HYQUIP
+44 (0)1204 699 959
enquiries@hyquip.co.uk
www.hyquip.co.uk

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The Drive & Control Company

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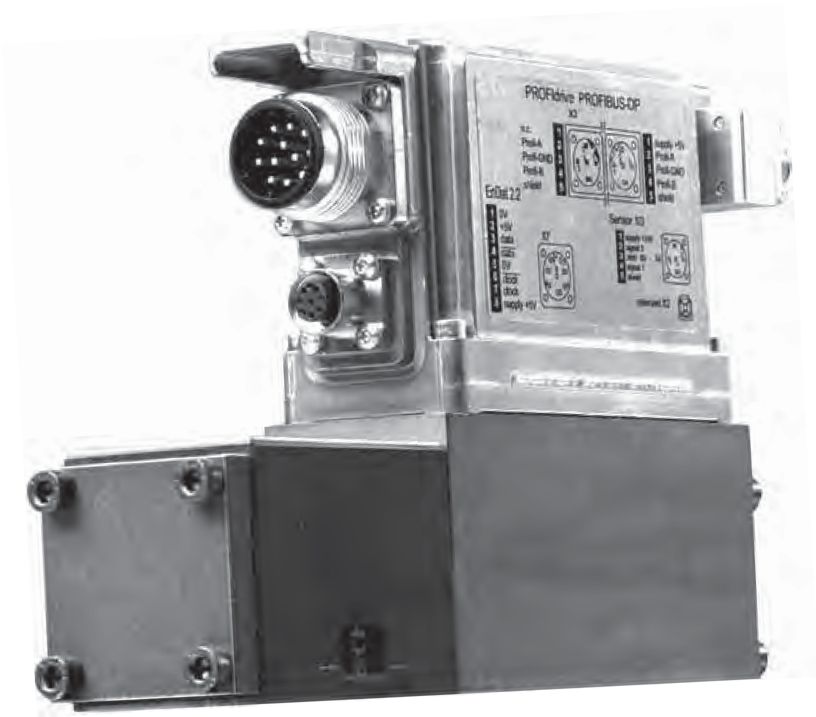
4WRPNH.../24F.

High-response valve with integrated digital axis controller (IAC-R) and clock-synchronized PROFIBUS DP/V2 (PROFIdrive profile)

Operating instructions
RE 29291-B/06.2013

Replaces: 08.2012
English



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.

An example configuration is shown on the title page. The delivered product may, therefore, differ from the product which is pictured.

The original operating instructions were created in the German language.

Contents

1 About this documentation

1.1 Validity of documentation

This documentation is valid for valves with integrated axis controller (IAC-R, type 4WRPN) and clock-synchronized PROFIBUS interface (PROFIdrive profile).
This documentation is intended for fitters, operators, service technicians and plant operators.
This documentation contains important information on the safe and appropriate installation, transport, commissioning, operation, use, maintenance, deinstallation and simple troubleshooting.

- Read this documentation completely, especially Chapter 2 “Safety instructions” and Chapter 3 “General notes on damage to property and the product“, before working with the product.

1.2 Required and related documentation

- Only commission the product, when you have the documents marked with the book symbol 🕮 at hand and have understood and observed them.

Table 1: Required and related documentation

	Title	Document number	Type of document
🕮	System documentation of the plant manufacturer		
🕮	High-response valve with integrated digital axis controller (IAC-R) and clock-synchronized PROFIBUS DP/V2 (PROFIdrive profile)	RE 29291	Data sheet
	Installation, commissioning and maintenance of proportional valves	RE 07800	Data sheet
	Installation, commissioning and maintenance of hydraulic systems	RE 07900	Data sheet
	Online help	Online document available on the Internet at `http://www.boschrexroth.com/IAC`	
	Hydraulic valves in industrial applications	RE 07600-B	Operating instructions

1.3 Representation of information

In order that this documentation allows you to work directly and safely with your product, standardized safety notes, symbols, terms and abbreviations are used. For a better understanding, these are explained in the following sections.

1.3.1 Safety notes

This documentation contains safety notes in Chapter 2.6 “Product-specific safety instructions“ and Chapter 3 “General notes on damage to material and the product“ as well as before a sequence of activities or instructions for action, which involve the risk of personal injury or damage to equipment. The measures described for averting the hazard must be observed.

Safety notes are structured as follows:

⚠ SIGNAL WORD
Type and source of hazard! Consequences in the case of non-observance ▶ Measures to avert the hazard ▶ <LIst>

- **Warning symbol:** draws attention to a hazard
- **Signal word:** identifies the degree of hazard
- **Type and source of hazard!:** identifies the type or source of the hazard
- **Consequences:** describes the consequences in the case of non-observance
- **Precautions:** states, how the hazard can be avoided

Table 2: Hazard classes according to ANSI Z535.6-2006

Warning sign, signal word	Meaning
⚠ DANGER	Indicates a hazardous situation which, if not avoided, will certainly result in death or serious injury.
⚠ WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Damage to property: The product or the environment can be damaged.

1.3.2 Symbols

The following symbols refer to notes, which are not relevant to safety, but increase the legibility of the documentation.

Table 3: Meaning of symbols

Symbol	Meaning
ℹ	If this information is disregarded, the product cannot be used or operated in an optimum manner.
▶	Single, indented step of action
1. 2. 3.	Numbered instruction for action: The numbers indicate that the activities are to be carried out consecutively.

1.3.3 Terms used

The following terms are used in this documentation:

Table 4: Terms

Term	Meaning
IAC-R	Integrated Axis Controller
IAC-R valve	4WRPNH.../24F.. valve with integrated axis controller IAC-R
WinHPT®	Windows Hydraulics Parameter Tool
U_B	Supply voltage
V_{pp}	Peak-to-peak voltage

1.3.4 Abbreviations used

The following abbreviations are used in this documentation:

Table 5: Abbreviations

Abbreviation	Meaning
AVC	Automatic Valve Compensation
CPU	Central Processing Unit
DPM1	DP Master class 1
DPM2	DP Master class 2
DSC	Dynamic Servo Control
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
GSD	Gerätestammdatei (device master file)
HMI	Human Machine Interface
Kv	Kreisverstärkung (loop gain)
LSB	Least Significant Bit
MeldW	Meldungswort (message word)
MD	Machine datum
MSB	Most Significant Bit
NG	Nenngröße (size)
PNO	PROFIBUS Nutzerorganisation (PROFIBUS user organization)
PNU	Parameter number
SSI	Synchronous Serial Interface
ZSW	Zustandswort (status word)

2 Safety instructions

2.1 About this chapter

The product has been manufactured according to the generally accepted rules of current technology. There is, however, still a risk of personal injury or damage to equipment if you do not observe this Chapter and the safety instructions contained in this documentation.

- ▶ Read these instructions completely and thoroughly before working with the product.
- ▶ Keep this documentation in a location where it is accessible to all users at all times.
- ▶ Always pass the product together with the required documentation on to third parties.

2.2 Intended use

The product is an electrohydraulic component.
You may use the valve with integrated axis controller IAC-R and clock-synchronized PROFIBUS interface as follows:

- as actuating element for controlling the position of electrohydraulic drives with inner-loop velocity controller.
- for operation in industrial areas in accordance with DIN 50081-2
- for operation with hydraulic fluids based on mineral oil according to the data sheet

The product is intended for professional use and not for private usage.
Use according to the intended purpose implies that you have read and understood these instructions completely, especially Chapter 2 “Safety instructions”.

2.3 Improper use

Any use other than described in the section “Intended use” is considered as improper and is therefore not permitted.
For damage resulting from improper use, Bosch Rexroth AG will not bear liability. The risks arising from improper use lie exclusively with the user.
If unsuitable products are installed or used in safety-relevant applications, unintended operational states may occur in the application that can cause personal injury and/or damage to property. For this reason, use a product only in safety-relevant applications, if this use is expressly specified and permitted in the documentation of the product. For example, in explosion-protection areas or in safety-related parts of a control (functional safety).
The product is used improperly:

- if you operate the valve outside specified performance limits and operating conditions, especially prescribed ambient conditions.
- if you make modifications or conversions on the valve.
- if you store, transport or install the valve improperly.

2.4 Personnel qualifications

The activities described in this documentation require basic knowledge of mechanics, electrics and hydraulics as well as knowledge of the associated technical terms. To ensure safe usage, these activities may therefore only be carried out by qualified personnel or under the direction and supervision of qualified personnel.
Qualified personnel are those who can recognize possible hazards and institute 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 done. Qualified personnel must observe the rules relevant to the subject area and have the required expertise in this field.
With regard to hydraulic products, expertise means, for example:

- The ability to read and entirely understand hydraulic circuit diagrams,
- the complete understanding in particular of interrelationships with regard to safety equipment and
- knowledge of the function and structure of hydraulic components.

Bosch Rexroth offers qualifying training courses in specific fields. You can find an overview of training contents on the Internet at:
`http://www.boschrexroth.com`

2.5 General safety instructions

- Observe the valid regulations for accident prevention and environmental protection.
- Observe the safety regulations and rules of the country where the product is used/ operated.
- Only use Rexroth products in good technical order and condition.
- Observe all notes given on the product.
- Persons who install, commission, operate, demount or maintain Rexroth products must not consume any alcohol, drugs or pharmaceuticals that may affect their ability to respond.
- Only use accessory and spare parts released by the manufacturer in order to rule out personnel hazards arising from unsuitable spare parts.
- Adhere to the technical data and ambient conditions provided in the product documentation.
- If unsuitable products are installed or used in safety-relevant applications, unintended operational states can occur in these applications, which can cause personal injury and damage to property. Therefore, use the product only in safety-relevant applications such as in explosion protection areas or in safety-related parts of a control (functional safety), if this use is expressly specified and permitted in the documentation.
- You may commission the product only when it has been established that the final product (for example, a machine or system), in which the Rexroth products are installed, comply with national regulations, safety regulations and standards relevant for the application.

2.6 Product-specific safety instructions

⚠ WARNING

Hazardous movements!

Risk of injury due to incorrect activation or improper parameterization and resulting unforeseeable machine movements.

- If persons have to enter the danger zone while the control is active, provide monitoring features or take other higher-level precautions on the plant side to ensure personal safety. These features must be rated according to the specific situation on site on the basis of a risk and failure analysis of the plant manufacturer/user. The safety instructions valid for the plant must be taken into account.
- Before installing the axis controller or connecting or disconnecting plug-in connectors or before carrying out any work in conjunction with this, de-energize and depressurize the relevant plant section and secure it against being switched on.
- The axis controller emits interference to other electronics within the given limit values. It also responds to electromagnetic interference emitted by non-shielded, improperly installed or incorrectly connected signal cables. This may result in malfunction in the activation. Only use electronics below EMC limit values or provide appropriate shielding.
- Electrostatic processes, an incorrect grounding concept or no equipotential bonding can cause damage to the electronics and consequently lead to malfunction or uncontrolled movements of the machine. Ensure proper grounding and provide equipotential bonding.
- When the product is used outside the specified IP protection class, short-circuits and malfunction can occur, which can result in uncontrolled machine movements. Therefore, use the product only within the IP protection class and environments specified in the data sheet.
- Provide safety functions for personal safety separately. The IAC-R valve itself does not include safety functions for personal safety and is not a safety-relevant component.
- Avoid contact with salty environments and adhere to the ambient temperature specified in the data sheet.
- Incorrectly parameterized valves can cause unintended movements or unintended behavior of the machine (e.g. in the case of parameters accidentally set incorrectly). Please note that changed parameters become effective directly on the valve. The behavior of the IAC-R valves is therefore directly influenced.
- Inform your service and repair department immediately in the case of malfunction of the system.

Great mechanical forces and high acceleration!

Danger to life and risk of injury!

- Never stay in the danger zone of the machine while the system is switched on.
- Never render safety-relevant plant parts ineffective.

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enquiries@hyquip.co.uk
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⚠ WARNING

Ejected oil jet!

Danger to life and risk of injury!

- Never open pressurized lines.
- Before carrying out any work on the hydraulic system, depressurize the relevant system part.
- Install the IAC-R valve according to the instructions!

Pressurized lines!

Risk of injury.

- Never disconnect, open or cut depressurized lines!
- Before installing the valve or carrying out any work, depressurize the system.

Systems not shut down!

Working on systems in operation poses a danger to life and limb. The work steps described in these operating instructions may only be performed on systems after they were shut down. Before beginning work:

- Make sure that the drive motor cannot be switched on.
- Make sure that all power-transmitting components and connections (electric, hydraulic) are switched off according to the manufacturer's instructions and secured against being switched on again. If possible, remove the main fuse of the system.
- Ensure that the system is completely hydraulically relieved and depressurized. Please follow the system manufacturer's instructions.
- Only qualified personnel (see Chapter 2.4 "Personnel qualifications" on page 9) are authorized to install the IAC-R valve.

High electrical voltage due to incorrect connection!

Danger to life, risk of injury from electric shock.

- Before starting installation work, plugging and unplugging connectors and carrying out any work, switch the system off. Secure the electrical equipment against being switched on.
- Before switching the system on, check the protective conductor on all electrical devices for proper connection according to the wiring diagram.
- Only connect devices, electrical components and cables that feature PELV = Protective Extra Low Voltage to connections and terminals for voltages of 0 to 50 V.
- Only connect voltages and electric circuits provided with a safe isolation from dangerous voltages. Safe electrical isolation can be achieved, for example, with isolating transformers, safe optocouplers, or mains-free battery operation.

Easily inflammable hydraulic fluid!

Hydraulic fluid mist escaping due to defective or incompletely installed hydraulic valves and improperly connected lines in conjunction with fire or other heat sources can cause fire and explosion.

- Do not use hydraulic valves in areas with naked flames and only at a sufficient distance to heat sources.

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⚠ CAUTION

Hot surfaces!
Risk of burning!
- Let the valve cool down before touching it.
- Protect yourself by wearing heat-resistant protective clothes, e.g. gloves.
- Also observe standard ISO 13732-1.

Fault currents and short-circuits!
Reduced safety and malfunction.
- The environment must be free from conductive contamination (acids, lyes, anti-corrosion agents, salts, metal vapors, etc.), and the device must not be exposed to them. Generally, rule out deposits in accordance with the IP protection class.

Improper mounting!
Mounting the hydraulic valves with mounting screws of reduced strength, insufficient mounting or mounting to blocks and manifolds of insufficient stability can cause the hydraulic valve to loosen itself and fall down. Hydraulic fluid can flow out and lead to personal injury and damage to property.
- Mount the hydraulic valve completely with the help of suitable mounting aids in accordance with the installation instructions.
- Mount the hydraulic valves only to blocks or manifolds that are adequate in terms of the valve weight.
- Observe the tightening torques and the screw strength.

Improperly installed lines and cables!
Risk of stumbling!
- Install cables and lines so that nobody can stumble across them..

Uncontrolled system behavior!
The failure of an IAC-R valve can lead to malfunction of the assembly and therefore to unforeseeable behavior!
- Replace or have defective components replaced immediately.

Contaminated hydraulic fluid!
Contaminants in the hydraulic fluid can lead to malfunction e.g. jamming or clogging of orifices of the hydraulic valve. In the worst case, this can result in unexpected system movement and therefore pose a risk of personal injury.
- Make sure that the hydraulic fluid achieves the cleanliness class prescribed for the hydraulic valve within the entire operating range.

Exceeding maximum temperatures!
When hydraulic valves are used outside the specified temperatures, malfunction may occur, e.g. overheating of valve solenoids. In the worst case, this can result in unexpected system movements and therefore poses a risk of injury.
- Only operate the hydraulic valves at temperatures within the specified ambient and fluid temperature range.

⚠ CAUTION

Leakage at improper operating temperatures!

When hydraulic valves are used outside the specified temperatures, permanent leakage may occur on the hydraulic valves. As a result, hydraulic fluid can be ejected in the form of a hydraulic fluid jet and injure people and cause damage to property or pose a risk to the environment.

- Only operate hydraulic valves at ambient temperatures and at fluid temperatures provided for them.
- In the case of leakage, replace damaged seals or the hydraulic valve immediately.

Corrosion!

When hydraulic valves are used in a humid environment or in water, the hydraulic valve and the mounting screws may corrode. Consequently, both, mounting screws and the hydraulic valves lose their strength and can loosen and in the end pose a risk of injury.

- Use only mounting screws that feature adequate corrosion protection and replace mounting screws that show severe corrosion damage.
- Ensure adequate corrosion protection and replace valves with serious corrosion damage in good time

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3 General notes on damage to material and the product

NOTICE

Pressure intensification!

Risk of damage to the cylinder chamber, the supply line and the valve, if the valve is connected to the piston rod-sided chamber of a single-rod cylinder.

- Make sure that the hydraulic fluid can flow away from this chamber!

Overheating!

Risk of damage to the solenoid coil.

- Adhere to the ambient conditions in accordance with the data sheet.
- Do not use free-wheeling diodes in the solenoid cables!
- Observe the prescribed minimum distance when installing several valves to form a valve battery.
- Adhere to the prescribed minimum size and the minimum thermal conductivity of the valve subplate.

Wrong cables!

Loss of voltage or melting of cable.

- For solenoid cables up to 50 m length, use cable type LiYCY 1.5 mm², for position transducer cables, cable type LiYCY 0.5 mm² shielded. In the case of greater lengths, please consult us!

Cables lying around!

Risk of damage to cables!

- Install cables and lines so that they cannot be damaged..

Uncontrolled unplugging and plugging of plug-in connectors!

The device can be destroyed!

- Before carrying out any installation work, plugging or unplugging connectors from the device, disconnect the device from the mains or power source or reliably de-energize it. Damage to the product caused by improper installation is not covered by the warranty!

Impermissible mechanical loading!

Hitting or impacts on the hydraulic valve can damage or even destroy the valve.

- Never utilize the hydraulic valve as a handle or step. Do not lay/place any objects on it.

Foreign particles and contaminants in the hydraulic valve!

Dirt and foreign particles getting into the hydraulic valve will lead to wear and malfunction. The safe operation of the hydraulic valve can consequently no longer be ensured.

- When installing the valve, observe strictest cleanliness to prevent foreign bodies such as welding beads and metal cuttings from entering hydraulic lines.
- Do not use linty cloths for cleaning.
- Take care that no detergents get into the hydraulic system.

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NOTICE

Environmentally harmful hydraulic fluid!

Escaping hydraulic fluid leads to environmental pollution.

- Remove any leakages immediately.
- Dispose of the hydraulic fluid in accordance with the national regulations of your country.

The warranty is valid exclusively for the configuration delivered.

- Warranty claims will be rejected in the case of improper installation, commissioning and operation as well as in the case of use not in accordance with the intended purpose and/or improper handling.

4 Scope of delivery

The scope of delivery includes:

- IAC-R valve

Accessories such as mating connectors and terminating resistors are not included in the scope of supply, but have to be ordered separately. See Chapter 14.1 “Optional accessories“ on page 123.

Check the scope of delivery for transport damage. Check that all seal rings are present on the valve connection surface.

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5 About this product

5.1 Performance description

High-response valve with integrated digital axis controller (IAC-R) with clock-synchronized PROFIBUS and PROFIdrive profile.
For technical data, see data sheet 29291.
Functionality: Position control of a hydraulic axis with inner velocity control loop and optional force control.
Decentralized intelligence for the hydraulic drive technology through integration of digital technology in proven high-response valves. A microprocessor integrated in the valve electronics assumes all essential functionalities of the valves. The valves are connected to machine control systems via a clock-synchronized PROFIBUS DP/V2 (PROFIdrive profile V4.0). The position measuring system of the drive is connected directly to the integrated axis controller IAC-R.
The valve behavior corresponds to PROFIdrive application class 4 with DSC.
The functionality of position control with inner velocity control loop is supported.
The control variable “position” (e.g. of a hydraulic cylinder) follows specified characteristics of the reference variable (control difference) (follow-up control).
The characteristics of the reference variable are provided by the higher-level control (PROFIBUS master) over the clock-synchronized PROFIBUS. In order to realize a control behavior with constant Kv (loop gain) (precondition for the interpolation of several drive types), the position controller is complemented by an inner velocity control loop.
The following position measuring systems are supported:

- Absolute position measuring system with SSI interface
- Absolute position measuring system with EnDat 2.2 interface
- Incremental position measuring system with $1V_{ss}$ interface
- Analog position measuring system

Optionally, alternating control can be realized. In this case, force control is activated in addition to position control. The actual force value is calculated by sensing the differential pressure and taking account of the cylinder areas.

5.2 Device description

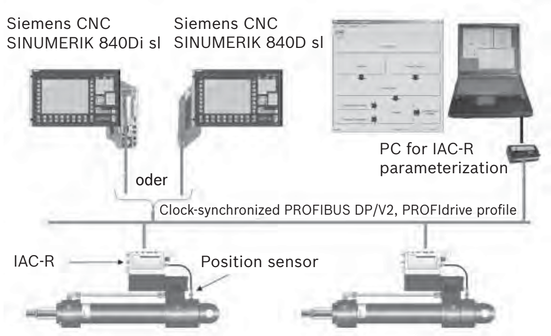

Fig. 1: System overview of NC control system and IAC-R with clock-synchronized PROFIBUS connection for interpolating hydraulic axes

The IAC-R valve is tested and calibrated in the factory. Connection cables and connectors are not included in the scope of delivery. The connected valve is actuated directly in the housing by means of supply lines, with the actuation being maintenance-free.
The valves are delivered ex factory with default parameters. However, application-specific parameters of the valves have to be set during commissioning. The control parameters can be adjusted over PROFIBUS DP/V1.

5.2.1 Parameterization and commissioning

The PC program WinHPT® helps the user accomplish his/her project planning tasks and parameterize the IAC-R valves. Communication with the devices can be handled via a PROFIBUS DP/V1 interface. The parameterization is determined, optimized, and saved as data record on the PC or the machine control system during the initial start-up. Optionally, the parameterization can be made directly via the machine control system and the PROFIBUS DP/V1.

Fig. 2: Parameterization using a PC

5.2.1.1 Commissioning software WinHPT®

Functionality: parameterization, commissioning and diagnosis, project storage on the PC.

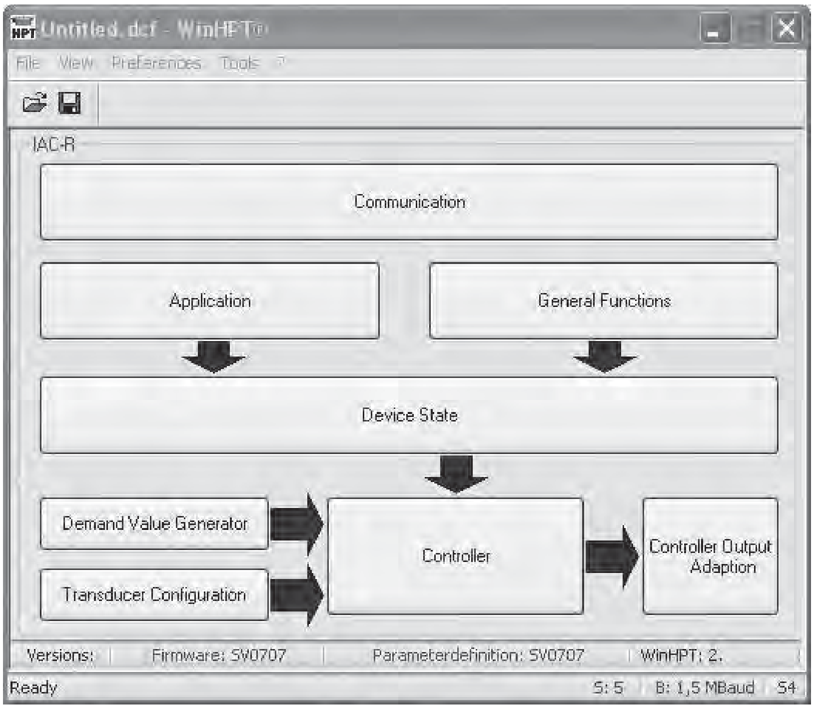

Fig. 3: Commissioning software WinHPT®

5.2.1.2 Online support on the Internet

On the website `http://www.boschrexroth.com/IAC` Rexroth provides the software WinHPT® with online help as well as further downloads.

