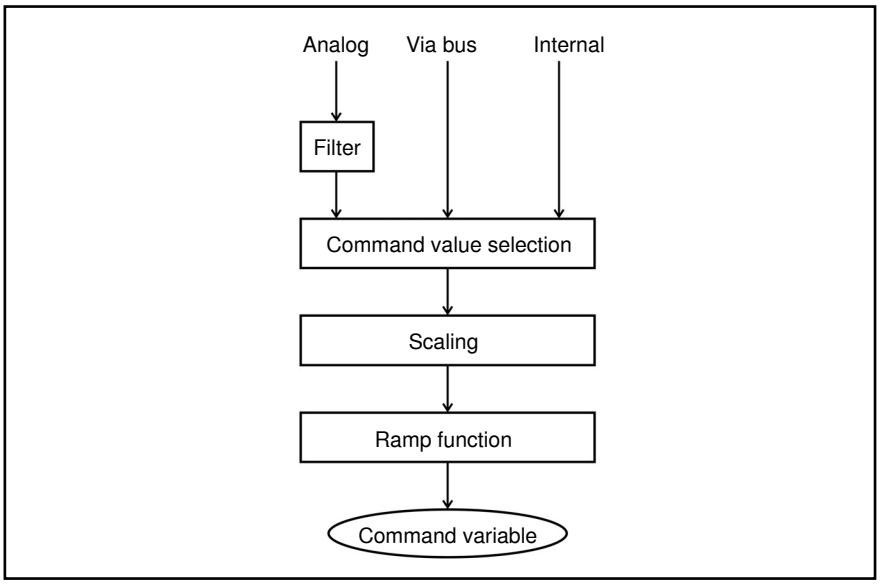

Fig. 30: Flow chart for the command value preparation

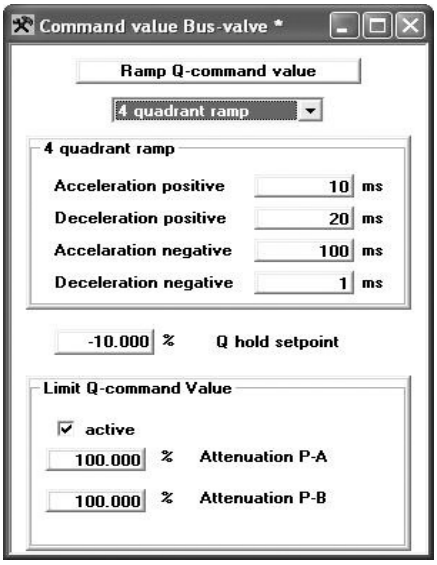

Fig. 31: Settings for the command value preparation

Ramp Q command value

For the setting of the ramp function type (M400), there are four options:

- Ramp switched off
- One-quadrant ramp = Identical ramp time for increasing (acceleration) and decreasing command value (delay)
- Two-quadrant ramp = Different ramp times for increasing (acceleration) and decreasing command value (delay)
- Four-quadrant ramp = Different ramp times for increasing (acceleration) and decreasing command value (delay), separated for positive and negative direction.

Ramp times [ms]

Depending on the ramp function set, the ramp times can be set:

- Time for one-quadrant ramp or for the acceleration of the two-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M401)
- Time for the delay of the two-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M404)
- Time for the acceleration in positive direction of the four-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M402)
- Time for the acceleration in negative direction of the four-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M403)
- Time for the delay in positive direction of the four-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M405)
- Time for the delay in negative direction of the four-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M406)

Hold command value [%]

Specification of the Q hold setpoint (M446). It is used if the Hold mode has been activated with digital control word specification or if with analog control word specification, the preferred position without release is “Hold”.

Limit Q-command Value [%]

After activation of Limit Q command value, the attenuation has to be set separately for the valve directions P -> A (M554) and P -> B (M555). In this connection, a value of 100% corresponds to no attenuation, a value of 0% to complete attenuation of the command value.

The attenuation parameter quasi corresponds to a command value factor (value range 0...100%).

4.2.10.4.3 Q function

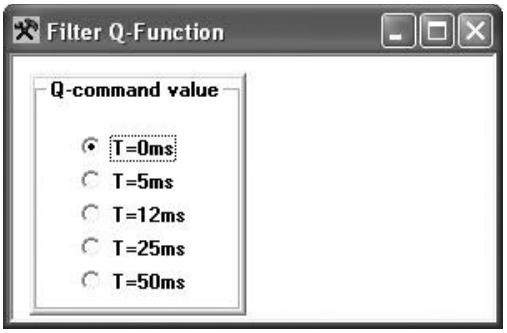

Fig. 32: Filter setting Q function *

Q command value [ms]

For the filter of first order, five time constants between 0 ms (filter off) and 50 ms (maximum filter effect) can be selected. The filter is particularly suitable if the analog Q command value is noisy.

Fig. 33: Other settings Q function

Monitor function

The monitor function allows for the monitoring of the valve spool position.

- The threshold [%] parameter (M532) specifies the window width. Settings are 0...100 %. If the valve position in this window is around the position command value, the corresponding bit is set in the status word. If the valve position leaves the window, the bit and the digital output will be reset after the adjustable Flow target window time (M531).
- Flow target window time [ms]: Is not effective if the window is reached.

4.2.10.4.4 Actuating variable adaptation

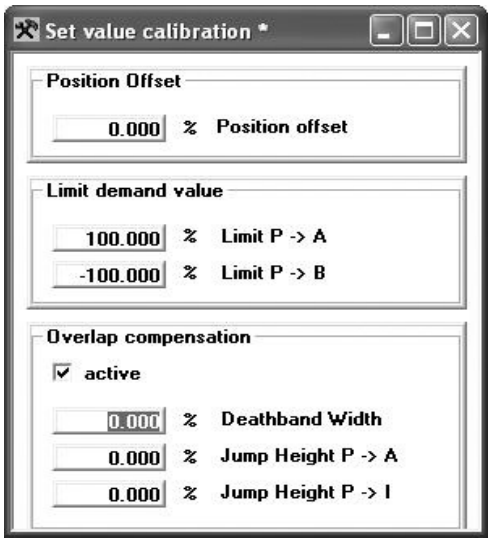

Fig. 34: Actuating variable adaptation with activated overlap compensation

Position offset

The Position offset (M411) has been adjusted ex works and doesn't have to be readjusted.

Limit demand value

The actuating variable of the valve controller can be limited depending on the direction by the parameters limitation P -> A (M550) or limitation P -> B (M551).

The value range for the limitation P -> A is 0% (maximum limitation) to +100% (no limitation).

The value range for the limitation P -> B is 0% (maximum limitation) to -100% (no limitation).

By the limitation, the actuating variable is limited “hard”. That also means that actuating variables between 0% and the limitation value are output without changes.

Overlap compensation

The overlap compensation serves the compensation of the spool overlap, especially with E and W spools. Default setting = not activated.
V spools must not be compensated. The overlap compensation (activation via M407) has three parameters:

- Dead band width (M410)
  This value specifies the entire width of the dead band for P-A and P-B.
- Jump height P-A (M408)
  Value of the overlap compensation in direction P-A
- Jump height P-B (M409)
  Value of the overlap compensation in direction P-B

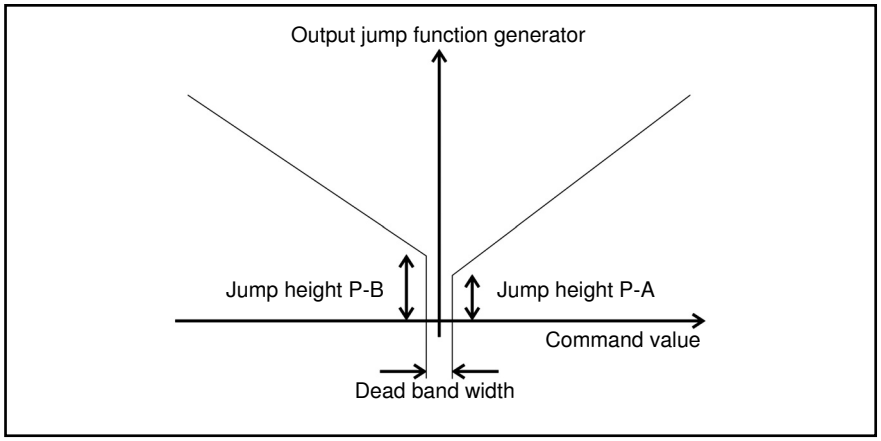

Fig. 35: Principle of the overlap compensation

4.2.10.5 Diagnosis

The diagnosis window offers the possibility to monitor process variables and query error states and/or status messages:

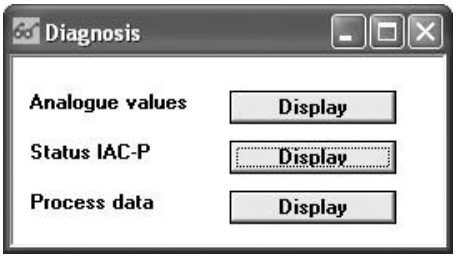

Fig. 36: Diagnosis selection window

4.2.10.5.1 Analog values

Not used.

4.2.10.5.2 IAC-P status

Here, all communication-independent device and error states are displayed. Bus-specific error states are not displayed.

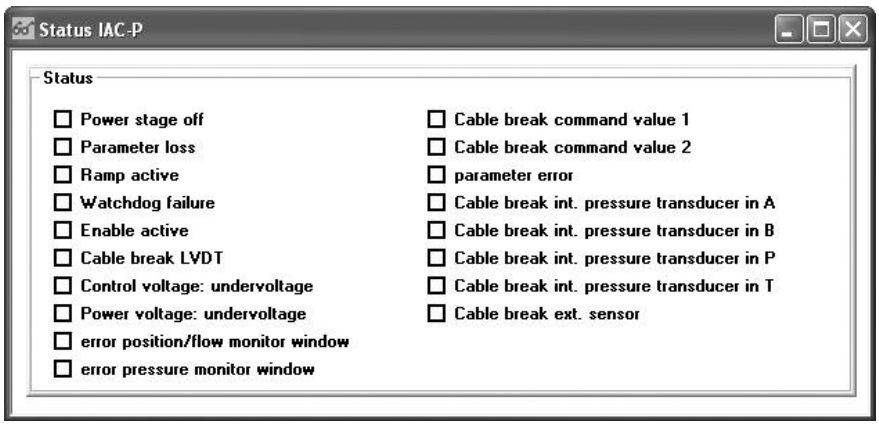

Fig. 37: IAC-P status

- Power stage off (M004/bit 0):
  The output stage is switched off. The reason for this may be a missing release or an error.
- Parameter loss (M004/bit 1):
  In the device parameterization, at least one parameter has not been recorded. This may have been caused by the too fast sending of the parameters from the master (CAN or PROFIBUS) or an excessive bus load (only with the CAN bus). As a consequence of this state, the device is switched off.
- Ramp active (M004/bit 2):
  The ramp is currently still being processed. When the ramp generator output has reached the command value, this state bit will be deleted again.
- Watchdog failure (M004/bit 3):
  Marks a program crash of the microcontroller, e.g. as a consequence of a hardware defect of a serious fault.
  As a consequence of this state, the device will be switched off.
- Enable active (M004/bit 4):
  In case of the bus valve with 6+PE connector, the release is internally fixedly wired with +24 V and is thus switched on permanently.
  Not relevant with digital control word specification.
- Cable break LVDT (M004/bit 5):
  At least one line to the position encoder of the valve is interrupted.
  As a consequence of this state, the device will be switched off.
- Control voltage: Undervoltage (M004/bit 6):
  The voltage at pin A of the 6+PE connector is below 16 V.
  As a consequence of this state, the device will be switched off.
- Power voltage: Undervoltage (M004/bit 7):
  Not relevant for IFB valves.
- Error position/flow monitor window (M004/bit 16):
  Not relevant for IFB valves.
- Error pressure monitor window (M004/bit 17):
  Not relevant for IFB valves.
- Cable break command value 1 (M004/bit 10):
  At pin D of the 6+PE connector, a cable break has been identified.
  This function is only available with the current interface 4 … 20 mA (device code F1). As a consequence of this state, the device will be switched off.

- Cable break command value 2 (M004/bit 8):
  Not relevant for IFB valves.
- Parameter error (M004/bit 11):
  An incorrect parameter value has been specified. One pressure reference value is, for example, above the pressure sensor measurement range.
  As a consequence of this state, the device will be switched off.
- Cable break int. pressure transducer in A (M004/bit 9):
  Not relevant for IFB valves.
- Cable break int. pressure transducer in B (M004/bit 12);
  Not relevant for IFB valves.
- Cable break int. pressure transducer in P (M004/bit 13):
  Not relevant for IFB valves.
- Cable break int. pressure transducer in T (M004/bit 14):
  Not relevant for IFB valves.
- Cable break ext. sensor (M004/bit 15):
  Not relevant for IFB valves.

4.2.10.5.3 Process data

In the process data window, states of control and status word and the command and actual values can be monitored.

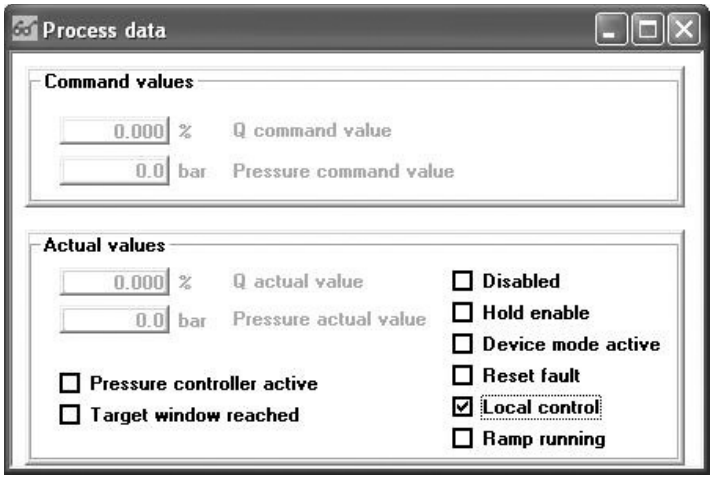

Fig. 38: Process data window

The content of the process data window corresponds to that of the cyclic data objects of the CANopen (PDOs) and PROFIBUS bus systems (default telegrams 3 … 6, depending on the type).

Command value [%] Command value display.

Actual value Display of the actual value and the status word (see description of the state machine chapter 4.2.7.4 on page 31).

4.2.10.6 Measuring data

The measuring data window serves the control of the WinView® visualization program.

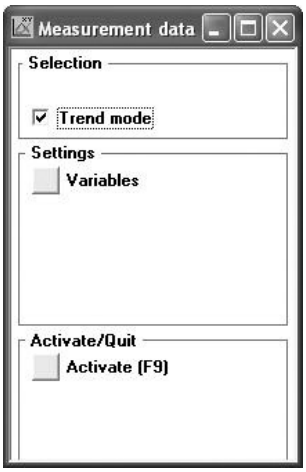

Fig. 39: Measuring data window

Selection If the trend mode is activated, long-time records of signals can be prepared.

Settings By clicking on the "Variables" button, the parameters to be recorded can be selected. The parameters to be recorded are selected in the following window:

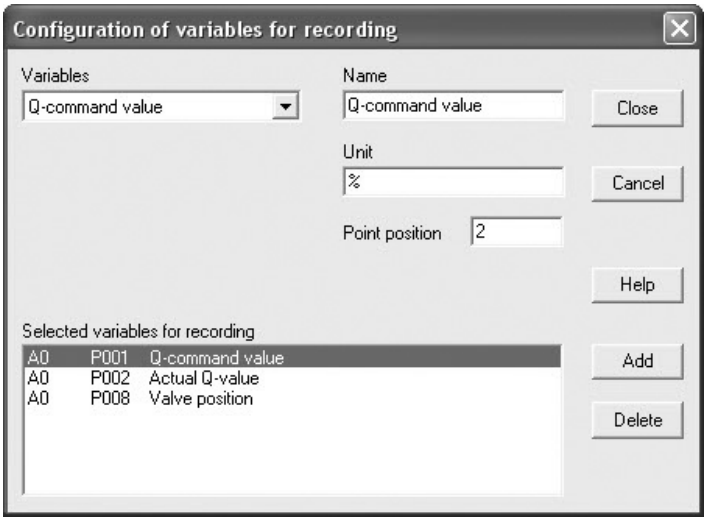

Fig. 40: Window for selecting the measuring data

- "Variables":
  List of the parameters that can be selected for recording.
- "Selected variables for recording":
  Clicking on "Add" accepts the selected parameter.
  A maximum of three parameters can be displayed simultaneously.
  Clicking on "Delete" removes the parameter from the definition window again.

- The parameter selection is exited by clicking on "Close" and the WinView® program starts automatically. The parameters selected in advance are recorded.

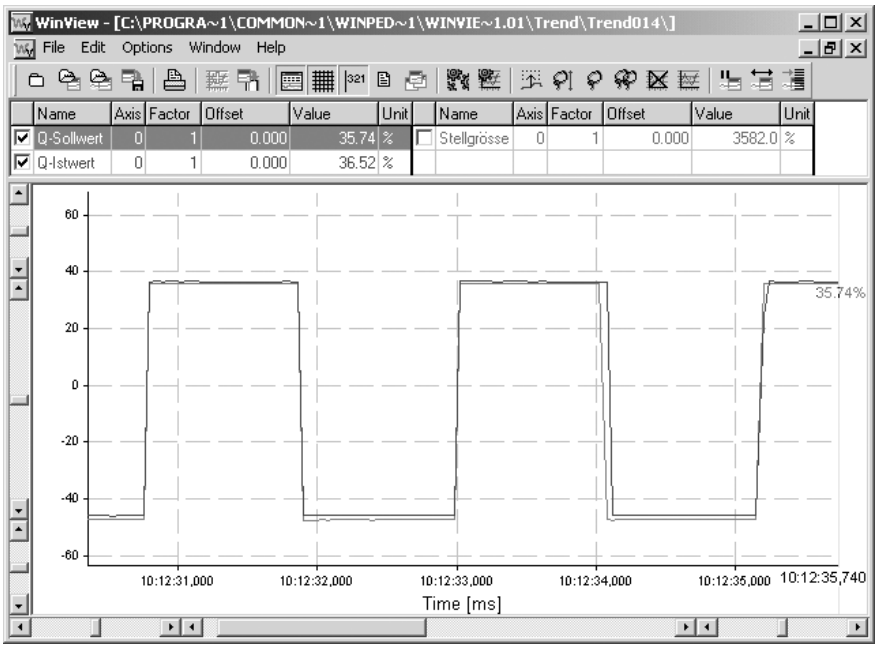

Fig. 41: Presentation of WinView®

Activate/Exit "Exit" stops the recording. The "Activate" button starts the recording.

4.2.11 Control type pQ valve (without Q control)

4.2.11.1 Overview

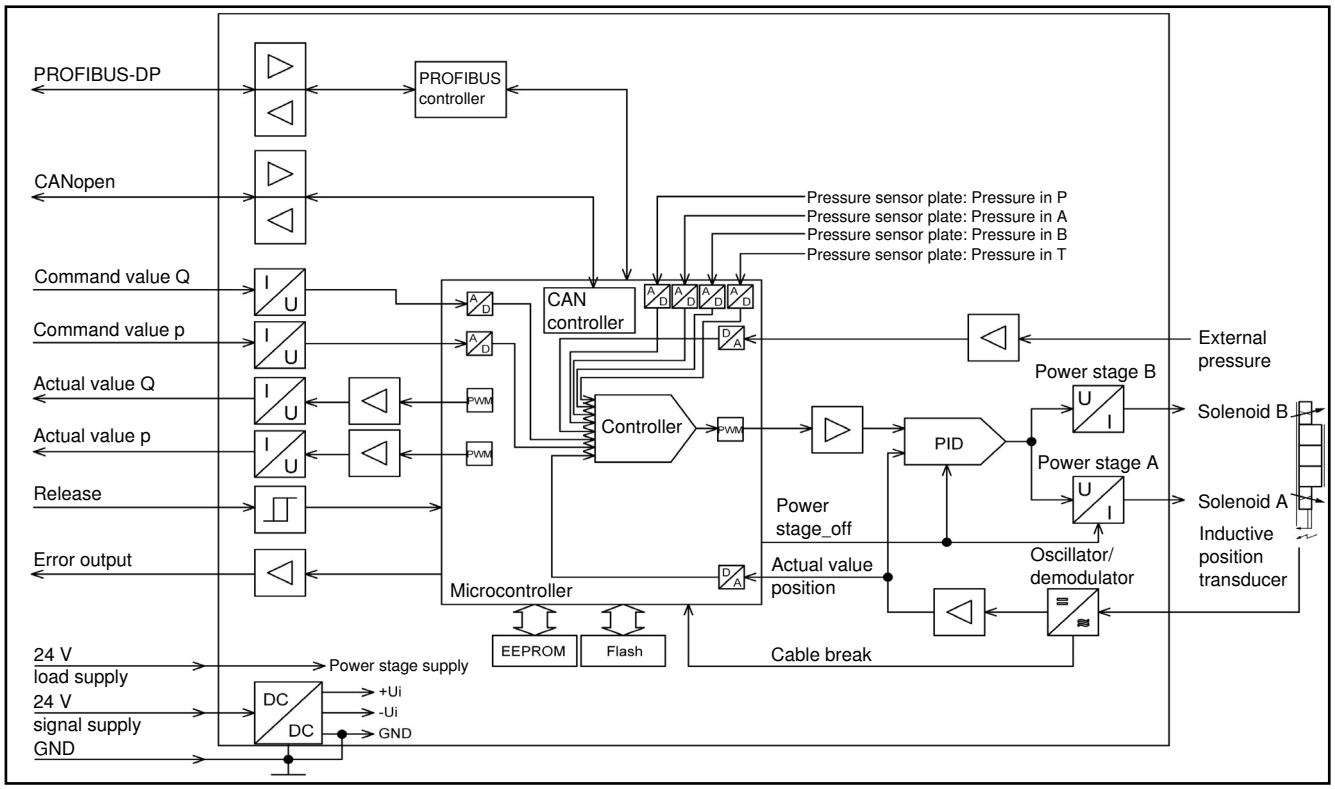

Fig. 42: IAC-P block diagram with all functions

The block diagram also shows the optional functions of the IAC-P valve. Not all functions can be combined. A device supports either CANopen or PROFIBUS-DP.

4.2.11.2 Project window

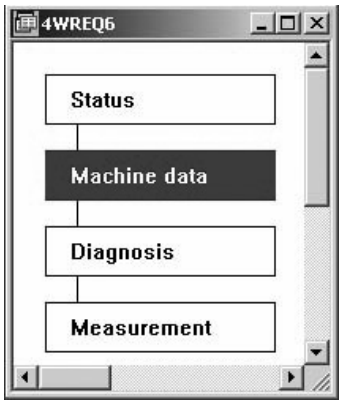

Fig. 43: Project window

The project window gives an overview of the possible functions for operating a device; in this case for a project with the exemplary name "4WREQ6".

4.2.11.3 Status

The status window gives an overview of basic valve settings. It is updated once after the connection to the valve has been established.

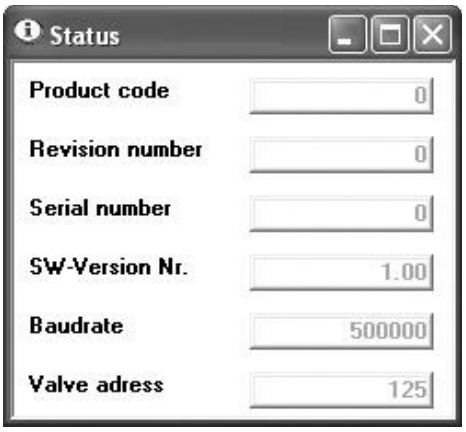

Fig. 44: Status window

Product code The product code corresponds to a "Basic valve type" as it is also differentiated when creating a new "WIN-PED 6" project. E.g. "Bus valve" or "pQ with two sensors in ZP (A and B)".

Revision number Not used.

Serial number Not used.

SW version no. Valve software version.

Baud rate Display in baud, in the example 500000 for 500 kBaud.

Valve address Active valve address.

4.2.11.4 Machine data

In the machine data window, the basic settings are made.
These are general settings as well as settings for the command value preparation, regarding the system controller and the actuating variable adaptation.
The system controller consists of the pressure controller and the Q function. The actual value preparation (sensor preparation) corresponds to the setting of the analog "Pressure" transducer.

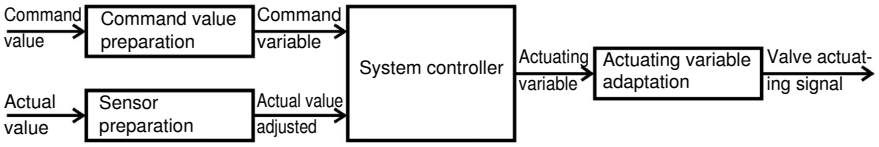

Fig. 45: Block diagram controller structure

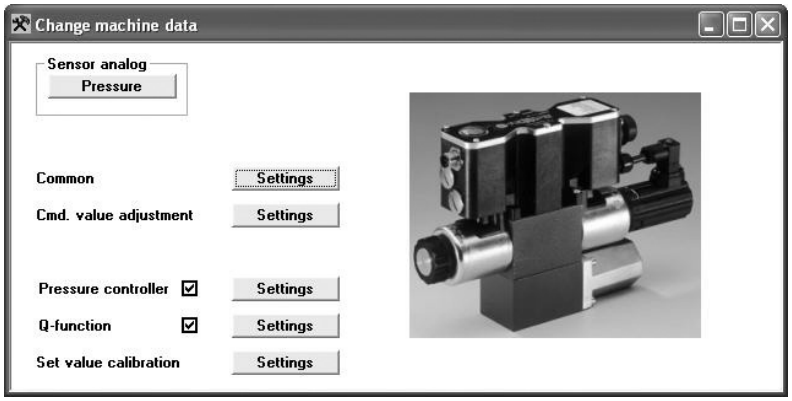

Fig. 46: Machine data window

4.2.11.4.1 Analog transducer

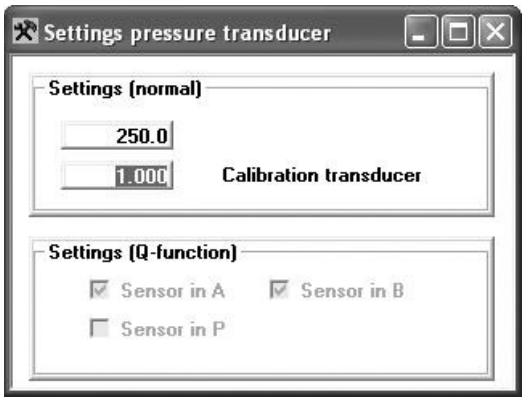

Fig. 47: Settings for the pressure sensors

Settings (normal) Here, the nominal pressure of the pressure sensors used can be read out and, in case of devices with external pressure sensor, also be set (M426).
With "Pressure sensor calibration", a pressure sensor deviation (gain) can be re-calibrated (M324). The settings take effect on all pressure sensors of the valve and not on the individual sensor.

Settings (Q function) Here, the current configuration of the pressure sensors is shown.

4.2.11.4.2 General

The general settings refer to the switching input and the switching output of the X1 connector and the type of command value and control word specification.

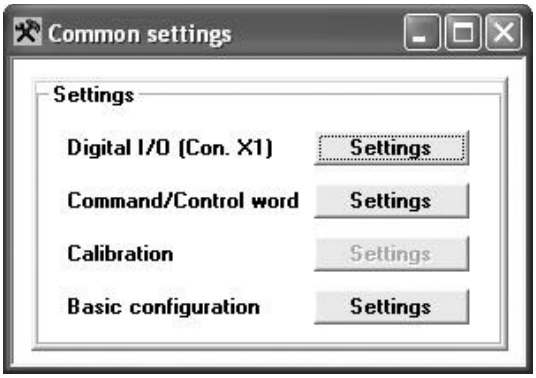

Fig. 48: General settings

Digital I/O (Con. X1) By means of these settings, the functions of pin 3 (analog release) and pin 11 (analog error output) can be re-programmed (M501).

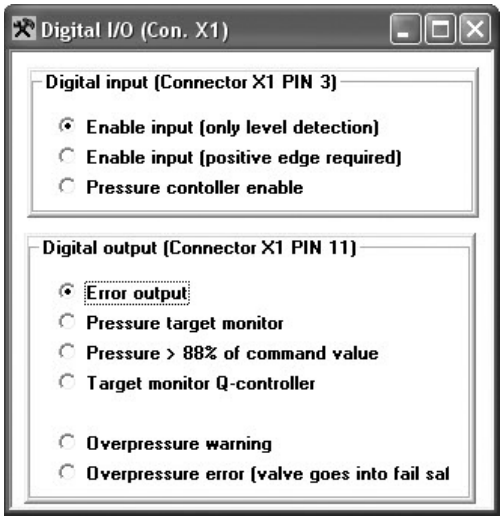

Fig. 49: Settings digital I/O (X1 connector) *

For the digital input (X1 connector PIN 3), there are the following possibilities:

- Enable input (only level detection). Default setting = analog release. An H level at the input activates the pQ controller.
  With an L level, the valve remains in fail-safe position unless the “Hold” has been activated.
- Enable input (positive edge required). Analog release.
  An H level at the input activates the pQ controller. After application of the supply voltage or after restart in case of an error, the transition from L to H is expected (edge recognition).
- Pressure controller enable. With this option, the valve controller is always active. After application of the release, the pressure controller is activated (minimum value generator concept). Without release signal, the actual Q value follows the Q command value. This setting overwrites the “Hold”.

For the digital output (X1 connector PIN 1), there are the following possibilities:

- Default setting = error output. If no error is detected, the electronics output an H level, otherwise an L level.
- Pressure target monitor.
  If no error is detected and if the actual pressure value is within the target window, the electronics output an H level at pin 11, otherwise an L level.
- Pressure > 88 % of command value. Irrespective of the error state of the valve, the output outputs an H level at pin 11 if the actual pressure value is > 88 % of the pressure command value. Otherwise, an L level is output.
- Overpressure warning (without shut-off). This function is only useful if the pressure controller is switched off. The actual pressure value is then only monitored. If the actual pressure value is higher than the pressure command value, an L level will be output at pin 11 as warning. The pQ controller and the valve function remain active.
- Overpressure warning + shut-off. This function is only useful if the pressure controller is switched off. The actual pressure value is then only monitored. If the actual pressure value is higher than the pressure command value, an L level will be output at pin 11 and the valve takes the fail-safe position.

Command/Control word

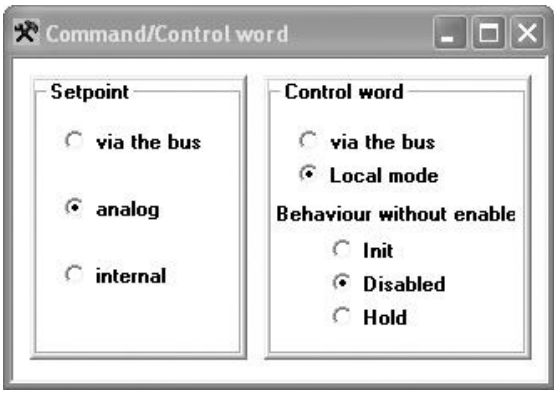

Fig. 50: Settings regarding command value and control word

Setpoint:

For the command value specification, there are the following options (M429):

- Command value "via the bus"
- Command value "analog" via connector X1
  The interface version (voltage or current interface) can be seen from the device type key.
- Command value "internal"

Control word setting:

The control word can be specified as follows (M431):

- Control word "via the bus"
- Control word via “Local mode”. Release via PIN 3 of the X1 connector.

Setting "Behavior without enable":

Using the "Behavior without enable" parameter, the analog release function can be set (M460):

- The "Init" and "Disabled" states behave identically in the pQ mode and as an effect, the valve will, without release, take the fail-safe position.
- As an effect of the “Hold” state, the valve will, without release, remain active and use the set Hold command values. If the release input has been changed to "Pressure controller enable", the Hold mode is inactive.

Calibration Not used.

Basic configuration Not used.

4.2.11.4.3 Command value preparation

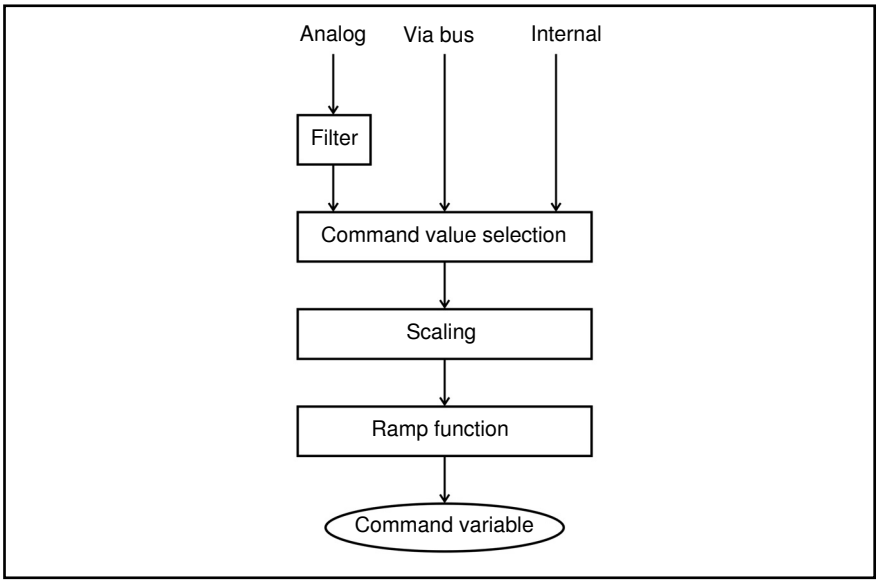

Fig. 51: Flow chart for the command value preparation

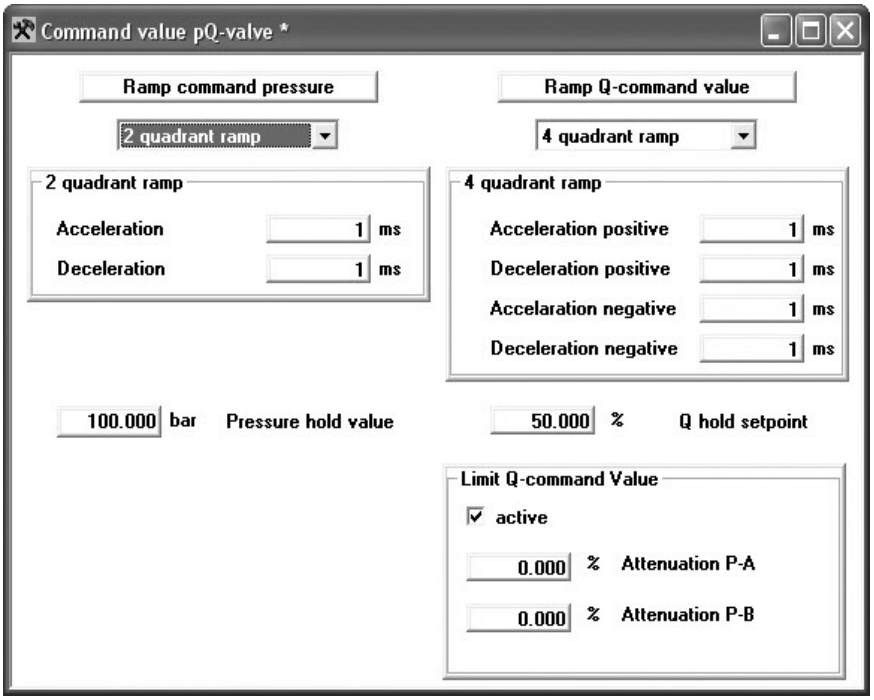

Fig. 52: Settings for the command value preparation

Ramp command pressure For the setting of the ramp function type (M451), there are three options:

- Ramp switched off
- One-quadrant ramp = identical ramp time for increasing (acceleration) and decreasing command value (delay)

- Two-quadrant ramp = different ramp times for increasing (acceleration) and decreasing command value (delay)

Ramp times (pressure command value) [ms]

Depending on the ramp function set, the ramp times can be set:

- Time for the one-quadrant ramp or for the acceleration of the two-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M452)
- Time for the delay of the two-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M455)

Pressure hold value [bar]

Specification of the Pressure hold value (M450). It is used if the Hold mode has been activated with digital control word specification or if with analog control word specification, the preferred position without release is “Hold”.

Ramp Q command value

For the setting of the ramp function type (M400), there are four options:

- Ramp switched off
- One-quadrant ramp = identical ramp time for increasing (acceleration) and decreasing command value (delay)
- Two-quadrant ramp = different ramp times for increasing (acceleration) and decreasing command value (delay)
- Four-quadrant ramp = different ramp times for increasing (acceleration) and decreasing command value (delay), separated for positive and negative direction

Ramp times (Q command value) [ms]

Depending on the ramp function set, the ramp times can be set:

- Time for one-quadrant ramp or for the acceleration of the two-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M401)
- Time for the delay of the two-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M404)
- Time for the acceleration in positive direction of the four-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M402)
- Time for the acceleration in negative direction of the four-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M403)
- Time for the delay in positive direction of the four-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M405)
- Time for the delay in negative direction of the four-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M406)

Q hold setpoint [%] or [l/min]

Specification of the Q hold setpoint (M446). The value is either set in [%] (Q-controlled) or in [l/min] (Q-regulated). It is used if the Hold mode has been activated with digital control word specification or if with analog control word specification, the preferred position without release is “Hold”.

Limit Q-command Value [%]

After activation of Limit Q command value, the attenuation has to be set separately for the valve directions P -> A (M554) and P -> B (M555). In this connection, a value of 100% corresponds to no attenuation, a value of 0% to complete attenuation of the command value.

The attenuation parameter quasi corresponds to a command value factor (value range 0...100%).

4.2.11.4.4 Pressure controller

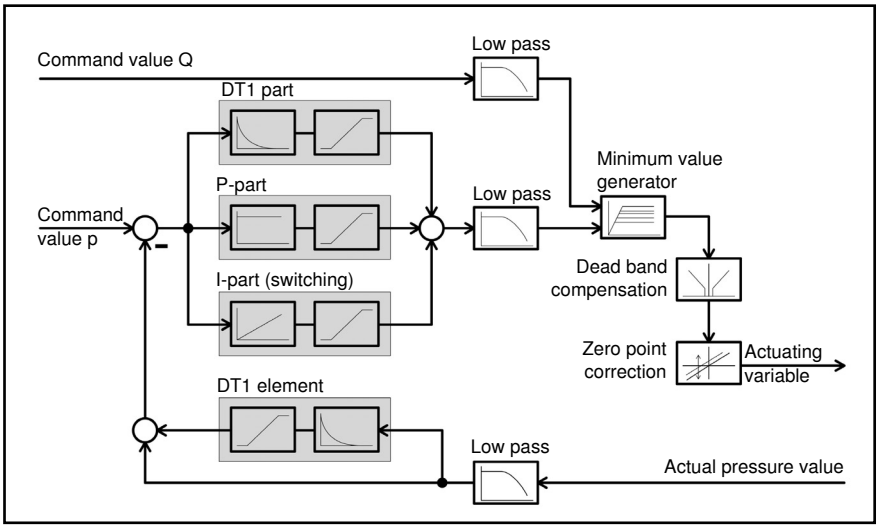

Fig. 53: Block diagram of the pressure controller with minimum value generator and actuating variable preparation

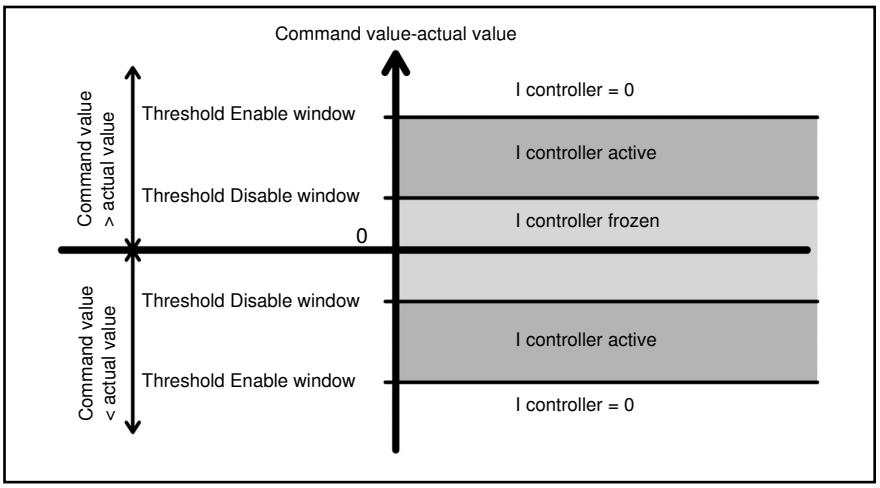

Fig. 54: Scheme of the switching integrator

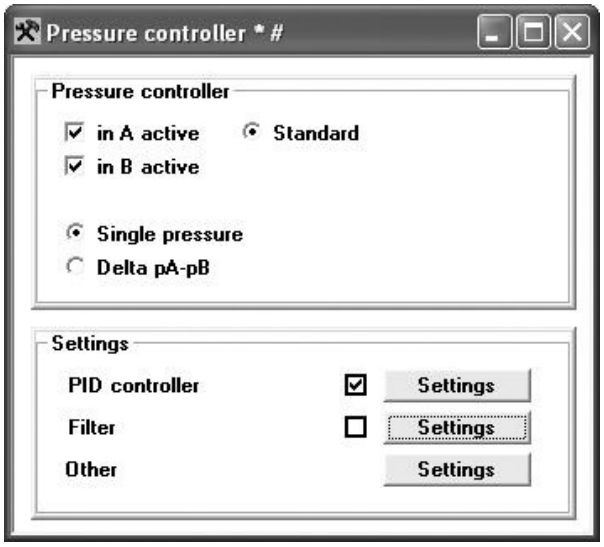

Fig. 55: Settings for the pressure controller

Pressure control

Depending on the valve type, there are the following basic pressure control settings:

- In A active: Activation of the pressure control in valve port A.
  This option is available if the valve has an integrated pressure sensor in A or if an external pressure sensor can be connected to the valve. For the pressure control in A, you can choose between three configuration options:
  - Default: With a positive Q command value, the pressure is controlled on the A side of the valve.
  - Single pressure (backpressure control):
    The pressure in A is also controlled if the Q command value is negative. Nevertheless, the alternating control remains active. In this connection, the Q command value still limits the actuating variable in positive direction. This function is not possible if the pressure controller on the B side is simultaneously activated.
  - Delta pA-pB (special Q function):
    With positive Q command values, the actuating variable of the pressure controller is limited in positive direction (P-A), with negative Q command values in negative direction (P-B). A Q command value of 0 % is not admissible. This function is not possible if the pressure controller on the B side is simultaneously activated.

- In B active: Activation of the pressure control in valve port A.
  This option is available if the valve has an integrated pressure sensor in B. For the pressure control in B, one configuration option is available:
  - With a negative Q command value, the pressure is controlled on the B side of the valve.
  - Single pressure: In the pressure measurement, no difference between the pressure in A and B is calculated.
  - Delta pA-pB (pressure differential): The difference of the pressure in A and B is calculated in an area ratio-evaluated form. The area ratio can be set in the range from 0...15.99 (fig. 56 "Setting the area ratio" on page 64; M481).
    If the valve with the A side controls the bottom side of the single-rod cylinder, an area ratio > 1 is to be set.
    If the rod side is controlled with P-A, an area ratio < 1 is to be set. With a double-acting cylinder, a value of "1" is to be set.
    The calculation of the pressure command value and the output actual pressure value will then result with a positive Q command value:
    p = pA - pB/F.

With negative Q command value, the following applies:
p = pB/F – pA.

with:
p = Pressure command value or actual pressure value
pA = Pressure in valve port A
pB = Pressure in valve port B
F = Area ratio

The area ratio is set in the "Pressure differential calculation" window. The window is called via the Delta pA-pB/"Settings" option.

Fig. 56: Setting of the area ratio

Settings More settings include "PID controller", "Filters" and "Others".

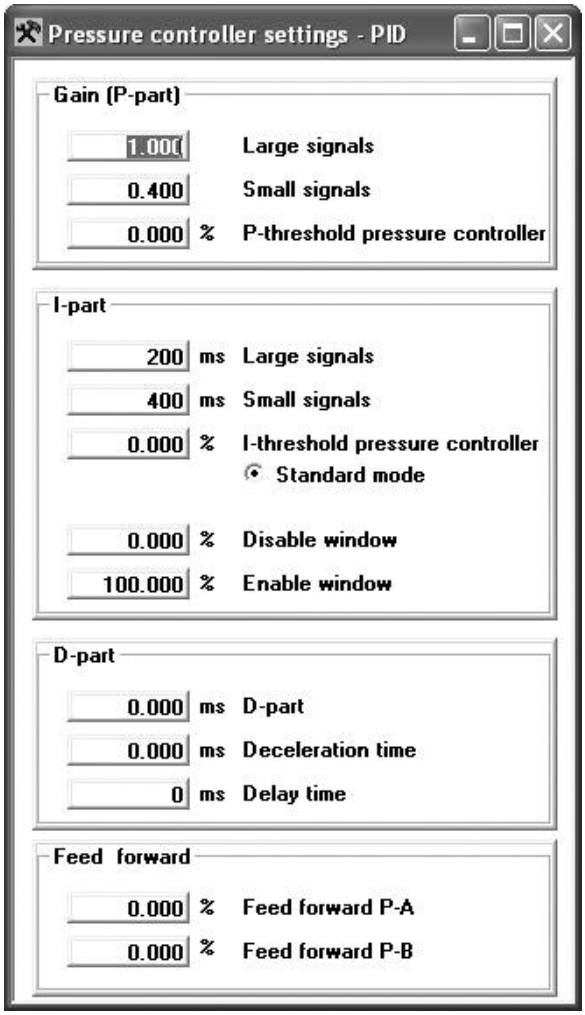

Fig. 57: PID controller for the pressure control

- PID controller:
  If the pressure controller in A and/or B is activated, the pressure controller can be set (fig. 55 "Settings for the pressure controller" on page 63). The pressure controller has a PID structure with switching I-part.
  The following controller parameters can be set:
  - Gain (P-part)
    The gain can be set separately for control errors that are greater or smaller than the changeover threshold.

    The “large signal” range (M412) applies to control errors that are greater than the value of the P-threshold (M414). The setting range is 0...16.

    The “small signal” range (M413) applies to control errors that are smaller than the value of the P-threshold (M414). The setting range is 0... 6.

    The "P-threshold" of the P controller (M414) is 0...100 % = absolute value of the control error.

  - Integrator (I-part):
    The integration time (reset time) can be set separately for control errors that are greater or smaller than the changeover threshold. A short reset time corresponds to a fast integrator.

    The “large signal” range (M415) applies to control errors that are greater than the value of the I-threshold (M417). The maximum setting is 30000 ms. With a value of "0", the I-part is switched off.

    The “small signal” range (M415) applies to control errors that are smaller than the value of the I-threshold (M417). The maximum setting is 30000 ms. With a value of "0", the I-part is switched off.

    The setting range of the "I-threshold" of the I controller (M417) is 0..100 % = absolute value of the control error in the standard mode. In the position-dependent mode, the switching between large and small signal range does not depend on the control error but on the spool position. In this connection,
    0 % I-threshold correspond to the complete opening A-T
    50 % I-threshold to the approximate control edge P-A/A-T and
    100 % I-threshold the complete opening P-A.
    This mode is limited to the STW195/196 valves due to their one-arm design.

    "Disable window" pressure controller (M418): If the absolute control error value is smaller than the value of the Disable window, the integrator is "frozen". The setting range is 0...100 %.

    "Enable window" pressure controller (M419): If the absolute control error value is greater than the value of the Enable window, the I-part is reset and the I controller is deactivated. The setting range is 0...100 %.

  - Derivative action (D-part). Here, there are the following settings:
    The "D-part" (M420) takes effect on the control error of the pressure controller. The value range is 0...16 ms. With 0 ms, the D-part is switched off, with 16 ms, the D-part has a very strong effect.

    The "Deceleration time" (M421) has the same effect as the D-part, however only on the actual pressure value of the pressure controller. The value range is also 0...16 ms. Here, the function is also switched off in case of 0 ms and with 16 ms, the effect is very strong.

    The value of the "Delay time" (M422) applies to the D-part and the Deceleration time and has the same effect as a first order delay. The setting range is 0...60000 ms. With 0 ms, the delay is switched off. Values greater than ca. 50

ms are usually not necessary for a pressure controller.

– Command value “feed forward”:
The Command value “feed forward” can be set separately for the P-A (M479) and P-B (M480) direction. In the Command value “feed forward”, the attenuated command value is directly added to the actuating variable. The setting range is 0...100 %

- Filter:
For the pressure controller, you can choose between two filters of first order.

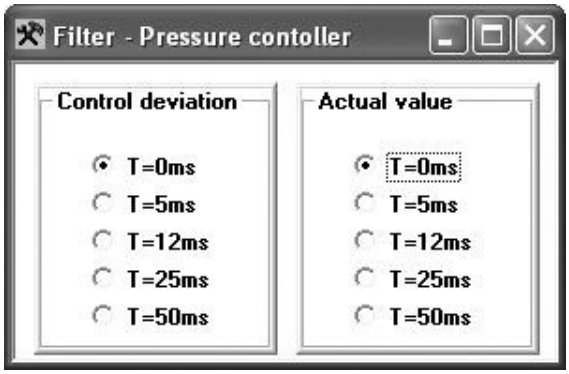

Fig. 58: Filter*

– The "control deviation" filter influences the control error, i.e. the difference between pressure command value and actual pressure value. The filter serves the filtration of noisy pressure command and actual pressure values.
– The “Actual value” filter only influences the actual pressure value and only as long as the valve is not in pressure control. In the pressure control, the filter is switched off. The filter is e.g. used for suppressing pressure peaks during the cylinder travel movement; during that time, activation of the pressure controller is still not desired.

- Others:
For the pressure controller, the following other settings can be made.

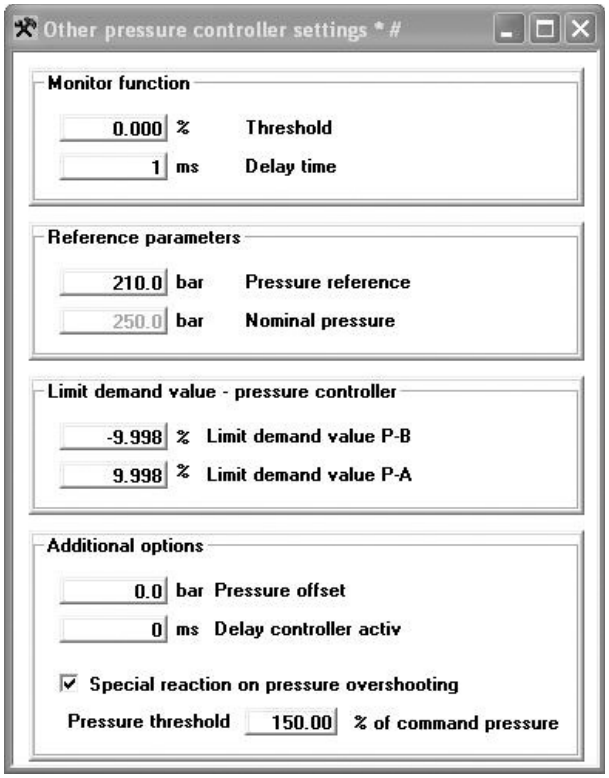

Fig. 59: Other pressure controller settings

– Monitor function:
  The monitor function allows for the pressure control monitoring:
  The "Threshold" parameter (M459) specifies the window width in [%] of the pressure reference. Settings are 0...100 %. If within this window, the actual pressure value lies around the pressure command value, the corresponding bit in the status word and also the digital output are set (depending on the configuration of X1/pin 11).

  If the pressure leaves the window, the bit and the digital output are reset after the adjustable “Delay time” (M458). The Delay time is not effective if the window is reached.

– Reference parameters:
  "Pressure reference" (M425) specifies the maximum pressure that is to be set. The analog inputs and outputs are also normalized by means of the pressure reference. 100 % of the analog input and output value correspond to the pressure reference.

  Using the “Nominal pressure” parameter, the setting for the pressure reference is limited upwards.
  The lower limit is approx. 14 % of the nominal pressure sensor pressure.
  Recommended values for the pressure reference are ca. 50...95 % of the nominal pressure sensor pressure.

– Limit demand value - pressure controller:
  Depending on the spool used, the actuating variable should be limited during the pressure control. This can be set depending on the direction.

  "Limit demand value P-B" (M482):
  While the valve is in the pressure control in port A, the stroke in P-B direction can be limited by using this parameter. With spool Q5, a limitation value of 10 % prevents e.g. the valve from connecting port P and B during the pressure control in A. With 100 %, there is no P-B limitation.

  "Limit demand value P-A" (M483):
  This parameter limits the stroke in P-A direction when the valve is in pressure control in port B. With spool Q5, the pre-set limitation value would be +10 %. With +100 %, there is no P-A limitation.

– Additional options:
  Using "Pressure offset" (M424), a zero point correction of the pressure control is directly possible in [bar]. The value range depends on the valve pressure rating.

  With "Delay controller active" (M484), the activation of the pressure controller after a sign change of the Q command value can be delayed. In this way you can, for example, suppress start-up pressure peaks. During the delay, the pressure cannot be limited/controlled! Use of this parameter is therefore only possible with periodic and known cycles.