5.2.2 IAC-R with clock-synchronized PROFIBUS interface

5.2.2.1 Features

The IAC-R valve integrated axis controller with clock-synchronized PROFIBUS, type 4WRPNH, is based on the high-response valve series 4WRPEH...2X and is characterized by the following features:

- Type 4WRPNH...2X, sizes 6 and 10
- Clock-synchronized input of the reference variable (control difference)
- Position control with inner velocity control loop
- Force control
- Hydraulics-specific controller functionalities
  - PIDT1 controller
  - actuating variable adaptation
  - state controller

- Device behavior corresponds to PROFIdrive application class 4
- Support of DSC functionality
- Separate voltage supply for controller assembly and power part
- Supported position measuring systems:
  - absolute position measuring system with SSI interface
  - absolute position measuring system with EnDat 2.2 interface
  - incremental position measuring system with $1V_{ss}$ interface
  - analog position measuring systems

- Completely matched unit consisting of valve, digital control assembly, and PROFIBUS connection
- Short commissioning time thanks to connected PC and commissioning software WinHPT® via PROFIBUS DP/V1
- The appropriate parameterization is determined, optimized, and saved to the PC during the commissioning procedure.

The controller structure looks as follows:

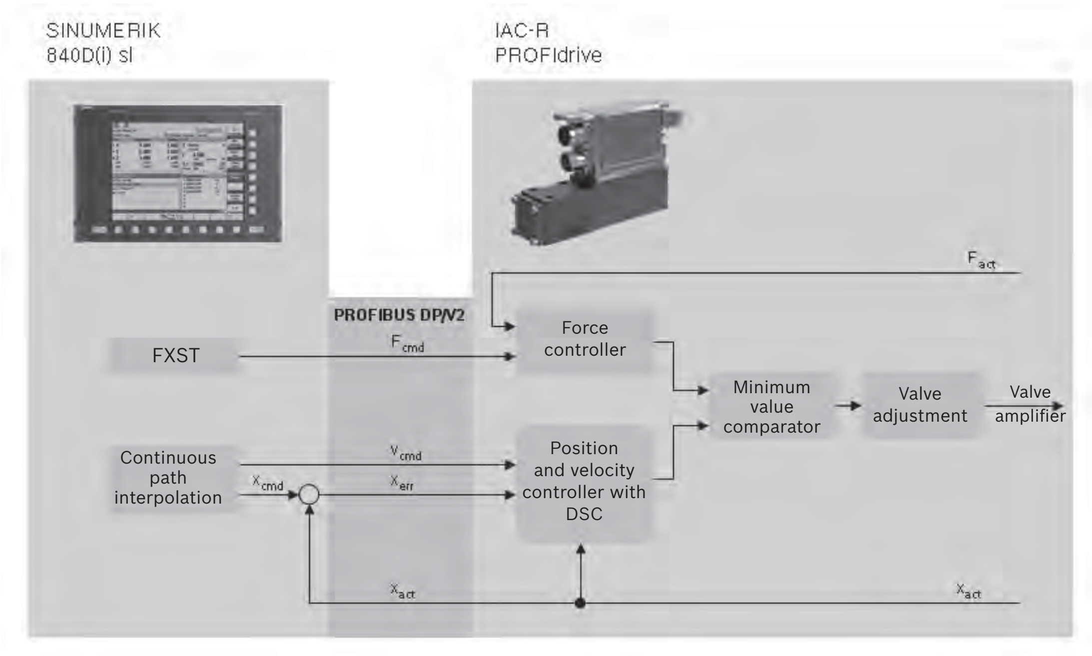

Fig. 4: Overview of controller structure

5.2.3 Principle and system of 4WRPNH with PROFIdrive

5.2.3.1 Overview

The IAC-R valve is characterized by the following essential features:
- Closed-loop position control with inner velocity control loop
- Force control
- SSI sensor interface or
  $1V_{ss}$ sensor interface or
  EnDat 2.2 sensor interface
- Analog sensor interfaces
- Automatic drive measurement
- All parameter settings can be saved in the IAC-R valve in a non-volatile memory.

Operating an IAC-R is only possible in conjunction with a higher-level NC control system SINUMERIK 840D(i) or SINUMERIK 840Di(sl) by Siemens.

5.2.4 Basic settings

The commissioning procedure of the IAC-R valve with reference to a control axis described in the following is only applicable in conjunction with the SINUMERIK 840D(i) sl. The knowledge of handling and operating the SINUMERIK 840D(i) sl is considered a prerequisite.
The SINUMERIK 840D(i) sl is not described in detail here (see documentation by Siemens). Only the relevant machine data and optimization options required for the commissioning procedure are addressed.
The drive respectively control structure is specified by the PROFIdrive profile of PNO version 4.0 as DSC (Dynamic Servo Control).
The clock-synchronized communication between the IAC-R valve and the SINUMERIK 840D(i) sl is based on the constant cycle time drive bus PROFIBUS DP/V2.
For parameterization and diagnosis of the IAC-R you require the operating software WinHPT®.
The axis-specific machine data in the SINUMERIK 840D(i) sl detailed below have to be parameterized in conjunction with the commissioning procedure of the IAC-R valve.

5.2.4.1 Basic settings of the drive-relevant parameters in the SINUMERIK 840D(i) sl

Table 6: Basic settings

MD	Function	Value
13050	Initial address	X
13060	$MN_DRIVE_TELEGRAM_TYPE DPV2 telegram type	
	Position Control	5
	Alternating Control	105
	Alternating Control	116
13070	$MN_DRIVE_FUNCTION_MASK Note: Bit 2 = 0 -> parameter accesses to the IAC-R (e.g. PNU979) are activated	0x43EA or 0x43A2
13080	Drive type PROFIBUS	3
30110	Command value assignment: drive No./assembly	X
30130	Output type command value axis active/inactive	1
30200	Number of encoders	1
30220	Actual value assignment: drive No./assembly	X
30230	Actual value assignment: input on drive module/measurement loop card	1
30240	Type of actual value acquisition	
	Incremental position measuring system (1Vss)	1
	Absolute position measuring system (SSI, analog, EnDat 2.2)	4
30242	Encoder is independent	0
30244	Encoder measurement type	1
30260	Encoder fine resolution	4
30300	Rotary axis/spindle	0
31000	Direct measurement system (linear scale)	1
31010	Division period linear scale	
	Incremental position measuring system (1Vss)	= point spacing
	Analog	0.2 mm
	SSI	Encoder resolution in [mm] x 2048
	EnDat 2.2	Encoder resolution in [mm] x 2048
31020	Encoder points per revolution	1
31025	Encoder multiplication	2048
31040	Encoder mounted directly on the machine	1
32000	Maximum axis velocity	X
32010	Conventional rapid motion	X
32020	Conventional axis velocity	X
32100	Travel direction	X
32110	Sign actual value (control direction)	1
32200	Kv (loop gain) value	X
32250	Nominal output voltage	100 %
32260	Nominal engine speed	1000 rev/min

MD	Function	Value
32300	Acceleration	X
32450	Backlash compensation	0
32490	Mode of operation friction compensation	1
32500	Enable friction compensation	0/1
32510	Adaptation friction compensation active	0
32520	Friction compensation rate	X mm/min
32540	Friction compensation time constant	X sec
32610	Velocity pilot control weighting	X
32620	Pilot control type	1
32630	Pilot control type activated by program	0
32640	DSC on/off	1
32642	Configured dynamic stiffness control	0
32800	Time constant current regulation loop for pilot control	0
32810 [1)]	Time constant velocity pilot control	0.0 sec
32900	Dynamic adaptation Kv value	0
32910	Time constant dynamic adaptation	0
32930	Activate low-pass filter at position controller output	0
32940	Time constant low-pass filter at position controller output	0
34090	Reference value (reference point offset)	X
34200	Homing mode	
	Incremental position measuring system (1Vss)	1
	Absolute position measuring system (SSI, analog, EnDat 2.2)	0
34990	Smoothing time constant for actual values	0
36000	Exact stop, rough	X
36010	Exact stop, fine	X
36030	Standstill tolerance	X
36040	Delay time standstill monitoring	X
36300	Encoder frequency	30 MHz
37620	Resolution of torque reduction on PROFIBUS	0.01 %

[1)] Generally enter the value “0“.

Machine data values marked with an “X” are axis-specific values.

5.2.4.2 Commissioning software WinHPT®

In order to parameterize the IAC-R valve, you have to press the “FEED STOP” button of the SINUMERIK 840D(i) sl. See Chapter 5.2.8.4 “General operating instructions” on page 81.

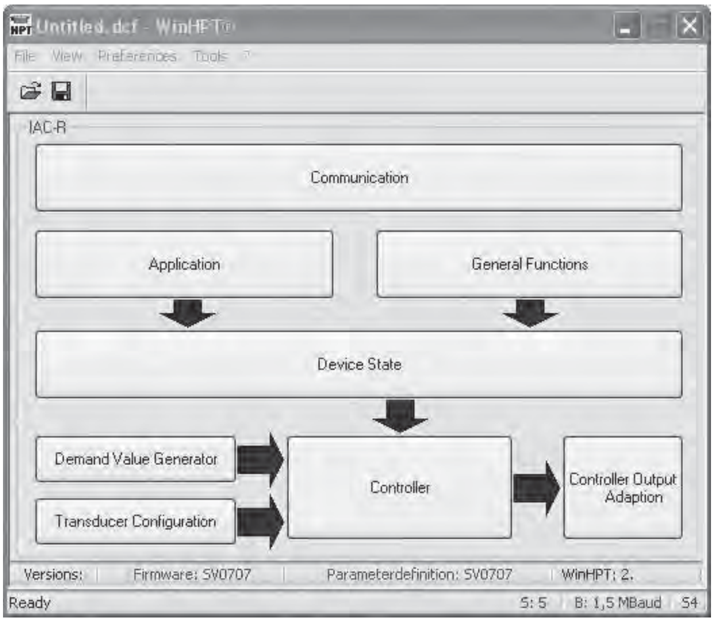

Fig. 5: Commissioning software WinHPT®

▶ Select “Application” in the basic view of WinHPT®.

Application

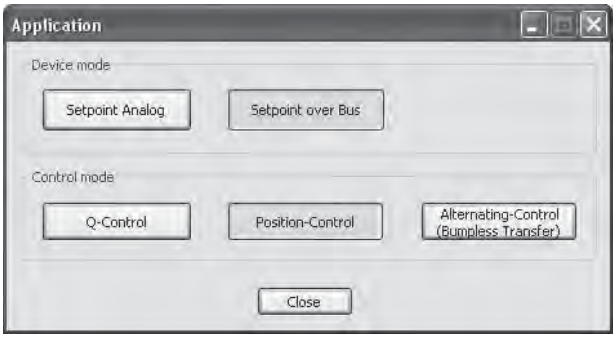

Fig. 6: Application

For an axis control with one SINUMERIK 840D(i) sl you simply have to select the combination “Setpoint over Bus” with “Position Control” (for pure position control) or “Alternating Control“ (for position control with force control). Confirm your selection by clicking the “Close“ button.

▶ Open “Transducer Configuration” in the basic view of WinHPT®.

Transducer Configuration

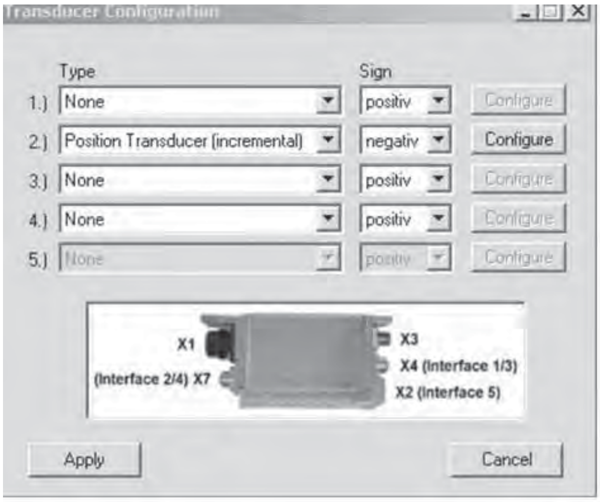

Fig. 7: Transducer Configuration (1 to 4 = interface number)

1.] Analog sensors

2.] Incremental, SSI, EnDat 2.2 or analog sensors (depending on device)

3.] Analog sensors

4.] Analog sensors for IAC-R with SSI, EnDat 2.2 and $1V_{pp}$(incremental) interface not available

For highly precise applications, normally an incremental position transducer with 1 V_{PP} signals, EnDat 2.2, or SSI interface is used. The position transducer is connected to connector X7 at interface 2. An analog transducer with ±10 V or 4-20 mA interface can be used as well (order option).
The “Sign“ is determined by the “mounting orientation” of the position transducer with reference to the direction of travel with positive valve opening. The following table describes this correlation with a simple rule.

Table 7: Transducer Sign

Transducer “Sign“	Note
Positive	When the sensor delivers increasing actual position values with positive valve opening (P→A + B→T)
Negative	When the sensor delivers decreasing actual position values during positive valve opening (P→A + B→T)

▶ Make your settings by selecting “Configure“.

5.2.4.2.1 Incremental (1 V_{pp}) sensors

When the function “Configure” is selected, a window for entering the position transducer data for incremental encoder 1 V_{pp} is displayed.

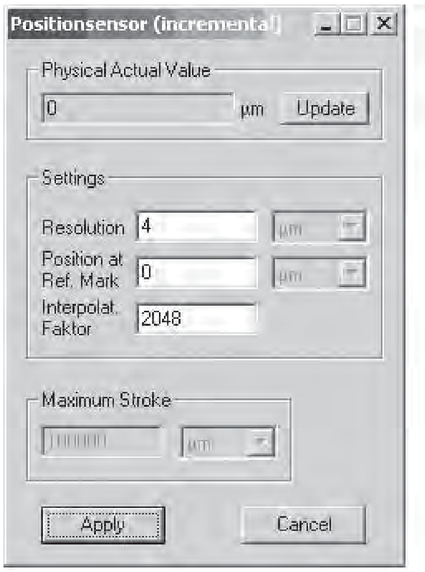

Fig. 8: Position sensor (incremental)

Resolution

Grid constant of the position transducer, e.g. 4 µm

Position at Ref. Mark

As the homing mode is implemented by the higher-level control system SINUMERIK 840D(i) sl, the reference value (reference point offset) is to be entered in MD 34090 of the same. Entry always “0”.

Interpolatation factor

Default value: 2048

- ▶ Confirm your selection by clicking the “Apply“ button.
- ▶ Set the parameters MD 31010, 31020 and 31025 as follows in the SINUMERIK 840D(i) sl:

Table 8: Settings SINUMERIK 840D(i) sl

MD	Note	Value
31010	Division period linear scale	Encoder resolution in [mm]
31020	Encoder points per revolution	1
31025	Encoder multiplication	2048

5.2.4.2.2 EnDat 2.2 sensors

EnDat 2.2 position sensors need not to be configured, because the IAC-R valve reads out the information from the sensor.

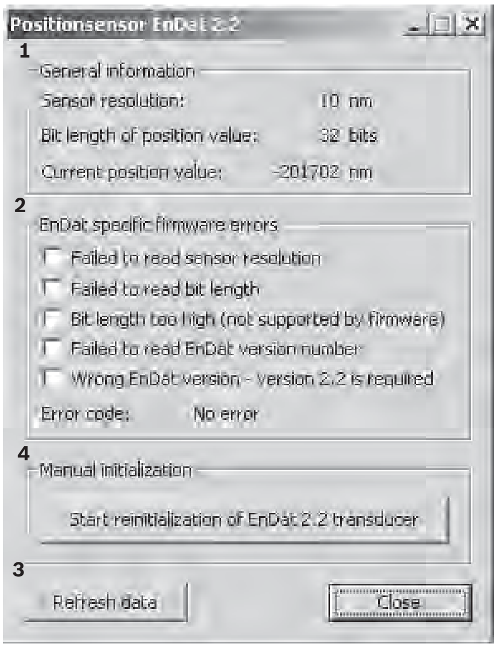

Fig. 9: Position sensor EnDat 2.2

1] EnDat 2.2 sensor data

2] EnDat 2.2 error messages

3] Check if error message is present

4] Starts re-initialization; e.g. error acknowledgement or sensor replacement

- Exit the dialog by clicking the “Close” button.
- In the SINUMERIK 840D(i) sl set the parameters MD 31010, 31020 and 31025 as follows:

Table 9: Settings SINUMERIK 840D(i) sl

MD	Note	Value
30260	Encoder fine resolution	4
31010	Division period of linear scale	Encoder resolution in [mm] x 2048
31020	Encoder points per revolution	1
31025	Encoder multiplication	2048

+44 (0)1204 699 959
enquiries@hyquip.co.uk
www.hyquip.co.uk

5.2.4.2.3 SSI sensors

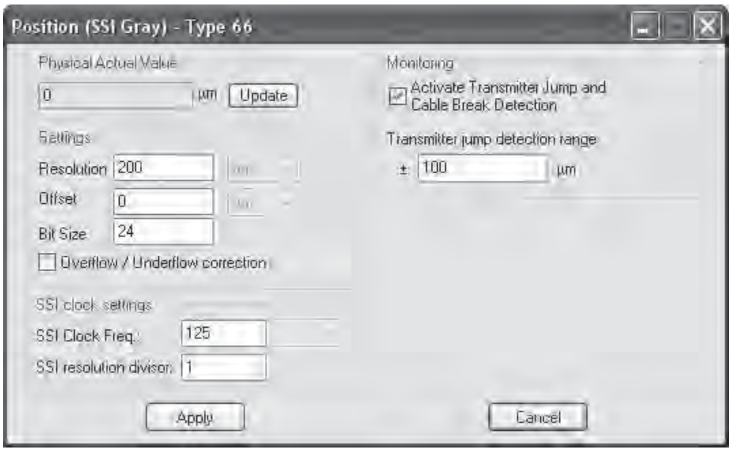

Fig. 10: Position sensor SSI (Gray code)

Resolution
Bit Size

▶ You have to enter values for “Resolution“ and “Bit Size“ of the position transducer.

Offset

The reference point offset is performed by the control SINUMERIK 840D(i) sl (MD 34090).

Overflow/Underflow correction

This function is required for rotary encoders. When the encoder exceeds its maximum value, this function performs further calculations.
Example: Maximum value shown for the sensor 16383
Next increment with activation 16384
Next increment without activation 0

Monitoring

When activated, jumps that exceed the position value change rate within 4 ms are reported and an error is issued.

SSI clock settings
SSI Clock Freq.

The frequency must be set irrespective of cable length and encoder specification.

SSI resolution divisor

Adjustment of sensor resolution in the case of gearboxes.

ℹ The parameter **“**Offset“ in WinHPT® must always be set to “0“!

▶ Confirm by clicking the “Apply“ button.
▶ In the SINUMERIK 840D(i) sl set the parameters MD 31010, 31020 and 31025 as follows:

Table 10: Settings SINUMERIK 840D(i) sl

MD	Note	Value
30260	Encoder fine resolution	4
31010	Division period of linear scale	Encoder resolution in [mm] x 2048/SSI resolution division
31020	Encoder points per revolution	1
31025	Encoder multiplication	2048

- Enter the “Sensor Resolution“ of the encoder used in MD 31010.
- Set the encoder multiplication MD 31025 to the value “2048“.
- Set the encoder resolution MD 30260 to “4“.

5.2.4.2.4 Position sensor (analog)

- For the analog position sensors, enter 2 positions in μm with the appropriate voltage values (mV) or current values (mA).

Example 1: Sensors with voltage output

Point 1: Position = 0 μm, signal = -10000 mV
Point 2: Position = 100000 μm, signal = 10000 mV

Example 2: Sensors with current output

Point 1: Position = 0 μm, signal = 4 mA
Point 2: Position = 100000 μm, signal = 20 mA

In order to improve the output signal quality of the sensor in case of faults, a low-pass filter in the form of a time delay element can be used. The entry is to be made in μs.

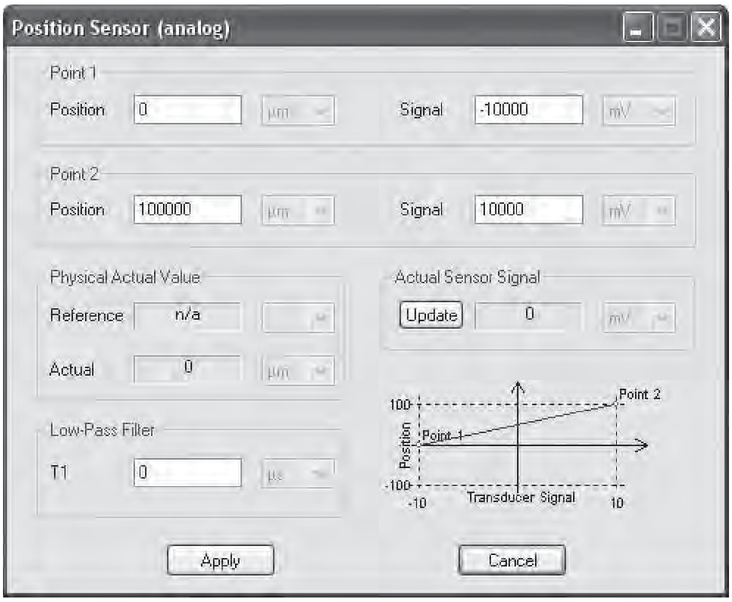

Fig. 11: Position sensor (analog)

- Confirm by clicking the “Apply” button.

▶ In the SINUMERIK 840D(i) sl set the parameters MD 31010, 31020 and 31025 as follows

Table 11: Settings SINUMERIK 840D(i) sl

MD	Note	Value
30260	Encoder fine resolution	4
31010	Division period of linear scale	0.2 mm
31020	Encoder points per revolution	1
31025	Encoder multiplication	2048

▶ Generally, enter the value “200 µm” in MD 31010 and the value “2048” in MD 31025 for sensors with analog output signal (irrespective of current or voltage and resolution).

▶ Set the sensor fine resolution MD 30260 to “4”.

5.2.4.2.5 Pressure sensor (analog)

With analog pressure sensors, 2 pressures in mbar have to be entered with the corresponding voltage values (mV) or current values (mA).

Example 1: Sensors with voltage output

Point 1: Pressure = 0 mbar, signal = 0 mV
Point 2: Pressure = 100000 mbar, signal = 10000 mV

Example 2: Sensors with current output

Point 1: Pressure = 0 mbar, signal = 4 mA
Point 2: Pressure = 100000 mbar, signal = 20 mA

The entries of piston rod (Rod) and barrel diameter (Cylinder) determine the areas to be considered. If the piston rod diameter (Rod) is set to the value 0, no piston rod is available on the cylinder side that is assigned to the pressure sensor.

Example

Pressure sensor in A
Rod = 0 µm
Cylinder = 63000 µm

Pressure sensor in B
Rod = 45000 µm
Cylinder = 63000 µm

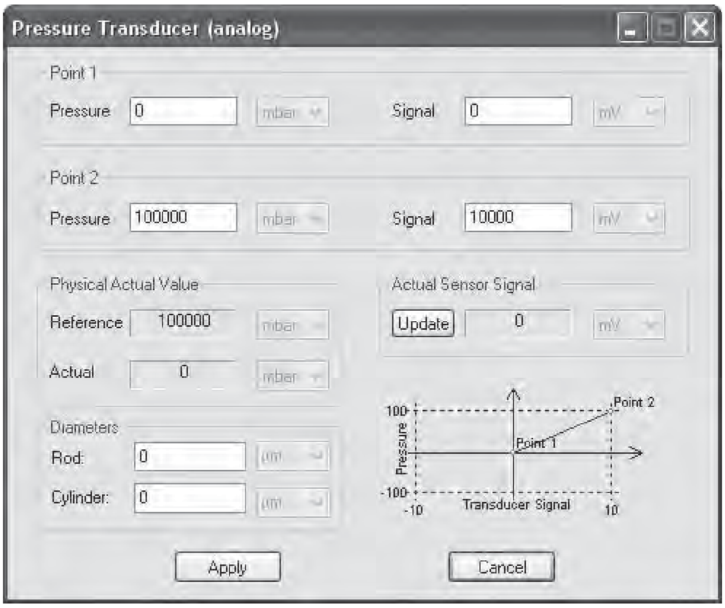

Fig. 12: Pressure sensor (analog)

▶ Confirm by clicking the "Apply" button"

5.2.4.3 Valve calibration

⚠ WARNING

Uncontrolled movement of the drive!

Risk of injury! During the measurement process, the IAC-R valve initiates movements of the drive on its own. In this case, the higher-level control SINUMERIK 840D(i) sl has no control over the drive movement!

- ▶ Make sure that during the measurement process (axis movement) nobody stays within the working area of the hydraulic drives and the machine cannot be damaged.
- ▶ Make sure that the machine is in a safe state which allows the measurement procedure to be carried out.
- ▶ Only one axis may be measured at a time!
- ▶ The axis movements can be cancelled at any time by clicking "Abort measurement" in WinHPT®. See Fig. 19, button 5, on page 35.

5.2.4.3.1 Measurement with WinHPT®

The IAC-R valve offers the possibility of manual (semi-automatic) or automatic measurement AVC (automatic valve compensation) for linearizing the valve characteristic curve. With AVC the following data are calculated:

- K_{VOL} (flow adaptation)
- Zero point calibration (offset)
- Valve linearization (inflection compensation)

- Direction-dependent gain
- Axis model

The IAC-R valve provides for two measurement modes, automatic and semi-automatic. The difference refers to the setting of the “operating range”, i.e. within which range (position value) the axis may travel during the actual measurement procedure.
During automatic measurement, the IAC-R valve first determines the cylinder end positions on its own and subtracts a value of 1.5 mm from each. Afterwards, the actual measurement starts within this range.
During semi-automatic measurement, the admissible travel range, or the end positions, respectively, within which the actual measurement procedure is to take place, must be set manually in the dialog.
The measurement process consists of the IAC-R valve establishing the working range for the measurements after START either automatically or manually (semi-automatically). Then, the axis is measured in both cases through sinusoidal movements at various amplitudes and frequencies. This measurement procedure takes place without operating the SINUMERIK 840D(i) sl and is controlled by means of the operating software WinHPT®
In order that the measurement process can be carried out successfully, the following boundary conditions must be fulfilled:

Controller Output Adaption

▶ Select menu field “Controller Output Adaption” in WinHPT®.

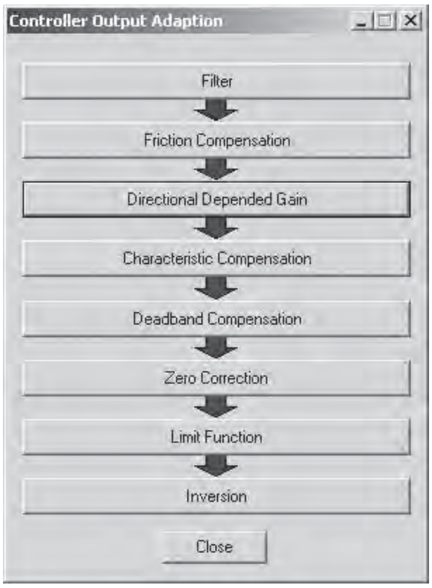

Fig. 13: Controller Output Adaption

Characteristic Compensation

▶ Select menu item “Characteristic compensation” in the parameterization field.

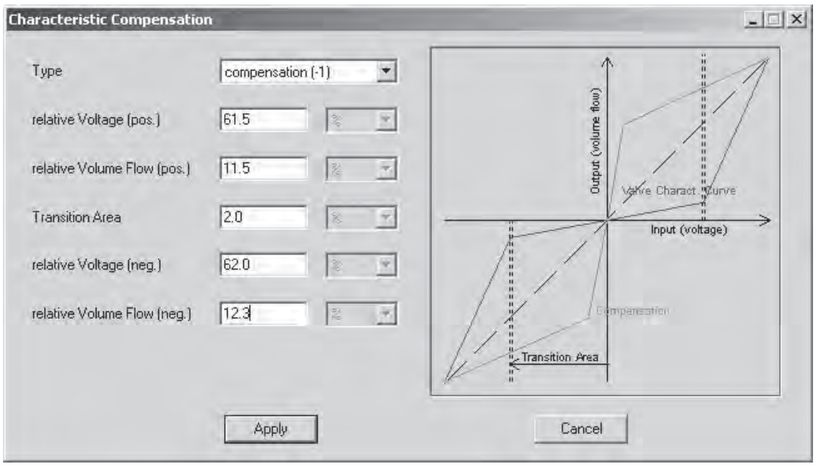

Fig. 14: Characteristic Compensation

▶ Set parameter “Type” to “compensation (-1)“ if the valve used has an inflected characteristic curve. When using linear valves, set parameter “Type” to “none“. In this case, the axis is measured as with valves with inflected characteristic curve. The values “relative Voltages“, “relative Volume Flow“ and “Transition Area“ are irrelevant at this point in time. Click the button “Apply” to confirm the selection and close the dialog by clicking the “Cancel” button.

Directional Depended Gain

▶ Call the dialog ”Directional Depended Gain“.

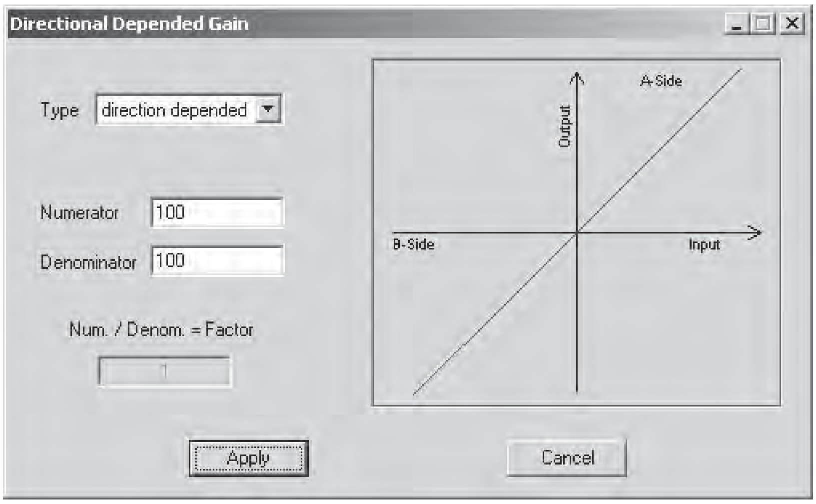

Fig. 15: Directional Depended Gain

▶ In the case of a single-rod or double-rod cylinder or hydraulic motor, set the “Type“ to “direction depended“. The values “Numerator“ and “Denominator“ are irrelevant at this point in time.

- Confirm your entry by clicking the "Apply" button and then close the dialog by clicking the "Cancel" button.
- Close the menu field "Controller Output Adaption" by clicking the "Close" button.
- Call "Controller" in the WinHPT® basic view.

In this dialog, the parameter "Axis model" must be set to "0", because this parameter is also calculated and set automatically.

- Click the "Apply" button to confirm your entry and then close the dialog by clicking the "Cancel" button.

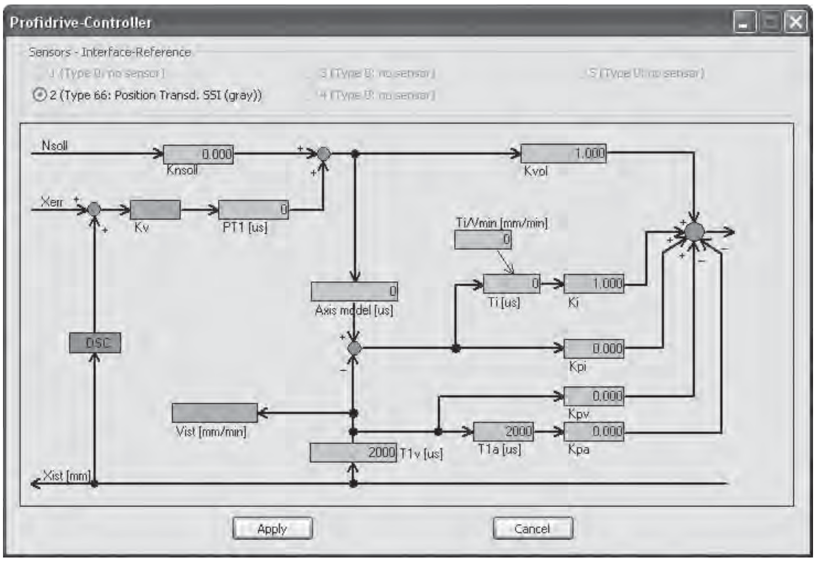

Fig. 16: PROFIdrive controller

Before the measurement process can take place, the following conditions must be fulfilled:

- Oil pressure present
- IAC-R valve is configured for position control
- Enable was set by the control

It is recommended that the measurement is started when the machine and oil supply have reached the operating temperature in order to obtain reproducible results.

Because the axis moves independently of the control during the measurement process, the tolerance band/standstill monitor might signal an alarm/error. To prevent this without having to change relevant parameters in the control, the "start position" (= current actual position when the measurement process is activated) is automatically transmitted as actual position to the control as standard, i.e. the IAC-R valve simulates an axis at standstill!

The dialog for automatic valve compensation can be opened using the "General Functions" in the main window of WinHPT®.

Fig. 17: General Functions

▶ Call the dialog “Autom. valve comp.“.

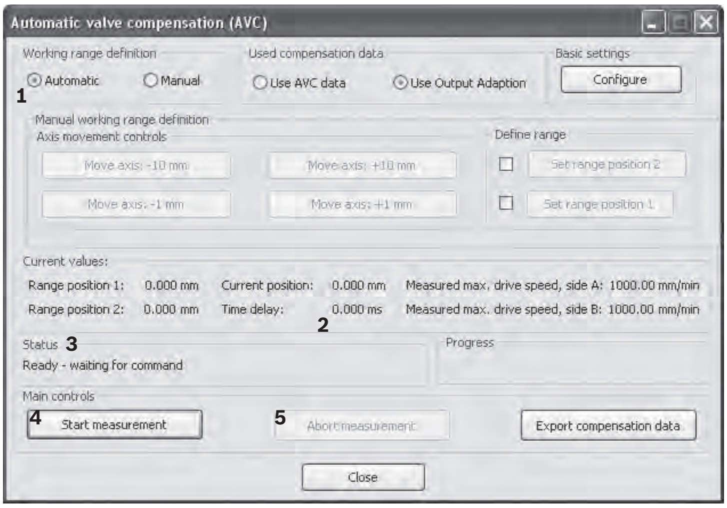

Fig. 18: Automatic valve compensation (AVC)

1] Select “Automatic” or “Manual”
2] Measured time corresponds to axis model value
3] Status and error messages, if present
4] Start measurement
5] Stop measurement

AVC Basic Settings

To adjust the “Basic settings“, select “Configure“.

Hydraulic system characteristic values

In order that the correct speed can be run for AVC, the hydraulic basic parameters must be adjusted.

Threshold settings

Permissible maximum travel speed while measuring. This value depends on the mechanical setup of the machine. Control characteristics for velocities greater than this value are not optimized.

Establish the general data and enter them. Enter the maximum speed permitted for the measurement process.

- Confirm your entry by clicking the "Apply" button and then close the dialog by clicking the "Cancel" button.

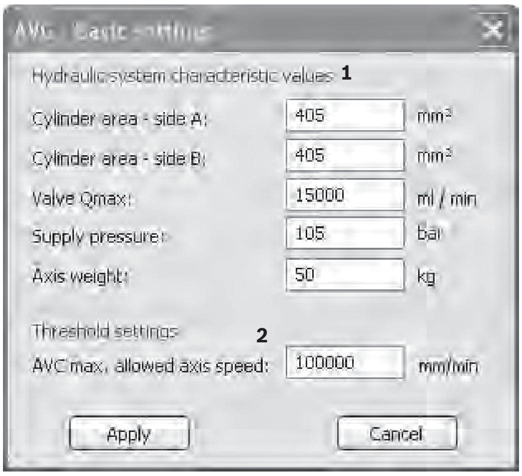

Fig. 19: Dialog "Basic Settings"

1] Dialog and description of settings of general data
2] Max. allowed axis speed for the measurement process.

5.2.4.3.2 Starting the automatic measurement process

- Select "Automatic" in the field "Working range definition".
- Start the measurement process by clicking the "Start measurement" button.
- Upon successful completion of the measurement process, the radio button in the field "Used compensation data" is automatically set to "Use AVC data" and the measured characteristic curve is used for linearizing the valve.

The measurement process takes about 5 minutes and can be cancelled at any time by pressing the button "Abort measurement".

The progress of the measurement is shown by the progress bar in the dialog. The two positive stop positions are displayed in the dialog at "Range position 1 + 2". You can save the established characteristic curve by clicking the button "Export compensation data".

Should, for technical reasons, an automatic measurement of the valve be impossible, the valve characteristic curve can be adapted manually (see Chapter 5.2.5.5 "Manual adaptation of the valve characteristic curve" on page 52).

5.2.4.3.3 Starting the semi-automatic measurement process

The “semi-automatic measurement process“ differs from the “automatic measurement process” in the way, how the stroke is established for measuring. The user has to move the axis manually by means of the four buttons in the AVC dialog “Axis movement controls“- see Fig. 18 “Automatic valve compensation (AVC)“ on page 34. For this, the axis can be moved in 1 mm or 10 mm increments. In this case, the axis is open-loop-controlled with position monitoring. The position is not closed-loop-controlled.

- Select “semi-automatic measurement process” by activating “Manual” in the field “Working range definition”.
- Enable the semi-automatic process by clicking on the button “Start manual range definition“.
- Move the axis to the desired direction reversal position by means of the “Move” buttons and, when the desired position is reached, click the button “Set Range position 1“ or “Set Range position 2“.
- Start the measurement process by clicking the button “Start measurement“.

The measurement process takes about 5 minutes and can be interrupted at any time by clicking the button “Abort measurement“.

Upon successful completion of the measurement procedure, the radio button in the field “Used compensation data” is automatically set to “Use AVC data” and the measured characteristic curve is used for linearizing the valve.
You can save the established characteristic curve by clicking the button “Export compensation data”.

Should, for technical reasons, an automatic measurement of the valve be impossible, the valve characteristic curve can be adapted manually (see Chapter 5.2.5.5 “Manual adaptation of the valve characteristic curve” on page 52).

5.2.5 Controller function and optimization

5.2.5.1 General

The PROFIdrive profile describes the required basic controller structure that has to be implemented within the axis, see Figure below. The left block constitutes a part of the control system SINUMERIK 840D(i) sl.

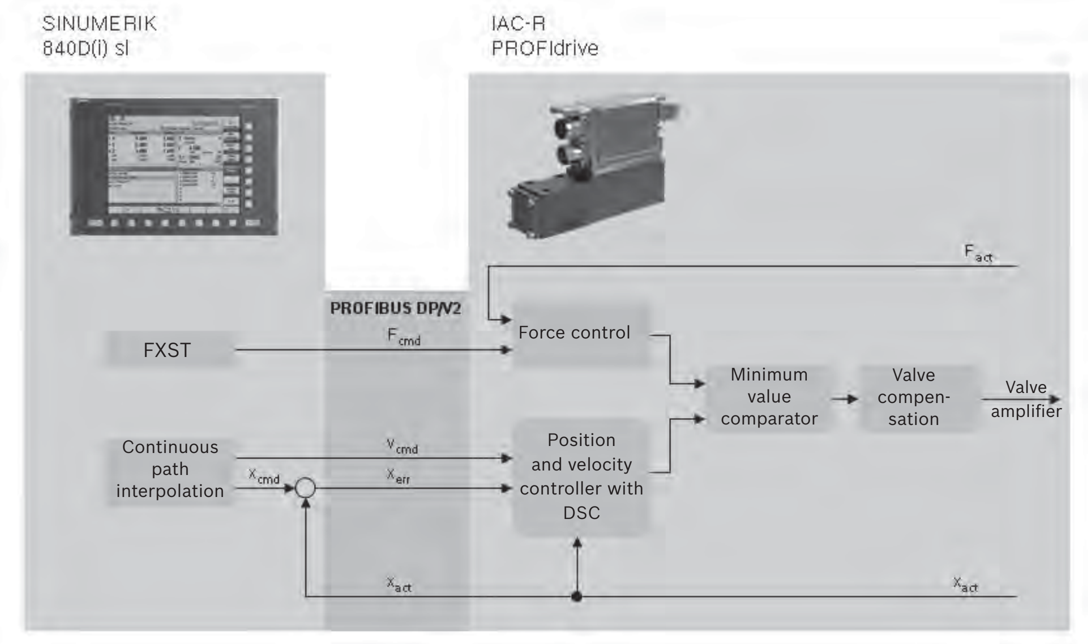

Fig. 20: Overview of controller structure

5.2.5.1.1 Measurement without WinHPT®

Preconditions

To be able to utilize the measurement function, certain preconditions must be fulfilled or basic settings made. More details can be found in the PROFIdrive commissioning instructions.
If PNU 3250 Bit 4 = 1, a constant actual position (= start position) is signaled to the control during the measurement process, although the axis moves when the measurements are being taken.

Attention: This will, of course, render all monitoring functions of the control ineffective.
If the distance between the traversing limits is not sufficient (stroke too short), the measurement process cannot be run!

Some notes on PNU 3084:
- While the measurement process (automatic or manual) is taking place, it can be interrupted at any time by writing 127 to bit 0-6.

- A new command may only be written, if bit 0-6 is zero. By means of this bit, the valve signals when it has received a command (the valve writes “0” to bit 0-6).
- Bit 29 is the error flag. If it is “1”, an error has occurred. The error code is contained in bit 24-28. The error can be acknowledged by writing “126“ to bit 0-6. If this was successful, bit 29 is cleared and error code is reset to “0” (bit 24-28).
- During the measurement process,bit 16-22 signals the progress in percent.
- When being set to “1” bit 14 signals that limit stop B was found.
- When being set to “1”, bit 15 signals that limit stop A was found.

Automatic measurement

The current status of the AVC function can be read via parameter PNU 3084. This parameter can also be used for giving commands to the AVC function of the IAC-R.

Exemplary sequence for automatic measurement

Without WinHPT®, that is directly via the control, the automatic measurement takes place as shown on the chart below. The individual steps are as follows:

1. Write to PNU 3084 = 1
2. Read PNU 3084 until bit 0-6 = 0.
3. Write to PNU 3084 = 2

   Automatic measurement is started.

4. Read PNU 3084, bit 12-13 must be 1 (→Automatic mode)
5. Read PNU 3084, bit 8-11 until it contains the value “4”

   Measurement was successful.

   During the measurement process, the progress in percent can be seen in bit 16-22 (unit [%] → 100 = 100 %)

6. Write to PNU 3084 = 127.

   The measurement mode is exited. The axis can again be operated under position control as usual via the control.

PNU 3250 bit 2 can be used to determine whether the measured characteristic curve is to be utilized (bit 2 = 1) or whether conventional inflection compensation is to be active (bit 2 = 0). When the measurement has been completed successfully, bit 2 is automatically set to “1”!

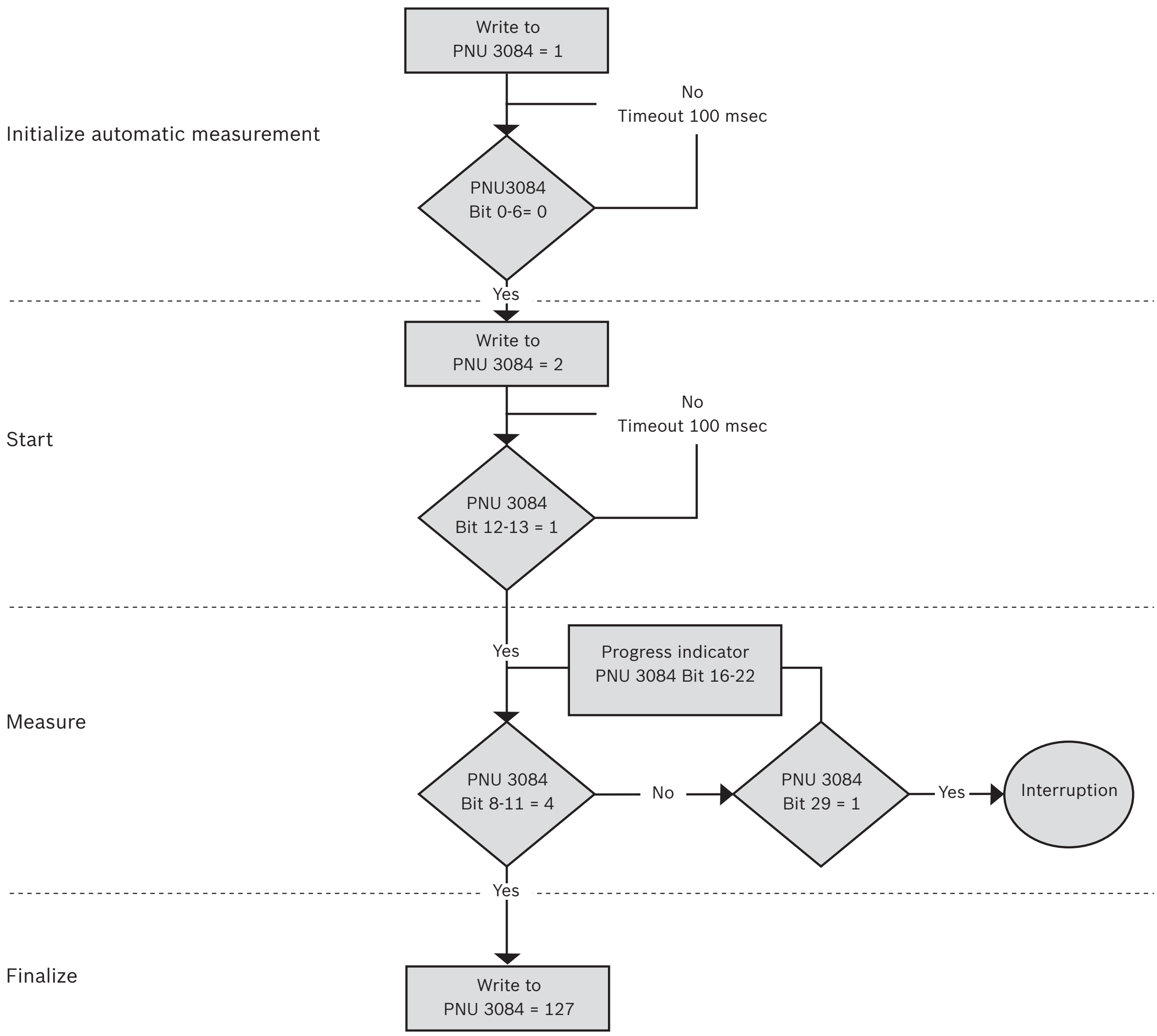

Fig. 21: Schematic sequence for automatic measurement process

Exemplary sequence for manual measurement

The manual measurement is carried out in individual steps as shown on the chart below:

1. Write to PNU 3084 = 1
2. Read PNU 3084 until bit 0-6 = 0.
3. Write to PNU 3084 = 3

   Set (start) manual measurement mode

4. Read PNU 3084; bit 12-13 must be “2” (→manual mode)
5. Use the relevant commands (see table) to move the axis in the positive or negative direction and set the corresponding limits for the subsequent measurement. When both traversing limits are set (bit 14 + 15 = 1), the actual measurement process can be started (next point)
6. Write to PNU 3084 = 4

   The measurement is started.

7. Read PNU 3084 bit 8-11 until it contains the value “4”.

   The measurement was successful.

   During the measurement process, the progress in percent can be seen in bit 16-22 (unit [%] → 100 = 100 %).