  "Special reaction on pressure overshooting":
  The integration time set may be too long for fast pressure reduction in case of pressure peaks. If this function is used and the set value of the actual pressure value (M492) is reached, the I total of the integrator of the pressure controller is reset to "0". The pressure build-up is accelerated.
  The maximum value of the "Pressure threshold" setting is 400 % of the pressure command value and should always be greater than 100 %.

4.2.11.4.5 Q function

Depending on the valve type, the following settings for the Q function are possible.
In this connection see also fig. 53 "Block diagram of the pressure controller" on page 62.

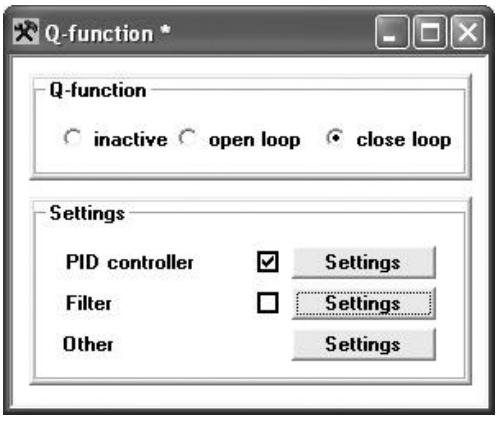

Fig. 60: Q function

Q function

- Inactive:
  Deactivation is only admissible if only the pressure controller in A has been activated. Pressure control on the B side is no longer possible in this mode. The Q command value is then internally specified with 100 % and doesn't have to be externally wired any more.
- Open loop:
  In this mode, the Q command value serves as command value for the valve position and for the selection of the pressure control side. The Q command value is used directly in the minimum value generator. A positive value is assigned to the direction P-A, a negative one to the direction P-B.

Settings

- Filter:
  For the Q command value, a filter can be selected.

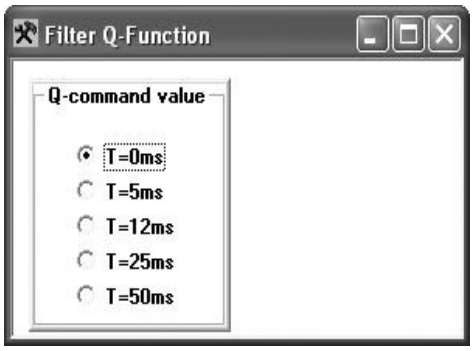

Fig. 61: Filter settings Q controller

  – Q command value:
    Five time constants between 0 ms (Filter off) and 50 ms (maximum filter effect) can be selected. The filter is necessary when the analog Q command value is noisy.

- Others:
  For the Q function, the following other settings can be made.

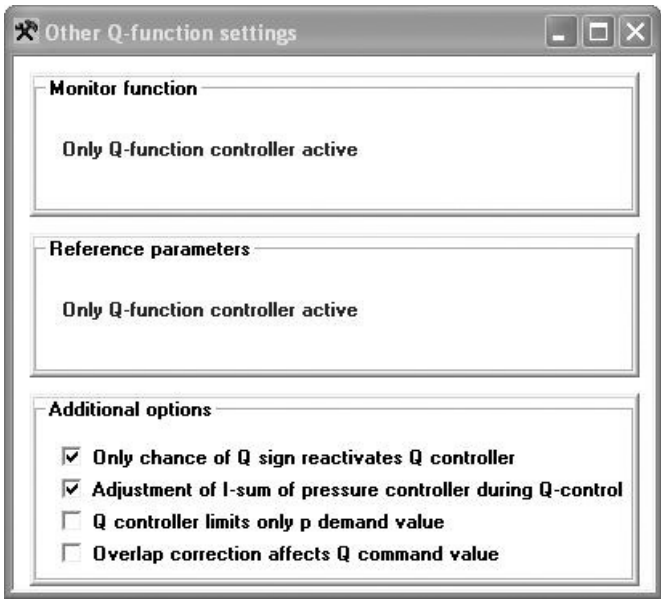

Fig. 62: Other settings Q function

– "Monitor function setting": Not used.
– "Reference parameters": Not used.
– "Additional options":
  If "Only change of Q sign reactivates Q controller" (default setting = on) is deactivated, the minimum value generator will, in case of a pressure drop, switch back from the pressure control to the Q function at an early time. This may accelerate a cylinder movement but also lead to a unstable system. Activation of this option will only activate the Q function after a sign change of the Q command value; otherwise, the pressure controller will remain effective. The Q function will in any case limit the pressure controller output.

  The "Adjustment of I-sum of pressure controller during Q control" option (default setting = on) will result in a smooth transition between pressure control and Q function. Deactivation of the option may sometimes lead to dynamic advantages or to sudden transitions between the pressure control and the Q function

  "Q controller limits only p demand value" (default setting = off) prevents the minimum value generator from switching back to the pure Q function. The Q function only serves the limitation of the pressure controller output. The dynamics of the cylinder travel movement only depend on the pressure controller setting.

  "Overlap correction affects on Q command value" (default setting = off). The overlap compensation usually only takes effect on the actuating variable. This is, for example, not reasonable for the Q5 spool as here, the pressure control edges P-A/A-T and P-B/B-T are in each case only zero overlapped. With regard to the Q command value there is, however, an overlap P-A/P-B of ±20 %. Activation of this option switches the effect of the overlap compensation and thus allows for the compensation on the command value side.

4.2.11.4.6 Actuating variable adaptation

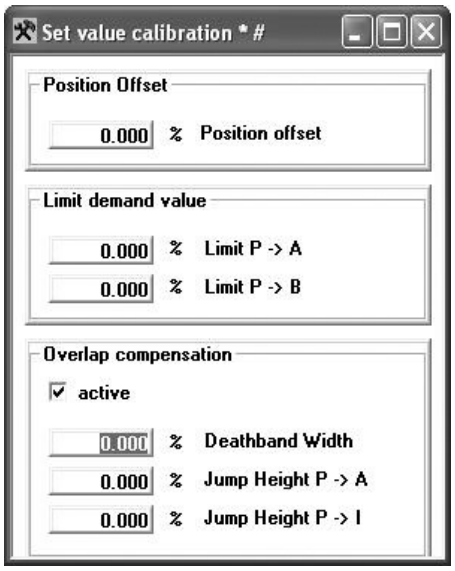

Fig. 63: Actuating variable adaptation with active overlap compensation

Position offset The Position offset (M411) has been adjusted ex works and doesn't have to be readjusted.

Adjustment of this parameter changes the adjustment of the flow control (Q function Close loop)!

Limit demand value

The actuating variable of the valve controller can be limited depending on the direction by the parameters limitation P -> A (M550) or limitation P -> B (M551).

The value range for the limitation P -> A is 0% (maximum limitation) to +100% (no limitation).

The value range for the limitation P -> B is 0% (maximum limitation) to -100% (no limitation).

By the limitation, the actuating variable is limited “hard”. That also means that actuating variables between 0% and the limitation value are output without changes.

Overlap compensation

The overlap compensation serves the compensation of the spool overlap, especially with E and W spools. Default setting = not activated.
V spools must not be compensated. The overlap compensation (activation via M407) has three parameters:

- Dead band width (M410)
  This value specifies the entire width of the dead band for P-A and P-B.
- Jump height P-A (M408)
  Value of the overlap compensation in direction P-A
- Jump height P-B (M409)
  Value of the overlap compensation in direction P-B

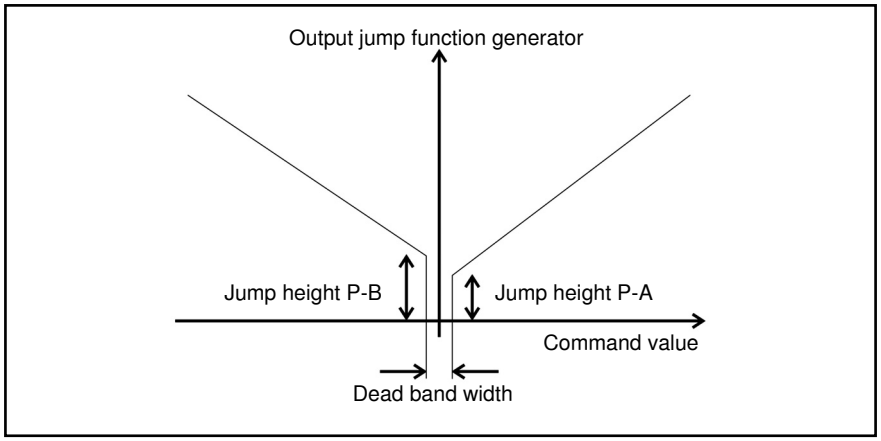

Fig. 64: Principle of the overlap compensation

4.2.11.5 Diagnosis

The diagnosis function offers the possibility to monitor process variables and query error states and/or status messages:

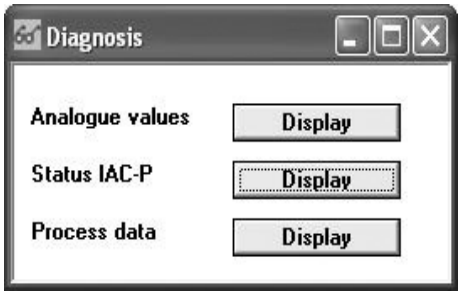

Fig. 65: Diagnosis selection window

4.2.11.5.1 Analog values

Not used.

4.2.11.5.2 IAC-P status

Here, all communication-independent device and error states are displayed. Bus-specific error states are not displayed.

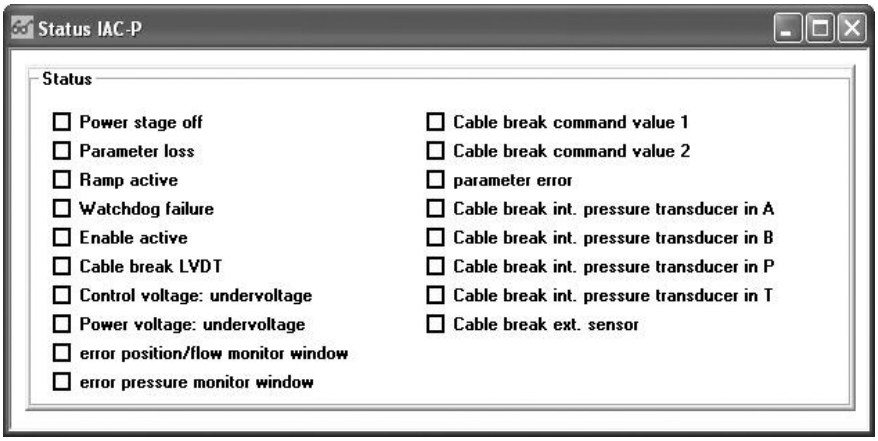

Fig. 66: IAC-P status

- Power stage off (M004/bit 0):
  The output stage is switched off. The reason for this may be a missing release or an error.
- Parameter loss (M004/bit 1):
  In the device parameterization, at least one parameter has not been recorded. This may have been caused by the too fast sending of the parameters from the master (CAN or PROFIBUS) or an excessive bus load (only with the CAN bus). As a consequence of this state, the device is switched off.
- Ramp active (M004/bit 2):
  The ramp is currently still being processed. When the ramp generator output has reached the command value, this state bit will be deleted again.
- Watchdog failure (M004/bit 3):
  Marks a program crash of the microcontroller, e.g. as a consequence of a hardware defect of a serious fault.
  As a consequence of this state, the device will be switched off and an error message will be output at PIN 11 of the 11+PE connector.
- Enable active (M004/bit 4):
  Analog release is available at PIN 3 of the 11+PE connector.
  In case of the bus valve with 6+PE connector, the release is internally fixedly wired with +24 V and is thus switched on permanently.
  Not relevant with digital control word specification.
- Cable break LVDT (M004/bit 5):
  At least one line to the position encoder of the valve is interrupted.
  As a consequence of this state, the device will be switched off and an error message will be output at PIN 11 of the 11+PE connector.
- Control voltage: Undervoltage (M004/bit 6):
  The voltage at pin 9 of the 11+PE connector is below 16 V (PIN A with 6+PE connector). As a consequence of this state, the device will be switched off and an error message will be output at PIN 11 of the 11+PE connector.
- Power voltage: Undervoltage (M004/bit 7):
  The voltage at pin 1 of the 11+PE connector is below 16 V (PIN A with 6+PE connector). As a consequence of this state, the device will be switched off; there will, however, not be an error message at PIN 11 of the 11+PE connector.
- Error position/flow monitor window (M004/bit 16)
  This function is only available with the devices for the cylinder position control,

for example types STW0240 or WREA.
The bit is set if the actual cylinder value is within the window limits of the position monitor window to be set.
This display does not influence the device function.

- Error pressure monitor window (M004/bit 17)
  The bit is set if the actual pressure value is within the window limits of the pressure monitor window to be set.
  This display does not influence the device function.
- Cable break command value 1 (M004/bit 10):
  A cable break has been detected at pin 4 of the 11+PE connector (pin D with 6+PE connectors). This function is only available with the current interface 4…20 mA (device code F6 for the 1+PE connector and F1 for the 6+PE connector). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Cable break command value 2 (M004/bit 8):
  At pin 7 of the 11+PE connector, a cable break has been identified.
  This function is only available with the current interface 4 … 20 mA (device code F6 for the 11+PE connector). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Parameter error (M004/bit 11):
  An incorrect parameter value has been specified, for example a pressure reference value that is above the pressure sensor measurement range.
  As a consequence of this state, the device will not be switched off.
- Cable break int. pressure transducer in A (M004/bit 9):
  The supply line to the pressure sensor in A in the pressure measuring sandwich plate is interrupted (message only possible if a sensor is available). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Cable break int. pressure transducer in B (M004/bit 12):
  The supply line to the pressure sensor in B in the pressure measuring sandwich plate is interrupted (message only possible if a sensor is available). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Cable break int. pressure transducer in P (M004/bit 13):
  The supply line to the pressure sensor in P in the pressure measuring sandwich plate is interrupted (message only possible if a sensor is available). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Cable break int. pressure transducer in T (M004/bit 14):
  The supply line to the pressure sensor in T in the pressure measuring sandwich plate is interrupted (message only possible if a sensor is available). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Cable break ext. sensor (M004/bit 15):
  The supply line to the external pressure transducer is interrupted. The message is only possible if the sensor has a suitable interface (for example 4…20 mA or 0.5…5 V). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Overpressure warning (M004/bit 18):
  Indicates that the actual pressure value exceeds the pressure command value. The bit can only be set if the function has been activated in the "Digital I/O (X1 connector)" window. As a consequence of this state, the device will not be switched off.
- Overpressure shut-off (M004/bit 19):
  Indicates that the actual pressure value exceeds the pressure command value. The bit can only be set if the function has been activated in the "Digital I/O (X1 connector)" window. As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.

4.2.11.5.3 Process data

In the process data window, states of control and status word and the command and actual values can be monitored.

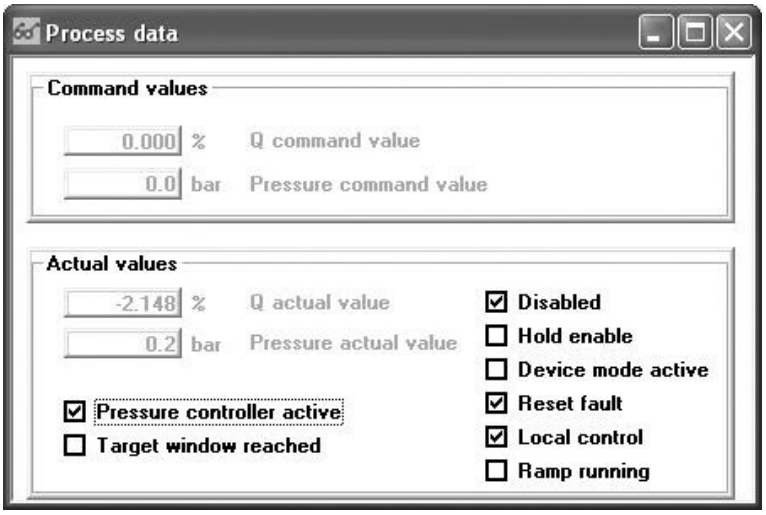

Fig. 67: Process data window

The content of the process data window corresponds to that of the cyclic data objects of the CAN (PDOs) and PROFIBUS bus systems (default telegrams 3 … 6, depending on the type).

Command value [%] Command value display.

Actual value Display of the actual value and the status word (see description of the state machine chapter 4.2.7.4 on page 31 et seq).

4.2.11.6 Measuring data

The measuring data window serves the control of the WinView® visualization program.

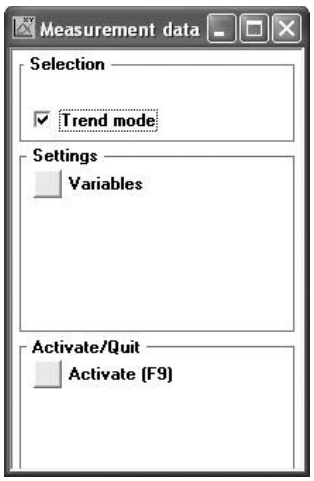

Fig. 68: Measuring data window

Selection If the trend mode is activated, long-time records of signals can be prepared.

Settings By clicking on the "Variables" button, the parameters to be recorded can be selected. The parameters to be recorded are selected in the following window:

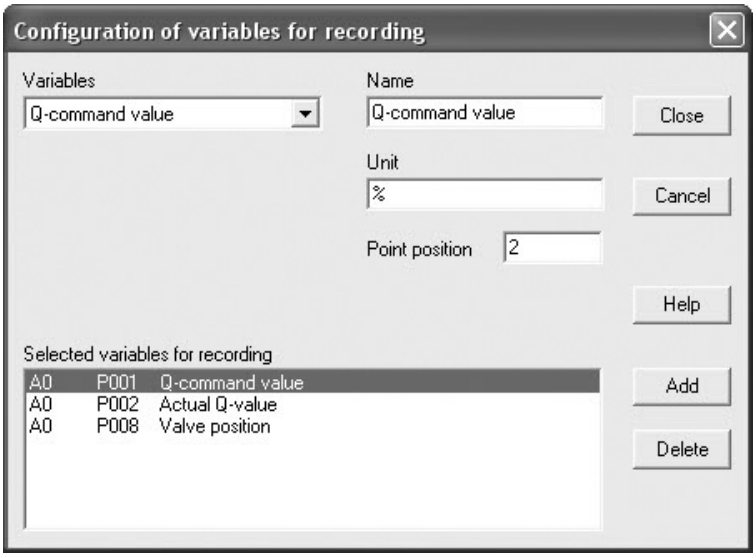

Fig. 69: Window for selecting the measuring data

- "Variables":
  List of the parameters that can be selected for recording.
- "Selected variables for recording":
  Clicking on "Add" accepts the selected parameter.
  A maximum of three parameters can be displayed simultaneously.
  Clicking on "Delete" removes the parameter from the definition window again.
- The parameter selection is exited by clicking on "Close" and the WinView® program starts automatically. The parameters selected in advance are recorded.

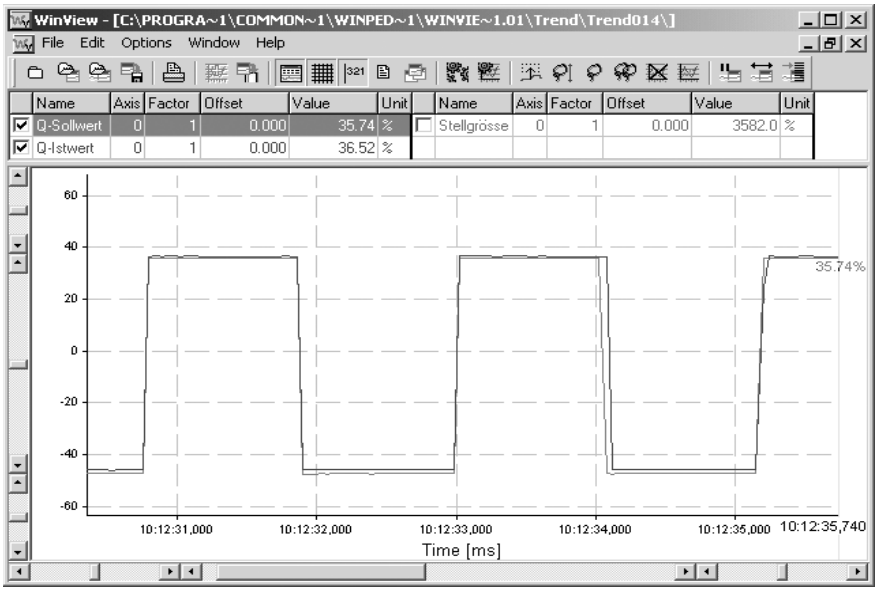

Fig. 70: Presentation of WinView®

Activate/Exit "Exit" stops the recording. The "Activate" button starts the recording.

4.2.12 Control type pQ valve (with Q control)

4.2.12.1 Overview

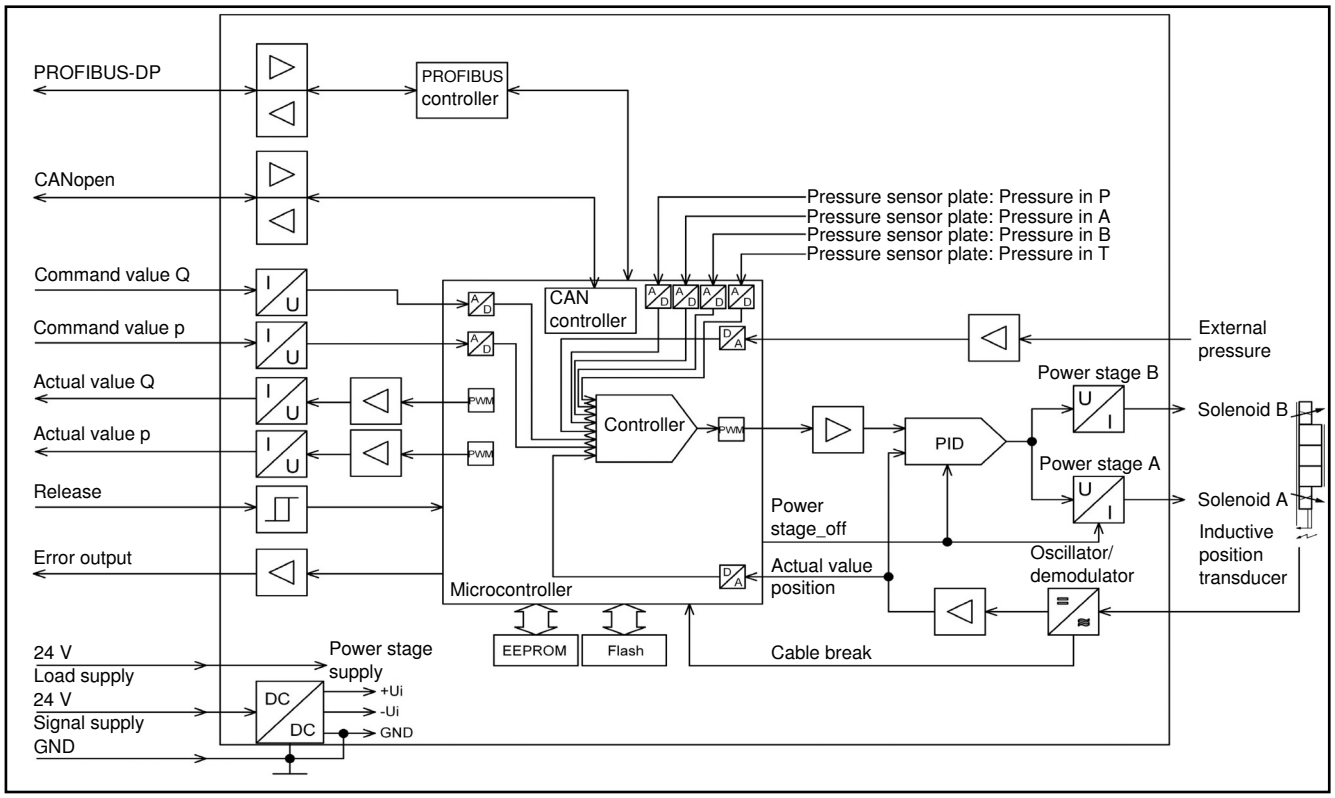

Fig. 71: IAC-P block diagram with all functions

The block diagram also shows the optional functions of the IAC-P valve. Not all functions can be combined. A device supports either CANopen or PROFIBUS-DP.

4.2.12.2 Project window

Fig. 72: Project window

The project window gives an overview of the possible functions for operating a device; in this case for a project with the exemplary name "4WREQ6".

4.2.12.3 Status

The status window gives an overview of basic valve settings. It is updated once after the connection to the valve has been established.

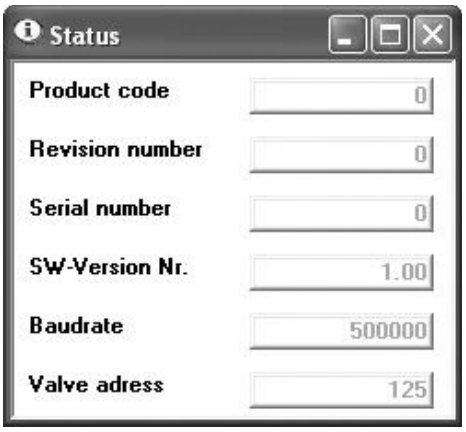

Fig. 73: Status window

Product code The "product code" corresponds to a "Basic valve type" as it is also differentiated when creating a new "WIN-PED 6" project. E.g. "Bus valve" or "pQ with two sensors in ZP (A and B)".

Revision number Not used.

Serial number Not used.

SW version no. Valve software version.

Baud rate Display in baud, in the example 500000 for 500 kBaud.

Valve address Active valve address.

4.2.12.4 Machine data

In the machine data window, the basic settings are made.
These are general settings as well as settings for the command value preparation, regarding the system controller and the actuating variable adaptation.

The system controller consists of the pressure controller and the Q function. The actual value preparation (sensor preparation) corresponds to the setting of the analog "Pressure" transducer.