8. Write to PNU 3084 = 127

   The measurement mode is exited. The axis can again be operated under position control as usual via the control..

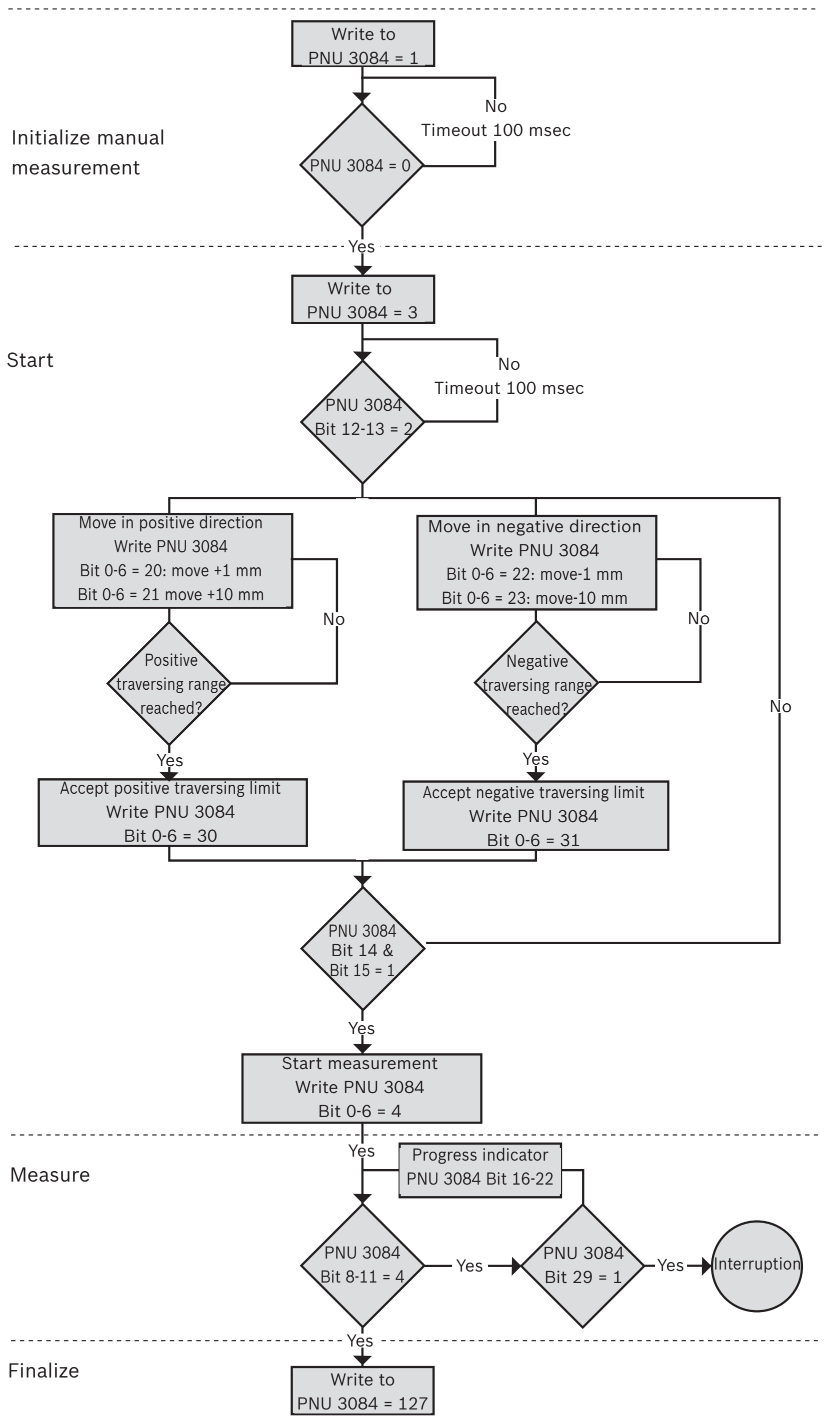

Fig. 22: Flowchart for manual measurement process

Description of PNU 084

Table 12: DPV2 command parameter = PNU 308

Bit	Value	Description
0-6		Current command
	0	Command processed (0 must not be written)
	1	init (the IAC-R saves the current position → "start position" - this is the position that is approached at the end of the measurement process)
	2	Start automatic mode
	3	Set manual mode
	4	Start measurement
	20	Move +1 mm
	21	Move +10 mm
	22	Move -1 mm
	23	Move -10 mm
	30	Accept positive traversing limit
	31	Accept negative traversing limit
	32	
	96	Use old compensation (not the characteristic curve measured)
	97	Use measured compensation characteristic curve
	120	Reset Compensation characteristic curve (i.e. set to 1:1 characteristic curve)
	121	Reserved (not used)
	126	Acknowledge error
	127	Interruption (current action/command is interrupted and the "start position" approached)
7		Not used
8-11		Current state
	0	Idle (Init/command worked off)
	1	Searching for limit stop
	2	Measurement
	3	Approach start position
	4	Ready (measurement completed successfully)
	5	
	6	
	15	Interruption active
12-13		Mode
	0	Idle
	1	Automatic mode
	2	Manual mode
	3	Reserved (irrelevant, not used)
14	0	
	1	Valid limit B found or set
15	0	
	1	Valid limit A found or set
16–22	0 – 100	Measurement progress in percent
23		Reserved
24-28		Error code
	0	No error (OK)
	1	Calculation error
	2	Limit stop passed/reached during measurement process
	3	Cylinder stroke too short (measurement cannot be taken)
	4	Measurement impossible, because no limit position set
	5	Interruption of measurement (e.g. axis does not move for longer than 1 sec)
	6	Interruption by user
	7	Measuring frequency too high (i.e. axis cannot be measured)

Bit	Value	Description
	16	General error (e.g. sensor error, U_B error, etc.)
29		Error flag
	0	Ok
	1	Error present
30-31		Reserved

5.2.5.2 Position controller structure of the IAC-R

The Figure below shows the controller structure of the IAC-R.

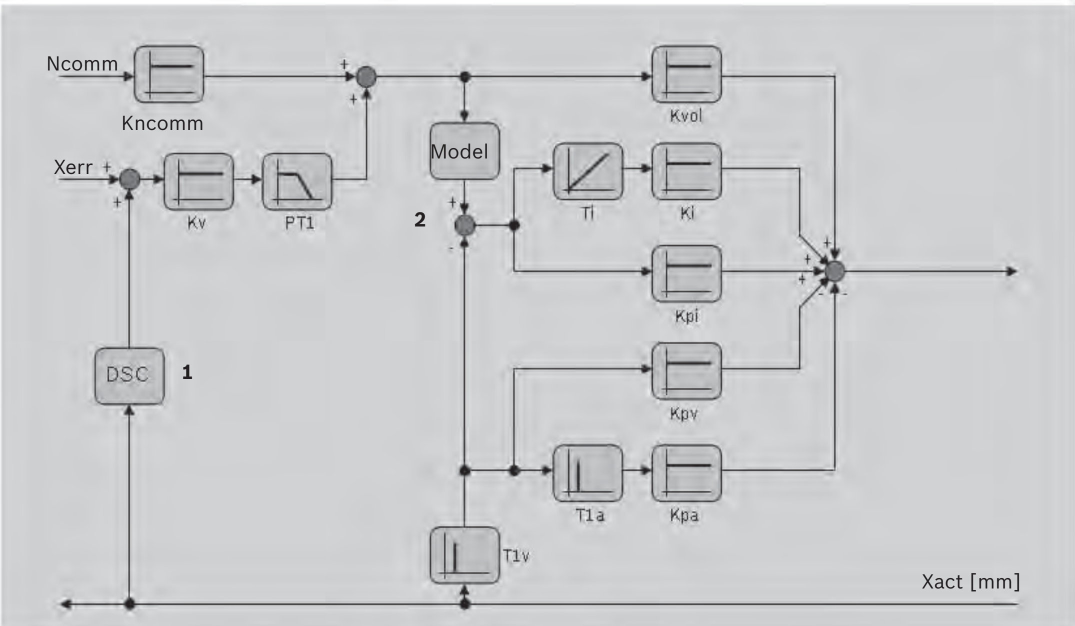

Fig. 23: IAC-R controller structure

1] DSC functionality

2] Inner-loop velocity controller

Support during commissioning and optimization is provided, amongst others, by the representation of the diagnosis/service axis in the SINUMERIK 840D(i) sl.

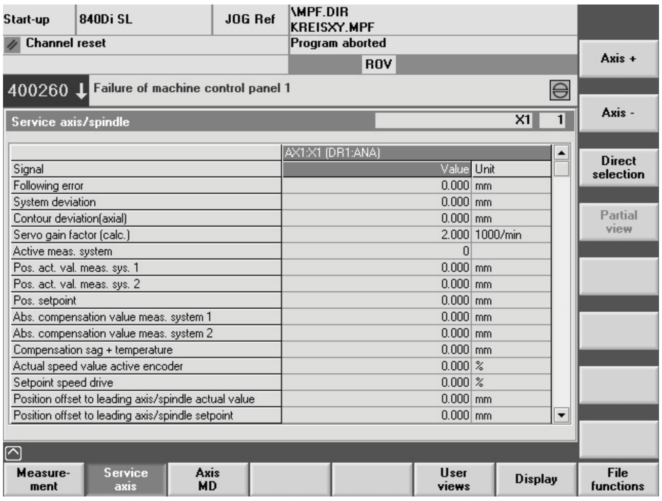

Fig. 24: Diagnosis/service axis of the SINUMERIK 840D(i) sl

5.2.5.2.1 Optimizing the position control loop

The optimization of a hydraulic axis with exacting requirements as regards precision requires a certain extent of experience with hydraulic axes. To that effect, the following Chapter can provide guidelines only. We recommend using the trace mode respectively the ballbar test in the SINUMERIK 840D(i) sl for optimization purposes. The control direction is determined in the IAC-R. See Chapter 5.2.1.1 "Commissioning software WinHPT®", "Transducer Configuration" on page 24.

5.2.5.2.2 PROFIdrive controller overview

Open the "PROFIdrive controller" in the basic view of WinHPT®.

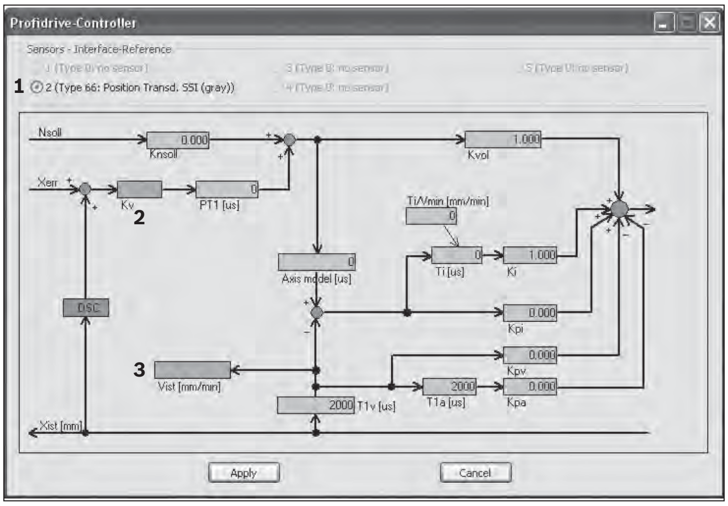

Fig. 25: PROFIdrive controller

1] Important: This setting must be suitable for the selected position sensor interface!

2] Here, the Kv value (MD 32200) set in the control system is displayed. Only when the enable is set!

3] Current actual velocity

5.2.5.2.3 Overview of parameters and basic settings

K_{Vol} [min/m] Gain factor to normalize the following error to the set Kv value (loop gain) in the MD 32200 SINUMERIK 840D(i) sl. This parameter is determined by automatic comparison and normally it is not changed afterwards.

Axis model [µs] Axis model (PT1). Serves for the optimization of the transient response with active velocity controller. This parameter is determined by automatic comparison and normally it is not changed afterwards.

Ti [µs] Integrator time for the inner-loop velocity feedback to correct the following error towards the actual velocity.
Default value: 0

Ti/Vmin [mm/min] If the actual velocity falls below this value, the integrator (Ti) is switched to a PT1 element.
Default value: 0

Ki Proportional gain for the inner-loop velocity feedback to correct the following error towards the actual velocity.
Default value: 1

Kpi Gain factor in conjunction with Ti for the inner-loop velocity feedback to correct the following error to the actual velocity.
Default value: 0

Kpv [s/m] Gain factor for a velocity feedback in the function as state controller. This parameter can be used for low-frequency axes in order to improve the control properties.
Default value: 0

Kpa [s^2/m] Gain factor for an acceleration feedback in the function as state controller. This parameter can be used for low-frequency axes in order to improve the control properties.
Default value: 0

T1v [µs] Parameter value for filtering the actual velocity signal.
Default value: 2000

T1a [µs] Parameter value to filter the actual velocity signal.
Default value: 2000

Kn_{soll} Pilot control factor. If this parameter = 1, the following error can be reduced to a minimum.
Default value: 0

PT1 [µs] Time delay T1 in the position controller.
Default value: 0

▶ Confirm by clicking “Apply“.

5.2.5.2.4 Loop gain

In order to be able to make basic adjustments, first a non-critical control loop gain has to be preset in the MD 32200 of the SINUMERIK 840D(i) sl:
Pilot control MD 32610 = 0
Loop gain MD 32200 = 1 m/min/mm

Modified machine data in the SINUMERIK 840D(i) sl, marked with “cf”, have to be confirmed by triggering a reset!

- Move the axis in the jog mode and increase the Kv value (m/min/mm) (MD 32200 POSCTRL_GAIN; SINUMERIK 840D(i) sl) up to the stability limit. Reduce the ascertained value to approx. 80 % for stability reasons. For this, select a travel speed below the inflection point of the valve characteristic curve or, in the case of valves with linear characteristic curve, within the range of the feed rate.
- In order to know if you have selected a speed above or below the inflection point, you can display the valve spool stroke of the IAC-R valve in % under WinHPT®/ Tools in the field “Parameter monitor” by means of PNU 1131. The % display is shown as follows:
  100 % = 100000 or 60 % = 60000.

You can find the inflection point of the valve in data sheet 29291.

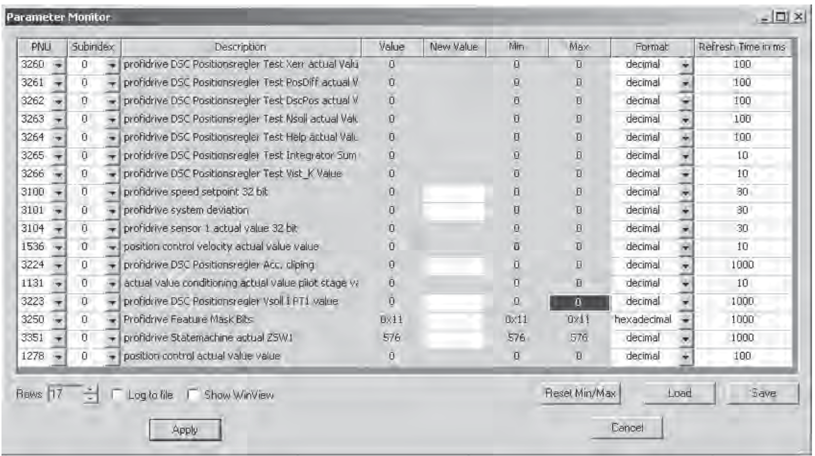

Fig. 26: Parameter Monitor

5.2.5.2.5 Setting of the inner-loop velocity controller

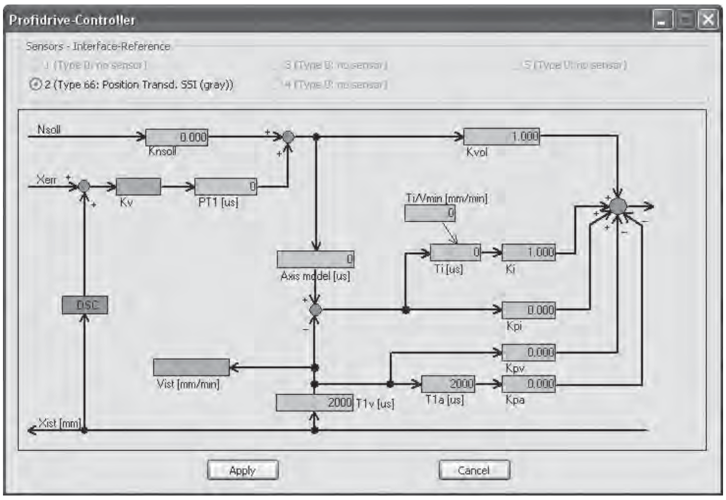

Fig. 27: PROFIdrive Controller

Ti Ti is the integrator time for the inner-loop velocity feedback to adjust the following error (lag) to the actual velocity. Enter a start value of "20000" in the controller field for the integrator time of the integrator. Reduce the Ti start value gradually from 20000 (integrator time of the integrator) until the stability limit of the axis is reached.

Ki Ki is a proportionality factor that normally should have a value of "1000 ≙ 1".

Kpi Kpi is the gain factor in conjunction with Ti for the inner-loop velocity feedback to adjust the following error (lag) to the actual velocity. It is always configured after the Ti value was optimized. However, practice showed that the Kpi for the inner-loop velocity feedback is rarely used. Normally, the value remains 0. The higher the natural frequency of an axis, the lower should/has to be selected the value for Kpi in order to avoid tendencies to oscillate.

Axis model [µs] The parameter "Axis model" is a delay element of the 1st order. This parameter should have nearly the same delay as the axis has. If this is the case, the axis reaches a steady state at the target position as quickly as possible. If the delay time is too high, the axis will overshoot.
This parameter is only effective while the inner-loop velocity controller is active.
The value "Axis model" is determined during the automatic measurement process, provided that it was set to "0" before. In case of manual valve linearization, the value has to be determined empirically. Normal values are between 500 µs and 3000 µs.

Ti/Vmin The parameter Ti/Vmin can be used to effectively dampen slight oscillations around the target position (stick slip). The parameter constitutes a minimum velocity (in [mm/min]). If the actual velocity of the axis falls below the value of Ti/Vmin, the integrator is switched to a delay element of the 1st order. This way, the "integrator" is followed up and "oscillations" are dampened or even suppressed !
Ti/Vmin = "0" means "no function".

Kn_{soll} The parameter Kn_{comm} weighs the sent velocity command value of the SINUMERIK 840D(i) sl in the DSC-PROFIdrive profile, which is added to the following error. With the help of this weighting factor, it is therefore possible to reduce the following error to almost “0” during the movement.

Table 13: Preconditions in the SINUMERIK 840D(i) sl

Parameter	Value
MD 32250 RATED_OUTVAL	100 %
MD 32260 RATED_VELO	1000 rev/min
MD 32630 FFW_ACTIVATION_MODE	0
MD 32810 EQUIV_SPEEDCTRL_TIME	0.00 s

The value for Kn_{comm} is increased starting from “0”, which results in a reduction of the following error and an increase in the calculated Kv value. Generally, the sign of the following error is identical with the sign of velocity. If the value for Kn_{comm} required for moving without following error has been determined, you will notice that the following error increases again when Kn_{comm} is increased further - however, with the inverted sign. The value for Kn_{ciomml} is too high, there has been an over-compensation. If Kn_{comm} = 1.0, the following error should be minimized.

In any case, the Kn_{comm} value must be identical for all axes that are to work together within the interpolation group.

PT1 The parameter value PT1 provides for the option of damping the position controller of the IAC-R. It is a time delay of 1st order. This can be helpful on dynamic axes with high tendencies to oscillation. However, the dynamics of the axis is reduced accordingly.

5.2.5.3 Optimizing the force control/force control loop

Setting the force/torque reference value

▶ Call the dialog "Demand Value Generator".

5.2.5.4 Force controller

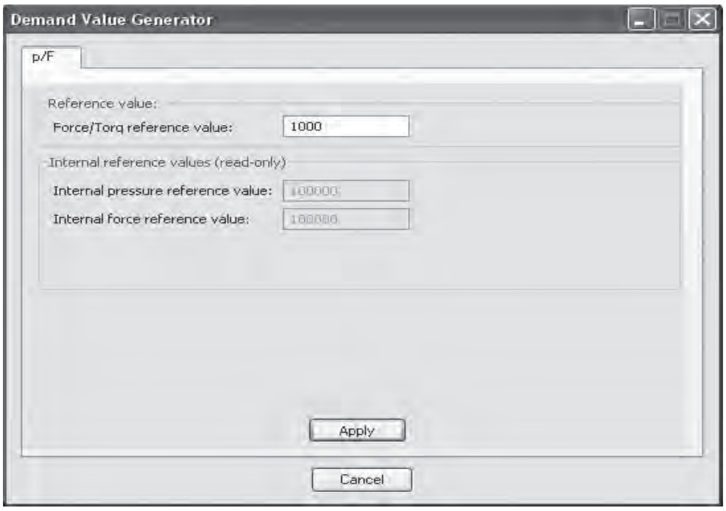

Fig. 28: Demand Value Generator

Here, you have to set the reference of the torque reduction value (MomRed), which the control sends to the IAC-R valve using the cyclic telegram (105 or 116).
The force command value in the valve is formed as follows:
IAC-R force command value = torque reference x (1.0 - MomRed/10000)
The current force command value of the IAC-R valve can be read out with the help of parameter PNU 1380 (unit = [N]).
The current actual force value can be read out using parameter PNU 1402 (unit = [N]).
For a 100 % torque reduction (MomRed), the control sends the value "10000" to the valve. For this, MD 37620 must be set to 0.01 % in the control.
The current torque reduction value (MomRed) in the IAC-R valve can be read out from PNU 3106.
The parameters (PNU) can be displayed via "Tools/Parameter Monitor".
In the SINUMERIK 840D(i) sl the parameter MD 37620 must be set as follows:

Table 14: Settings of SINUMERIK 840D(i) sl

MD	Remark	
37620	Resolution of the torque reduction at PROFIBUS	0.01 %

General functional notes

The force/torque reference value in the IAC-R valve should be set to the possible maximum force value. This can be, for example, the possible max. force value at max. acceleration. Or the max. force value that can be reached while traveling to the limit stop, which is determined by the system pressure and the cylinder areas.
In the status word ZSW1 Bit 14 of telegram 105 or 116, the IAC-R DPV2 signals to the control whether the force controller is active (1 → active) or not.

Force controller parameter

In the WinHPT “Controller Dialog“ (tab p/Q) - Controller you can adjust the parameters of the force controller (see Figure. 31 below).
The structure of the force controller is illustrated in the Figure below.

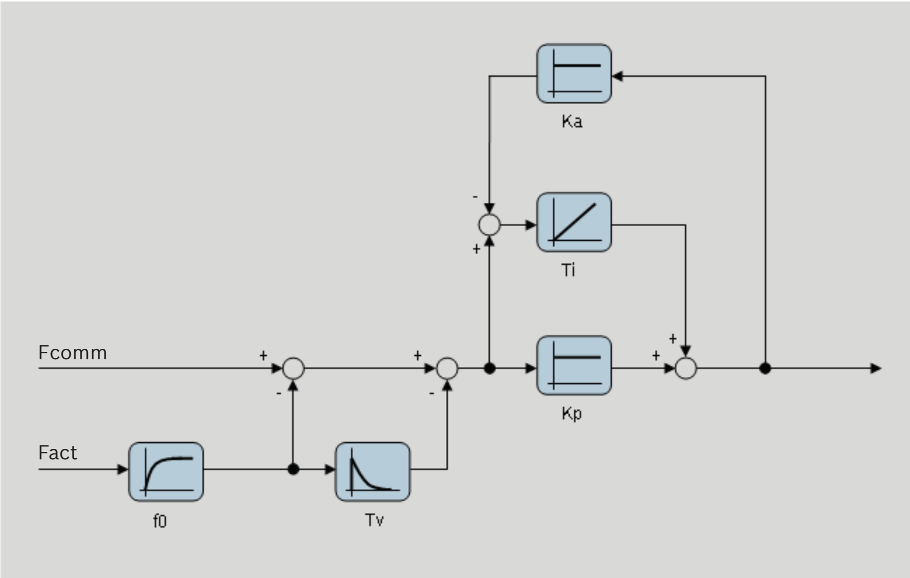

Fig. 29: Force controller structure

5.2.5.4.1 p/Q controller overview

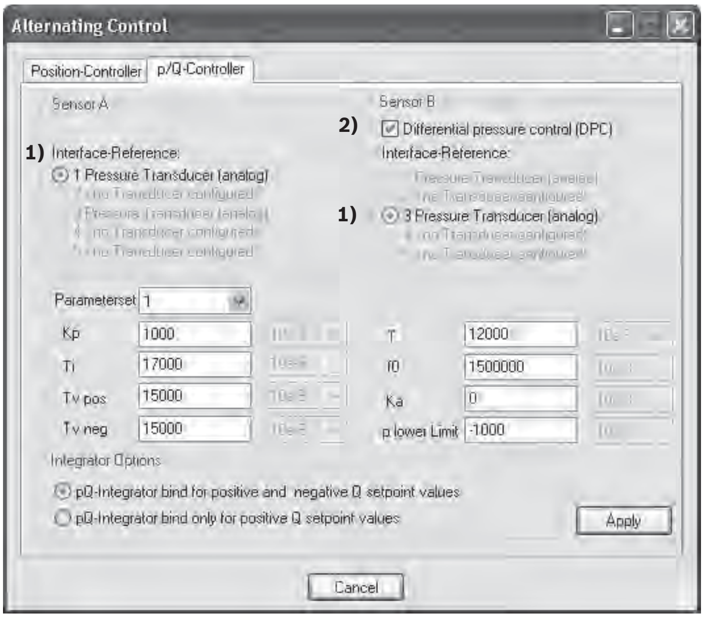

Fig. 30: Dialog of the force controller parameters

1] Important: This setting must be suitable for the selected pressure sensor interfaces.

2] In the case of differential pressure control (force control), this option must be activated.

5.2.5.4.2 Overview of parameters and basic settings

Kp [1e-3] Proportional gain of the force controller
Default value

T1 [µs] Integrator time of the force controller integrator
Default value

Tv pos [µs] Derivative time, positive (pressure/force build-up)
Default value

Tv neg [µs] Derivative time, negative (pressure/force reduction)
Default value

T [µs] Delay time. Is used to compensate for the time delay between the control and the measurement of actual values.
Default value

f0 [mHz] Limiting frequency of the Bessel low-pass filter on the actual force value
Default value

Ka [1e-3] Reduction of integrator overshoots
Default value

p lower limit Limitation of the negative actuating signals
Default value

If the absolute value of the pressure control deviation falls below a value defined by means of PNU 3145, the Ka parameter is no longer effective. This prevents a permanent control deviation when the axis is shifted. The “switch-off limit” results from PNU 3145 (unit = 1e-3, i.e. 1000 → 1.0) multiplied by the current internal force command value. Example: if the “threshold” is to be 10 % of the pressure command value, PNU 3145 must be set to 100.

5.2.5.5 Manual adaptation of the valve characteristic curve

If "automatic/semi-automatic measurement" of the valves was carried out, you can skip to Chapter 5.2.6.

If manual adaptation of the valve characteristic curve is required, because automatic measurement of the valve is impossible for technical reasons, we recommend the following proceeding:

▶ Open the dialog for "Automatic Valve Compensation" via "General Functions" from the main window of WinHPT®.

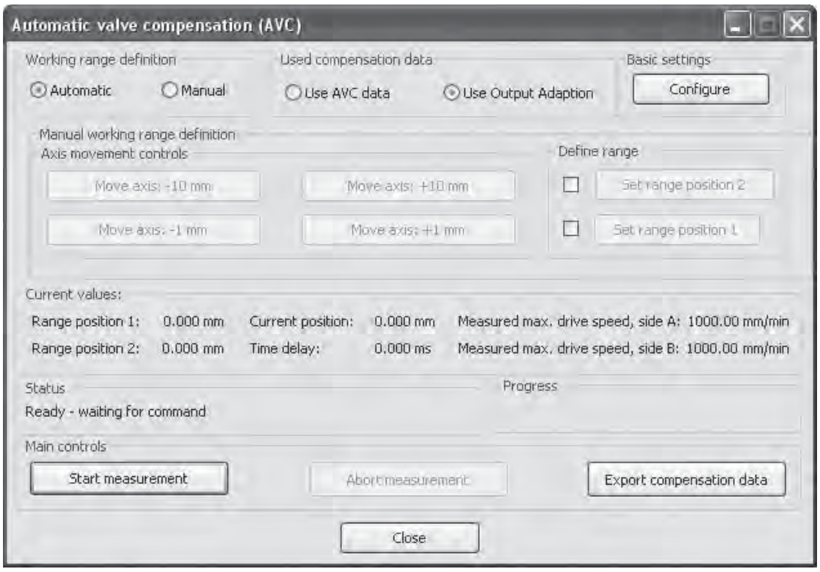

Fig. 31: Automatic valve compensation (AVC)

▶ Set option "Used compensation data" to "Use Output Adaption".
▶ Then close the dialog by clicking "Close".

For manual adaptation of the valve and axis characteristics the following menu items are available in the field "Controller Output Adaption". For this, open the field "Controller Output Adaption" in the basic view of WinHPT®.

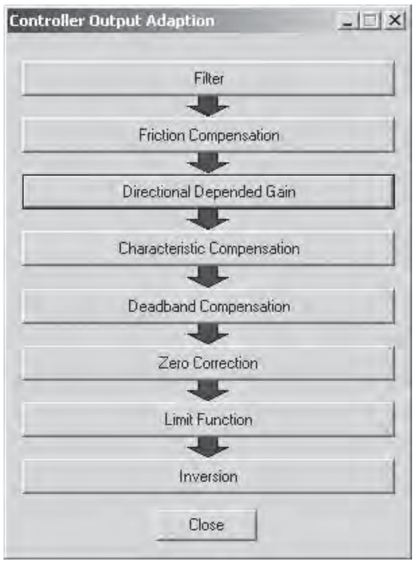

Fig. 32: Controller Output Adaption

5.2.5.5.1 Zero Correction

The hydraulic zero point of the IAC-R valve is set when the unit is manufactured. However, it is advisable to check and, if applicable, adjust the zero point while the axis is active. The zero point is checked respectively set when the axis is enabled in closed-loop control. The current following error value provides information on the zero point (following error in the diagnosis/service axis of the SINUMERIK 840D(i) sl). Using “Zero Correction” in the field “Controller Output Adaption”, the zero point error can be minimized by means of the offset.

Fig. 33: Zero Correction

5.2.5.5.2 Characteristic Compensation

For valves with linear flow characteristic curve, set the “Type” in the WinHPT® dialog “Characteristic Compensation” to “No”.
For valves with inflected flow characteristic curve, set the “Type” in the WinHPT® dialog “Characteristic Compensation” to “compensation (-1)”.
The values for “Relative voltage” relate to the stroke of the valve and can be found in the data sheet of the valve, e.g. 60 %.
The signs of the parameters (positive) = P→A and (negative) = P→B refer to the flow direction of the valve.

Using the parameter value “Relative volume flow”, the Kv value above the inflection point is equalized with the Kv value below the inflection point.
Using the value “Transition area”, the inflection area of the valve can be rounded electronically, e.g. 2 %.

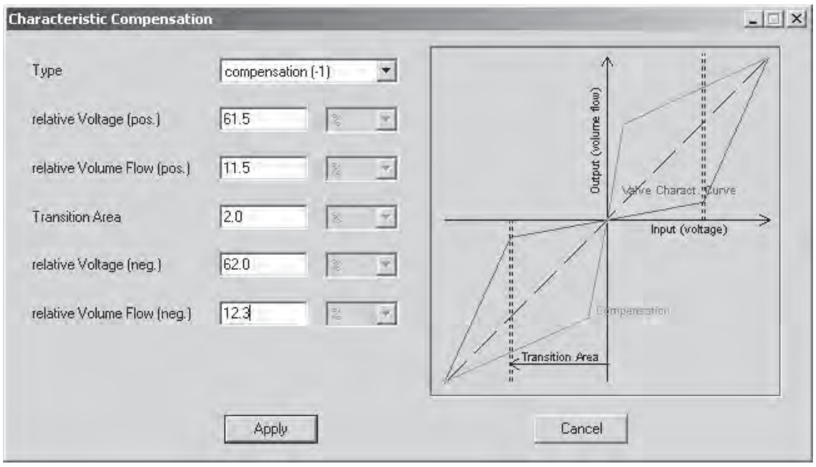

Fig. 34: Characteristic Compensation

▶ Enter the relevant Q value from the data sheet in the parameter value “relative Volume Flow“.

An increase of the parameter value “relative Volume Flow“ also results in an increase of the Kv value above the point of inflection.
A reduction of the parameter value “relative Volume Flow“ also results in a reduction of the Kv value above the point of inflection.
When single-rod cylinders are used, the different cylinder area ratios result in a gain dependent on the direction of travel that will be perceivable in that different lags or Kv values are obtained in the two directions of travel. For linearization, these direction-dependent differences in gain are irrelevant. The only important aspect is that the Kv values below or above the point of inflection must be considered separately for each direction of travel and should be approximately equal.

5.2.5.5.3 Directional Depended Gain

Menu item “Directional Depended Gain” in the field “Controller Output Adaption“ is used for adjusting the Kv value depending on the direction of travel. You have merely to take account of the Kv value at a travel speed below the point of inflection!

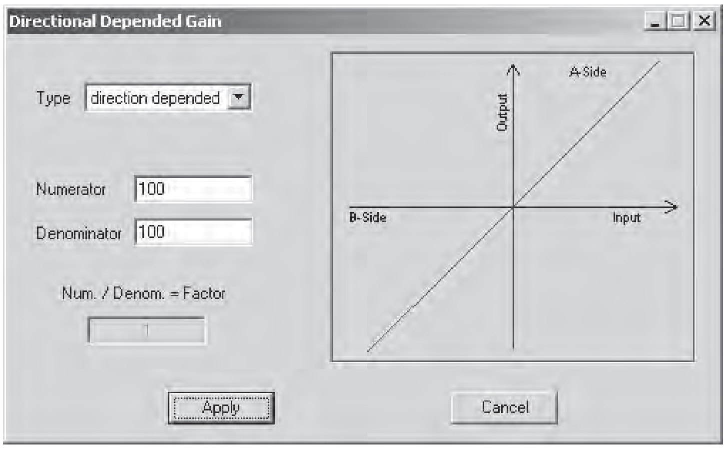

Fig. 35: Directional Depended Gain

Example:
Positive direction of travel Kv (calulated) = 1.3
Negative travel direction Kv (calculated) = 1.0

Correction:
As the positive travel direction (P→A flow) in the example has the higher Kv value, the same is reduced by setting the factor < 1:
Numerator = 100
Denominator = 130
Factor = 100/130 = 0.77

If the Kv value for the negative travel direction (P→B flow) is higher, a factor > 1 has to be selected (numerator > denominator).

5.2.5.5.4 Filter

Using the function “Filter” of the actuating variable adaptation, the control signal of the controller is filtered before it is passed on the valve controller. A whole series of filter types are available for exercising an influence on the control signal:
- Low pass 1st order
- Low pass 2nd order
- Bandstop filter
- Bessel filter

If required, the use of the various filter types can be tested to suit the application at hand.

5.2.5.5.5 Friction Compensation

The effect of friction compensation is based on the fact that with “zero overlap” control lands of the hydraulic part of the IAC-R valve the electrical gain can be increased to a limited extent to minimize the break-away of hydraulic drives from adhesive friction (particularly during changes in direction→ballbar test). Also, the SINUMERIK 840D(i) sl provides friction compensation based on a temporary velocity feedforward that turned out to be more effective in ballbar tests.
Default value: Type “No compensation”

5.2.5.5.6 Deadband Compensation

The setting for overlap compensation “Deadband compensation” is not required as normally IAC-R valves with so-called “zero overlap” or “zero cut” are used

5.2.5.5.7 Limit Function

The Limit Function limits the control value. The default values (+100, -100) should not be altered.

5.2.5.5.8 Inversion

Normally, no adaptation is required.
Default setting: “OFF”.

5.2.5.6 Friction compensation in the SINUMERIK 840D(i) sl

The parameters of friction compensation offer additional possibilities of optimization in the SINUMERIK 840D(i) sl.

Table 15: Friction compensation

Parameter	Value
32490 FRICT_COMP_MODE	1
32500 FRICT_COMP _ENABLE	1
32510 FRICT_COMP_ADAPT_ENABLE	0
32520 FRICT_COMP _CONST_MAX	xmm/min
32540 FRICT_COMP_TIME	0.00x

The values highlighted in gray have to be optimized.

5.2.6 Finalization of parameterization

Upon completion of parameterization, execute the function “Make Data Persistent“ (“File“ → “Make Data Persistent“) to permanently save the data.

5.2.7 Communication over PROFIBUS DP

5.2.7.1 General notes on PROFIBUS DP

A PROFIBUS DP network works according to the master/slave principle. There can be several masters in one network, communicating by means of a token ring procedure. The IAC-R valve is a PROFIBUS slave.
The master having the token controls the bus at this point in time. If this master has finished its communication activities, the token is passed to the next master. If there

is only one master, it passes the token to itself. The slaves never access the bus in a self-dependent manner, but only if a master requires the slaves to do so.
In a PROFIBUS DP network, the IAC-R valve works as slave only.
The IAC-R valve supports the PROFIBUS DP protocol with:
- Cyclical data transmission, corresponds to the PROFIBUS DP/V0 functionality
- Acyclic data transmission, corresponds to the PROFIBUS DP/V1 functionality
- Clock synchronization mechanism according to PROFIBUS DP/V2

5.2.7.1.1 Cyclical communication with PROFIBUS DP/V0

The PROFIBUS DP/V0 functionality describes the cyclical data exchange between a master (usually a control system) and its dedicated slaves.
The data traffic between the master and its dedicated slaves is handled automatically by the master in a specified, recurring order.
When configuring the master (with the help of the GSD files), the user specifies the relation of the individual slaves to the master. Networks containing several masters are possible as well. A slave can only be assigned to one master at a time.
The masters communicate by owning and passing on a token. If a master owns the token, it alone controls the activities on the bus.
The data traffic between master and slave can be classified in a parameterization, a configuration, and a data transfer phase. Before the master enters into the data transfer phase with a slave, the parameterization and configuration phase is used to check if the planned target configuration corresponds to the actual device configuration. For this check, the device type and the information on data format and data length for the subsequent data transfer phase have to be identical.
Additionally, the master can implement several optional settings on the slave. If the check has been successful, the communication between master and slave enters into the data transfer phase. In this phase, the master cyclically sends telegrams with process data (e.g. command values, control information) to the slave. The slave responds to all of these telegrams by sending data consisting of firmly selected unit parameters (e.g. actual values, status information) to the master, which are required by the master for its process.
The length of the telegrams has been checked and determined in the configuration phase.

5.2.7.1.2 Acyclic communication with PROFIBUS DP/V1

The PROFIBUS DP/V1 functionality serves for reading respectively writing device parameters that are required sporadically (acyclically) only.
The PROFIBUS DP/V1 distinguishes between two classes of masters: DPM1 and DPM2. DPM1 covers automation systems (control systems for example), DPM2 covers engineering and operating tools.
The DPM1 master already has a cyclical connection to its assigned slaves, as described under PROFIBUS DP/V0. Now, this cyclical connection is coupled with an acyclic data access (read or write) by the DPM1 master as required. This connection is called MSAC1 connection and can only be used by the DPM1 master the slave is assigned to. A precondition for the connection is the proper completion of the parameterization and configuration phase.
The connection between master and slave is monitored by the cyclical connection.

The DPM2 master does not have a cyclical connection to the slave. The slave needs not have to be assigned to the master by means of project planning either. Thus, the parameterization and configuration phase is not required. For the DPM2 master being able to establish an acyclic MSAC2 connection to any slave, it sends an initiate telegram to the desired slave. If the slave is able to establish an MSAC2 connection, it acknowledges the same by means of a positive reply telegram. Now, the master can access parameters within the slave at any time using the MSAC2 connection. If the DPM2 master no longer requires access to the slave, it terminates the MSAC2 connection by sending an abort telegram to the relevant slave. The slave acknowledges the successful termination of the connection, if possible. As there is no additional cyclical connection with MSAV2, the DPM2 master has to monitor the MSAC2 connection itself. This is implemented by the master addressing the slave regularly and waiting for the slave acknowledging the same.
PROFIBUS networks with DP/V1 functionality can contain several masters. These communicate with each other in accordance with the token procedure (see DPV0 functionality) mentioned above.

5.2.7.1.3 Clock synchronization with PROFIBUS DP/V2

The mode of operation “Isochronous mode” and the services of PROFIBUS DP/V2 allow for synchronizing the activities of several slaves. The objective is to achieve constant bus cycle times and a synchronous behavior of all stations. This is required, if several stations (e.g. axis controllers) work in one system that have to determine the actual values at exactly the same points in time and that are to process new inputs from the master simultaneously.
Thus, the master sends a global synchronization telegram at the beginning of each bus cycle. Global telegrams are received by all bus stations and all stations in the isochronous mode will be re-synchronized in each bus cycle. All slaves will record their input values at a certain time (Ti) simultaneously. Within the framework of the subsequent cyclical data exchange, the master queries these values and provides new command values. These command values are used by all slaves at the same point in time (To). An important factor is a constant cycle time that has to be complied with by the master.
The relevant time values, such as bus cycle TDP, Ti, and To, and others, are entered in the project planning tool of the PROFIBUS master. During the boot phase, the master sends these values to the assigned slaves by means of a parameterization telegram, see Chapter 5.2.7.4.3 “Parameterization telegram“ on page 66.

5.2.7.1.4 Setting the PROFIBUS address

The PROFIBUS address of an IAC-R valve is set by means of an internal, permanently saved parameter. There is no mechanical adjustment option by means of a button. The valve is delivered with the default address = 125.
The standard procedure during the initial start-up of an IAC-R valve is as follows:

1. Establish a PROFIBUS DP/V1 connection to the valve by means of WinHPT® and the PROFIBUS interface.
2. In WinHPT® you can set the address via “Communication/Configure Node“. Alternatively, you can assign a new PROFIBUS address via the control: Write a new address to parameter (PNU 918) (permissible values: 0...126). Attention: Duplex addresses lead to bus malfunction or non-booting of the bus.

3. Save the parameters permanently in the EEPROM of the IAC-R valve by means of the WinHPT® function “Save settings (make data persistent)“.
4. RESET the IAC-R valve.

   The IAC-R valve starts with new PROFIBUS address.

5.2.7.1.5 PROFIBUS baud rates

The transmission rate with the PROFIBUS is configured on the master and recognized automatically by the IAC-R electronics. The transmission rate for PROFIBUS can be set to the following values:

Table 16: PROFIBUS baud rates

Baud rates
9.6 kBit/s
19.2 kBit/s
93.75 kBit/s
187.5 kBit/s
500 kBit/s
1.5 MBit/s
3 MBit/s
6 MBit/s
12 MBit/s

On the IAC-R valve, the baud rate needs not to be set, it is recognized automatically.

5.2.7.1.6 GSD file

Each PROFIBUS device has a device description file (GSD file) containing the PROFIBUS properties. This file is read by the project planning tool of the PROFIBUS master and thus the system is informed about the slave.
The GSD file “RX01010E.GSD” for the IAC-R valve can be downloaded from the website `www.boschrexroth.com/iac`

5.2.7.1.7 PROFIdrive profile

The IAC-R valve operates in accordance with the specifications of the PROFIdrive profile in application class 4. This application class defines continuous path control (motion control) with central interpolation using a velocity command value interface. This profile has been published by the PROFIBUS User Organization (PNO) as open device profile for the transmission types PROFIBUS and PROFINET.
It describes the functionality and the behavior of a device as well as its interfaces.
The following items defined in the profile are important for the IAC-R valve:
- Classification into one of the 6 application classes
- Exchange of process data (command and actual values) with the higher-level control system
- Data backup mechanisms during operation
- Access mechanisms to device-internal parameters via PROFIBUS DP/V1 services
- Prescribed and optional parameters
- Device status machine
- Diagnosis options
- Sensorics
- Synchronization of several IAC-R valves through PROFIBUS DP/V2 services

5.2.7.2 Process data interface and telegram description

The higher-level control system exchanges the command and actual values of the control loop with the IAC-R valve via the process data interface. For this the data telegram of the PROFIBUS DP/V0 connection is used, which is exchanged cyclically between master and slave after the bus started up.
Standard telegram 5 according to PROFIdrive and two manufacturer-specific telegrams 105 an 116 are available as process data interface for the IAC-R valve.

Table 17: Meaning of the signals used

Signal name abbreviation	Meaning	Parameter (PNU)	16/32 bit
	Command values		
STW1	Control word 1	3353	16
NSOLL_B	Speed command value B	3100	32
STW2	Control word 2	3354	16
G1_STW	Sensor 1 control word	3452	16
XERR	Control difference	3101	32
KPC	Gain factor of the position controller	3102	32
MomRed	Torque limitation	3106	16
G2_STW	Sensor 2 control word	-	16
	Actual values		
ZSW1	Status word 1	3351	16
NIST_B	Actual speed value B	3103	32
ZSW2	Status word 2	3352	16
G1_ZSW	Sensor 1 status word	3451	16
G1_XIST1	Sensor 1 actual position value 1	3104	32
G1_XIST2	Sensor 1 actual position value 2	3105	32
MeldW	Message word	3356	16
G2_2STW	Sensor 2 status word	-	16
G2_XIST1	Sensor 2 actual position value 1	-	32
G2_XIST2	Sensor 2 actual position value 2	-	32
AIST_GLATT	Utilization of torques	3213	16
MIST_GLATT	Actual torque value, smoothened	3211	16
PIST_GLATT	Active power, smoothened	3212	16
ITIST_GLATT	Actual valve value	-	16

5.2.7.2.1 Structure of standard telegram 5

Standard telegram 5 has a length of 18 bytes (in both directions) and is transmitted consistently in its entire length. The telegram contains so-called standard signals. The following tables show the arrangement of the standard signals within the telegram.

Table 18: Command values in telegram 5

Command values in telegram 5 (IAC-R control)																		
Byte Nr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Sollwert	STW1		NSOLL_B				STW2		G1_STW		XERR				KPC			

Table 19: Actual values in telegram 5

Actual values in telegram 5 (IAC-R control)																		
Byte no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Actual value	ZSW1		NIST_B				ZSW2		G1_ZSW		G1_XIST1				G1_XIST2			

5.2.7.2.2 Structure of manufacturer-specific telegram 105

The manufacturer-specific telegram 105 has the same structure as the standard telegram, but it is extended by an additional signal. The higher-level control system sends a torque reduction value to the IAC-R valve. In the opposite direction, the IAC-R valve sends a manufacturer-specific message word (MeldW), which is used for signaling traveling to a fixed limit stop.

Table 20: Command values in telegram 105

ommand values in telegram 105 (IAC-R control)																				
Byte no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Command value	STW		NSOLL_B				STW2		Mom-Red		G1- STW		XERR				KPC			

Table 21: Actual values in telegram 105

Actual values in telegram 105 (IAC-R control)																				
Byte no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Actual value	ZSW1		NIST_B				ZSW2		MeldW		G1- ZSW		G1_XIST1				G1_XIST2			

5.2.7.2.3 Structure of manufacturer-specific telegram 116

The manufacturer-specific telegram is extended by additional signals. The higher-level control sends a torque reduction value to the IAC-R valve. In the opposite direction, the IAC-R valve sends a manufacturer-specific message word (MeldW) and the actual torque reduction value (MIST-GLATT), which is used for signaling traveling to a fixed limit stop.