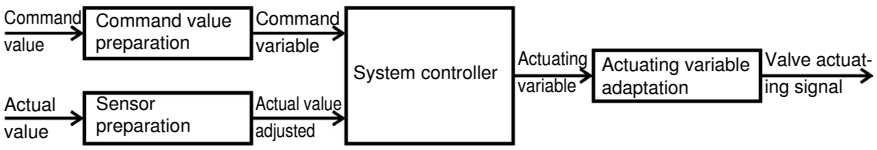

Fig. 74: Block diagram controller structure

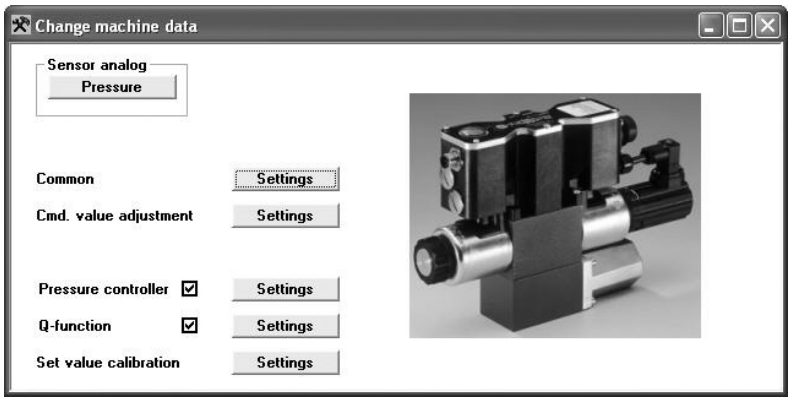

Fig. 75: Machine data window

4.2.12.4.1 Analog transducer

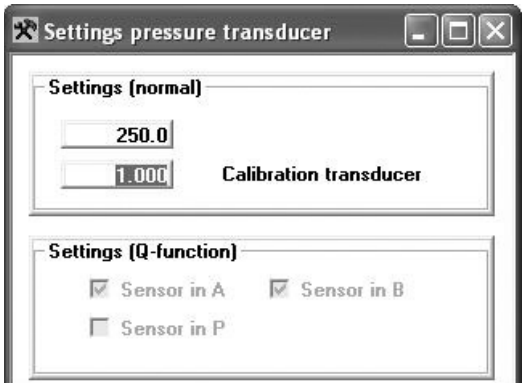

Fig. 76: Settings for the pressure sensors

Settings (normal) Here, the nominal pressure of the pressure sensors used can be read out and, in case of devices with external pressure sensor, also be set (M426).

With "Calibration transducer", a pressure sensor deviation (gain) can be re-calibrated (M324). The settings take effect on all pressure sensors of the valve and not on an individual sensor.

Settings (Q function) Here, the current configuration of the pressure sensors is shown.

4.2.12.4.2 General

The general settings refer to the switching input and the switching output of the X1 connector and the type of command value and control word specification.

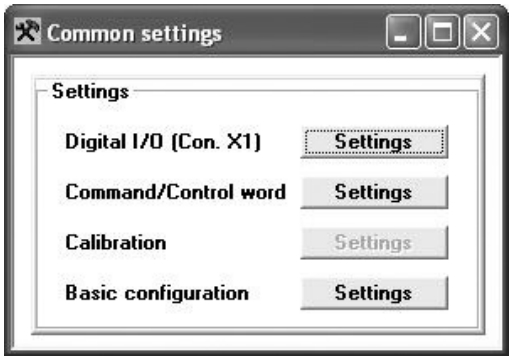

Fig. 77: General settings

Digital I/O (Con. X1) By means of these settings, the functions of pin 3 (analog release) and pin 11 (analog error output) can be re-programmed (M501).

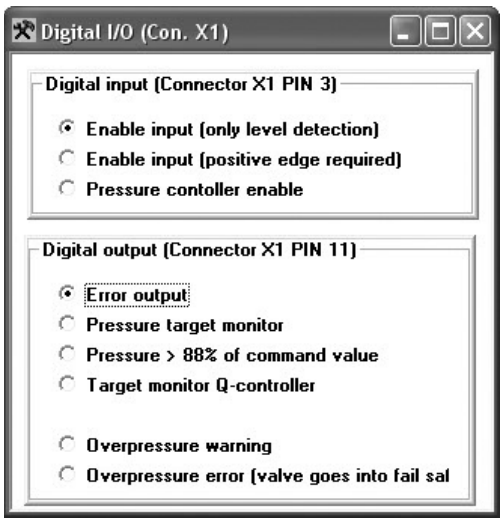

Fig. 78: Settings digital I/O (X1 connector)

For the digital input (X1 connector PIN 3), there are the following possibilities:

- Enable input (only level detection).
  Default setting = analog release. An H level at the input activates the pQ controller. With an L level, the valve remains in fail-safe position unless the “Hold” has been activated.
- Enable input (positive edge required). Analog release.
  An H level at the input activates the pQ controller. After application of the supply voltage or after restart in case of an error, the transition from L to H is expected (edge recognition).
- Pressure controller enable. With this option, the valve controller is always active. After application of the release, the pressure controller is activated (minimum value generator concept). Without release signal, the actual Q value follows the Q command value. This setting overwrites the “Hold”.

For the "Digital output (X1 connector PIN 11)", there are the following possibilities:

- Default setting = error output. If no error is detected, the electronics output an H level, otherwise an L level.
- Pressure target monitor.
  If no error is detected and if the actual pressure value is within the target window, the electronics output an H level at pin 11, otherwise an L level.
- Pressure > 88 % of command value. Irrespective of the error state of the valve, the output outputs an H level at pin 11 if the actual pressure value is > 88 % of the pressure command value. Otherwise, an L level is output.
- Target monitor Q controller.
  If no error is detected and if the actual flow value is within the target window, the electronics output an H level at pin 11, otherwise an L level.
- Overpressure warning (without shut-off). This function is only useful if the pressure controller is switched off. The actual pressure value is then only monitored. If the actual pressure value is higher than the pressure command value, an L level will be output at pin 11 as warning. The pQ controller and the valve function remain active.
- Overpressure warning + shut-off. This function is only useful if the pressure controller is switched off. The actual pressure value is then only monitored. If the actual pressure value is higher than the pressure command value, an L level will be output at pin 11 and the valve takes the fail-safe position.

Command/Control word

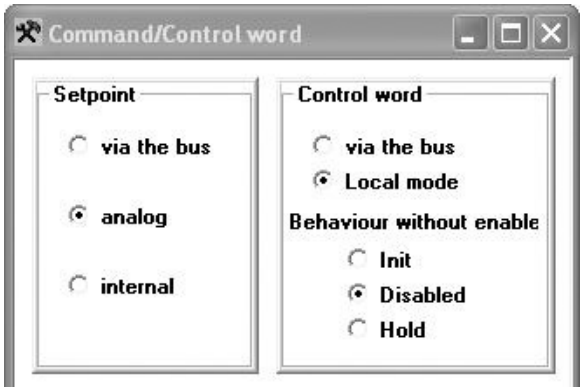

Fig. 79: Settings regarding command value and control word

Setpoint:

For the command value specification, there are the following options (M429):

- Command value "via the bus"
- Command value "analog" via connector X1
  The interface version (voltage or current interface) can be seen from the device type key.
- Command value "internal"

Control word setting:

The control word can be specified as follows (M431):

- Control word "via the bus"
- Control word via “Local mode”. Release via PIN 3 of the X1 connector.

Setting "Behavior without enable":

Using the "Behavior without enable" parameter, the analog release function can be set (M460):

- The "Init" and "Disabled" states behave identically in the pQ mode and as an effect, the valve will, without release, take the fail-safe position.

- As an effect of the “Hold” state, the valve will, without release, remain active and use the set Hold command values. If the release input has been changed to "Pressure controller enable", the Hold mode is inactive.

Calibration Not used.

Basic configuration Not used.

4.2.12.4.3 Command value preparation

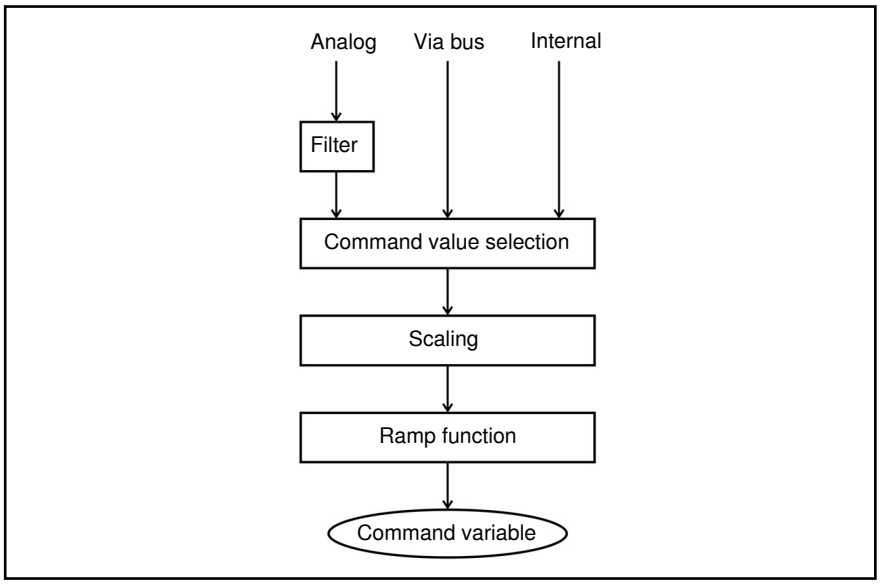

Fig. 80: Flow chart for the command value preparation

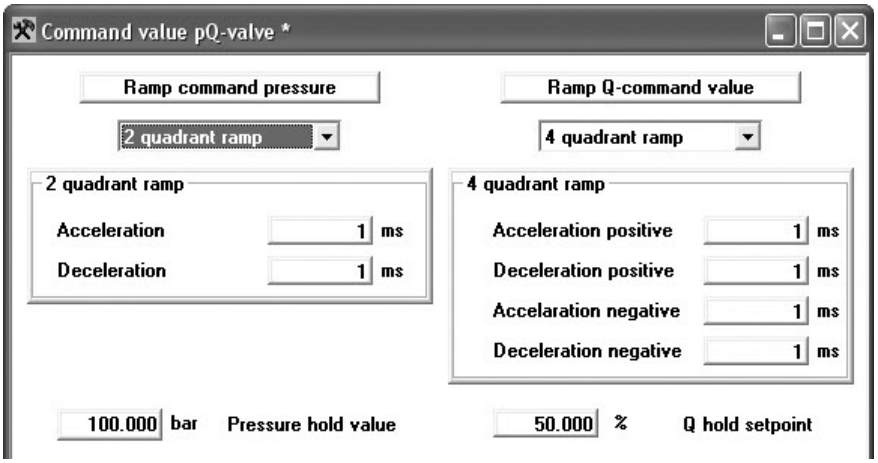

Fig. 81: Settings for the command value preparation

Ramp command pressure

For the setting of the ramp function type (M451), there are three options:

- Ramp switched off
- One-quadrant ramp = identical ramp time for increasing (acceleration) and decreasing command value (delay)
- Two-quadrant ramp = different ramp times for increasing (acceleration) and decreasing command value (delay)

Ramp times (pressure command value) [ms]

Depending on the ramp function set, the ramp times can be set:

- Time for the one-quadrant ramp or for the acceleration of the two-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M452)
- Time for the delay of the two-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M455)

Pressure hold value [bar]

Specification of the Pressure hold value (M450). It is used if the Hold mode has been activated with digital control word specification or if with analog control word specification, the preferred position without release is “Hold”.

Ramp Q command value

For the setting of the ramp function type (M400), there are four options:

- Ramp switched off
- One-quadrant ramp = identical ramp time for increasing (acceleration) and decreasing command value (delay)
- Two-quadrant ramp = different ramp times for increasing (acceleration) and decreasing command value (delay)
- Four-quadrant ramp = different ramp times for increasing (acceleration) and decreasing command value (delay), separated for positive and negative direction.

Ramp times (Q command value) [ms]

Depending on the ramp function set, the ramp times can be set:

- Time for one-quadrant ramp or for the acceleration of the two-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M401)
- Time for the delay of the two-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M404)
- Time for the acceleration in positive direction of the four-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M402)
- Time for the acceleration in negative direction of the four-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M403)
- Time for the delay in positive direction of the four-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M405)
- Time for the delay in negative direction of the four-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M406)

Q hold setpoint [% or l/min]

Specification of the Q hold setpoint (M446). The value is either set in [%] (Q-controlled) or in [l/min] (Q-regulated). It is used if the Hold mode has been activated with digital control word specification or if with analog control word specification, the preferred position without release is “Hold”.

4.2.12.4.4 Pressure controller

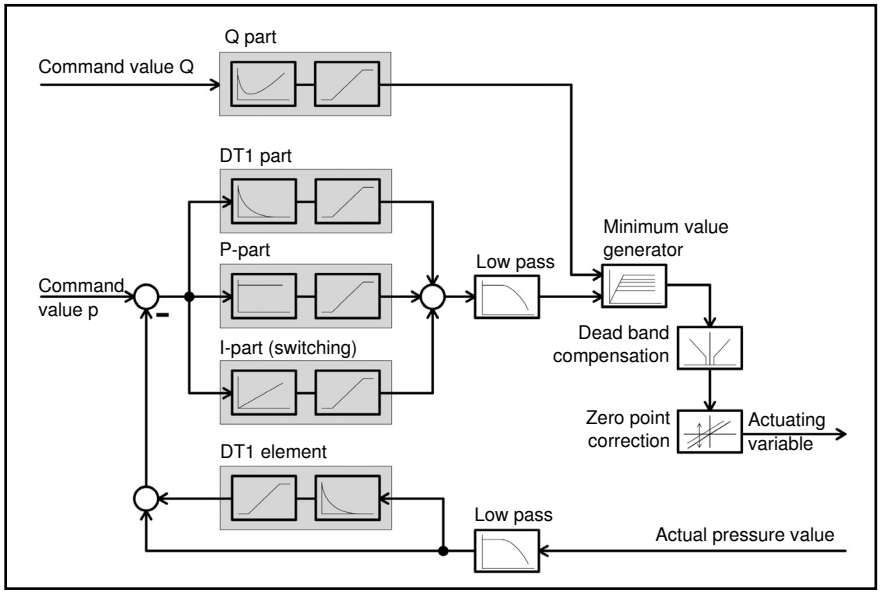

Fig. 82: Block diagram of the pressure controller with minimum value generator and actuating variable preparation

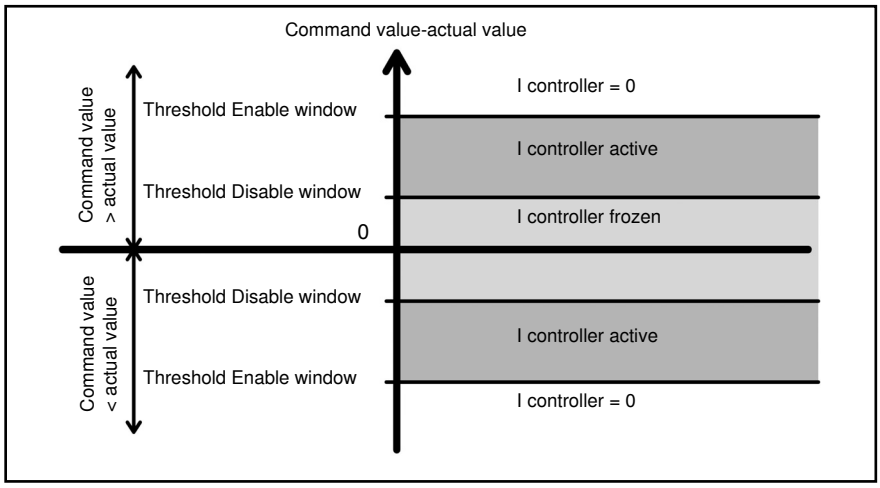

Fig. 83: Scheme of the switching integrator

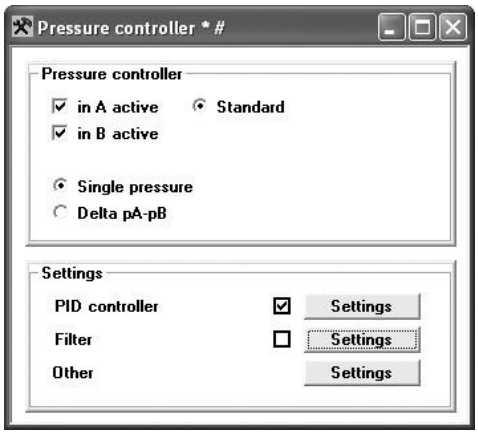

Fig. 84: Settings for the pressure controller

Pressure control

Depending on the valve type, there are the following basic pressure control settings:

- In A active: Activation of the pressure control in valve port A.
  This option is available if the valve has an integrated pressure sensor in A or if an external pressure sensor can be connected to the valve. For the pressure control in A, you can choose between three configuration options:
  - Standard: With a positive Q command value, the pressure is controlled on the A side of the valve.
  - Single pressure (backpressure control):
    The pressure in A is also controlled if the Q command value is negative. Nevertheless, the alternating control remains active. In this connection, the Q command value still limits the actuating variable in positive direction. This function is not possible if the pressure controller on the B side is simultaneously activated.
  - Delta pA-pB (special Q function):
    With positive Q command values, the actuating variable of the pressure controller is limited in positive direction (P-A), with negative Q command values in negative direction (P-B). A Q command value of 0 % is not admissible. This function is not possible if the pressure controller on the B side is simultaneously activated.

- In B active: Activation of the pressure control in valve port A.
  This option is available if the valve has an integrated pressure sensor in B. For the pressure control in B, one configuration option is available:
  - With a negative Q command value, the pressure is controlled on the B side of the valve.
  - Single pressure: In the pressure measurement, no difference between the pressure in A and B is calculated.
  - Delta pA-pB (pressure differential): The difference of the pressure in A and B is calculated in an area ratio-evaluated form. The area ratio can be set in the range from 0...15.99 (fig. 85 "Setting the area ratio" on page 86; M481).
    If the valve with the A side controls the bottom side of the single-rod cylinder, an area ratio "> 1" is to be set.
    If the rod side is controlled with P-A, an area ratio "< 1" is to be set. With a double-acting cylinder, a value of "1" is to be set.
    The calculation of the pressure command value and the output actual pressure value will then result with a positive Q command value:
    $p = pA - pB/F$.

    With negative Q command value, the following applies:
    $p = pB/F - pA$.

with:
p = Pressure command value or actual pressure value
pA = Pressure in valve port A
pB = Pressure in valve port B
F = Area ratio

The area ratio is set in the "Pressure differential calculation" window. The Delta pA-pB option is selected under "Settings".

Fig. 85: Setting of the area ratio

Settings More settings include "PID controller", "Filters" and "Others".

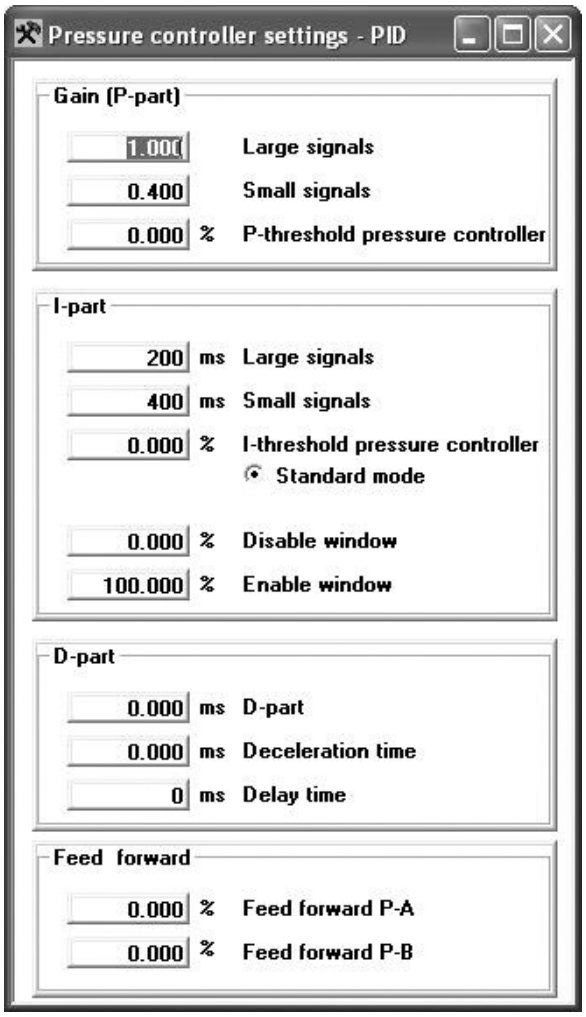

Fig. 86: PID controller for the pressure control

- PID controller:
  If the pressure controller in A and/or B is activated, the pressure controller can be set (fig. 84 "Settings for the pressure controller" on page 85). The pressure controller has a PID structure with switching I-part.
  The following controller parameters can be set:
  - Gain (P-part)
    The gain can be set separately for control errors that are greater or smaller than the changeover threshold.

    The “large signal” range (M412) applies to control errors that are greater than the value of the P-threshold (M414). The setting range is 0...16.

    The “small signal” range (M413) applies to control errors that are smaller than the value of the P-threshold (M414). The setting range is 0... 6.

    The "P-threshold" of the P controller (M414) is 0...100 % = absolute value of the control error.

  - Integrator (I-part):
    The integration time (reset time) can be set separately for control errors that are greater or smaller than the changeover threshold. A short reset time corresponds to a fast integrator.

    The “large signal” range (M415) applies to control errors that are greater than the value of the I-threshold (M417). The maximum setting is 30,000 ms. With a value of "0", the I-part is switched off.

    The “small signal” range (M415) applies to control errors that are smaller than the value of the I-threshold (M417). The maximum setting is 30,000 ms. With a value of "0", the I-part is switched off.

    The setting range of the "I-threshold" of the I controller (M417) is 0..100 % = absolute value of the control error in the standard mode. In the position-dependent mode, the switching between large and small signal range does not depend on the control error but on the spool position. In this connection,
    0 % I-threshold correspond to the complete opening A-T
    50 % I-threshold to the approximate control edge P-A/A-T and
    100 % I-threshold the complete opening P-A.
    This mode is limited to the STW195/196 valves due to their one-arm design.

    "Disable window" pressure controller (M418): If the absolute control error value is smaller than the value of the Disable window, the integrator is "frozen". The setting range is 0..100 %.

    "Enable window" pressure controller (M419): If the absolute control error value is greater than the value of the Enable window, the I-part is reset and the I controller is deactivated. The setting range is 0...100 %.

  - Derivative action (D-part). Here, there are the following settings:
    The "D-part" (M420) takes effect on the control error of the pressure controller. The value range is 0...16 ms. With 0 ms, the D-part is switched off, with 16 ms, the D-part has a very strong effect.

    The "Deceleration time" (M421) has the same effect as the D-part, however only on the actual pressure value of the pressure controller. The value range is also 0...16 ms. Here, the function is also switched off in case of 0 ms and with 16 ms, the effect is very strong.

    The value of the "Delay time" (M422) applies to the D-part and the Decelera-

tion time and has the same effect as a first order delay. The setting range is 0...60000 ms. With 0 ms, the delay is switched off. Values greater than ca. 50 ms are usually not necessary for a pressure controller.

– Command value “feed forward”:
The Command value “feed forward” can be set separately for the P-A (M479) and P-B (M480) direction. In the Command value “feed forward”, the attenuated command value is directly added to the actuating variable. The setting range is 0...100 %

- Filter:
For the pressure controller, you can choose between two filters of first order.

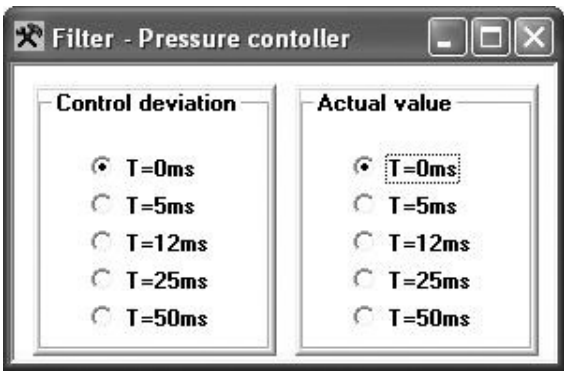

Fig. 87: Filter

– The "control deviation" filter influences the control error, i.e. the difference between pressure command value and actual pressure value. The filter serves the filtration of noisy pressure command and actual pressure values.
– The “Actual value” filter only influences the actual pressure value and only as long as the valve is not in pressure control. In the pressure control, the filter is switched off. The filter is e.g. used for suppressing pressure peaks during the cylinder travel movement; during that time, activation of the pressure controller is still not desired.

- Others:
For the pressure controller, the following other settings can be made.

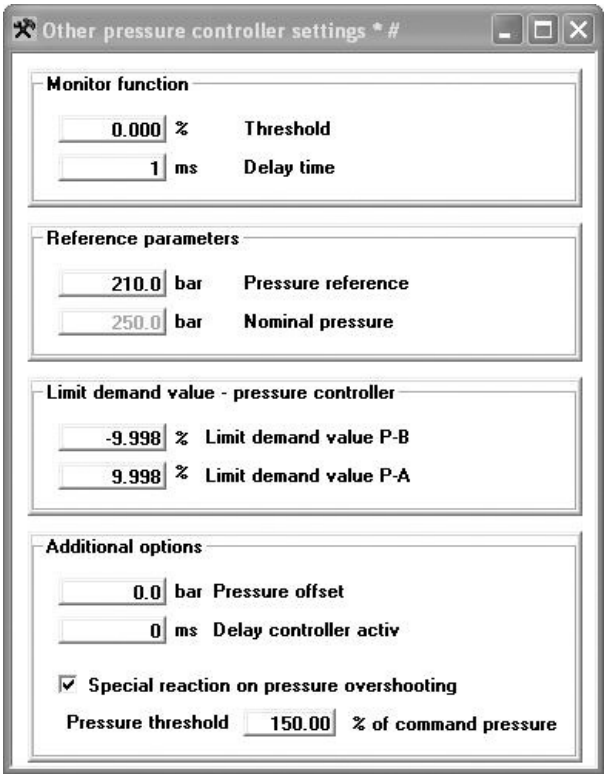

Fig. 88: Other pressure controller settings

- Monitor function:
  The monitor function allows for the pressure control monitoring:
  The "Threshold" parameter (M459) specifies the window width in [%] of the pressure reference. Settings are 0...100 %. If within this window, the actual pressure value lies around the pressure command value, the corresponding bit in the status word is set and also the digital output is set (depending on the configuration of X1/pin 11).

  If the pressure leaves the window, the bit and the digital output are reset after the adjustable “Delay time” (M458). The Delay time is not effective if the window is reached.

- Reference parameters:
  "Pressure reference" (M425) specifies the maximum pressure that is to be set. The analog inputs and outputs are also normalized by means of the pressure reference. 100 % of the analog input and output value correspond to the pressure reference.

  Using the “Nominal pressure” parameter, the setting for the pressure reference is limited upwards.
  The lower limit is approx. 14 % of the nominal pressure sensor pressure.
  Recommended values for the pressure reference are ca. 50..5 % of the nominal pressure sensor pressure.

- Limit demand value - pressure controllerl:
  Depending on the spool used, the actuating variable should be limited during the pressure control. This can be set depending on the direction.

"Limit demand value P-B" (M482):
While the valve is in the pressure control in port A, the stroke in P-B direction can be limited by using this parameter. With spool Q5, a limitation value of 10 % prevents e.g. the valve from connecting port P and B during the pressure control in A. With 100 %, there is no P-B limitation.

"Limit demand value P-A" (M483):
This parameter limits the stroke in P-A direction when the valve is in pressure control in port B. With spool Q5, the pre-set limitation value would be +10 %. With +100 %, there is no P-A limitation.

– Additional options:
Using "Pressure offset" (M424), a zero point correction of the pressure control is directly possible in bar. The value range depends on the valve pressure rating.

With "Delay controller active" (M484), the activation of the pressure controller after a sign change of the Q command value can be delayed. In this way you can, for example, suppress start-up pressure peaks. During the delay, the pressure cannot be limited/controlled! Use of this parameter is therefore only possible with periodic and known cycles.

"Special reaction on pressure overshooting":
The integration time set may be too long for fast pressure reduction in case of pressure peaks. If this function is used and the set value of the actual pressure value (M492) is reached, the I total of the integrator of the pressure controller is reset to "0". The pressure build-up is accelerated.
The maximum value of the "Pressure threshold" setting is 400 % of the pressure command value and should always be greater than 100 %.

4.2.12.4.5 Q function

Depending on the valve type, the following settings for the Q function are possible. In this connection see also fig. 52 "Block diagram of the pressure controller" on page 62.

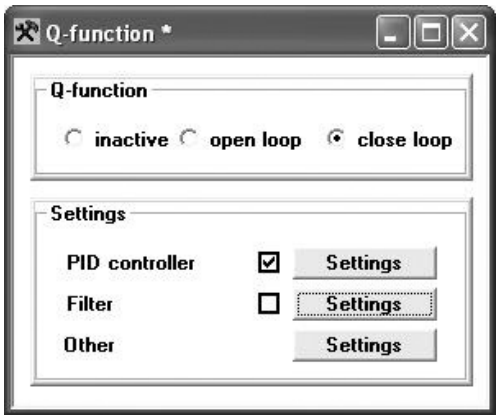

Fig. 89: Q function

Q function

- Inactive:
  Deactivation is only admissible if only the pressure controller in A has been activated. Pressure control on the B side is no longer possible in this mode. The Q command value is then internally specified with 100 % and doesn't have to be externally wired any more.
- Open loop:
  In this mode, the Q command value serves as command value for the valve position and for the selection of the pressure control side. The Q command value is used directly in the minimum value generator. A positive value is assigned to the direction P-A, a negative one to the direction P-B.
- Close loop:
  In this mode, the Q command value serves as command value for the flow controller (load compensation) and it is used for selecting the pressure control side. The flow controller output now serves as command value for the valve position and is fed into the minimum value generator. Here, as well, a positive value is assigned to P-A and a negative value to P-B.

Settings

- PID controller (only if "Q function Close loop" is selected):
  The PID controller for the Q control is shown in the following block diagram. This controller can also be used for the flow control or for the load compensation. Settings are to be made according to fig. 91 "PID controller for the Q control" on page 92.

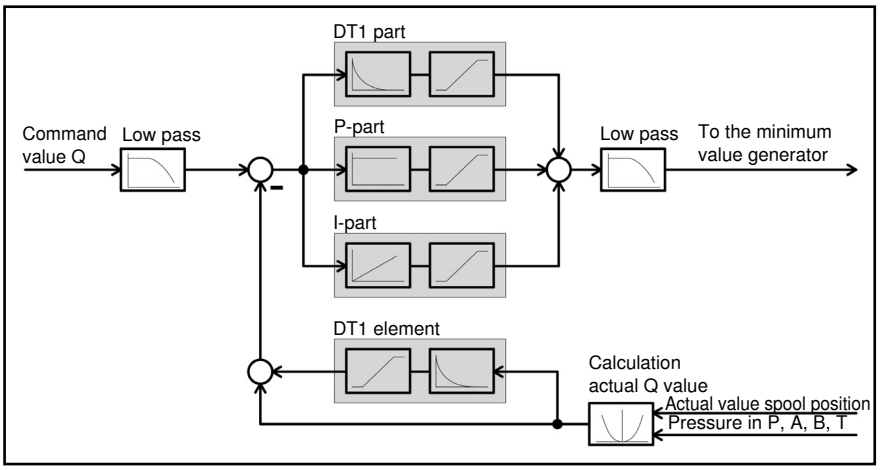

Fig. 90: Simplified block diagram of the Q controller

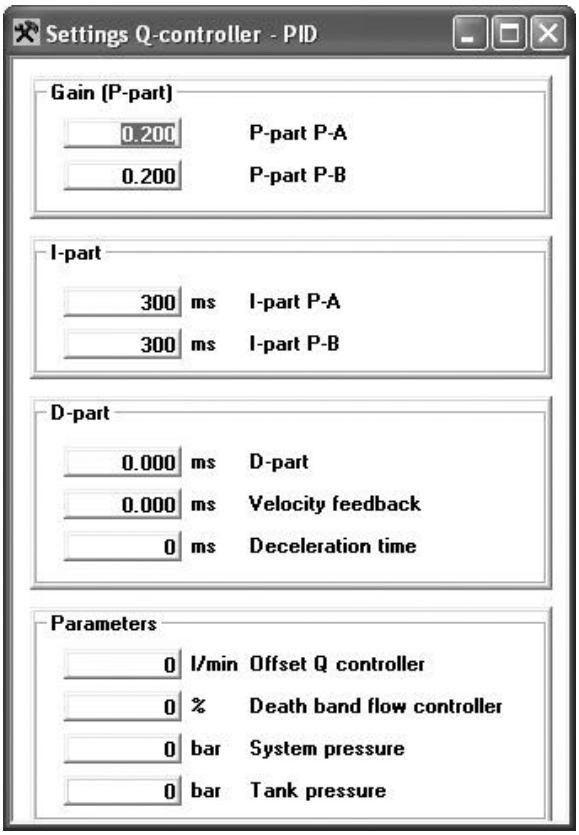

Fig. 91: PID controller for Q control

– Gain (P-part):
The gain can be set separately, depending on the direction:
The "P-part P-A" (M512) takes effect if the Q command values are positive. The setting range is 0...16.

The "P-part P-B" (M521) takes effect if the Q command values are negative. The setting range is 0...16.

– Integrator (I-part):
The integration time (reset time) can be set separately, depending on the direction. Short rest times correspond to a fast integrator. The "I-part P-A" (M513) takes effect if the Q command values are positive. The maximum setting range is 30000 ms. With a value of "0", the I-part P-A is switched off.

The "I-part P-B" (M522) takes effect if the Q command values are negative. The maximum setting range is 30000 ms. With a value of "0", the I-part P-B is switched off.

The I-part may only be shut off or activated on both sides.
Shut-off on one side is not useful and may lead to unexpected control errors!

– Derivative action (D-part):
The derivative action is set jointly for both directions P-A and P-B.

The "D-part" (M517) takes effect on the control error of the Q controller. The value range is 0...16 ms. With 0 ms, the D-part is switched off, with 16 ms, the D-part has a very strong effect.

The "Velocity feedback" (M518) has the same effect as the D-part, however only on the actual Q value of the Q controller. The value range is also 0...16 ms. Here, the function is also switched off in case of 0 ms and with 16 ms, the effect is very strong.

The "Deceleration time" (M519) time constant applies to the D-part and the velocity feedback and has the same effect as a 1st order delay. The setting range is 0...60000 ms. Values of more than ca. 50 ms are usually not reasonable for a Q controller. With 0 ms, the delay is switched off.

– Parameters:
Using the offset and the dead band setting of the Q command value, the control behavior can be optimized. In addition, these system variables have to be directly set for the valve versions without installed pressure sensors in pump channel P and/or tank channel T.

With the "Offset Q controller" correction value, the drive velocity can be minimized with a Q command value of "0". The offset is specified in [l/min].

With "Dead band flow controller", interferences with command value "0" can be suppressed. If the specified Q command value lies within this window, the system is controlled to command value "0". The setting range is 0...5 %.

"System pressure" can be set if the Q control for a valve without pressure sensor in the P line is selected although the selected spool would normally require it. In this case, one prerequisite is that pressure sensors are available in A and B and that the system pressure at the valve is known and constant.

"Tank pressure" can be set if the Q control for a valve without pressure sensor in the T line has been selected although the selected spool would normally require it. In this case, one prerequisite is that pressure sensors are available in P and A and that the tank pressure at the valve is known and constant

• Filter:
For the Q controller, two filters can be selected.

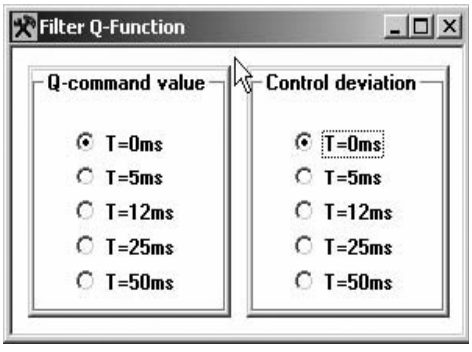

Fig. 92: Filter settings Q controller

– Q command value:
Five time constants between 0 (Filter off) and 50 ms (maximum filter effect) can be selected. The filter is necessary when the analog Q command value is noisy.

– Control deviation:
for the filter of the control deviation of the Q controller (Q command value – actual Q value), you can also select five time constants between 0 (Filter off) and 50 ms (maximum filter effect). The filter serves the noise suppression or also the suppression of interference caused by pressure pulses.

• Others:
For the Q function, the following other settings can be made.

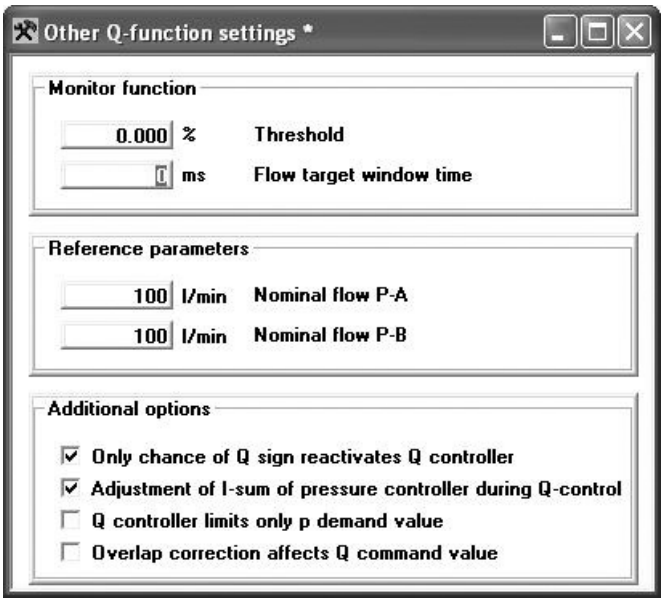

Fig. 93: Other settings Q controller

– Monitor function:
The monitor function allows for the flow control monitoring:
The "Threshold" parameter (M532) specifies the window width in [%] of the flow reference. Settings are 0...100 %. If the actual flow value in this window is around the flow command value, the corresponding bit is set in the status word and (depending on the configuration of X1/pin 11), the digital output is set, as well. If the flow leaves the window, the bit and the digital output will be reset after the adjustable Flow target window time (M531). The Flow target window time is not effective if the window is reached.

– Reference parameters:
The reference flow can be set separately for P-A (M509) and P-B (M510). The reference flow corresponds to the maximum flow that can be controlled for the direction concerned. The analog inputs and outputs are also normalized by means of the reference flow. 100 % of the analog input and output value correspond to the reference flow.

When setting the reference flow, the spool-specific features like nominal flow and performance limit have to be taken into account, as has the pressure rating of the pressure sensors used!

– Additional options:
If "Only change of Q sign reactivates Q controller" (default setting = on) is deactivated, the minimum value generator will, in case of a pressure drop, switch back from the pressure control to the Q function at an early time. This may accelerate a cylinder movement but also lead to a unstable system. Activation of this option will only activate the Q function after a sign change of

the Q command value; otherwise, the pressure controller will remain effective. The Q function will in any case limit the pressure controller output.

The "Adjustment of I-sum of pressure controller during Q control" option (default setting = on) will result in a smooth transition between pressure control and Q function. Deactivation of the option may sometimes lead to dynamic advantages or to sudden transitions between the pressure control and the Q function

"Q controller limits only p demand value" (default setting = off) prevents the minimum value generator from switching back to the pure Q function. The Q function only serves the limitation of the pressure controller output. The dynamics of the cylinder travel movement only depend on the pressure controller setting.

The "Overlap correction affects on Q command value" option (default setting = off) must not be used when the Q controller is used.

4.2.12.4.6 Actuating variable adaptation

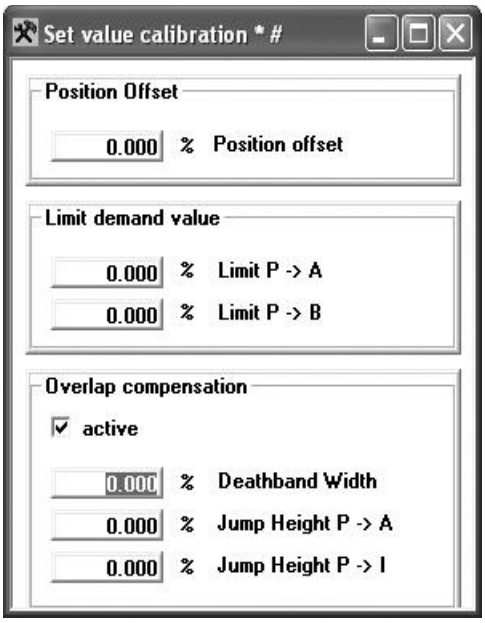

Fig. 94: Actuating variable adaptation with active overlap compensation

Position offset

The Position offset (M411) has been adjusted ex works and doesn't have to be readjusted.

Adjustment of this parameter changes the adjustment of the flow control (Q function Close loop)!

Limit demand value

The actuating variable of the valve controller can be limited depending on the direction by the parameters limitation P -> A (M550) or limitation P -> B (M551).

The value range for the limitation P -> A is 0% (maximum limitation) to +100% (no limitation).

The value range for the limitation P -> B is 0% (maximum limitation) to -100% (no limitation).

By the limitation, the actuating variable is limited “hard”. That also means

that actuating variables between 0% and the limitation value are output without changes.

Overlap compensation

The overlap compensation serves the compensation of the spool overlap, especially with E and W spools. Default setting = not activated.
V spools must not be compensated. The overlap compensation (activation via M407) has 3 parameters:

- Dead band width (M410)
  This value specifies the entire width of the dead band for P-A and P-B.
- Jump height P-A (M408)
  Value of the overlap compensation in direction P-A
- Jump height P-B (M409)
  Value of the overlap compensation in direction P-B

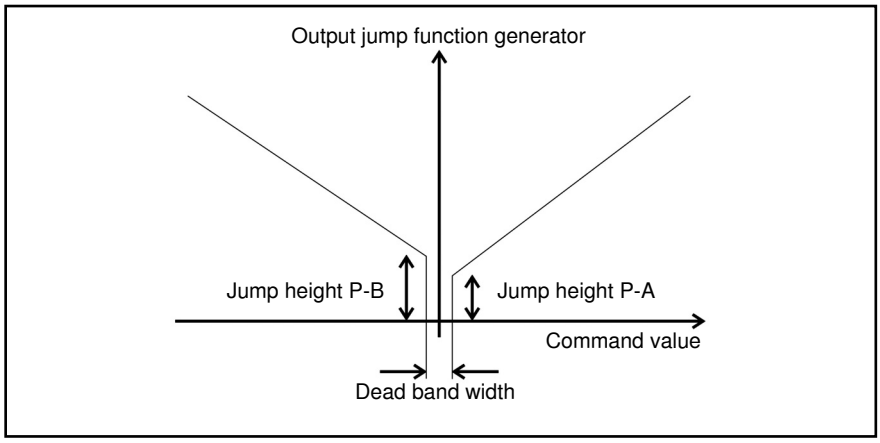

Fig. 95: Principle of the overlap compensation

4.2.12.5 Diagnosis

The diagnosis function offers the possibility to monitor process variables and query error states and/or status messages:

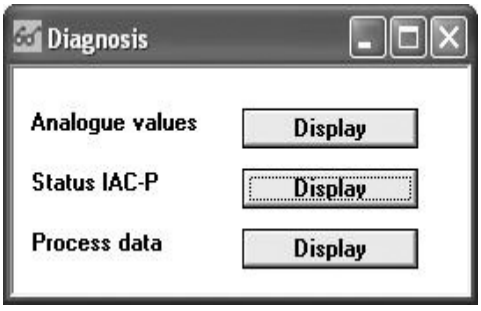

Fig. 96: Diagnosis selection window

4.2.12.5.1 Analog values

Not used.

4.2.12.5.2 IAC-P status

Here, all communication-independent device and error states are displayed. Bus-specific error states are not displayed.

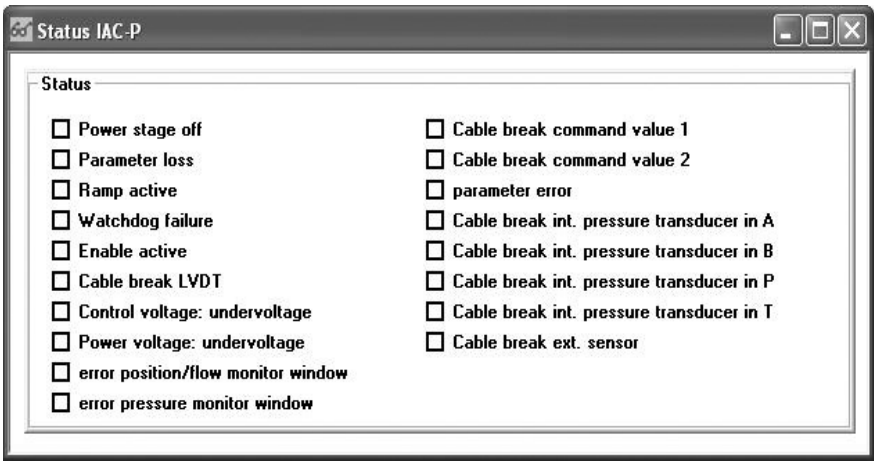

Fig. 97: IAC-P status

- Power stage off (M004/bit 0):
  The output stage is switched off. The reason for this may be a missing release or an error.
- Parameter loss (M004/bit 1):
  In the device parameterization, at least one parameter has not been recorded. This may have been caused by the too fast sending of the parameters from the master (CAN or PROFIBUS) or an excessive bus load (only with the CAN bus). As a consequence of this state, the device will not be switched off.
- Ramp active (M004/bit 2):
  The ramp is currently still being processed. When the ramp generator output has reached the command value, this state bit will be deleted again.
- Watchdog failure (M004/bit 3):
  Marks a program crash of the microcontroller, e.g. as a consequence of a hardware defect of a serious fault.
  As a consequence of this state, the device will be switched off and an error message will be output at PIN 11 of the 11+PE connector.
- Enable active (M004/bit 4):
  Analog release is available at PIN 3 of the 11+PE connector.
  In case of the bus valve with 6+PE connector, the release is internally fixedly wired with +24 V and is thus switched on permanently.
  Not relevant with digital control word specification.
- Cable break LVDT (M004/bit 5):
  At least one line to the position encoder of the valve is interrupted.
  As a consequence of this state, the device will be switched off and an error message will be output at PIN 11 of the 11+PE connector.
- Control voltage: Undervoltage (M004/bit 6):
  The voltage at pin 9 of the 11+PE connector is below 16 V (PIN A with 6+PE connector). As a consequence of this state, the device will be switched off and an error message will be output at PIN 11 of the 11+PE connector.
- Power voltage: Undervoltage (M004/bit 7):
  The voltage at pin 1 of the 11+PE connector is below 16 V (PIN A with 6+PE connector). As a consequence of this state, the device will be switched off; there will, however, not be an error message at PIN 11 of the 11+PE connector.
- Error position/flow monitor window (M004/bit 16)
  This function is only available with the devices for the cylinder position control, for example types STW0240 or WREA.
  The bit is set if the actual cylinder value is within the window limits of the position monitor window to be set.
  This display does not influence the device function.

- Error pressure monitor window (M004/bit 17)
  The bit is set if the actual pressure value is within the window limits of the pressure monitor window to be set.
  This display does not influence the device function.
- Cable break command value 1 (M004/bit 10):
  A cable break has been detected at pin 4 of the 11+PE connector (pin D with 6+PE connectors). This function is only available with the current interface 4…20 mA (device code F6 for the 1+PE connector and F1 for the 6+PE connector). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Cable break command value 2 (M004/bit 8):
  At pin 7 of the 11+PE connector, a cable break has been identified.
  This function is only available with the current interface 4 … 20 mA (device code F6 for the 11+PE connector). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Parameter error (M004/bit 11):
  An incorrect parameter value has been specified, for example a pressure reference value that is above the pressure sensor measurement range.
  As a consequence of this state, the device will not be switched off.
- Cable break int. pressure transducer in A (M004/bit 9):
  The supply line to the pressure sensor in A in the pressure measuring sandwich plate is interrupted (message only possible if a sensor is available). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Cable break int. pressure transducer in B (M004/bit 12):
  The supply line to the pressure sensor in B in the pressure measuring sandwich plate is interrupted (message only possible if a sensor is available). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Cable break int. pressure transducer in P (M004/bit 13):
  The supply line to the pressure sensor in P in the pressure measuring sandwich plate is interrupted (message only possible if a sensor is available). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Cable break int. pressure transducer in T (M004/bit 14):
  The supply line to the pressure sensor in T in the pressure measuring sandwich plate is interrupted (message only possible if a sensor is available). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Cable break ext. sensor (M004/bit 15):
  The supply line to the external pressure transducer is interrupted. The message is only possible if the sensor has a suitable interface (for example 4…20 mA or 0.5…5 V). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Overpressure warning (M004/bit 18):
  Indicates that the actual pressure value exceeds the pressure command value. The bit can only be set if the function has been activated in the "Digital I/O (X1 connector)" window. As a consequence of this state, the device will not be switched off.
- Overpressure shut-off (M004/bit 19):
  Indicates that the actual pressure value exceeds the pressure command value. The bit can only be set if the function has been activated in the "Digital I/O (X1 connector)" window. As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.

4.2.12.5.3 Process data

In the process data window, the states of control and status word and the command and actual values can be monitored.

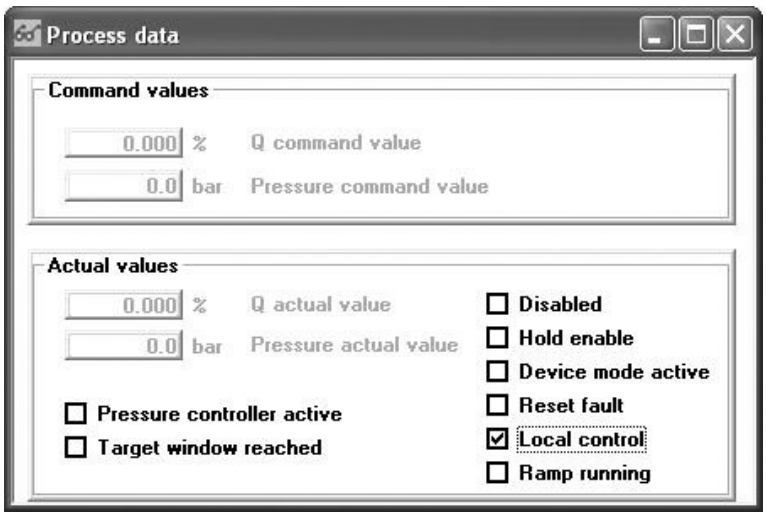

Fig. 98: Process data window

The content of the process data window corresponds to that of the cyclic data objects of the CAN (PDOs) and PROFIBUS bus systems (default telegrams 3 … 6, depending on the type).

Command value [%] Command value display.

Actual value Display of the actual value and the status word (see description of the state machine chapter 4.2.7.4 on page 31).

4.2.12.6 Measuring data

The measuring data window serves the control of the WinView® visualization program.

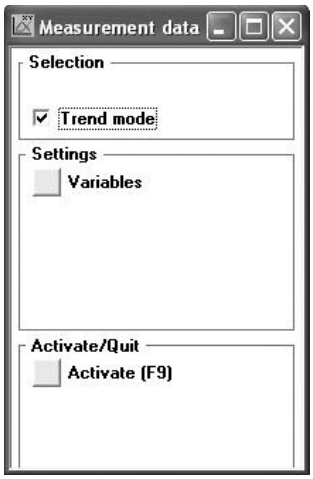

Fig. 99: Measuring data window

Selection If the trend mode is activated, long-time records of signals can be prepared.

Settings By clicking on the "Variables" button, the parameters to be recorded can be selected. The parameters to be recorded are selected in the following window:

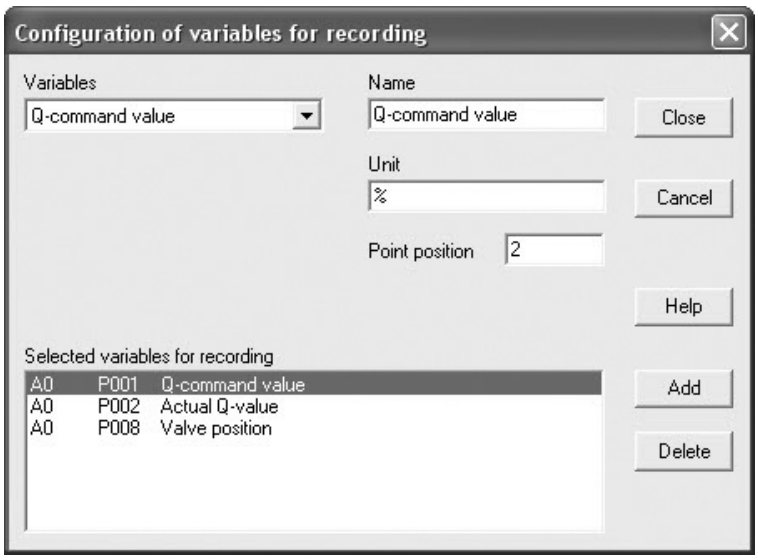

Fig. 100: Window for selecting the measuring data

- "Variables":
  List of the parameters that can be selected for recording.
- "Selected variables for recording":
  Clicking on "Add" accepts the selected parameter.
  A maximum of three parameters can be displayed simultaneously.
  Clicking on "Delete" removes the parameter from the definition window again.
- The parameter selection is exited by clicking on "Close" and the WinView® program starts automatically. The parameters selected in advance are recorded.