Table 22: Command values in telegram 116

Command values in telegram 116 (IAC-R control)																						
Byte no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Command value	STW1		NSOLL_B				STW2		MOMRED		G1- STW		G2STW		XERR				KPC			

Table 23: Actual values in telegram 116 (IAC-R control)

Actual values in telegram 116 (IAC-R control)																																						
Byte no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Actual value	ZSW1		NIST_B				ZSW2		MeldW		G1- ZSW		G1_XST1				G1_XIST2				G2_ZSW		G2_XIST				G2__XIST2				AIST-GLATT		MIST-GLATT		PIST-GLATT		ITIST-GLATT	

5.2.7.3 Description of signals

STW 1 control word 1

Control word 1 is used to control the PROFIdrive status machine of the IAC-R valve. The bits have the following meaning:

Table 24: STW 1 control word 1

Bit	Value	Meaning
0	0	Off - switching to state "Ready to switch on" (S2)
	1	On - switching to state "Switched on" (S3)
1	0	Initiating axis stop 1
	1	Deactivating axis stop 1
2	0	Initiating axis stop 2
	1	Deactivating axis stop 2
3	0	Position controller deactivated
	1	Activate position controller
4	0	-
	1	-
5	0	-
	1	-
6	0	-
	1	-
7	0	No meaning
	1	Error acknowledgement through transition from 0 to 1
8-15	0	-
	1	-

STW 2 control word 2

Control word 2 comprises the sign of life of the PROFIBUS master (4-bit counter).

Table 25: STW 2 control word 2

Bit	Value	Meaning
0-7	X	Not implemented
8	0	Do not suppress the alarm "Speed controller at positive stop" For comment, see ZSW2.8
	1	Suppress the alarm "Speed controller at positive stop" For comment, see ZSW2.8
9-11	X	Not implemented
12-15	X	Master life sign counter (4 bits) (bit 12: = LSB, bit 15: = MSB)

NSOLL_B- command value velocity pilot control

The velocity pilot control is transmitted as percentage of a maximum velocity using the signal NSOLL_B.
In the control system, MD 32250, 32260, 32610, and 32810 have to be set to the values stated in Chapter 5.2.5 to ensure consistent settings.
The value transmitted, for example, for Nsoll = 1m/min = 0.01666 m/s is approx. 2982616. The maximum possible value is 2147483647 (= 0x7FFFFFFF) and corresponds to a velocity of 12 m/s (= 720 m/min).

G1_STW sensor control word 1

Table 26: G1_STW sensor control word 1

Bit	Value	Meaning
0-3	0	No function selected
	x	Function selected. Check of whether at least one bit is set. Which bit has been set is currently not evaluated.
4-6	0	No command activated (stand-by state)
	1	Function active
	2	Read value
	3	Abort of active function
	4-7	Reserved (results in error message)
7	0	Search reference mark or positive stop as reference mark (selection using PNU 3460)
	1	Not implemented
8	0	Reserved (irrelevant)
9	0	Reserved (irrelevant)
10	0	Reserved (irrelevant)
11	x	Home position mode implemented in the IAC-R
12	0	Not implemented
	1	Not implemented. An error message is generated.
13	x	Not implemented
14	0	Normal operation of the sensor
	1	Sensor parking activated (sensor can be disconnected without the valve going into an error state for example)
15	0	No meaning
	1	Error acknowledgement through transition from 0 to 1.

XERR control difference

The command value datum XERR contains the control difference for DSC transmitted by the higher-level control system to the IAC-R valve.
The control difference XERR is transmitted in the same data format as the actual position value G1_XIST1.

KPC gain factor of the position controller

The gain factor “Kv” (KPC in the cyclical telegram) is transmitted in the unit [meter/millimeter/minute] = 1000 /min. If the Kv in the control system is set to the value of “EINS” (one), the value = 16666 will be transmitted to the IAC-R.

MomRed - reduction of force limitation

Is used with the SIEMENS drive 611-U to reduce the torque limitation set in the drive even further. A factor “k” is calculated that can be used to reduce the currently valid torque limitation down to 0.

ZSW1 status word 1

Table 27: ZSW1 status word 1

Bit	Value	Meaning
0	0	Not ready for activation
	1	Ready for activation
1	0	Not ready for operation
	1	Ready for operation
2	0	Controller is deactivated
	1	Controller is working
3	0	No errors
	1	At least one error has occurred. The error cause has to be remedied and the error acknowledged.
4	0	-
	1	-
5	0	-
	1	-
6	0	Activation locked
	1	Activation enabled
7	0	-
	1	-
8	0	-
	1	-
9	0	Guidance by higher-level control system not possible. Currently, the valve can be controlled by a commissioning tool only.
	1	Guidance required. The valve can be operated in conjunction with a higher-level control system with process data interface and awaits command values.
10-15	0	-
	1	-

ZSW2 status word 2

Control word 2 comprises the sign of life of the PROFIBUS master (4-bit counter).

Table 28: ZSW2 status word 2

Bit	Value	Meaning
0-7	x	Not implemented
8	0	The alarm "Speed controller at positive stop" is not suppressed
	1	The alarm "Speed controller at positive stop" is suppressed [1)]
9-11	x	Not implemented
12-15	x	Life sign counter (4 bits) (bit 12 := LSB, bit 15 := MSB)

[1)] The IAC-R does not know the alarm “Speed controller at positive stop”. This bit (ZSW2.8) ONLY serves as confirmation of the STW2.8 and is used in connection with homing to positive stop! Actually, the ZSW2.8 is a “copy” of STW2.8

NIST_B actual velocity value B

The actual velocity value is transmitted as percentage in the same format as the signal NSOLL_B.

G1 ZSW status word

Status word of the position sensor interface.

Table 29: G1 ZSW status word

Bit	Value	Meaning
0-3	x	Function status (signals, which function is active at the moment)
	x	Bit 0: function 1 (reference mark 1)
	x	Bit 1: function 2 (reference mark 2)
	x	Bit 2: function 3 (reference mark 3)
		Bit 3: function 4 (reference mark 4)
4-7		Status: values 1 to 4 received [1)]
	1	Bit 4: value available (reference mark 1)
	1	Bit 5: value available (reference mark 2)
	1	Bit 6: value available (reference mark 3)
	1	Bit 7: value available (reference mark 4)
8	0	Not used
9	0	Not used
10	0	Reserved
11	1	Error acknowledgement requested
12	0	Not implemented
13	0	Not implemented (send absolute sensor value)
14	0	Sensor not "parked"
	1	Acknowledgement for active parked sensor or signaling of an invalid actual sensor value in Gx_IST1
15	0	No sensor error

1) Simultaneously with bit 0 - 3 (value only available when related function is available as well).

G1_XIST1 position actual value of position sensor 1

The process datum G1_XIST1 transmits the actual position value with the same resolution as detailed in the transducer dialog for the set position sensor in WinHPT®.

G1_XIST2 additional actual value of position sensor 1

In G1_XIST2 the actual position value (as G1_XIT1) divided by a factor of 16 is transmitted.

MeldW message word

Additional message word that is used to report reaching the positive stop respectively exceeding a set torque limit during the homing procedure (see also description of the SIEMENS drive 611-U).

Table 30: MeldW - message word

Bit	Value	Meaning
0	x	Not implemented
1	0	Axis standstill detected [1)]
	1	Axis is not at positive stop!!
2-15	x	Not implemented

1) The following conditions must be fulfilled:
Travel speed = 0 and valve spool aperture > 95 %

MIST_GLATT actual torque value, smoothened

The process datum MIST_GLATT transmits the normalized actual force value. The normalization is set using PNU 3140. PNU 2003 can be used to read out the normalization and is provided for reasons of compatibility.

PIST_GLATT effective power, smoothened

The smoothened effective power PIST_GLATT results from P = F * Vact (1 W = Nm/s) and is transmitted in a normalized form. The normalization is set using parameter PNU 2004.
This value can be visualized on the control as “vaPower“, e.g. in Trace.

AIST_GLATT utilization of torque, smoothed

The process datum AIST_GLATT transmits the normalized actual force (normalized to PNU 3140 = PNU 2003). A value greater than 100 % cannot be realized due to the normalization. On the control, this datum can be displayed under the variable name = “vaLoad“.

5.2.7.4 Parameter access

The parameters of the IAC-R valve are accessed exclusively in accordance with the protocol described in the PROFIdrive profile using the PROFIBUS DP/V1 services “DS_READ” and “DS_WRITE” on slot 0/index 47.
This protocol works with requests (write and read) and the related replies. In one DPV1 telegram several parameters can be transmitted.
You will find a detailed description of the parameter requests and parameter replies over PROFIBUS DP/V1 in the PROFIdrive profile.

5.2.7.4.1 Connection to the PROFIBUS DP master

In order to be able to commission a PROFIBUS network, a project planning procedure of the network has to be implemented in the PROFIBUS master. The required software tools for creating such projects are provided by the manufacturer of the PROFIBUS master.

5.2.7.4.2 Device master file and project planning

The device properties of the IAC-R valve are stored in a standardized device master file (GSD). In order to be able to add the IAC-R valve to the project for a PROFIBUS master, the relevant GSD file has to be read in by the project planning software of the PROFIBUS master.
The GSD file of the IAC-R valve can be downloaded from the BOSCH Rexroth website `http://www.boschrexroth.com/IAC`

5.2.7.4.3 Parameterization telegram

The IAC-R valve works in the clock-synchronized mode according to PROFIBUS DP/V2. A detailed description can be found in Chapter 5.2.7.1. The parameterization telegram is used to transmit to the valve the time parameter according to PROFIBUS DP/V2 required for this mode. During the bus start-up the PROFIBUS master checks and sends the parameterization telegram to the hooked-up slaves on its own.
The settable parameters such as DP watchdog time, bus cycle time TDP, and the points in time Ti and To can be set in the project planning tool. During the bus start-up, the master automatically sends the values to the valve.

5.2.7.4.4 Configuration telegram

Using the configuration telegram the PROFIBUS master sends the length and the consistency details on the drive telegram to the IAC-R valve. The drive telegram is to be exchanged between the two during process operation.

During project planning the user can only select telegrams that have been enabled in the GSD file. Currently, telegrams 5, 105 and 116 can be selected as drive telegrams. During the bus start-up, the PROFIBUS master automatically sends the configuration telegram to the project IAC-R valve.

5.2.7.4.5 Commissioning at PROFIBUS

For commissioning in conjunction with the PROFIBUS, the PROFIBUS address has to be set in the IAC-R valve. As described in Chapter 5.2.7.1.4 “Setting the PROFIBUS address” on page 58, the address is set using the commissioning software WinHPT®.

5.2.7.4.6 Diagnosis options

Any faults occurring on the IAC-R valve are logged in the IAC-R valve’s internal fault buffer. Each fault is recorded with a fault number, the time of occurrence and the fault value. The fault buffer can be accessed using the following parameters:

- PNU 947 - fault number
- PNU 948 - fault time
- PNU 949 - fault value

Table 31: Structure of the fault buffer of the IAC-R valve

Index	PNU 947 fault number	PNU 948 fault time	PNU 949 fault value	
0				Fault event 1
1				
2				
3				
4				
5				
6				
7				
8				Fault event 2
9				
10				
...				
...				
15				
16				
...				
...				
...				
56				Fault event 8
57				
58				
...				
...				
63				

Pending faults are reported using status bit 3 in status word 1 (ZSW 1).

The fault buffer is designed in accordance with the specifications of the PROFIdrive profile. It logs up to 8 fault events with 8 fault entries per fault event.
Fault event 1 contains the fault entries still present and not acknowledged yet. By remedying the cause(s) and acknowledging the fault afterwards, the entries are passed from fault events 1 to fault event 2, the entries of fault event 2 to fault event 3, etc. Thus, the entries of the oldest failure will be deleted from the list.
Each entry in the fault buffer since the last start of the IAC-R valve results in an alteration of the error message counter in parameter PNU 947.

5.2.7.5 Synchronization with PROFIBUS DP/V2

As already mentioned in Chapter 5.2.7.1 “General notes on PROFIBUS DP/V2” the services of PROFIBUS DP/V2 can be used to synchronize a PROFIBUS master and its assigned slaves. The IAC-R valve can only be operated with a higher-level control system that works in accordance with the PROFIdrive profile and masters clock synchronization according to PROFIBUS DP/V2.

5.2.7.5.1 Structure of the constant-time bus cycle

The constant bus cycle according to PROFIBUS DP/V2 has a previously specified duration (as opposed to the normal DPV0 bus cycle) that is configured in the PROFIBUS master. At the beginning of each bus cycle, the master sends a global synchronization telegram to all slaves.

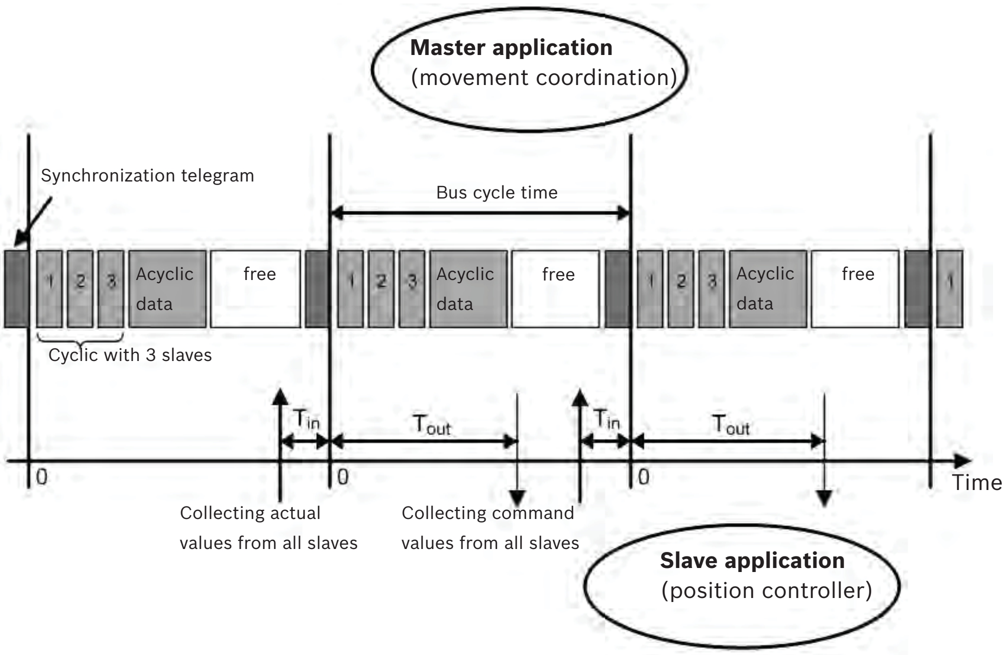

Fig. 36: Synchronization telegram to all slaves

5.2.7.5.2 Time parameters of the constant bus cycle

The time parameters required for PROFIBUS DP/V2 are listed below. The limits are specified in the GSD file of the IAC-R valve.

Table 32: Time parameters of the constant bus cycle

Parameters	Value	Unit	Modifiable/specified by GSD	Limits	Description
T_{BASE_DP}	12000	1 / 12 µs = 83,3 ns	Fixed in GSD, not modifiable	-	Time basis as smallest unit for setting the bus cycle TDP. The bus cycle can only be a multiple of TBASE_DP.
T_{DP}	1...24	T_{BASE_DP}	To be set in network project planning	Min: 1 Max: 24	Duration of a bus cycle. The duration is calculated from TBASE_DP* TDP of a bus cycle and can be set between 1 ms and 24 ms in increments of 1 ms.
T_{BASE_IO}	1500	1 / 12 µs = 83,3 ns	Fixed in GSD, not modifiable	-	Time basis as smallest unit for setting the processing times TI and TO.
T_I	1...	T_{BASE_IO}	To be set in network project planning	Min: 1	Point in time before the end of the bus cycle, at which the actual values are collected and saved for transmission. The time is calculated from TI* TBASE_IO.
T_O	1...	T_{BASE_IO}	To be set in network project planning	Min: 1	Point in time after the start of the bus cycle, at which the received command values for internal processing are used. The time is calculated from TO* TBASE_IO.
T_{MAPC}	1...14	T_{DP}	Can be set in network project planning	Min: 1 Max: 14	Factor used to calculate the cycle time of the master application. This cycle time is required by the higher-level control system to generate new command values for all slaves. The master application time is calculated from TMAPC* TDP.
T_{DX}	1... 2^{32} - 1	1 / 12 µs = 83.3 ns		Min: 1 Max: 2^{32} - 1	Duration required to transmit the process data to all stations during the bus cycle. This time needs not to be entered manually, it depends on the length of the process data and the number of bus stations.
T_{PLL_W}	1... 2^{32} - 1	1 / 12 µs = 83.3 ns		Min: 1 Max: 2^{32} - 1	Window width, within which the synchronization signal has to arrive at the slave.
T_{PLL_D}	0... 2^{16} - 1	1 / 12 µs = 83.3 ns		-	Artificial delay time to adjust the times Ti and To. This function is not available at the moment.

5.2.7.5.3 Payload data saving via life signs

During the exchange of payload data, the master and the slave monitor each other by means of a life sign exchanged in the drive telegram. This is a 4-bit counter, the value of which is counted up from 1 to 15 and then re-starts at 1. Thus, the IAC-R valve monitors if the master application is still active.

If sign of life errors occur (e.g. due to short-term failure of communication), the internal error counter counts up until a settable limit is exceeded. When this limit is exceeded, the valve reports an error by setting bit 3 in status word 1 and stops the axis movement.

The sign of life of the master is transmitted to the IAC-R valve in control word 2 (STW1 bit 12...15). The valve returns its sign of life in status word 2 (SW2 bit 12 ... 15) to the master.

The tolerable number of errors can be set using parameter PNU 925.

5.2.7.6 Example: Project planning of the IAC-R valve on the higher-level control system SINUMERIK 840D(i) sl

A project planning example is described in the following two Chapters 5.2.7.6.1 and 5.2.7.6.2.

5.2.7.6.1 Configuring the IAC-R valve for commissioning using WinHPT®

In order that the IAC-R valve can be commissioned without any difficulties when connected to the NC control, some configuration settings must be made before. The parameters are saved permanently in the IAC-R valve and can be accessed using the commissioning tool WinHPT®. For the proceeding with regard to installation and operation of WinHPT®, see Chapter 5.2.7.1 ”General notes on PROFIBUS DP“ on page 56.
In this context, two settings are of particular importance:
- PROFIBUS address (PNU 918)
- Drive telegram type (PNU 922)

The IAC-R valve is delivered with the following default values ex factory:
- PROFIBUS address = 125
- Drive telegram type = 5

Set both values have as desired. Afterwards, store the parameters permanently using the WinHPT® function “Make data persistent”. The modifications will only become valid upon resetting the IAC-R valve (power off and on reset).

5.2.7.6.2 Integration into the SIMATIC STEP7 project

- STEP7 version used: 5.3 + SP3

In order to be able to connect an IAC-R valve to a higher-level control system (here: Siemens SINUMERIK 840D(i) sl) by means of a PROFIBUS, the valve first has to be integrated into the project of the control system. In the case of the Siemens control system, this is achieved using the project planning software STEP7.

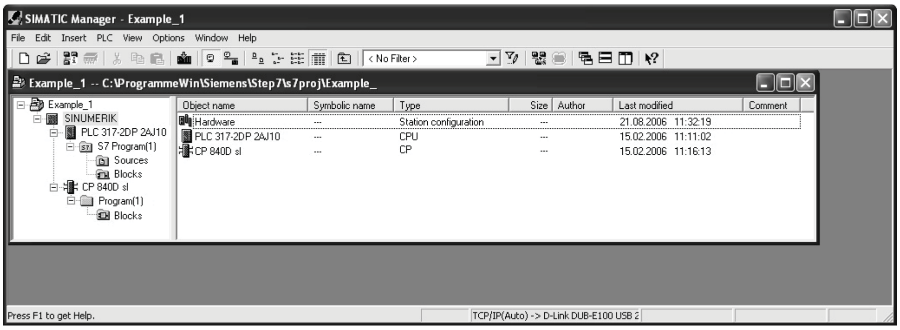

Fig. 37: STEP7 project overview

A PROFIBUS device can be integrated in the hardware configuration of STEP7 using the program “HW Config”. This program can be started by double-clicking on the object “Hardware”.
The following figure shows the hardware configuration dialog. No PROFIBUS bus station has been configured yet.

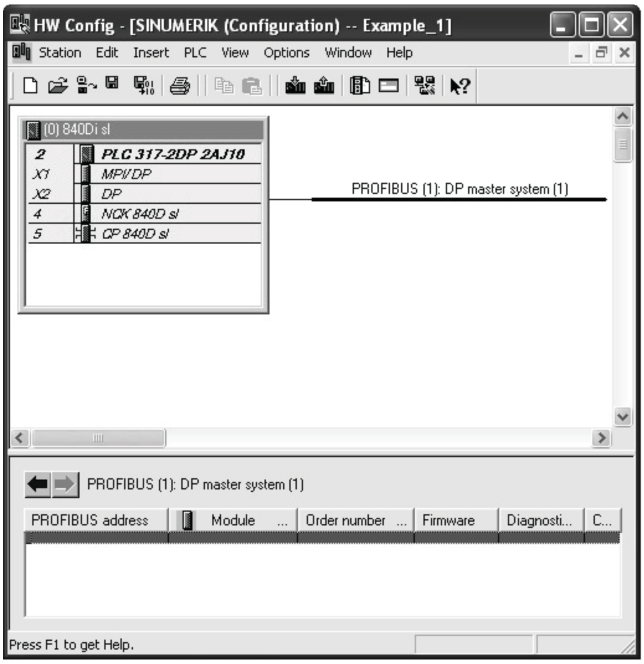

Fig. 38: Empty PROFIBUS master system

Using the hardware catalog, the IAC-R valve can be dragged to the PROFIBUS master system by means of drag&drop. You will find the IAC-R valve in the catalog path under the name “IAC-R 1x PROFIdrive”:
`Further field units/valves/Rexroth/IAC-R 1x PROFIdrive`
If the IAC-R valve with PROFIdrive functionality is not yet listed in the catalog, it has to be imported using the function “Tools/install GSD files”. Install the GSD file for the IAC-R valve (“RX01010E.GSD”). Afterwards, you will find the IAC-R valve in the catalog at `Further field units/valves/Rexroth/IAC-R 1x PROFIdrive`.
You will gain access to the freely selectable drive telegram types by clicking on the symbol “+” to the left of the entry “IAC-R 1x PROFIdrive”.

ℹ The entry “Universal module” is a standard entry of STEP7 and is not used here.

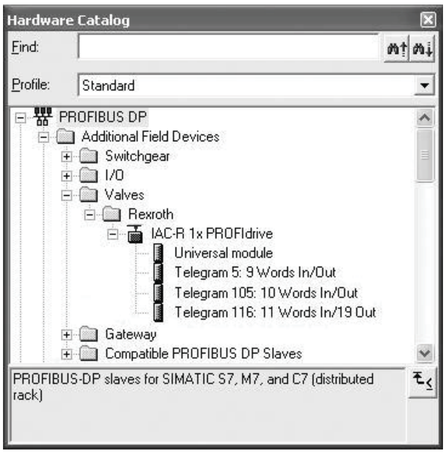

Fig. 39: Hardware catalog

In order to hook up a new IAC-R valve to the PROFIBUS, click the entry “IAC-R 1x PROFIdrive” and drag and drop the device to the PROFIBUS string in the window “HW Config”.
This opens the dialog, in which you have to enter the PROFIBUS address of the IAC-R valve to be hooked up. Here, select the PROFIBUS address that has been configured in the IAC-R valve with WinHPT® before.