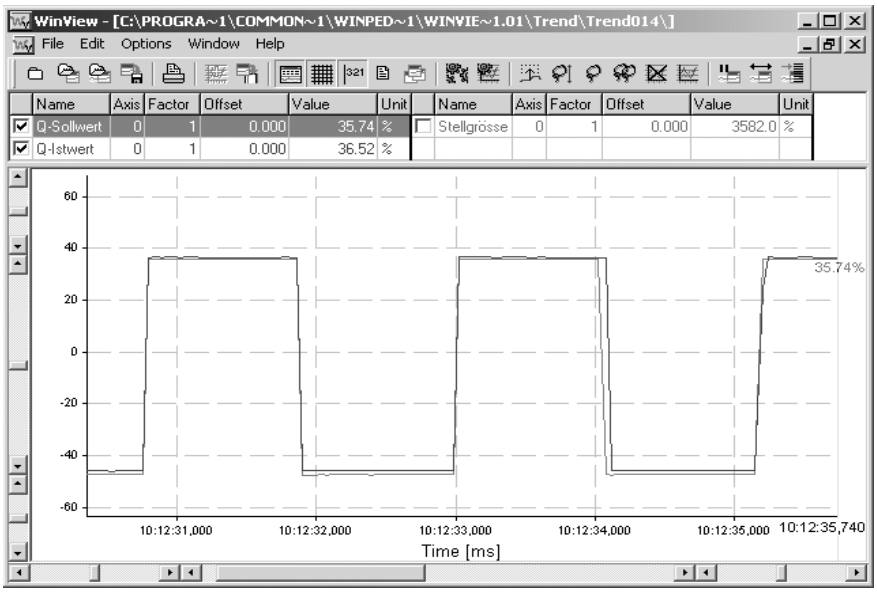

Fig. 101: Presentation of WinView®

Activate/Exit "Exit" stops the recording. The "Activate" button starts the recording.

4.2.13 Valve with axis controller function

4.2.13.1 Overview

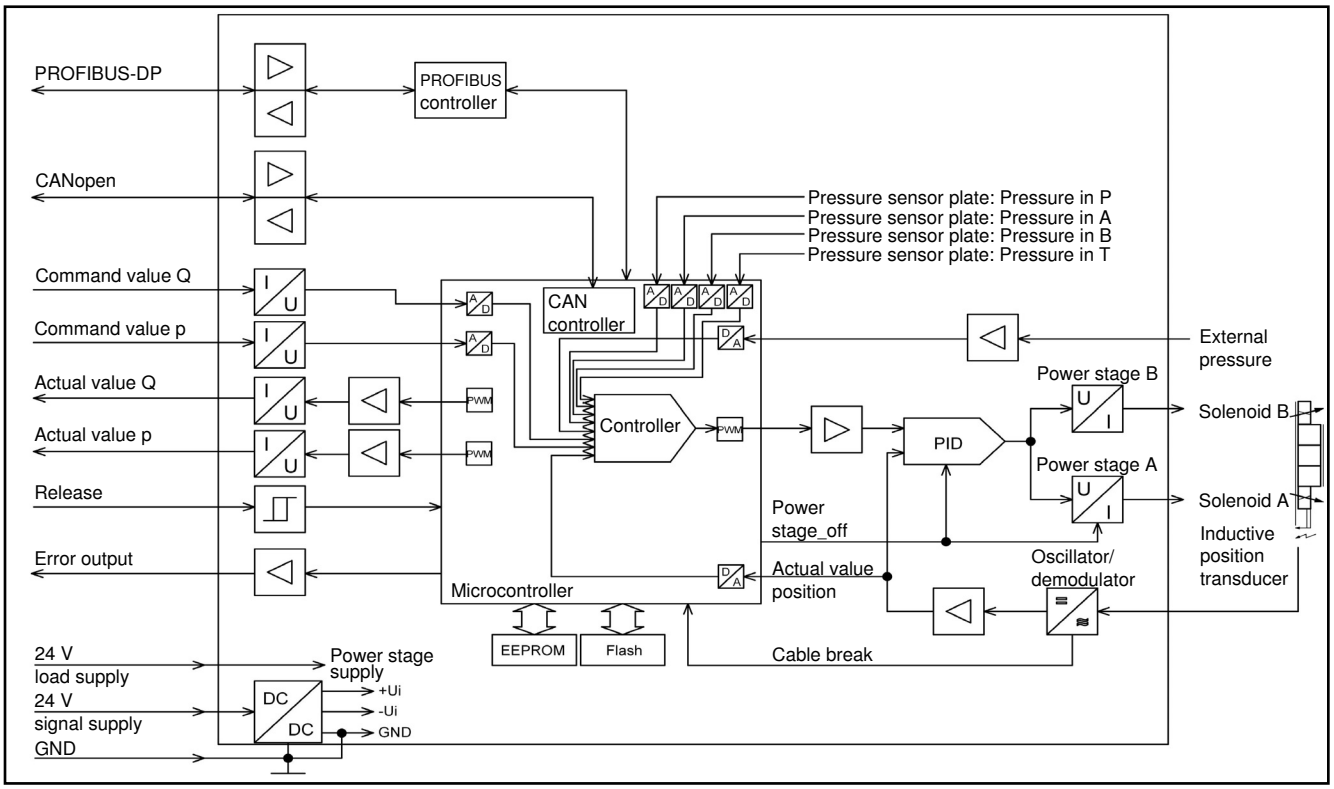

Fig. 102: IAC-P block diagram with axis controller function

The block diagram also shows the optional functions of the IAC-P valve with axis controller function. Not all functions can be combined. A device supports either CANopen or PROFIBUS-DP.

4.2.13.2 Project window

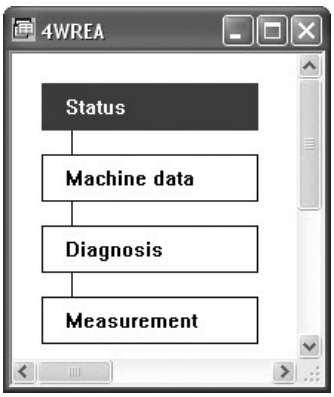

Fig. 103: Project window

The project window gives an overview of the possible functions for operating a device; in this case for a project with the exemplary name "4WREA".

4.2.13.3 Status

The status window gives an overview of basic valve settings. It is updated once after the connection to the valve has been established.

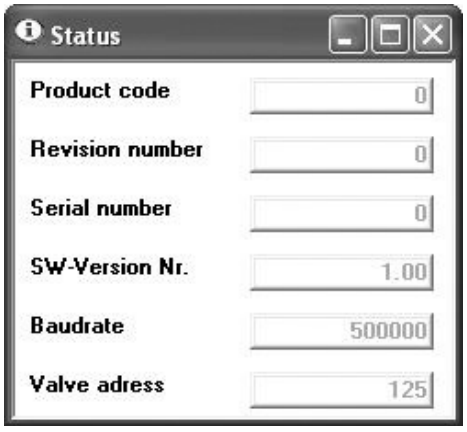

Fig. 104: Status window

Product code The product code corresponds to a "Basic valve type" as it is also differentiated when creating a new "WIN-PED 6" project, e.g. "bus valve" or "pQ with two sensors in ZP (A and B)".

Revision number Not used.

Serial number Not used.

SW version no. Valve software version.

Baud rate Display in baud, in the example 500000 for 500 kBaud.

Valve address Active valve address.

4.2.13.4 Machine data

In the machine data window, the basic settings are made.
These are general settings as well as settings for the command value preparation, regarding the system controller and the actuating variable adaptation.

The system controller consists of the controller for the cylinder position control. The actual value preparation (sensor preparation) corresponds to the setting of the analog "Position" transducer.

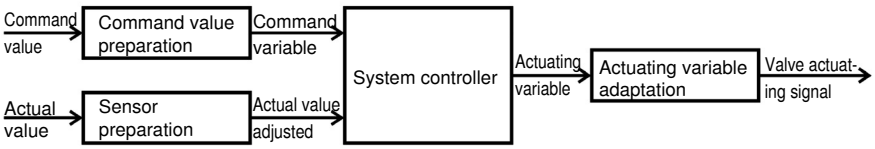

Fig. 105: Block diagram controller structure

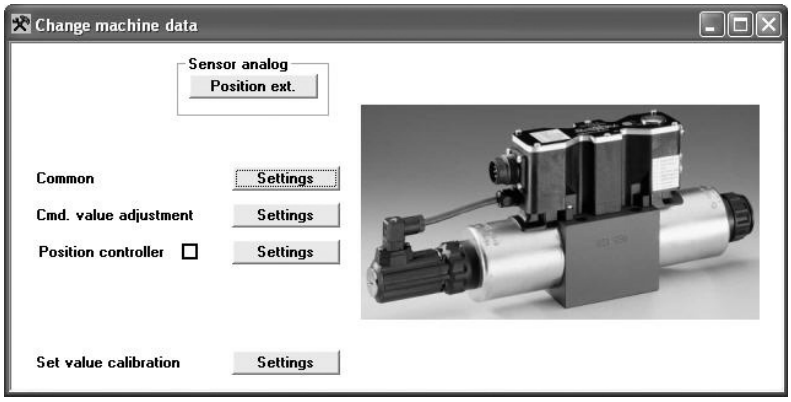

Fig. 106: Machine data window

4.2.13.4.1 Analog transducer

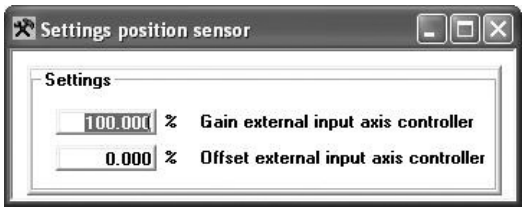

Fig. 107: Settings for the position sensor

Gain external input This parameter (M525) serves the calibration of the position sensor sensitivity. By increasing the gain, the stroke of the cylinder can be set.

Offset external input By means of the offset (M526), the cylinder stroke range can be offset.

The position measurement system must be designed so that the entire cylinder stroke range is recorded. Thus, only an increase in the gain is reasonable and no attenuation!

4.2.13.4.2 General

The general settings refer to the switching input and the switching output of the X1 connector and the type of command value and control word specification.

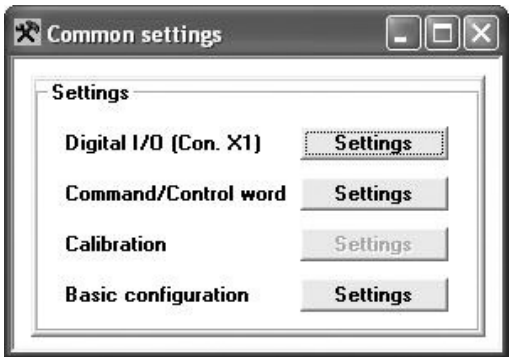

Fig. 108: General settings

Digital I/O (Con. X1) By means of these settings, the functions of pin 3 (analog release) and pin 11 (analog error output) can be re-programmed (M501).

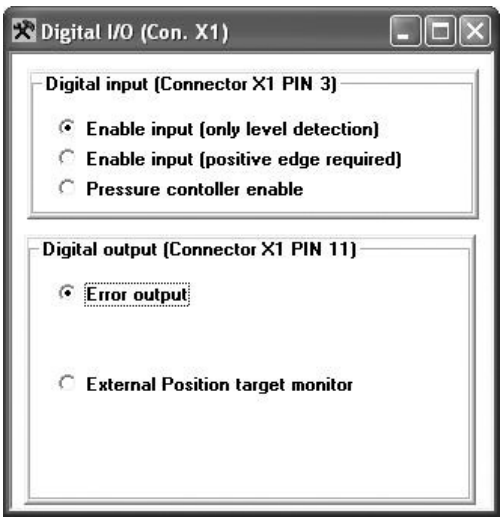

Fig. 109: Settings digital I/O (X1 connector)

For the digital input (X1 connector PIN 3), there are the following possibilities:

- Enable input (only level detection). Default setting = analog release. An H level at the input activates the pQ controller.
  With an L level, the valve remains in fail-safe position unless the “Hold” has been activated.
- Enable input (positive edge required). Analog release.
  An H level at the input activates the pQ controller. After application of the supply voltage or after restart in case of an error, the transition from L to H is expected (edge recognition).
- Pressure controller enable. Not used.

For the "Digital output (X1 connector PIN 11)", there are the following possibilities:

- Default setting = Error output. If no error is detected, the electronics output an H level at PIN 11, otherwise an L level.
- External Position target monitor (only with type 4WREA).
  If no error is detected and if the actual position value is within the target window, the electronics output an H level at PIN 11, otherwise an L level.

Command/Control word

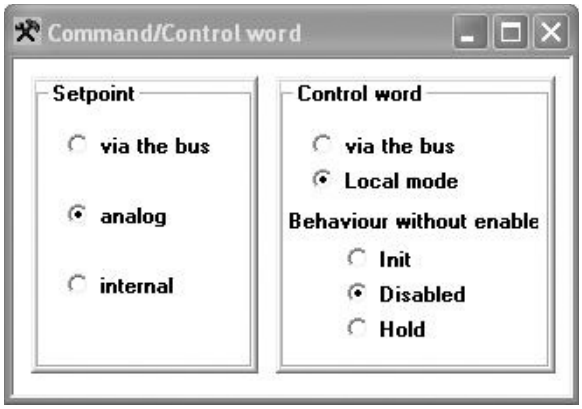

Fig. 110: Settings regarding command value and control word

Setpoint:

For the command value specification, there are the following options (M429):

- Command value "via the bus"
- Command value "analog" via connector X1
  The interface version (voltage or current interface) can be seen from the device type key
- Command value "internal"

Control word setting:

The control word can be specified as follows (M431):

- Control word "via the bus"
- Control word via “Local mode”. Release via PIN 3 of the X1 connector.

Setting "Behavior without enable":

Using the "Behavior without enable" parameter, the analog release function can be set (M460):

- The "Init" and "Disabled" states behave identically in the pQ mode and as an effect, the valve will, without release, take the fail-safe position.
- As an effect of the “Hold” state, the valve will, without release, remain active and use the set Hold command values.

Calibration Not used.

Basic configuration Not used.

4.2.13.4.3 Command value preparation

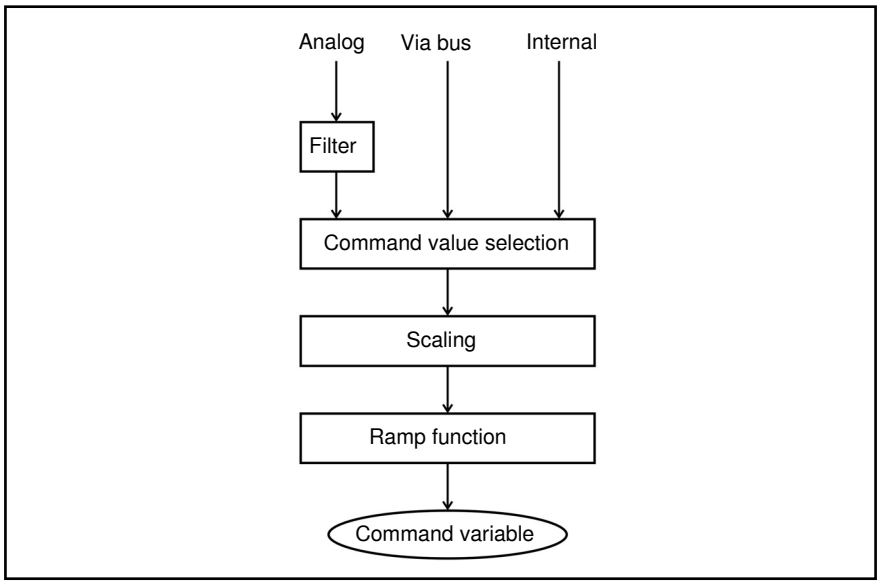

Fig. 111: Flow chart for the command value preparation

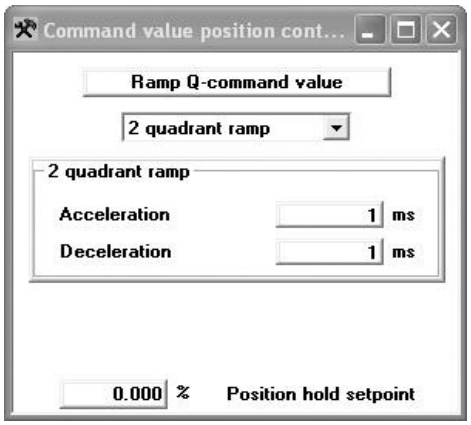

Fig. 112: Settings for the command value preparation

Ramp Q command value

The ramp serves the limitation of the cylinder travel velocity. For the setting of the ramp function type (M400), there are three options:

- Ramp switched off
- One-quadrant ramp = identical ramp time for increasing (acceleration) and decreasing command value (delay)
- Two-quadrant ramp = different ramp times for increasing (acceleration) and decreasing command value (delay)

Ramp times (Q command value) [ms]

Depending on the ramp function set, the ramp times can be set:

- Time for the one-quadrant ramp or for the acceleration of the two-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M401)
- Time for the delay of the two-quadrant ramp in the range from 1...65535 ms for 0...100 % command value change (M404)

Position hold command value [%] Specification of the position hold command value (M446). It is used if the Hold mode has been activated with digital control word specification or if with analog control word specification, the preferred position without release is “Hold”.

4.2.13.4.4 Position controller

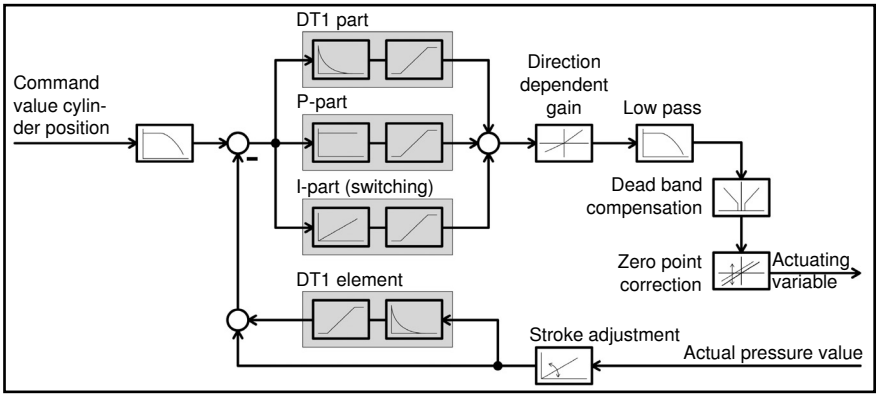

Fig. 113: Block diagram of the position controller with actuating variable preparation

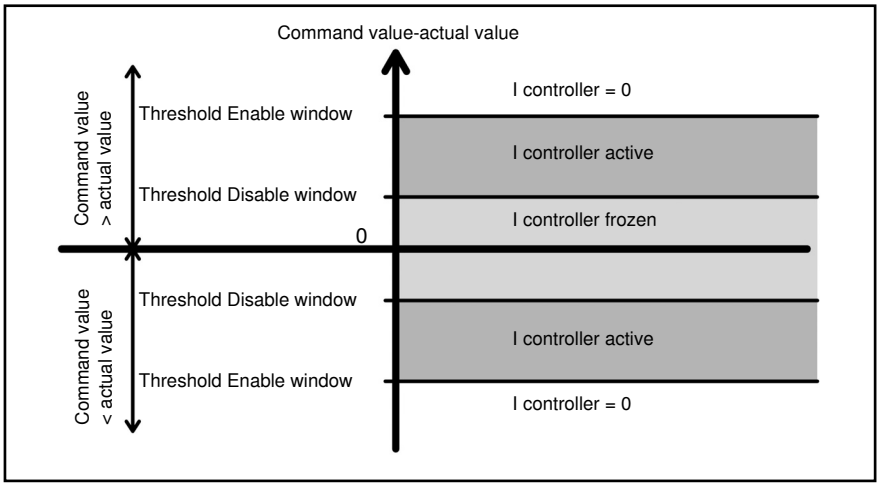

Fig. 114: Scheme of the switching integrator

Fig. 115: Settings for the position control

Settings The settings for the position controller are "PID controller", "Filters" and "Others". Activation of the PID controller and the filter are marked by a checkmark.

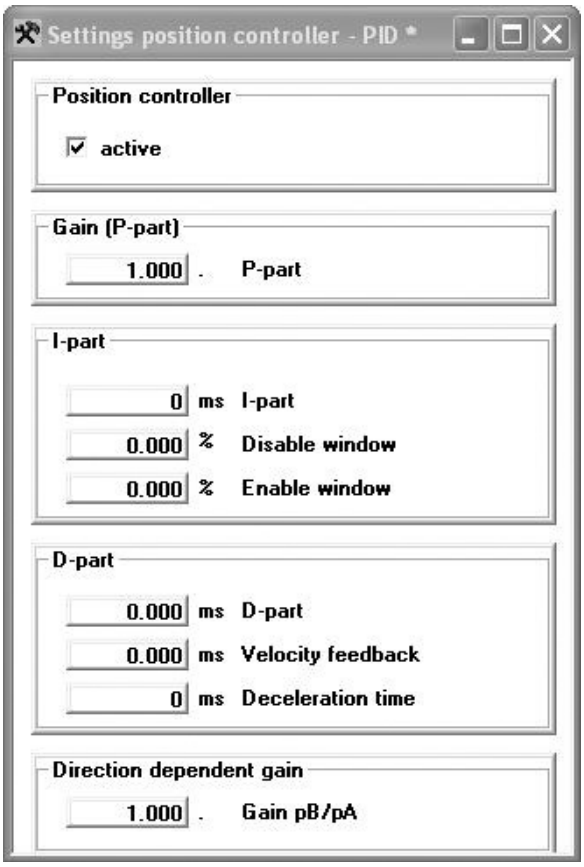

Fig. 116: PID controller for the position control

– Position control
  The position control can be switched off. In this case, the position command value is interpreted as command value for the valve position. In this way, the cylinder can be moved in a controlled form. In this case, the command value has to be specified including a sign:
  Command value for cylinder position = 0…+100 %
  Command value for valve position = –100…+100 %

– Gain (P-part)
  The gain can be set in the range from 0...6 (M600).

– Integrator (I-part)
  The maximum setting for the "I-part" (M601) is 30000 ms. With a value of "0", the I-part is switched off. Short reset times correspond to a fast integrator.

  "Shut-off threshold small signal" (M606)
  If the absolute value of the control error is smaller than the value of the Disable window, the integrator is "frozen".
  The setting range is 0...100 %.

  "Switch on threshold large signal" (M607)
  If the absolute control error value is greater than the value of the Enable window, the I-part is reset and the I controller is deactivated.
  The setting range is 0...100 %.

– Derivative action (D-part)
  The "D-part" (M603) takes effect on the position controller's control error. The value range is 0...16 ms. With 0 ms, the D-part is switched off, with 16 ms, the D-part has a very strong effect.

  The "Velocity feedback" (M604) has the same effect as the D-part, however only on the actual position value of the position controller. The value range is also 0...16 ms. Here, the function is also switched off in case of 0 ms and with 16 ms, the effect is very strong.

  The value of the "Deceleration time" (M605) applies to the D-part and the velocity feedback and has the same effect as a first order delay. The setting range is 0...60000 ms. With 0 ms, the delay is switched off. Values greater than ca. 100 ms are usually not necessary for a position controller.

– Direction-dependent gain (M602)
  For the direction P→B, gain of the actuating variable can be adjusted. The value range is 0…16. As start value of the optimization, the value of the cylinder area ratio can be used, whereas it is here assumed that the B port of the valve controls the cylinder rod side.

• Filter:
  For the position controller, you can choose between two filters of first order.

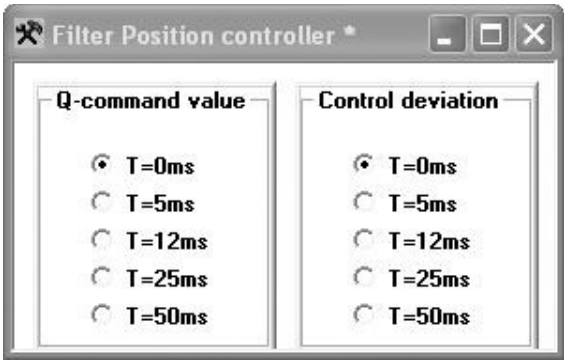

Fig. 117: Filter

– The "Q command value" filter serves the suppression of interference on the cylinder position command value.
– The "control deviation" filter influences the control error (difference between position command and actual position value). It serves the filtration of noisy position command and actual position values.

• Others:
For the position controller, the following other settings can be made.

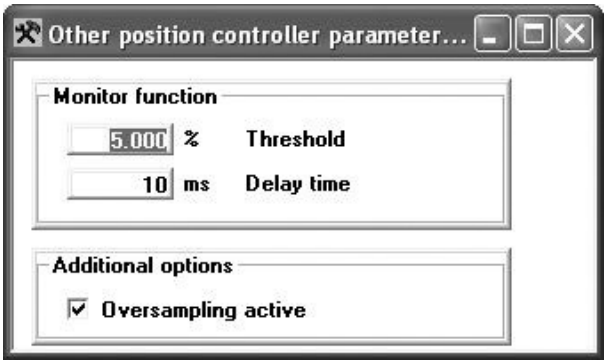

Fig. 118: Other position controller settings

– Monitor function:
The monitor function allows for the position control monitoring:
The "Threshold" parameter (M609) specifies the window width in [%]. Settings are 0...100 %. If within this window, the actual position value lies around the position command value, the corresponding bit in the status word is set and also the digital output is set (depending on the configuration of X1/pin 11).

If the position leaves the window, the bit and the digital output are reset after the adjustable “Delay time” (M608). The Delay time is not effective if the window is reached.

– Additional options:
With "Oversampling active", the calculative resolution of the position command value and the input for the analog cylinder position can be increased by calculation of the average value (4-times oversampling).

4.2.13.4.5 Actuating variable adaptation

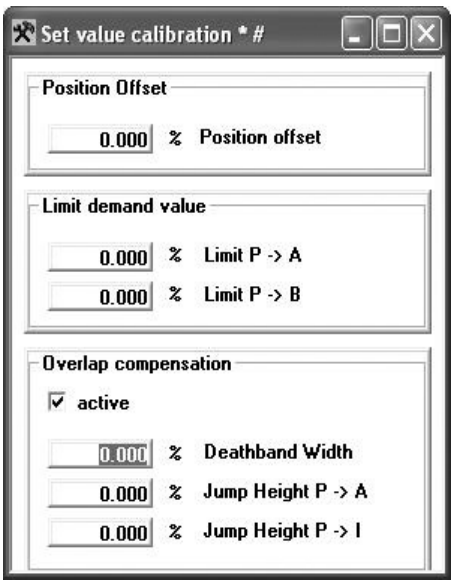

Fig. 119: Actuating variable adaptation with active overlap compensation

Position offset

The Position offset (M411) has been adjusted ex works and doesn't have to be readjusted.

Limit demand value

The actuating variable of the valve controller can be limited depending on the direction by the parameters limitation P -> A (M550) or limitation P -> B (M551).

The value range for the limitation P -> A is 0% (maximum limitation) to +100% (no limitation).

The value range for the limitation P -> B is 0% (maximum limitation) to -100% (no limitation).

By the limitation, the actuating variable is limited “hard”. That also means that actuating variables between 0% and the limitation value are output without changes.