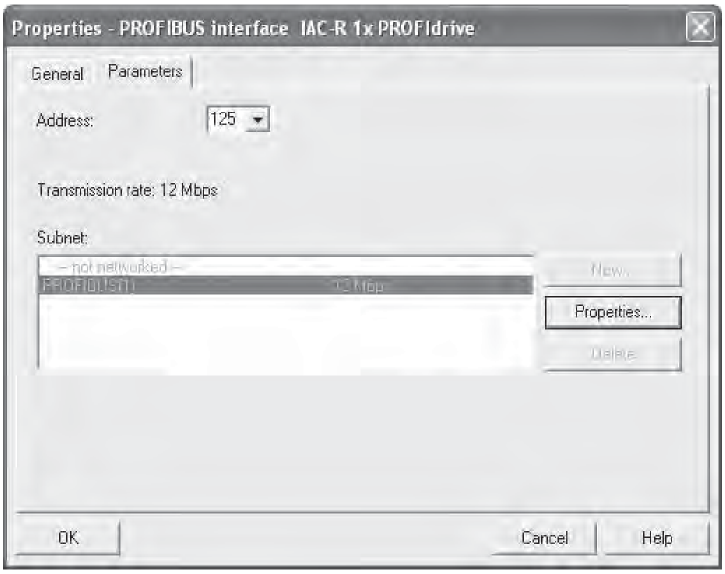

Fig. 40: Project planning the PROFIBUS address

The PROFIBUS address selected in “HW Config” has to be identical with the PROFIBUS address set in the IAC-R valve!
The IAC-R valve is delivered with address 125. In the dialog “Communication Configure Note” in WinHPT® you can set the address in the IAC-R valve to a value between 1 and 126. The setting has to be saved using “Make data persistent” in WinHPT®. The new PROFIBUS address only becomes valid after a reset of the IAC-R valve.

The following Figure shows a project with an IAC-R valve having PROFIBUS address 125. The lower part shows the free slot that is used to enter the desired drive telegram type afterwards.

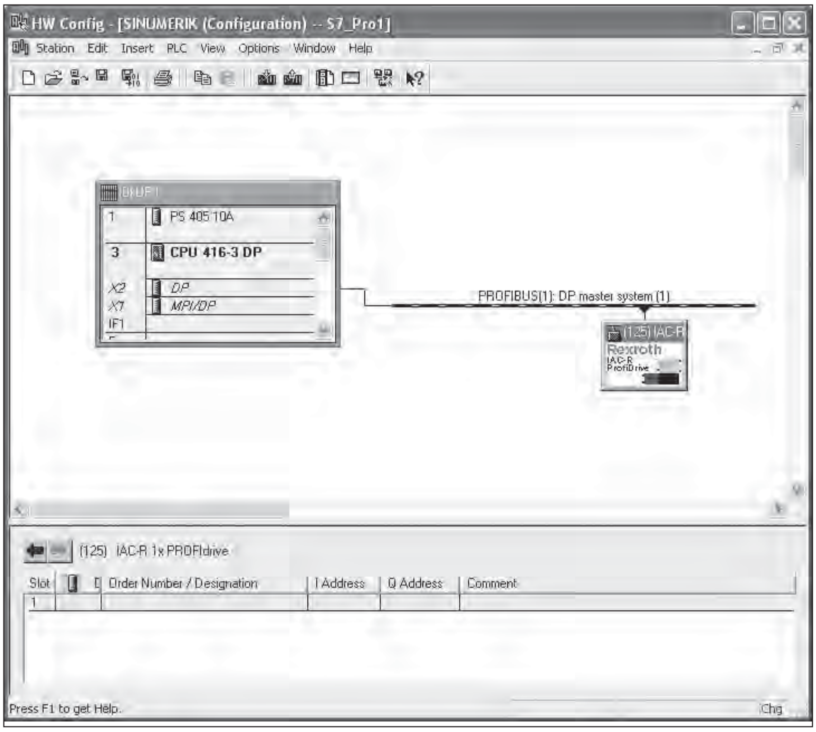

Fig. 41: HW configuration with hooked up IAC-R valve

After having added a new IAC-R valve, you have to determine the drive telegram type. Select the telegram type that was set in the preceding step with WinHPT® in the IAC-R and saved. For this, proceed as follows:
In the hardware catalog, click on the symbol “+” to the left of the entry “IAC-R 1x PROFIdrive” in order to have the available telegram types shown (see Fig. 42). Click on the desired telegram type and drag and drop the same to the free slot of the related IAC-R valve in the lower section of the window “HW Config”. You can assign only one telegram type per IAC-R valve.
An explanation on the structure of the drive telegrams can be found in Chapter 5.2.7.2 “Process data interface and telegram description” on page 73.

The drive telegram selected in the window “HW Config” has to be identical with the one set in the IAC-R valve, otherwise an error will occur while the bus is starting up!
By default, drive telegram 5 is set in the IAC-R valve.
If you wish to use another telegram, it also has to be set in the IAC-R valve using the dialog “Communication Configure Note“ in WinHPT®. The settings have to be saved using “Make data persistent” in WinHPT®. The new telegram type is only valid after a reset of the IAC-R valve

When including a new IAC-R valve in STEP7, input and output address ranges of the control system will be assigned automatically (see Fig. 42 in column I Address and O Address, respectively).
Using this memory area, the NC kernel of the SINUMERIK 840D(i) sl and the integrated PLC exchange the data of the IAC-R drive telegram between each other.

The project planner should write down the I/O address ranges, as these will have to be entered for the relevant axis in the machine data of the SINUMERIK 840D(i) sl at a later point in time.

In order to read or alter the start addresses for input and output data for the individual PROFIBUS stations assigned during project planning, the corresponding station has to be selected in the window “HW Config”. The lower part of the window shows the properties of the station, see Fig. 42. In the columns I Address and O Address the assigned address ranges are shown. These axis-specific address ranges have to be entered into the machine data of the SINUMERIK 840D(i) sl at a later point in time!

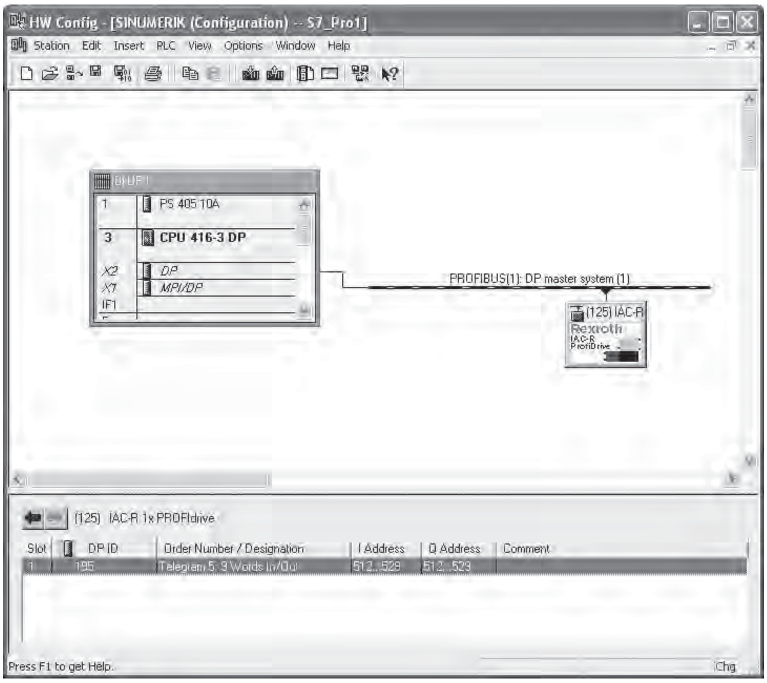

Fig. 42: Representation of the I/O addresses

Double-clicking on the line containing the I/O address details in the window “HW Config” opens a dialog in which you can alter the address ranges.

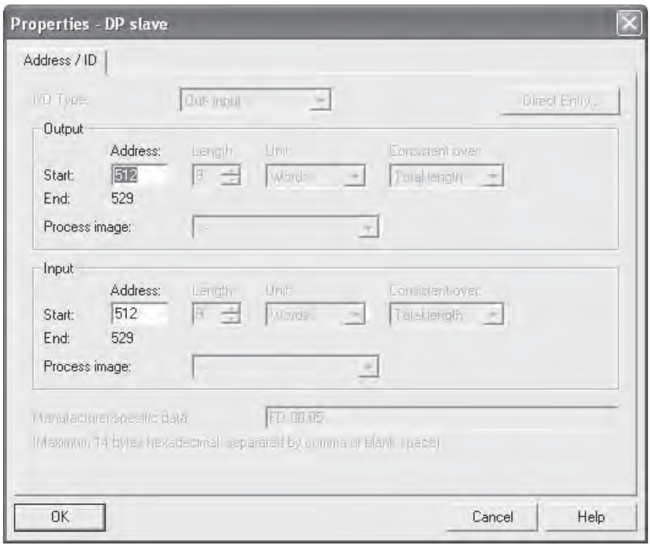

Fig. 43: Changing the I/O addresses

In this dialog you can only alter the start addresses of the input respectively output address range. The start addresses of the input and output data have to be identical, as the NC control system does not differentiate between input and output addresses.

To complete the process of hardware project planning in STEP7, the PROFIBUS settings have to be made. You can access them by right-clicking on the PROFIBUS string, selecting “Object properties” and navigating to the tab “Network settings” via the button “Properties”, see Fig. 43.

In order to achieve bus cycle times that are as short as possible, we recommend selecting the highest baud rate of 12 Mbit/s.

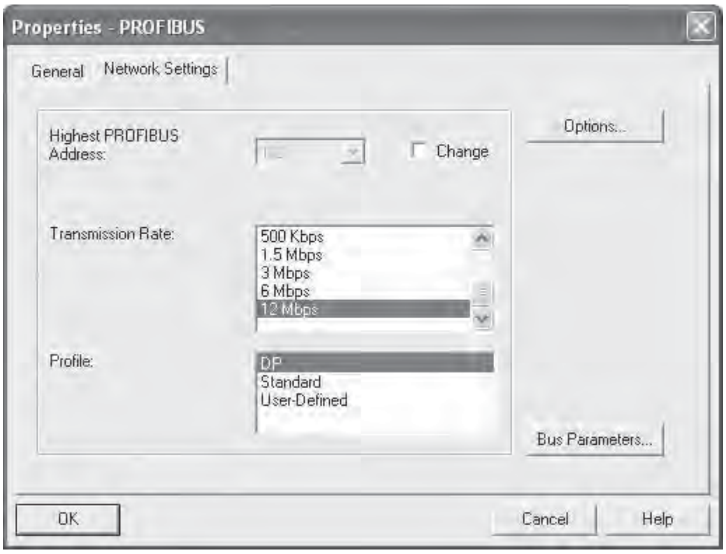

Fig. 44: Setting the baud rate

Apart from the baud rate, the parameters for clock synchronization according to PROFIBUS DP/V2 must be set. To get to the relevant dialog, select the tab "Constant Bus Cycle Time", see Figure below.

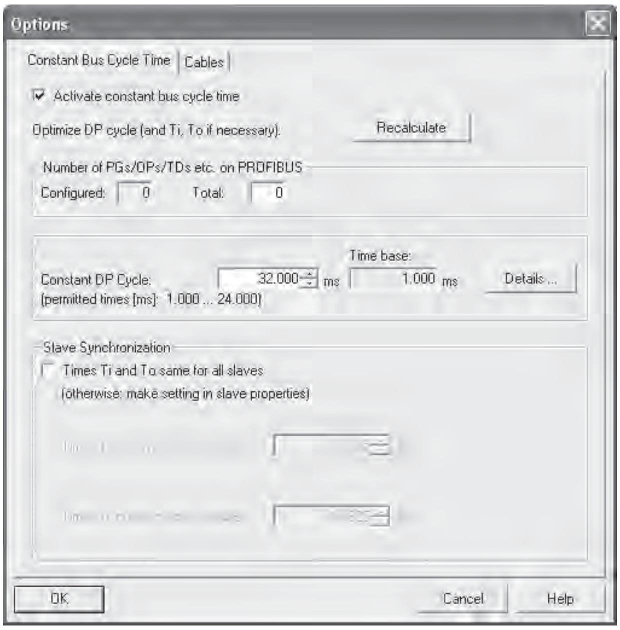

Fig. 45: Setting a constant bus cycle time

Here, activate the options "Activate constant bus cycle time" and "Slave Synchronization". You can then set the times of the bus cycle and the times of Ti

and To. For explanations on the constant bus cycle, see Chapter 5.2.7.5.2 "Time parameters of the constant bus cycle" on page 69.
Generally, the values for bus cycle time TDP and the time values Ti and To should be selected as small as possible. The settings dialog calculates the possible minimum and maximum values automatically. The minimum values can be used as a guideline at this point.
When all settings are made, the hardware configuration (see Figure below) has to be saved and compiled using button **1**. Furthermore, the data have to be loaded into the PLC (PLC 317) by clicking on button **2**

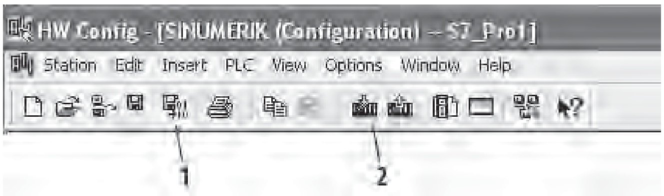

Fig. 46: Saving, compiling, and loading the hardware configuration

5.2.8 Setting the machine data of the SINUMERIK 840 D(i) sl

Each IAC-R valve represents an axis in the NC control system. The machine data have to be adapted to the previous settings. Below, you will find a description of the required settings for a trouble-free start of the NC control system.

Setting logical I/O addresses

For the NC control system being able to exchange data with the IAC-R valve connected over PROFIBUS, the NC control system must know the I/O addresses of the command/actual values from the drive telegram.
These addresses are the I/O addresses specified in the STEP7 project in the window "HW Config". The logical start address has to be entered in the SINUMERIK 840D(i) sl in the "General machine datum MD 13050". One start address has to be entered per machine address (as logical I/O address); it is therefore important that the start address for input data and the start address for output data in the STEP7 project are identical.
MD 13050: DRIVE_LOGIC_ADDRESS[n] (logical I/O address)= e.g. 272

Setting the drive telegram type

The telegram type describes the amount of data and the data structure of the telegrams exchanged during cyclical communication between the NC and the IAC-R valve using the PROFIBUS connection.
The drive telegram type is notified to the NC control system in machine datum MD 13060:
MD 13060: DRIVE_TELEGRAM_TYPE[n] (drive telegram type) = e.g. 5

Any alterations to the telegram type always have to be made consistently at 3 places in the system:
- in STEP7/HW config (+ compiling and loading!)
- in WinHPT® (+ saving and restart!)
- in the machine datum MD 13060 of the SINUMERIK 840D(i) sl control system
  (+ power on reset).

Setting the drive alarm evaluation

Machine datum MD 13070 can be used to activate drive alarm evaluation for the IAC-R valve that is deactivated by default. For this, bit 0 has to be set to value FALSE (that is, 0). All other values should be set to TRUE.
MD 13070: DRIVE_FUNCTION_MASK (DP functions used).

Setting drive type

Set drive type “Linear drive” (= value 3) for the IAC-R valve in machine datum MD 13080:
MD 13080: DRIVE_TYP_DP[n] (drive type PROFIBUS DP) = 3).

Setting command and actual value channels

In the NC control system, the command and actual value channels have to be activated for each axis, as these are declared as simulation axes by default. Furthermore, a command value channel and an actual value channel have to be set. For this, the following axis-specific machine data have to be set:
MD 30130: CTRLOUT_TYPE (output type of the command value) = 1 (command value encoder)
MD 30240: ENC_TYPE ENC_TYPE (type of actual value acquisition) = 1 (raw signal encoder)
MD 30110: CTRLOUT_MODULE_NR[0] (command value assignment: logical drive number)
MD 30220: ENC_MODUL_NR[n] (actual value assignment: logical drive number)
In MD 30110 and MD 30220 the identical logical drive number of the axis has to be entered, which represents the machine axis. The value entered refers to the axis, the I/O address of which is saved in MD 13050: DRIVE_LOGIC_ADDRESS[n].

5.2.8.1 Commissioning software WinHPT®

The commissioning software WinHPT® is available as download in two variants. One variant for installation on a PC, the other one can be installed directly on a Sinumerik 840 D(i). The present operating instructions describe the installation and operation with a PC. For the variant for installation on the Sinumerik 840 D(i) sl a separate documentation is available that can be downloaded at `http://www.boschrexroth.de/IAC`.
Together with WinHPT® you download WinView. WinView is a program for the graphical representation of recorded variables. The data are acquired in the controls from Bosch Rexroth. WinView is an integral part of the operating program of the relevant drives. The operating program passes data to WinView for visualization. The data can be saved in the specific file format .GRA and re-loaded.

5.2.8.2 System requirements

The following system requirements must be met in order to execute WinHPT®:
- Processor: Intel Pentium 4/AMD Athlon or higher
- RAM: at least 512 MB
- Operating system: Microsoft Windows XP, Microsoft Windows 7 (32- or 64-bit version)
- Memory space: at least 150 MB free memory space on the hard disk
- Graphics: at least 640x480 pixels with 16 bit color depth, recommended: 1024x768 with 32-bit color depth
- Input devices: mouse and keyboard
- An interface supported by WinHPT® for the bus system used

5.2.8.3 Setup including installation of the bus interface

The parameterization tool WinHPT® allows for accessing the parameters of the IAC-R valve over the existing bus system. It can be used to parameterize and diagnose an IAC-R valve.
The tool is provided by Bosch Rexroth at no costs. The most recently published version can be downloaded from the product site at:
`http://www.boschrexroth.de/IAC`
In order to install WinHPT®, you only have to execute the downloaded setup program. The individual installation steps will be described below using WinHPT® version V02.01 as an example.

5.2.8.3.1 Starting the installation

After having started the installation program, an information dialog will be displayed first.

Fig. 47: WinHPT® installation wizard

Confirm this dialog by clicking on the button “Next>”. Afterwards, the license conditions for WinHPT® are displayed. In order to be able to install WinHPT®, you have to accept these conditions.
In the following dialog you can select a destination for the installation, where WinHPT® is to be installed.

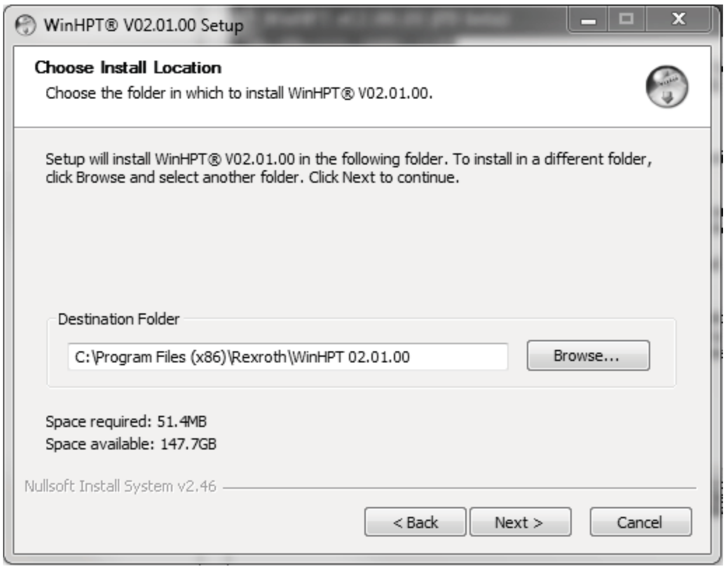

Fig. 48: WinHPT® Installation wizard

Using the button “Browse...” you can adapt the destination offered by the installation program as desired. Once you have selected the desired destination, click on the button “Next>” to open the dialog with the available components.
In the following dialog you can select the components you wish to install.

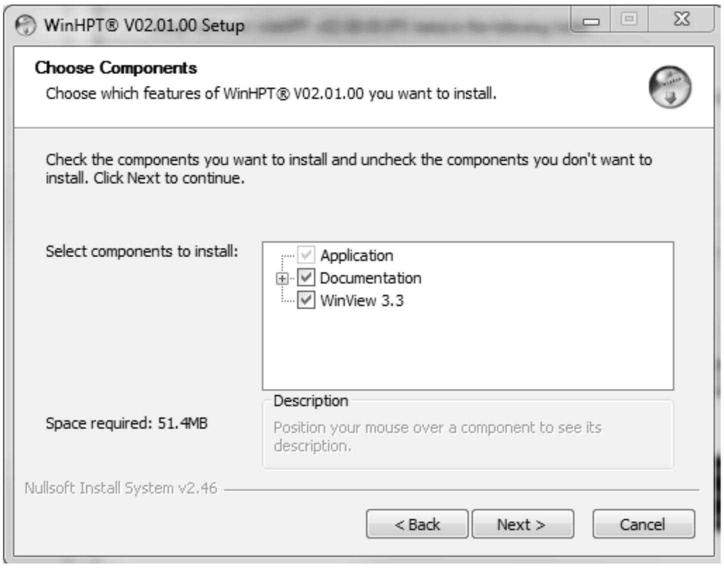

Fig. 49: Selection of components

Then click “Next >” to open the selection of the start menu folder. Start the installation by clicking on the “Install“ button.

5.2.8.3.2 Completing the installation

Once all files were installed, the finalize dialog of the setup wizard is displayed.

▶ Finalize the installation of WinHPT® by clicking on the “Finish” button.

WinHPT® is now installed on your PC and ready to operate

5.2.8.4 General operating instructions

5.2.8.4.1 Starting WinHPT®

WinHPT® can be started most easily using the start menu entry created by the installation program. After having started the program, a disclaimer dialog will be displayed first. Afterwards, either the main window of WinHPT® or the dialog for the configuration of the PROFIBUS bus parameters is displayed.

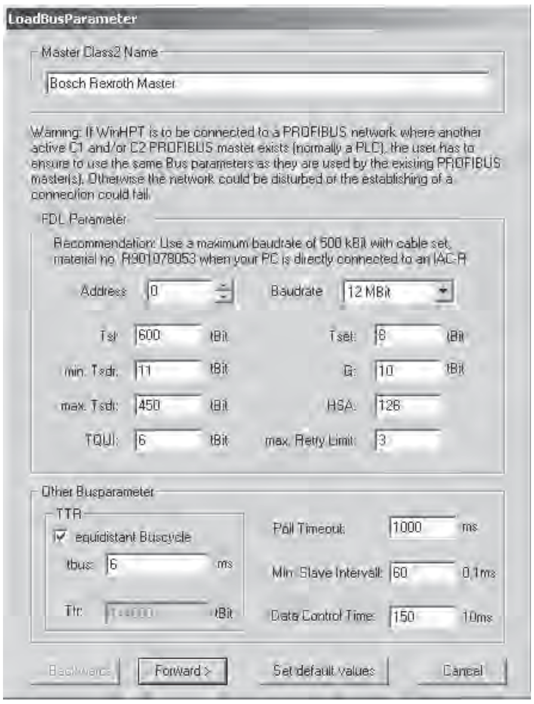

Fig. 50: LoadBusParameter

When starting WinHPT® for the first time, please proceed as described in Chapter 5.2.8.4.3 “Establishing the connection“ on page 83. Should you have established a connection before, this connection will be selected automatically with the next startup.

It must be noted that WinHPT® should only be opened once on a PC, as otherwise, this would result in conflicts regarding the access to the bus interface. Furthermore, the bus interface selected in WinHPT® must not be used by any other application.

5.2.8.4.2 Operating concept

In the main window of WinHPT® the main function blocks of the IAC-R valve are shown. Clicking on the corresponding function block causes sub-dialogs to open, which display the parameters/functions belonging to the relevant function block.