Overlap compensation

The overlap compensation serves the compensation of the spool overlap, especially with E and W spools. Default setting = not activated.
V spools must not be compensated. The overlap compensation (activation via M407) has three parameters:

- Dead band width (M410)
  This value specifies the entire width of the dead band for P-A and P-B.
- Jump height P-A (M408)
  Value of the overlap compensation in direction P-A
- Jump height P-B (M409)
  Value of the overlap compensation in direction P-B

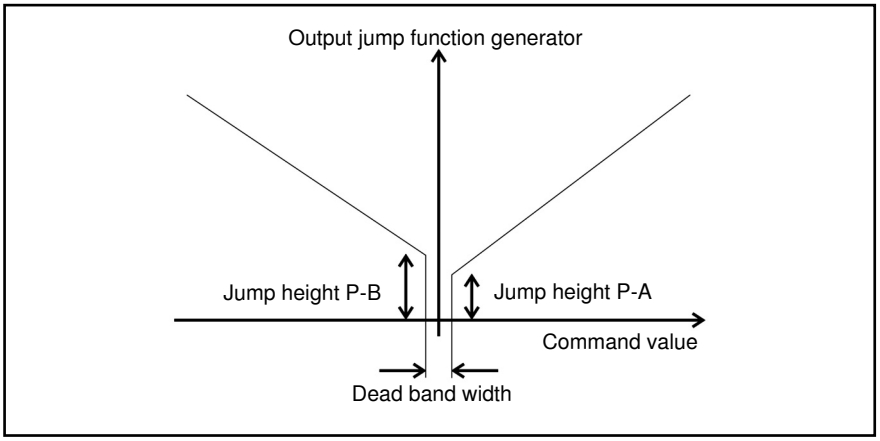

Fig. 120: Principle of the overlap compensation

4.2.13.5 Diagnosis

The diagnosis function offers the possibility to monitor process variables and query error states and/or status messages:

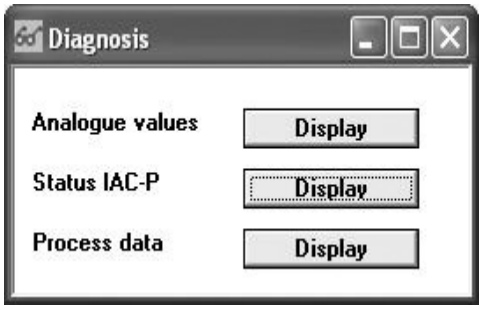

Fig. 121: Diagnosis selection window

4.2.13.5.1 Analog values

Not used.

4.2.13.5.2 IAC-P status

Here, all communication-independent device and error states are displayed. Bus-specific error states are not displayed.

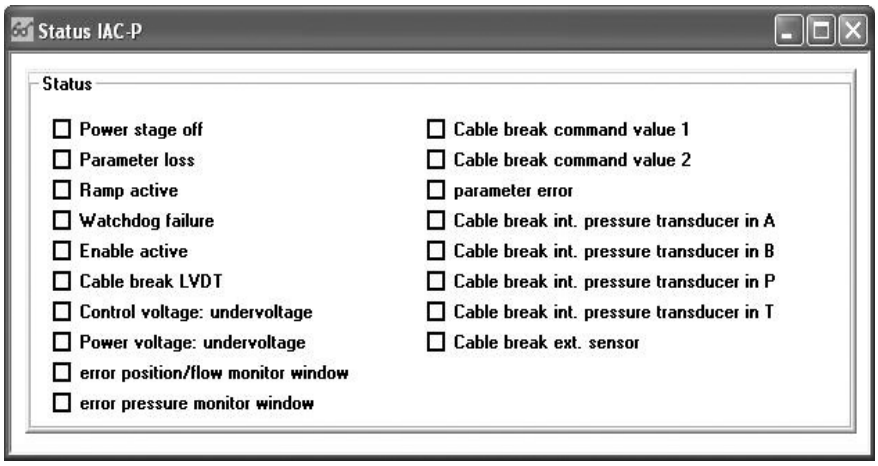

Fig. 122: IAC-P status

- Power stage off (M004/bit 0):
  The output stage is switched off. The reason for this may be a missing release or an error.
- Parameter loss (M004/bit 1):
  In the device parameterization, at least one parameter has not been recorded. This may have been caused by the too fast sending of the parameters from the master (CAN or PROFIBUS) or an excessive bus load (only with the CAN bus). As a consequence of this state, the device will not be switched off.
- Ramp active (M004/bit 2):
  The ramp is currently still being processed. When the ramp generator output has reached the command value, this state bit will be deleted again.
- Watchdog failure (M004/bit 3):
  Marks a program crash of the microcontroller, e.g. as a consequence of a hardware defect of a serious fault.
  As a consequence of this state, the device will be switched off and an error message will be output at PIN 11 of the 11+PE connector.
- Enable active (M004/bit 4):
  Analog release is available at PIN 3 of the 11+PE connector.
  In case of the bus valve with 6+PE connector, the release is internally fixedly wired with +24 V and is thus switched on permanently.
  Not relevant with digital control word specification.
- Cable break LVDT (M004/bit 5):
  At least one line to the position encoder of the valve is interrupted.
  As a consequence of this state, the device will be switched off and an error message will be output at PIN 11 of the 11+PE connector.
- Control voltage: Undervoltage (M004/bit 6):
  The voltage at pin 9 of the 11+PE connector is below 16 V (PIN A with 6+PE connector). As a consequence of this state, the device will be switched off and an error message will be output at PIN 11 of the 11+PE connector.
- Power voltage: Undervoltage (M004/bit 7):
  The voltage at pin 1 of the 11+PE connector is below 16 V (PIN A with 6+PE connector). As a consequence of this state, the device will be switched off; there will, however, not be an error message at PIN 11 of the 11+PE connector.
- Error position/flow monitor window (M004/bit 16):
  This function is only available with the devices for the cylinder position control, for example types STW0240 or WREA.

The bit is set if the actual cylinder value is within the window limits of the position monitor window to be set.
This display does not influence the device function.

- Error position/flow monitor window (M004/bit 17):
  Not relevant for IAC-P with axis controller function.
- Cable break command value 1 (M004/bit 10):
  A cable break has been detected at pin 4 of the 11+PE connector (pin D with 6+PE connectors). This function is only available with the current interface 4…20 mA (device code F6 for the 1+PE connector and F1 for the 6+PE connector). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Cable break command value 2 (M004/bit 8):
  Not relevant for IAC-P with axis controller function.
- Parameter error (M004/bit 11):
  An incorrect parameter value has been specified, for example a pressure reference value that is above the pressure sensor measurement range.
  As a consequence of this state, the device will not be switched off.
- Cable break int. pressure transducer in A (M004/bit 9):
  Not relevant for IAC-P with axis controller function.
- Cable break int. pressure transducer in B (M004/bit 12):
  Not relevant for IAC-P with axis controller function.
- Not relevant for IAC-P with axis controller function.
- Cable break int. pressure transducer in T (M004/bit 14):
  Not relevant for IAC-P with axis controller function.
- Cable break ext. sensor (M004/bit 15):
  The supply line to the external pressure transducer is interrupted. The message is only possible if the sensor has a suitable interface (for example 4…20 mA or 0.5…5 V). As a consequence of this state, the device will be switched off and an error message will be output at Pin 11 of the 11+PE connector.
- Overpressure warning (M004/bit 18):
  Not relevant for IAC-P with axis controller function.
- Shut-off warning (M004/bit 19):
  Not relevant for IAC-P with axis controller function.

4.2.13.5.3 Process data

In the process data window, the states of control and status word and the command and actual values can be monitored.

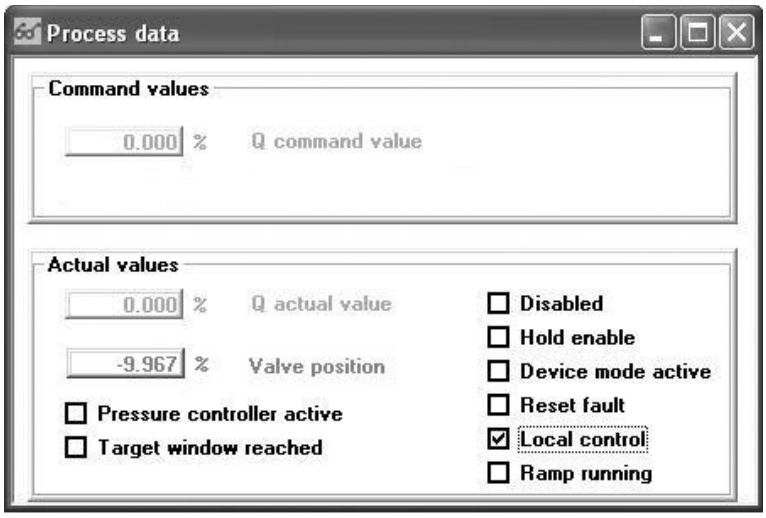

Fig. 123: Process data window

The content of the process data window corresponds to that of the cyclic data objects of the CAN (PDOs) and PROFIBUS bus systems (default telegrams 3 … 6, depending on the type).

Command value [%] Command value display.

Actual value Display of the actual value and the status word (see description of the state machine chapter 4.2.7.4 on page 31 et seq.).

4.2.13.6 Measuring data

The measuring data window serves the control of the WinView® visualization program.

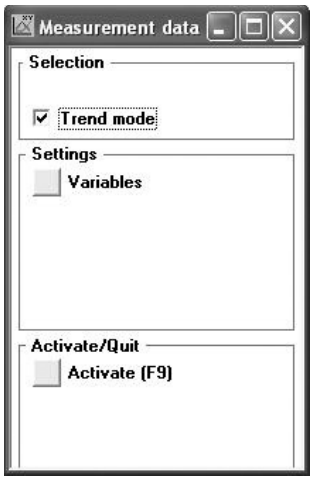

Fig. 124: Measuring data window

Selection If the trend mode is activated, long-time records of signals can be prepared.

Settings By clicking on the "Variables" button, the parameters to be recorded can be selected. The parameters to be recorded are selected in the following window:

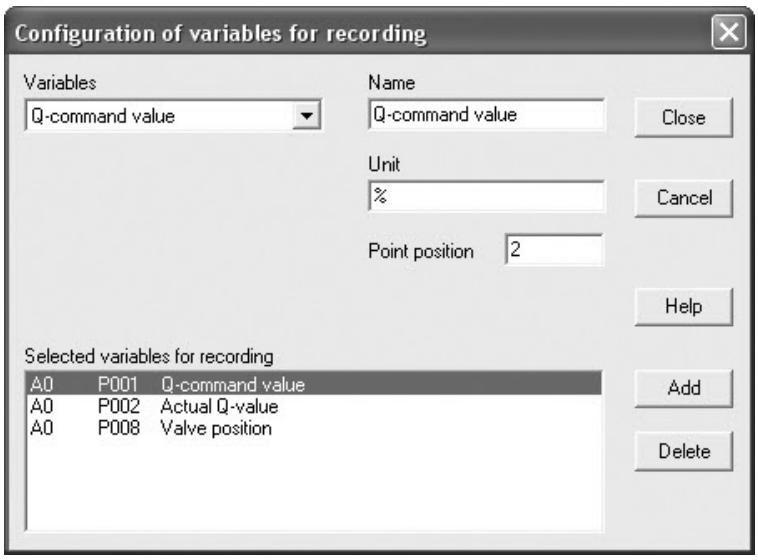

Fig. 125: Window for selecting the measuring data

- "Variables":
  List of the parameters that can be selected for recording.
- "Selected variables for recording":
  Clicking on "Add" accepts the selected parameter.
  A maximum of three parameters can be displayed simultaneously.
  Clicking on "Delete" removes the parameter from the definition window again.
- The parameter selection is exited by clicking on "Close" and the WinView® program starts automatically. The parameters selected in advance are recorded.

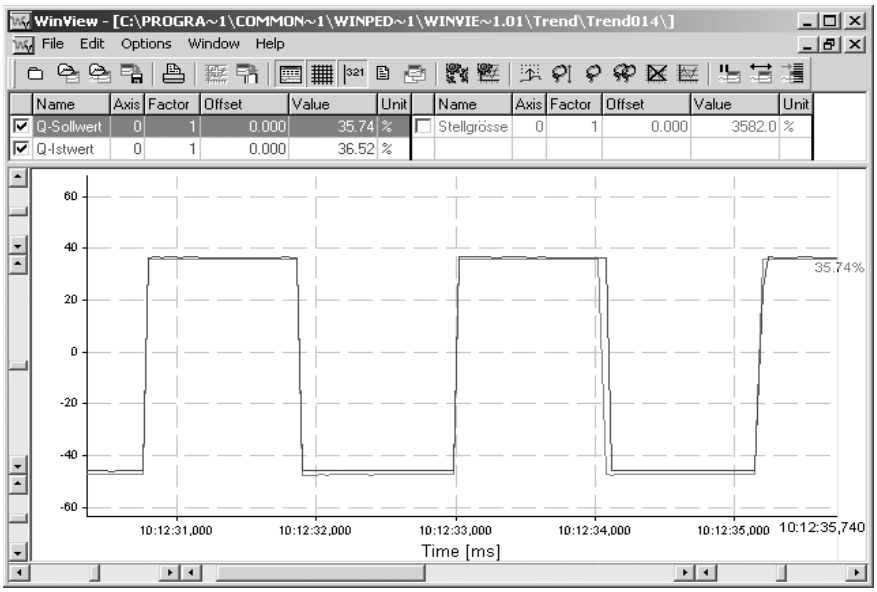

Fig. 126: Presentation of WinView®

Activate/Exit "Exit" stops the recording. The "Activate" button starts the recording.

4.2.14 Product identification

Information on the name plate

The meaning of the details on the name plate can be found on the basis of the enumerated fields from the following figures and the table.

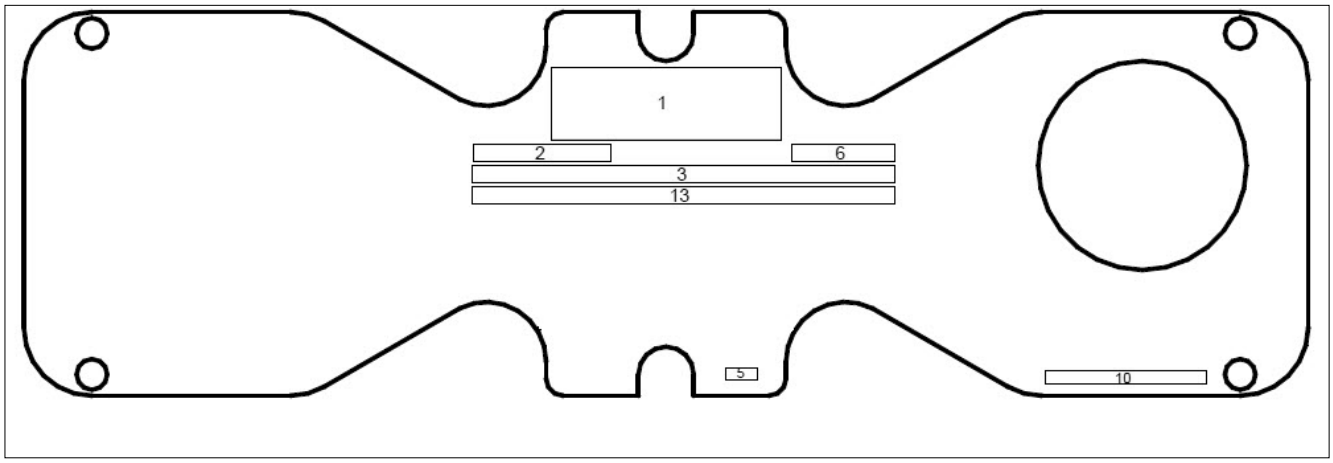

Fig. 127: Name plate IAC-P, IFB-P

Table 16: About the name plate

No.	Type of information	Information or example
1	Manufacturer's logo	Rexroth
2	Material no. of the valve (= order no.)	e.g.: R901078399
3	Type designation complete valve	e.g.: 4WREQ6Q5-08-2X/V8F-24CA60
5	Area / works number	e.g.: 7920
6	Date of manufacture	e.g.: FD: 98401
10	Designation of origin	Made in Germany
13	Customer material number or additional information	e.g.: CNR: 1234567890
20	Test stamp	Position can be freely selected depending on the available space
21	Installation stamp	

5 Transport and storage

For storing and transporting the product always observe the ambient conditions specified in the technical data (see "Technical data sheet").

6 Assembly

6.1 Unpacking

Dispose of the packaging in accordance with the national regulations of your country.

6.2 Coating the valve before installation

If the IAC-P/IFB-P valve is to be coated before being assembled, please observe the following:

- Protect the hydraulic ports against paint application by screwing-in plastic threaded plugs completely beforehand.
- Protect the mounting bores against paint application.
- Mask the valve connection surfaces as well as the subplates and end plates carefully before coating so that no dirt or paint may enter.
- Mask plastic connectors of the electrical connections and make sure not to cause any damage to the connector.

Name plates are protected ex works against the application of paint using a foil which can be removed after coating.

When removing the plastic threaded plugs, you must make sure that no paint chips enter the valve.

6.3 Installation conditions

For installing the product always observe the environmental conditions specified in the technical data (see "Technical data sheet").

6.3.1 Mounting orientation

See "Technical data sheet"

6.3.2 Requirements on the valve connection plate

WARNING!

Loss of valve function due to overheating

Falling below the minimum values (see "Technical data sheet" causes the risk of excess heating of the solenoid coil and thus of possible malfunctions.

- ▶ Observe the specified minimum distance when assembling several valves to one valve battery.
- ▶ Observe the specified minimum size and heat conductivity of the valve connection plate.

- For recommended subplates, see chapter "13.1 Optional accessories" on page 134.

6.3.3 Note on the valve use

- ▶ Observe the following information during the project planning:

WARNING!

Damage to the valve, the supply line, and other hydraulic components

Be aware of possible pressure intensification if the valve is connected to the chamber on the piston rod side of a single-rod cylinder. If the outflow of the hydraulic medium from this chamber is obstructed, pressure on the cylinder may result in a pressure intensification that may damage cylinder chamber, supply line, and valve.

- ▶ Make sure that there is adequate mechanical screening against any high-pressure water jet that may be used during cleaning.

CAUTION!

Safety-related control components

Signals provided by the control electronics or sent to the same (command value, actual value signal) must not be used to deactivate safety-relevant machine functions!

- ▶ Please observe DIN EN 954-1, -2.

6.4 Required tools

In order to install the IAC-P/IFB-P valve, you need standard tools only.

For information on the screws, see table 18 on page 123.

6.5 Before the assembly

Before installing the IAC-P/IFB-P valve into a device or system, the system must be flushed. Only then is the unobjectionable functioning of the valve guaranteed. Also observe the operating instructions of the device and/or system into which the valve is installed.

For flushing the system into which the valve is to be installed, flushing plates with FKM seals and porting pattern according to ISO 4401-03-02-0-05 (for valves size 6) or according to ISO 4401-05-04-0-05 (for valves size 10) are available.

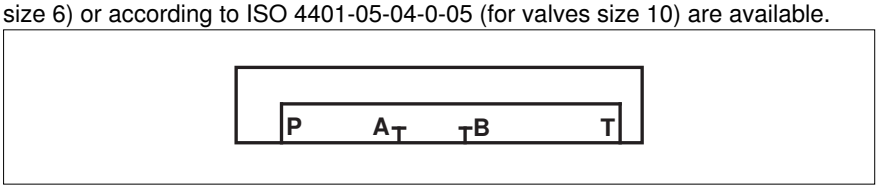

Fig. 128: Flushing plate according to ISO 4401-03-02-0-05 for valves size 6

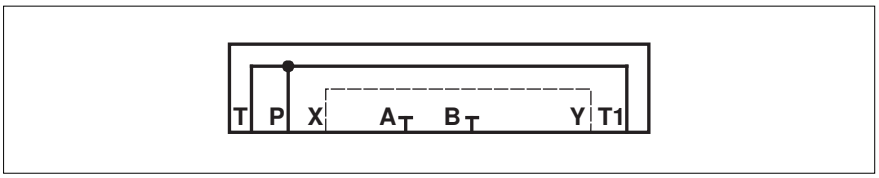

Fig. 129: Flushing plate according to ISO 4401-05-04-0-05 for valves size 10

- Install the flushing plate into the system instead of the IAC-P/IFB-P valve and subsequently flush it.

WARNING!

Risk of material damage and personal injuries due to improper installation!

Inappropriate mounting material and erroneous installation may result in damage to the IAC-P/IFB-P valve and adjacent components, as well as personal injuries due to escaping pressurized hydraulic oil.

- Always fasten the flushing plate/the valve with all four mounting screws as otherwise, leak-proofness is not guaranteed, see "Technical data sheet".
- Due to reasons of stability, only the valve mounting screws mentioned in chapter "13.1 Optional accessories" on page 134 have to be used!

When using the subplates mentioned in table 21 on page 134 or when installing on comparable cast iron installation surfaces, tighten all four mounting screws of the flushing plate with a torque power screwdriver and to the specified torque, see the following table.

This tightening torque refers to the maximum admissible operating pressure.

Table 17: Bolt dimension and tightening torque with admissible tolerance for flushing plate mounting screws

Size	Bolt dimension	Tightening torque
Size 6	M5 × 40	6 + 2 Nm
Size 10	M6 × 50	11 + 3 Nm

The use of a directional valve with port in accordance with ISO 4401-03-02-0-05 (for valves size 6) and/or in accordance with ISO 4401-05-04-0-05 (for valves size 10) is suited better. This valve can also be used for flushing the actuator ports.

The following is a guideline for the necessary flushing time t in hours:

$$t \geq \frac{V}{q_V} \times 5$$

V = Tank capacity in liters

q_V = Pump flow in liters/minute

The degree of contamination of the hydraulic fluid, which can be monitored by a

continuous measurement using a particle counter is decisive for the flushing time.

- Install a pressure differential-resistant pressure filter without bypass, if possible with integrated clogging indicator, directly in front of the IAC-P/IFB-P valve. During the flushing, check all filters in short intervals and exchange the polluted filter elements, if necessary.

6.6 Assembling the IAC-P/IFB-P valve

DANGER!

Risk of personal injury and damage to property!

Incorrectly assembled IAC-P/IFB-P valves can cause substantial material damage and personal injuries. An erroneously attached IAC-P/IFB-P valve may move in an uncontrolled manner and damage other system parts.

- Before any work such as assembly or disassembly is carried out at the IAC-P/IFB-P valve, the hydraulic system must be depressurized and the electrical control system de-energized.
- Assembly of the IAC-P/IFB-P valve requires basic mechanical, hydraulic, electrical and control knowledge.
  Only qualified personnel (see chapter "2.3 Qualification of personnel" on page 11) are authorized to assemble the IAC-P valve.
- Ensure that the IAC-P/IFB-P valve is attached securely.

6.6.1 Installing the IAC-P valve in the system

CAUTION!

Risk due to the use of an improper IAC-P/IFB-P valve

Installing an improper IAC-P/IFB-P valve may result in uncontrolled activities and in personal injuries or damage to other system components.

- Check based on the type designation on the name plate of the valve whether there is the correct IAC-P/IFB-P valve type.
- Check the scope of delivery for completeness, particularly the seal rings at the valve connection surfaces.
- Check the scope of delivery for possible transport damage.
- Check whether the operating instructions are suitable for the IAC-P/IFB-P valve and complete. Contact us if the operating instructions are incomplete.
- Please observe all safety instructions.

In order to ensure proper functionality, the pressure chamber of the solenoid has to be filled with hydraulic medium at all times and the tank line running empty has to be avoided. The tank line has to be equipped with a pre-charge valve in corresponding installation conditions providing for a pre-charging pressure of approx. 2 bar.

Due to the induction effect, the abrupt switch-off of the valve solenoid results in a voltage peak. As suppressor circuit, the valve solenoid coil already contains a suppressor diode with 47 V threshold voltage dampening these voltage peaks. However, additional external switching measures have to be taken to avoid connected circuits being influenced by the remaining residual voltage peak, if required.

- Before any assembly and disassembly work starts, the surroundings must be cleaned so that no dirt can get into the oil circuit. Only non-linting fabric or special paper may be used for cleaning.

- Check valve mounting face for required surface quality (see "Technical data sheet", unit dimensions). Remove the protective plate from the IAC-P/IFB-P valve and keep it safe for returns in case any repairs become necessary later.
- Check the seal rings at the valve connection surface for completeness. Other sealants are inadmissible.
- Check whether at the subplate, the pressure connection line is connected with P and the return line with T.

Confusing P and T can lead to damage at the IAC-P/IFB-P valve when the system is pressurized.

- Put the IAC-P/IFB-P valve onto the valve mounting face.
- When using the subplates mentioned in section "13.1 Optional accessories" on page 134 or when installing on comparable cast iron installation surfaces, tighten all mounting screws with a torque power screwdriver and to the specified torque, see the following table.

This tightening torque refers to the maximum admissible operating pressure.

If the IAC-P/IFB-P valve is to be used with reduced maximum pressure and installed on valve mounting faces made of another material (observe minimum heat conductivity!), a lower tightening torque has to be used to rule out damage, if necessary.

Table 18: Bolt dimension and tightening torque with admissible tolerance

Type	Bolt dimension	Friction coefficient μ.total	Tightening torque [1)]
WREQ size 6 with external pressure sensors STW0195/ STW0240(WREA) size 6 4WREF, size 6	4 hexagon socket head cap screws ISO 4762 M5 x 50 10.9-flZn-240h-L	0.09 to 0.14	7 Nm
	4 hexagon socket head cap screws ISO 4762 M5 x 50 10.9	0.12 to 0.17	8.9 Nm
WREQ size 6 with internal pressure sensors	4 hexagon socket head cap screws ISO 4762 M5 x 90 10.9-flZn-240h-L	0.09 to 0.14	7 Nm
	4 hexagon socket head cap screws ISO 4762 M5 x 90 10.9	0.12 to 0.17	8.9 Nm
WREQ size 10 with external pressure sensors STW0196/ STW0240(WREA) size 10 4WREF, size 10	4 hexagon socket head cap screws ISO 4762 M6 x 40 10.9-flZn-240h-L	0.09 to 0.14	12.5 Nm
	4 hexagon socket head cap screws ISO 4762 M6 x 40 10.9	0.12 to 0.17	15.5 Nm
WREQ size 10 with internal pressure sensors	4 hexagon socket head cap screws ISO 4762 M6 x 80 10.9-flZn-240h-L	0.09 to 0.14	12.5 Nm
	4 hexagon socket head cap screws ISO 4762 M6 x 80 10.9	0.12 to 0.17	15.5 Nm

[1)] The tightening torques are guidelines when using screws with the specified friction coefficients and when using a torque power screwdriver (tolerance ±10 %).

WARNING!

Risk of material damage and personal injuries due to improper installation!

Inappropriate mounting material and erroneous installation may result in damage at the IAC-P/IFB-P valve and adjacent components, as well as personal injuries due to escaping pressurized hydraulic oil.

- Always fasten the IAC-P/IFB-P valve with all four mounting screws as otherwise, leak-proofness is not guaranteed. See "Technical data sheet".
- Due to reasons of stability, only the valve mounting screws mentioned in section "13.1 Optional accessories" on page 134 have to be used!
- Check the structure of the hydraulic product using the circuit diagrams, device lists and assembly plans.
- Clarify possible discrepancies with the responsible persons.

- Make sure that pipes and/or hoses are connected to all ports and/or that the ports are sealed with screw plugs.
- Carry out a special check to make sure that the cap nuts and flanges are correctly tightened at the pipe fittings and flanges.

Mark all checked fittings, e.g. with permanent markers.

- Make sure that all pipes and hose assemblies and every combination of connection pieces, couplings or connection points with hoses or pipes are checked for their operational safety by someone who has the appropriate knowledge and experience.

6.6.2 Hydraulically connecting the IAC-P/IFB-P valve

Depressurize the relevant part of the system.

CAUTION!

Risk of injury when assembling under pressure!

If you fail to depressurize the product before starting the assembly, you may suffer injury and also damage the device or system components.

- Depressurize the corresponding part of the system before installing the IAC-P/IFB-P valve.

CAUTION!

Missing seals and caps will lead to non-compliance with protection class IP 65!

Liquids and foreign bodies may penetrate and damage the IAC-P/IFB-P valve.

- Ensure before the assembly that all seals and caps of the plug-in connections are tight.

CAUTION!

Damage to the valve!

When assembling hydraulic lines and hoses under mechanical stress, they are exposed to additional mechanical forces during operation which reduce the service life of the IAC-P/IFB-P valve and the entire machine or system.

- Assemble lines and hoses without mechanical stress.

CAUTION!

Wear, tear and malfunctions!

The cleanliness of the hydraulic fluid has a considerable impact on the cleanliness and service life of the hydraulic system as a whole. Any pollution/contamination of the hydraulic fluid will result in wear and malfunctions. In particular, foreign bodies like e.g. welding beads or metal chips in the hydraulic lines may damage the IAC-P/IFB-P valve.

- Always ensure absolute cleanliness.
- Install the IAC-P/IFB-P valve free from any pollution.
- Make sure that all connections, hydraulic lines and attachment parts (e.g. measuring instruments) are clean.
- Ensure that also when sealing the connections, no pollutants are able to penetrate.
- Ensure that no cleaning agents are able to penetrate the hydraulic system.
- Do not use cotton waste or linting cloths for cleaning.
- Do not under any circumstances use hemp as a sealant.

6.7 Installing the electrical system

De-energize the relevant part of the system. For more information refer to chapter "7.1.1 First commissioning, re-commissioning after extended standstill" on page 127 and Technical data sheets STW195/196 – RE 29014; 4WREQ – RE 29050; 4WREF – RE 29048.

CAUTION!

Risk of injury when assembling under voltage!

If you do not switch off voltage supply before assembling the product, you may get injured or the IAC-P/IFB-P valve or system components may be damaged.

- De-energize the corresponding part of the system before installing the IAC-P/IFB-P valve.

CAUTION!

Risk of personal injury and damage to property!

Incorrect energy supply may lead to uncontrolled valve positions. These may result in the valve behaving erroneously or failing and may cause injuries.

- Always connect the earthing connections of the IAC-P/IFB-P valve with the appropriate earthing system in your installation.
- Only use a mains adapter with safe disconnection.
- Always comply with the country-specific regulations.

CAUTION!

Connecting or disconnecting connectors under voltage will destroy the valve electronics!

Connecting or disconnecting connectors under voltage causes high potential differences which could damage the electronics of the IAC-P/IFB-P valve.

- Switch off power supply to the relevant system component before assembling the device or when connecting and disconnecting connectors.

CAUTION!

Risk of short-circuit due to missing seals and caps!

Fluids may enter the IAC-P/IFB-P valve and cause a short-circuit.

- Before commissioning, ensure that all seals and caps of the plug-in connections are leak-proof.

WARNING!

Risk due to improper connection wiring

The IAC-P/IFB-P valve may only be connected by or under the supervision of a specialized electrician.

The lines used have to be suitable for operating temperatures of –20 °C...+100 °C.

For details on suitable connection cables, see "Technical notes for the cable" in the "Technical data sheet".

- De-energize the connection line before the assembly.
- Connect the protective earthing conductor and the earthing properly.
- Avoid sharp bends in the connection line and the litz wires in order to avoid short-circuits and interruptions.
- Route the connection line(s) in a pull-relieved form. The first mounting point must be within 15 cm of the cable entry.
- Use finely stranded conductors only if they have pressed-on conductor sleeves.
- Use only lines satisfying the requirements on the terminals'connection areas. See "Technical data sheet".

The solenoid coil can be connected in a polarity-independent way.

Only the mating connectors specified in the "Technical data sheet" or mating connectors of the same type may be used.

Observe the assembly instructions printed on the packaging of the mating connector and the specified tightening torques.

- Cut heat shrinkable tubings to length and push the same over the litz wires of the control line to insulate the solder joints and the uncovered parts at a later point in time.
- Solder the litz wires of the control line to the solder buckets of the contact sockets of the mating connector according to the specified connection wiring (see "Technical data sheet.").
- Check the correct assignment of the litz wires to the contact sockets with the help of a continuity tester.
- Position the heat shrinkable tubings over soldering joints and blank parts and let shrink on.
- Check mutual insulation of contact sockets using a continuity tester.
- Assemble the mating connector according to the assembly instructions, plug onto the connector of the on-board electronics of the IAC-P/IFB-P valve and tighten the cap nut.
- For protection in case of a short-circuit, the on-board electronics supply voltage must be secured by means of a 2.5 A fuse with a fast-acting shut-off or a protective motor switch with short-circuit and thermal instantaneous tripping set to 2.5 A. The shut-off threshold of this fuse has to be equal to or greater than the possible short-circuit current of the supply voltage source. The fuse may be located in the related supply unit or has to be connected upstream separately.

7 Commissioning

CAUTION!

Risk of personal injury and damage to property!

Commissioning of the IAC-P/IFB-P valve requires basic hydraulic, electrical and control knowledge.

- Only qualified personnel (see chapter "2.3 Qualification of personnel" on page 11) are authorized to commission the IAC-P/IFB-P valve.

7.1 First commissioning; recommissioning after standstill

Proceed as follows in order to commission the IAC-P/IFB-P valve:

7.1.1 Check the electrical connections

- Electrical connections must be checked for proper condition by or under the guidance and supervision of a specialized electrician before the initial or any recommissioning.

7.1.2 Bleeding the hydraulic system

Observe the operating instructions of the device and/or system into which the IAC-P/IFB-P valve is installed.

- Switch the IAC-P/IFB-P valve several times under operating pressure before placing it into full operation. This will expel any remaining air from the valve. Mechanical damage due to inadmissibly high acceleration of the fluid and the valve spool is thus avoided and the service life of the IAC-P/IFB-P valve is increased.

7.1.3 Performing a leakage test

- Check whether during operation, hydraulic medium leaks at the IAC-P/IFB-P valve and at the connections.

8 Operation

See operating instructions of the hydraulic system into which the IAC-P/IFB-P valve has been installed.

9 Maintenance

9.1 Term definition

In accordance with DIN 31051:2003-6, the term maintenance means the combination of all technical and administrative measures and measures taken by the management during the life cycle of an item in order to maintain the functional condition or to return to the same, so that the item is able to meet the required function.

These measures can be classified into:

- **Maintenance** (measures to delay the decrease of the existing wear reserve)
- **Inspection** (measures to determine and assess the actual condition of an item, including the determination of the cause of wear and the derivation of the required consequences for a future use)
- **Repair** (measures to return an item to the functional state, except for improvements)
- **Improvement** (combination of all technical and administrative measures and measures taken by the management to increase the functional safety of an item, without modifying the function required)

9.2 Cleaning and care

CAUTION!

Penetrating dirt and liquids will cause faults!

Safe function of the IAC-P/IFB-P valve is no longer ensured.

- ▶ Always provide for absolute cleanness when working on the IAC-P/IFB-P valve.
- ▶ Do not use a pressure washer.

CAUTION!

Damage to the surface from solvents and aggressive cleaning agents!

Aggressive cleaning agents may damage the seals of the IAC-P/IFB-P valve and let them age faster.

- ▶ Never use solvents or aggressive cleaning agents.
- ▶ Do not use pressure washers for cleaning.

CAUTION!

Damage to the hydraulic system and seals!

A pressure washer's water pressure could damage the hydraulic system and the seals of the IAC-P/IFB-P valve. The water displaces the oil from the hydraulic system and seals.

- ▶ Do not use pressure washers for cleaning.

- ▶ Cover all openings with appropriate protective caps.
- ▶ Check that all seals and plugs for the plug-in connections are firmly fitted so that no humidity can penetrate the valve.
- ▶ Only clean the IAC-P/IFB-P valve using a damp, lint-free cloth. Only use water and a mild cleaning agent, if necessary, to do so.

9.3 Inspection and maintenance

Dust accumulations on the IAC-P/IFB-P valve have to be removed at regular intervals.

The following inspection, testing and maintenance works are to be carried out regularly. Also considering the operating conditions, the corresponding intervals are to be chosen so that defects that can reasonably be expected are dealt with in good time. The check must, however, at least be carried out every three years from the date of manufacture of the IAC-P/IFB-P of the valve.
The date of manufacture of the IAC-P/IFB-P valve can be found on the name plate, see chapter "4.2.14 Product identification" on page 118.

Order information for seal kits is available in chapter "9.5 Spare parts" on page 131.

The IAC-P/IFB-P valve is mainly maintenance-free. In order to ensure long service life and functionality, include the following activities in your maintenance schedule for the IAC-P/IFB-P integrated axis controller:

- Check valve for external leakage, replace the seals if necessary, see chapter "9.3.1 Rectifying external leakage" on page 129.
- Check all screws and connections for a tight seat.
- Check all plug-in and clamping connections of the IAC-P/IFB-P integrated axis controller for correct seat and damage at least once per year. Check lines for break or squeezing. Replace the connection line if there is any visible damage.
- In case of damage or defects, the system or machine must be decommissioned and secured immediately, if necessary.
- Have defective or damaged valves exchanged immediately.

9.3.1 Rectifying external leakage

External leakage at the valve connection surface can be rectified on site. Other leakage has to be rectified by specialists of the manufacturer.

9.3.2 Rectifying leakage at the valve connection surface

- Remove the IAC-P/IFB-P valve, see chapter "11 Removal and replacement" on page 132.
- Check the seal recesses on the valve connection surface for cleanliness and damage.
- Fit the new seals.

9.4 Repair

Service, maintenance, repair and troubleshooting may only be carried out by specialists according to the applicable regulations. For this purpose, the system and/or machine into which the IAC-P/IFB-P integrated axis controllers are installed must be switched off, de-energized and depressurized. The corresponding accident prevention regulations must be observed! Use suitable protective equipment, e.g. safety shoes, protective gloves! Use only suitable tools (e.g. voltage-insulated tools).

For establishing and ensuring the de-energized state, the following safety rules are to be observed:

- Unlock.
- Secure against unexpected re-activation: Lock the actuating elements with a padlock, as far as possible; at least you must, however, apply a warning sign.
- Ensure that there is no voltage.
- Cover or shield adjacent current-carrying parts.
- Apply warning signs.

If works at live components are necessary, call in a second person who will operate the emergency stop button in case of emergency.

DANGER!

Risk of personal injury and damage to property!

Damaged or defective valves may lead to unwanted movements and/or unwanted behavior at the machine and may cause considerable damage to property and personal injuries!

- The machine or system operation with damaged or improperly integrated IAC-P/IFB-P axis controllers (e.g. leaky hydraulic system) is dangerous and inadmissible.

Bosch Rexroth offers a wide range of repair services for the IAC-P/IFB-P valve.

- Only use genuine spare parts from Bosch Rexroth for repairing the Rexroth product.
- Tested and pre-assembled original Rexroth assemblies allow for successful repair requiring only little time.

9.4.1 Safety instructions regarding repairs

For repair works, the IAC-P/IFB-P valve may only be disassembled to the extent described in the operating instructions.

Defective parts may only be replaced by new, interchangeable, tested components in original equipment quality.

- Clean the external environment of fittings and devices before the disassembly. Do not use cotton waste for the cleaning.
- Close all openings using protective caps.

9.5 Spare parts

CAUTION!

Damage to property and personal injuries due to faulty spare parts!

Spare parts that do not meet the technical requirements specified by Bosch Rexroth may cause personal injuries and damage to property.

- Only use genuine spare parts from Bosch Rexroth.

- Order spare parts in writing. In urgent cases you can also order by phone, but you are kindly requested to confirm your order in writing e.g. by fax.
- Please send your spare parts order to the Bosch Rexroth service next to you or directly to the headquarters (see chapter "16.3 Address directory" on page 139).
- When ordering spare parts, please indicate the following information from the name plate:
  - The serial number
- Please indicate the following details from the parts list:
  - The material number
- Additionally indicate:
  - The desired number of spare parts
  - The required type of dispatch (e.g. as parcel, freight, air freight, by courier etc.).

The following spare parts are available for the IAC-P valve:

- Seals

Table 19: Seals

Type	Seal	Material no.
STW 0195	9.81 x 1.5 x 1.78	4 x R900017610
STW 0196	13.0 x 1.6 x 2.0	10 x R900017615
4WREQ size 6	9.81 x 1.5 x 1.78	4 x R900017610
4WREQ size 10 with internal pressure sensor	13.0 x 1.6 x 2.0	10 x R900017615
4WREQ size 10 with external pressure sensor	13.0 x 1.6 x 2.0	10 x R900017615
STW 0240 (4WREA) size 6	9.81 x 1.5 x 1.78	4 x R900017610
STW 0240 (4WREA) size 10	13.0 x 1.6 x 2.0	10 x R900017615
4WREF, size 6	9,81 x 1,5 x 1,78	4 x R900017610
4WREF, size10	13,0 x 1,6 x 2.0	10 x R900017615

Please observe the suitability of the sealing materials for the hydraulic medium used! See "Technical data sheet".

- Mating connectors, see "Technical data sheet"

For more information on the mating connector refer to "RE 08006" and "RE 08008".

Please refer to the address directory on the Internet at http://www.boschrexroth.com/service and in chapter "16.3 Address directory" on page 139.

10 Decommissioning

The IAC-P/IFB-P valve is a component that does not require decommissioning. As a result, this chapter of the instructions does not contain any information.

For details about how to disassemble or replace the IAC-P/IFB-P valve, please refer to chapter "11 Disassembly and replacement" on page 132.

10.1 Preparing the components for storage/further use

- Clean the IAC-P/IFB-P valve as specified in chapter "9.2 Cleaning and care" on page 128.
- Please observe the notes in the "Technical data sheet".

11 Disassembly and replacement

WARNING!

Risk of personal injuries and material damage due to pressurized and energized system components.

Works on pressurized and energized system components entail the risk of injuries caused by escaping hydraulic oil or electric shocks.

- Ensure before the disassembly that the hydraulic system is depressurized and the electrical control is de-energized.

1. Loosen the mating connector(s) and remove the mating connector(s).
2. Have a container ready for collecting the escaping hydraulic fluid.
3. Only loosen the mounting screws of the IAC-P/IFB-P valve using a suitable tool.
4. Remove the mounting screws and loosen the IAC-P/IFB-P valve from the valve mounting face.
5. Collect the escaping hydraulic fluid in the provided container and dispose of it properly.
6. If the IAC-P/IFB-P valve is to be returned to the manufacturer for repair, close the valve connection surface using the supplied protective plate or protect it using equivalent packaging in order to avoid pollution and damage.
7. Seal the subplate in order to avoid pollution.

12 Disposal

12.1 Environmental protection

Careless disposal of the IAC-P/IFB-P valve and the hydraulic fluid could lead to pollution of the environment.

- Thus, dispose of the IAC-P/IFB-P valve and the hydraulic fluid in accordance with the currently applicable national regulations in your country.
- Dispose of hydraulic fluid residues according to the respective safety data sheets valid for these hydraulic fluids.
- Please observe the following supplied notes for the environmentally-friendly disposal of the IAC-P/IFB-P valve.

12.2 Return to Bosch Rexroth AG

The products manufactured by us can be returned to us for disposal purposes at no costs. However, the precondition is that there are no spurious adherences or any other contamination. The hydraulic products have to be discharged before the same are returned. Furthermore, there must be no inappropriate foreign matter or third party components when products are returned.

The products have to be sent free to the door to the following address:

Bosch Rexroth AG

Service Industriehydraulik [Industrial hydraulics]

Bürgermeister-Dr.-Nebel-Straße 8

97816 Lohr am Main

Germany

12.3 Packagings

Upon request, reusable systems can be used for regular deliveries.

The materials for one-way packagings are mostly cardboard, wood, and styrofoam. They can be recycled without any problems. Due to ecological reasons, one-way packagings should not be used for returning products to us.

12.4 Materials used

Our products do not contain any hazardous materials that could be released during intended use. Normally, no adverse effects on human beings and on the environment have to be expected.

The products essentially consist of:

- Cast iron
- Steel
- Aluminum
- Copper
- Plastic materials
- Electronic components and assemblies

12.5 Recycling

Due to the high share of metal, the products can mostly be recycled. In order to achieve an ideal metal recovery, disassembly into individual assemblies is required. The metals contained in electric and electronic assemblies can be recovered by means of special separation procedures as well. If the products contain batteries or accumulators, these have to be removed before recycling and furnished to the battery recycling, if possible.

13 Extension and conversion

Do not retrofit the IAC-P valve.

13.1 Optional accessories

Valve mounting screws

Due to reasons of stability, only the following valve mounting screws have to be used.

Table 20: Valve mounting screws

Valve type	Hexagon socket head cap screws	Quantity	Material no.
STW 0195	ISO 4762 - M5 x 50 - 10.9	4	R913000064
STW 0196	ISO 4762 - M6 x 40 - 10.9	4	R913000058
4WREQ size 6	ISO 4762 - M5 x 50 - 10.9	4	R913000064
4WREQ size 10 with internal pressure sensor	ISO 4762 - M6 x 80 - 10.9	4	R913000512
4WREQ size 10 with external pressure sensor	ISO 4762 - M6 x 40 - 10.9	4	R913000058
STW 0240 (4WREA) size 6	ISO 4762 - M5 x 50 - 10.9	4	R913000064
STW 0240 (4WREA) size 10	ISO 4762 - M6 x 40 - 10.9	4	R913000058
4WREF, size 6	ISO 4762 - M5 x 50 - 10.9	4	R913000064
4WREF, size 10	ISO 4762 - M6 x 40 - 10.9	4	R913000058

Subplates

Table 21: Subplates

Valve type	Technical data sheet
STW 0195, STW 0196	RE 29014
4WREQ size 6 and10	RE 29050
STW 0240 (4WREA), size 6 and 10	RE 29018
4WREF, size 6 und 10	RE 29048

Address for ordering accessories and valves

Please refer to the address directory on the Internet at http://www.boschrexroth.de and in section "16.3 Address directory" on page 139 for the addresses of our responsible sales companies.

- Only use genuine spare parts from Bosch Rexroth.

14 Troubleshooting

Errors and warnings are stored in the IFB-P/IAC-P valve until they are remedied.

An error state can only be quit if the error cause has been remedied. Otherwise, the acknowledgement of errors will immediately lead to an error reaction again.

14.1 How to proceed for troubleshooting

- Always work systematically and focused, even when under time pressure. Random and imprudent disassembly and readjustment of settings can, in the worst-case scenario, result in the inability to determine the original cause of the fault.
- First get a general idea of how your valve works in conjunction with the overall system.
- Try to find out whether the valve has worked properly in conjunction with the overall system before the troubles occurred first.
- Try to determine any changes of the overall system in which the valve is integrated:
  - Were there any changes to the valve's operating conditions or operating range?
  - Were there any changes or repair works on the overall system (machine/system, electrics, control) or on the valve? If so: What were they?
  - Was the valve or machine used as intended?
  - How did the malfunction become apparent?
- Try to get a clear idea of the cause of the fault. Ask the direct (machine) operator, if necessary.

14.1.1 Recognizing an error state

The superior control system can be notified a pending error in two ways:

- By means of a digital state word (IAC-P valve and IFB-P valve)
  It contains information on the current system state and thus also information on a current error state.
- By means of an analog error signal output (only IAC-P valve)
  The error output at pin 11 of the X1 connector is active in case of an error 0 V (L-).
- With the CAN bus, the control is – in case an error occurs – moreover sent an EMCY object.

An error always leads to an error state. See chapter "4.2.7 Analog/digital operation with state machine, device function" on page 27 et seq.

14.1.2 Reading out the error state via the bus system

The current state can be seen from the last half byte of the status word.
See chapter "4.2.7.3.3 Device state: Status word" on page 33:

Table 22: Reading out the error state via bus system

Byte 1	Byte 2	
		State

If this parameter is read out, the following return values may occur and refer to the following system states:

Table 23: Return values

Status word (last half byte)	State
0x00	NOT READY
0x08	INIT
0x09	DISABLED
0x0B	HOLD
0x0F	ACTIVE
0x01	FAULT

The last entry refers to a possible error.

The system states can be comfortably queried by means of the "WIN-PED 6" user interface. See chapter "4.2.10.5 Diagnosis" on page 50.

14.1.3 Reading out the error state via analog error signal

The analog error signal of the IAC-P can be transmitted to pin 11 of the X1 connector of the superior control system via the error output. The IFB-P valves have only one 6+PE connector in which no error output is provided for reasons of space.

The IAC-P error signal can take the following states:

Table 24: Reading out the error state via analog error signal

System state	Error output (level)
NOT READY	HIGH
INIT	HIGH
DISABLED	HIGH
HOLD	HIGH
ACTIVE	HIGH
FAULT	LOW

14.1.4 Error list

The following error list contains the error bit of the internal status word (machine date M004), the error code for the CAN bus (object 1003), the meaning and the error type. With PROFIBUS, the error is only managed via the internal status word.

Table 25: Error list

Error bit in the status (M004)	Error code CAN (Hex)	Meaning	Error type
0x00	0x00	Cable break current input pin 4 (11+PE) or pin D (6+PE)	Error
0x01	0x00	Cable break current input pin 7 (11+PE)	Error
0x02	0x00	Control voltage: Undervoltage	Error
0x03	0x00	Voltage load supply: Undervoltage	Warning
0x04	0x00	Pressure sensor in sandwich plate in A	Error
0x05	0x00	Pressure sensor in sandwich plate in B	Error
0x06	0x00	Pressure sensor in sandwich plate in P	Error
0x07	0x07	Pressure sensor in sandwich plate in T	Error
0x08	0x00	External sensor	Error
0x09	0x01	Position sensor valve	Error
0x09	0x81	Software reset (watchdog)	Error without return
0x09	0x00	Parameter lost/overwritten	Warning
0x0A	0x00	Parameter error	Warning
0x0B	0x00	Communication error (CAN)	Warning
0x0C	0x00	Error position monitor	Warning
0x0D	0x00	Error pressure monitor	Warning
0x0E	0x00	Overpressure warning	Warning
0x0F	0x00	Overpressure shut-off	Error

14.1.5 Error reaction

Depending on the error type, the following reactions result:

Warning A "Warning" is only displayed in a bus-specific form; the device is, however, not shut off.

Error An "Error" leads to the immediate shut-off of the device. In this case, the fail-safe position is approached, if possible. After the error cause has been remedied, the device can be recommissioned.

Error without return This error type will also lead to the immediate shut-off of the device. In this case, the fail-safe position is approached, if possible. After the error cause has been remedied and the supply voltage has been re-activated, the device can be recommissioned.

14.1.6 Error acknowledgement

Errors can only be acknowledged if the error cause has been remedied!

Errors are acknowledged in a different form for the analog and the digital operating mode.

- Analog operating mode:
  With the analog operating mode of the IAC-P/IFB-P valve, errors are automatically acknowledged internally (delivery state). This behavior can be re-parameterized so that the error is acknowledged in case of a positive release edge.
  See chapter "4.2.11.4.2 General" on page 58 under definition "Digital I/O".
- Digital operating mode:
  With the digital operating mode, errors are acknowledged by the error reset bit in the control word (bit 3). In this connection, the state machine of the IAC-P/IFB-P valve expects an L→H edge of the error reset bit; otherwise, it will remain in the "error" state.

14.1.7 Fault table

The IAC-P/IFB-P valve is not susceptible to faults as long as the specified operating conditions are complied with, in particular the oil quality.

Table 26: Fault table

Fault	Possible causes	Remedy
No control by the IAC-P/IFB-P valve	Electrical connection interrupted, no current continuity, cable break	Replace the connection cable
	Short-circuit in the connection cable/mating connector	Replace the connection cable
	Operating voltage for OBE not available or less than 18 V	Check the operating voltage and re-establish it, if necessary. See "Technical data sheet", Electrical connection.
	OBE defective	Remove the IAC-P/IFB-P valve and have it repaired
	No pressure at P	Check and/or reapply pressure at port P
IAC-P/IFB-P valve reacts to control with interchanged function	D and E ports of the OBE are reverse-poled	Provide for correct polarity of the command value signal, see connection wiring and/or "Technical data sheet", electrical connection.
IAC-P/IFB-P valve does not provide any actual value signal	Electrical connection interrupted, no current continuity, cable break	Replace the connection cable
	Short-circuit in the connection cable/mating connector	Replace the connection cable
	OBE defective	Remove the IAC-P/IFB-P valve and have it repaired
External leakage	Seal at the contact surface is defective	Remove the IAC-P/IFB-P valve and replace the seals
	Other leakage	Remove the IAC-P/IFB-P valve and replace it with a new one

Following faults due to pollution, it is – in addition to the repair – essential to check the oil quality and improve it, if necessary, by suitable means such as flushing or the additional installation of filters.

If you should not be able to remedy an occurred defect, please contact one of the addresses that you can find on the Internet at http://www.boschrexroth.com or in chapter "16.3 Address directory" on page 139.

15 Technical data

For details about the technical data of your IAC-P/IFB-P valve please refer to the "Technical data sheet".

16 Appendix

16.1 Project/installation drawings

See "Technical data sheet".

16.2 Electrical schematics

See "Technical data sheet".

16.3 Address directory

Please refer to http://www.boschrexroth.com for the addresses of foreign subsidiaries.

Contacts for repairs and spare parts

Bosch Rexroth AG
Service Industriehydraulik [Industrial hydraulics]
Bürgermeister-Dr.-Nebel-Straße 8
97816 Lohr am Main
Germany

Phone +49 (93 52) 18-11 64
Fax +49 (93 52) 18-33 63
http://www.boschrexroth.com/service

Address for ordering accessories and valves

Headquarters:
Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main
Germany
Phone +49 (93 52) 18-0
Fax +49 (93 52) 18-40
or the respectively competent sales organizations.
You can find the addresses on the Internet at:
http://www.boschrexroth.de

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