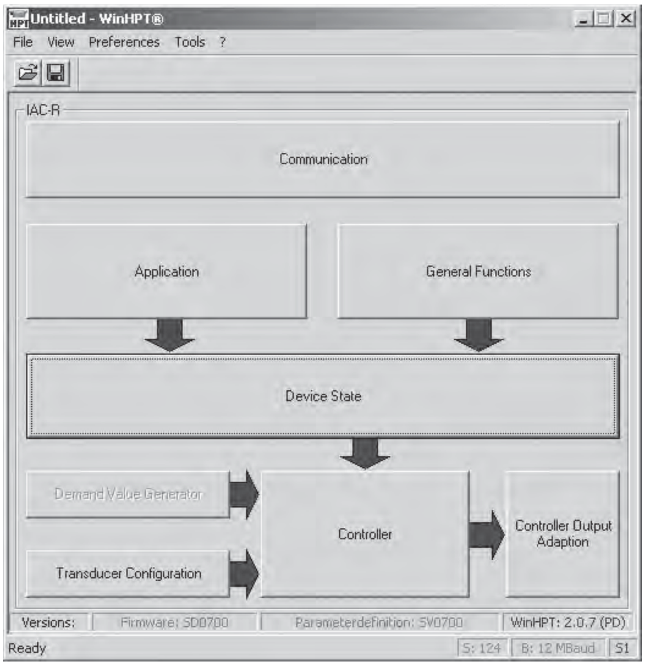

Fig. 51: Commissioning software WinHPT®

In most of the dialogs the current parameter values of the IAC-R valve are displayed directly. For this, the parameter values are queries directly from the IAC-R valve over the bus when the dialog is opened. You can then alter the parameters in the dialog as desired. In most of the dialogs, the modified values will only be transferred to the IAC-R valve after having been confirmed by clicking the button “Apply”. After the values were transferred, the displayed parameter values are updated in the dialog. This allows you to ascertain, whether previously set parameters have been rejected or limited by the IAC-R firmware

WARNING! Incorrect parameterization!
Risk of injury due to unintended movements or unintended behavior of the machine!

▶ Please note that modified parameters become effective immediately on the part of the valve. The behavior of the IAC-R valve is therefore directly influenced. Take suitable precautions to rule out any hazards to personnel.

5.2.8.4.3 Establishing the connection

In order to establish a communication connection between WinHPT® and an IAC-R valve, it is necessary to inform WinHPT®, which bus interface and which bus type it is to use. Furthermore, the communication parameters have to be set and the bus address of the device has to be entered. In order to implement these steps, you have to open the dialog "Interface configuration" in WinHPT® by selecting the menu item "Preferences → Businterface". In the displayed dialog, select the type of bus interface in the drop-down menu. For communication with a PROFIdrive IAC-R valve, a bus interface has to be selected that starts with bus type PROFIdrive in the drop-down list.

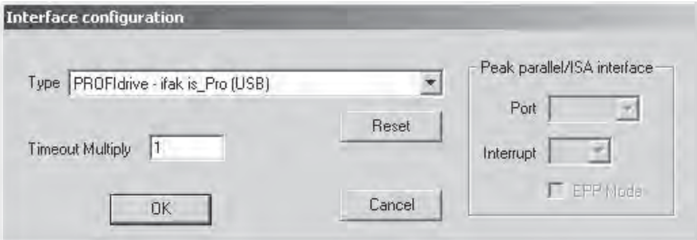

Fig. 52: Interface configuration

Once the desired bus interface has been selected, confirm the dialog by clicking the button "OK". Now, WinHPT® initializes the driver for the selected bus system. For a PROFIBUS/PROFIdrive interface, a new dialog will be displayed, in which you can set the bus parameters and the baud rate for the PROFIBUS interface.

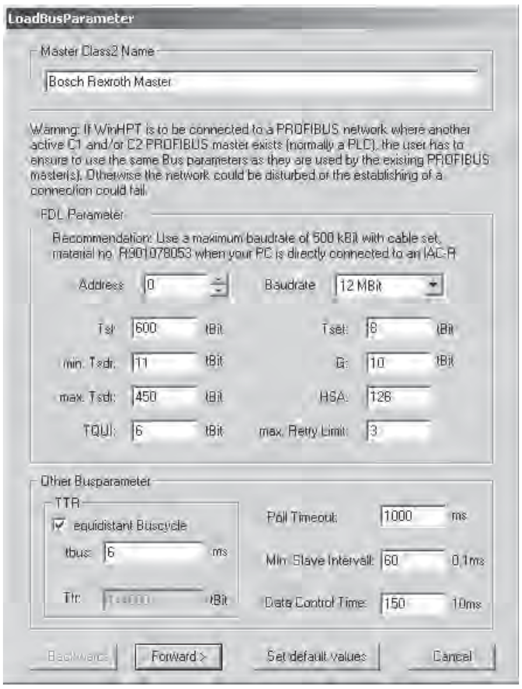

Fig. 53: LoadBusParameter

If there are several masters (the PC interface is a C2 master) connected to the PROFIBUS, all masters should utilize the same bus parameters to avoid communication problems.
Once all bus parameters have been set properly, you have to confirm the dialog by clicking on the button “Forward >”. A dialog to establish a C2 connection will be opened.

Fig. 54: C2-Service Initiate

Using the button “Live list”, you can have a list of the existing bus stations displayed and select the desired bus address. Additionally, you can enter the node number of the IAC-R valve directly in the field “Slave address”.
When you entered the desired address, confirm the dialog by clicking on the button “Forward >“. WinHPT® then establishes a C2 connection with an IAC-R valve with the bus address entered. WinHPT® is now ready to configure the set IAC-R valve.

5.2.8.4.4 Saving parameters

WinHPT® provides for the option of saving the application-specific parameters of an IAC-R valve as a file on a PC. This allows for saving certain settings and re-loading these back to an IAC-R valve, if required.
You can open the function for saving parameters using the menu item "File → Save Parameters as...".
Afterwards, a standard dialog is displayed that can be used to specify the destination and the file name for the backup file. By confirming your selection by clicking on the button "Save", you start the backup procedure. Application-specific parameters of the IAC-R valve are read over the bus and saved to the relevant file.

5.2.8.4.5 Loading parameters

You can load a parameter backup file by selecting the menu item "File → Load Parameters". Now, you can select the desired backup file in the dialog "Open". Clicking on the button "Open" starts the loading procedure and all parameters of the selected file will be transferred to the IAC-R valve.

5.2.8.4.6 Storing parameters

All modifications to parameters are first kept only in the volatile memory (RAM) of the IAC-R valve. After a restart of the IAC-R valve, all modifications would be lost. In order to save the modifications to the IAC-R valve persistently, you have to execute the function for permanent parameter backup using menu item "File → Make data persistent".
In order to undo all modifications and return to the settings saved last, you can select menu item "File→Reload persistent data". This function restores the configuration stored permanently within the IAC-R valve".

5.2.8.5 Diagnosis, parameter monitoring

In addition to the settings dialogs for the various parameters of the IAC-R valve, WinHPT® also offers functions for diagnostics and monitoring of certain parameters.

5.2.8.5.1 Parameter Monitor dialog

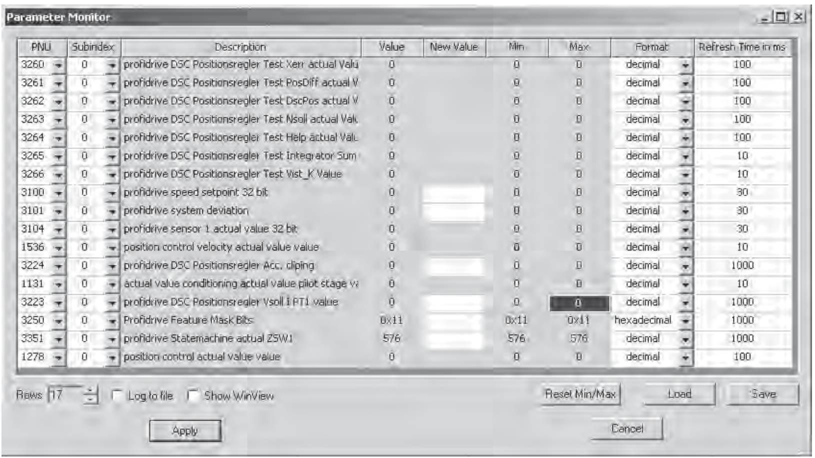

Fig. 55: Parameter Monitor

In the dialog “Parameter Monitor”, you can compile a list of parameters, which will be updated cyclically. With the help of this dialog, you can display specific parameter values and track modifications of the parameter values quasi “live”.
It is also possible to save a parameter compilation as file and to re-load the same into the dialog “Parameter Monitor” at a later point in time. This allows for compiling the most important parameters for certain tasks and accessing them with the help of a clearly structured list.
You can add additional lines to the list with the help of the increment/decrement buttons next to the box “Rows”.
In the first two columns (“PNU”/”Subindex” in the example), you can set the bus address of the parameter to be displayed.
If the parameter value can be written, you can enter a new value in the relevant parameter row using the field “New value” and send the same to the IAC-R valve. For “read-only” parameters the entry field is deactivated.

For a list of the most important parameters, see Annex, Chapter 17.3 “Important parameters” on page 128.

5.2.8.5.2 Monitor dialog

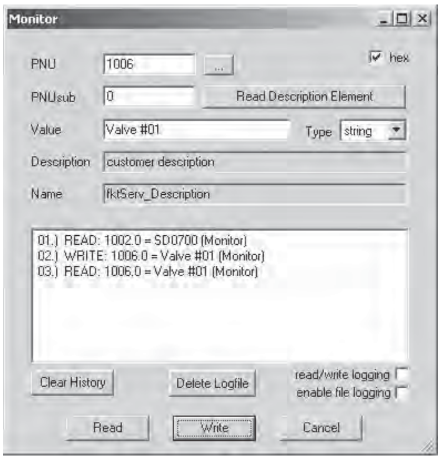

Fig. 56: Monitor

With the help of the dialog “Monitor”, you can read or write a certain parameter. Additionally, a log function is provided that can be used to monitor parameter accesses by WinHPT®.
Using the button “...” next to the fields for the parameter number, you can have a list of available parameters displayed. You can then select a certain parameter from the list. Alternatively, you can enter the parameter number of the parameter to be accessed directly in the dialog “Monitor”.
By clicking on the button “Read” the current value of the selected parameter is read by the IAC-R valve and displayed in the field “Value”.
If you change the value in the field “Value” and click the button “Write” afterwards, the entered parameter value is sent to the IAC-R valve.
If you activate the checkbox for “Read/write logging”, the log function will be activated. Now, the list shows the individual parameter accesses by WinHPT®, e.g. when a new dialog is opened.
Irrespective of whether the log function is activated or not, the list always shows all accesses made via the dialog “Monitor”. By double-clicking on a list entry, the associated parameter is selected in the dialog “Monitor”. Thus, the dialog “Monitor” allows for accessing individual parameters directly or for tracking automatic parameter accesses by WinHPT® to a certain extent.

For a list of the most important parameters, see annex, Chapter 17.3 “Important parameters“ on page 128.

5.2.8.6 Firmware update

5.2.8.6.1 Preparations

WinHPT® provides the option of updating the firmware of one or several IAC-R valves over the bus. For this, you require a file containing the firmware matching the relevant hardware version of the IAC-R valve.
To be on the safe side, you should make a manual parameter backup before executing the actual firmware update.

5.2.8.6.2 Configuration of the firmware update

You can open the firmware update function in WinHPT® by selecting the menu item "File→Update firmware". The following dialog will be displayed.

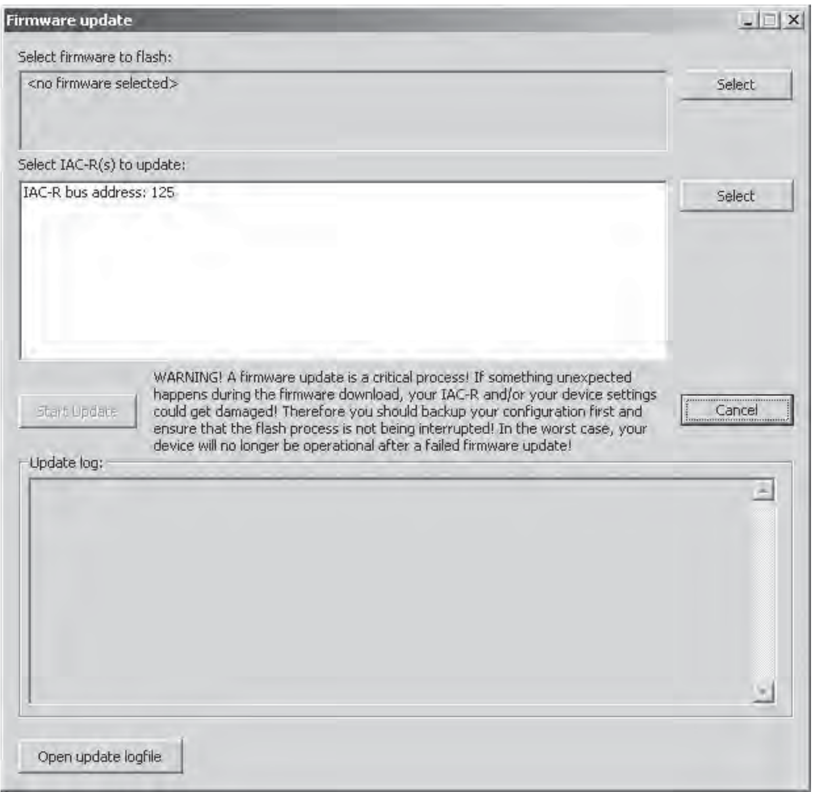

Fig. 57: Firmware update

First select the desired firmware version that you want to transfer. For this, click the button "Select" next to the upper field containing the information on the selected firmware.

The firmware selection dialog will be displayed.

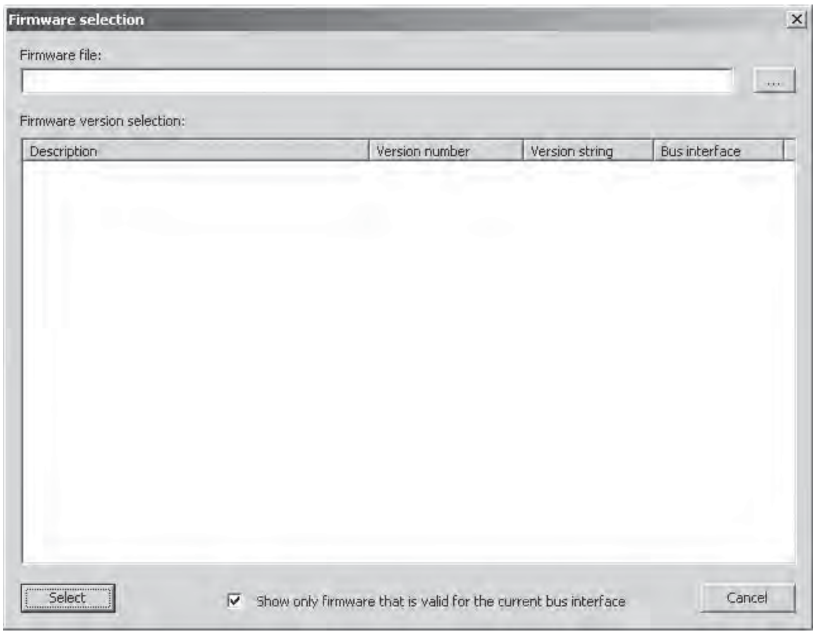

Fig. 58: Firmware dialog

In this dialog, first click on the button "..." next to the entry field for the firmware file. Select the file containing the firmware in the subsequent file selection dialog (file extension FL2). For reasons of compatibility the old firmware format "FLS" is supported as well. This format should, however, no longer be used, if possible. Once the firmware file has been selected, the firmware versions contained in the file will be displayed.

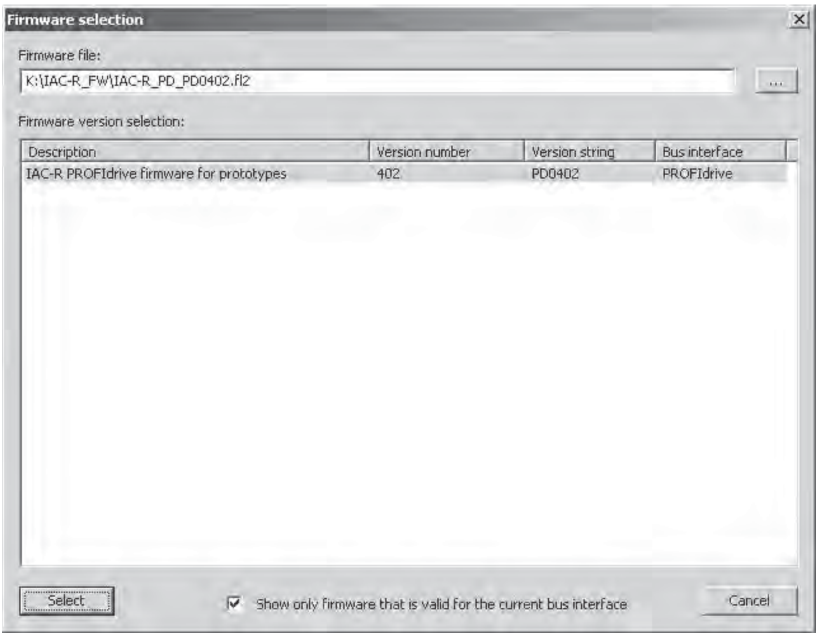

Fig. 59: Selecting the firmware

From the list of firmware versions you have to select the version you want to use for the update. By default only the firmware versions matching the active bus type are displayed.
Once a firmware version has been selected from the list, you have to exit the dialog by clicking on the button “Select”. Now, information on the selected firmware will be shown in the firmware update dialog.

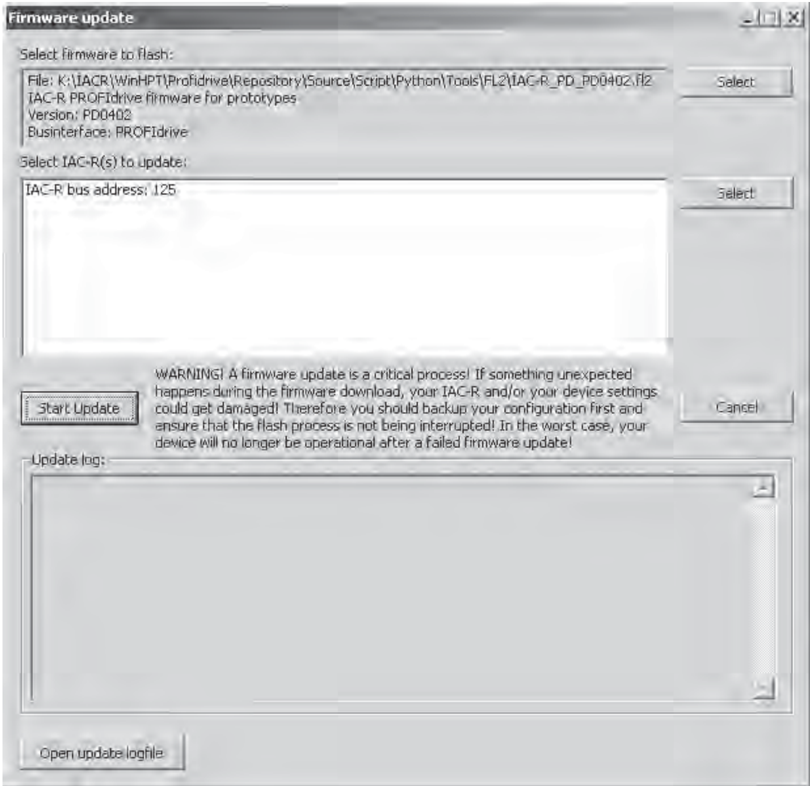

Fig. 60: Firmware update

In a next step, you have to inform WinHPT® to which IAC-R valve the selected firmware is to be transferred. For this, click on the button “Select” next to the field with the selected devices.

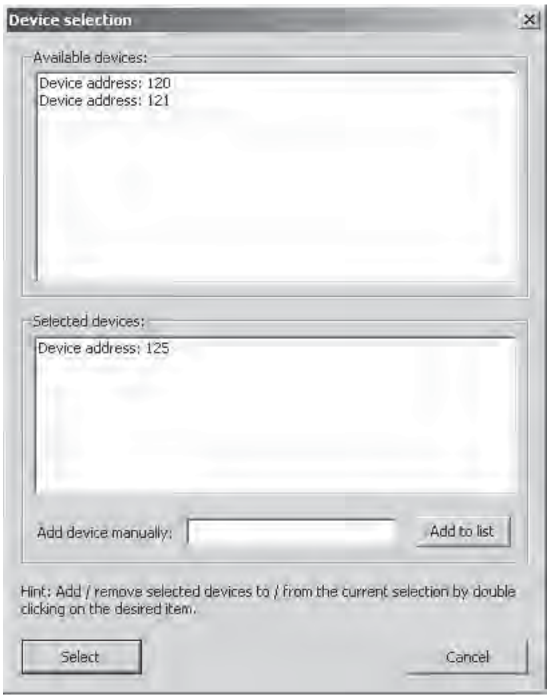

Fig. 61: Device selection

This dialog lists the devices available for selection in the section “Available devices”. In case of PROFIBUS/PROFIdrive these are the slaves from the live list. Double-clicking on a device address adds the same to the list of “Selected devices”.
In addition, you can enter the bus address of a device directly. For this, enter the address in the field “Add devices manually” and confirm by clicking on the button “Add to list”. The entered address will now be displayed in the field “Selected devices”.
Double-clicking on a selected device address removes the same from the selection.
Once the desired device has been selected, the dialog can be exited by clicking on the button “Select”.
Now, the list of the selected devices is also displayed in the firmware update dialog.

5.2.8.6.3 Starting the firmware update

Once a valid firmware version has been selected and the list containing the device addresses to be updated has been compiled, you can start the update procedure by clicking on the button “Start update”.
All selected devices will be updated to the selected firmware version one after the other.

During the flash procedure the power supply or the communication between WinHPT® and the IAC-R valve must never be interrupted, as otherwise, no executable firmware version would be available on the IAC-R valve.

The “Update log” section of the dialog window shows the individual steps executed. Warnings and error messages are issued in this area as well.

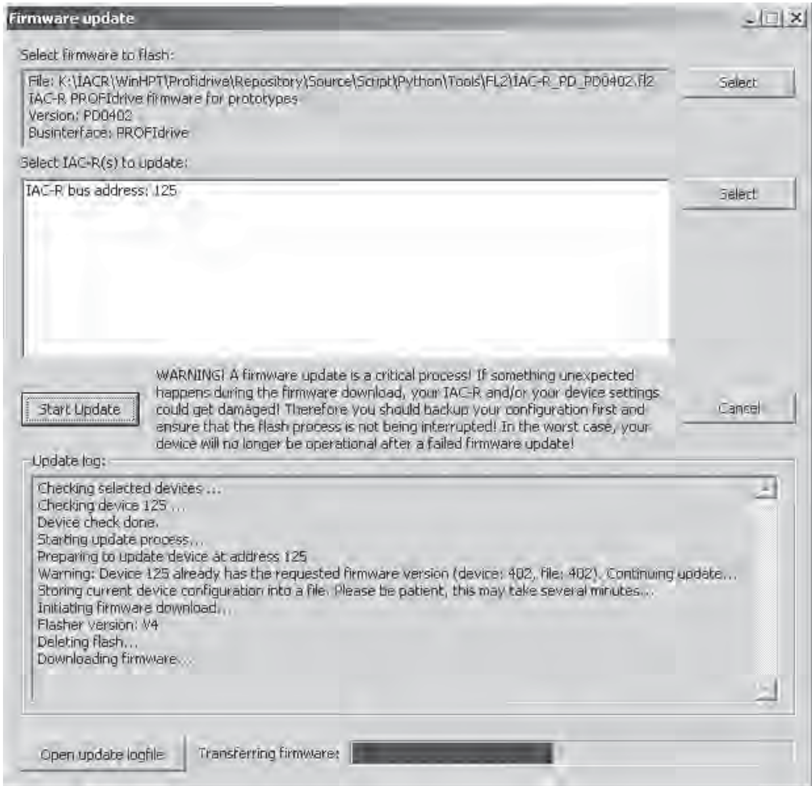

Fig. 62: Firmware update

5.2.8.6.4 Completion of the flash procedure

When all selected devices have been updated, updating is completed. If a serious error occurs during the update procedure, updating will be interrupted immediately with an error message.

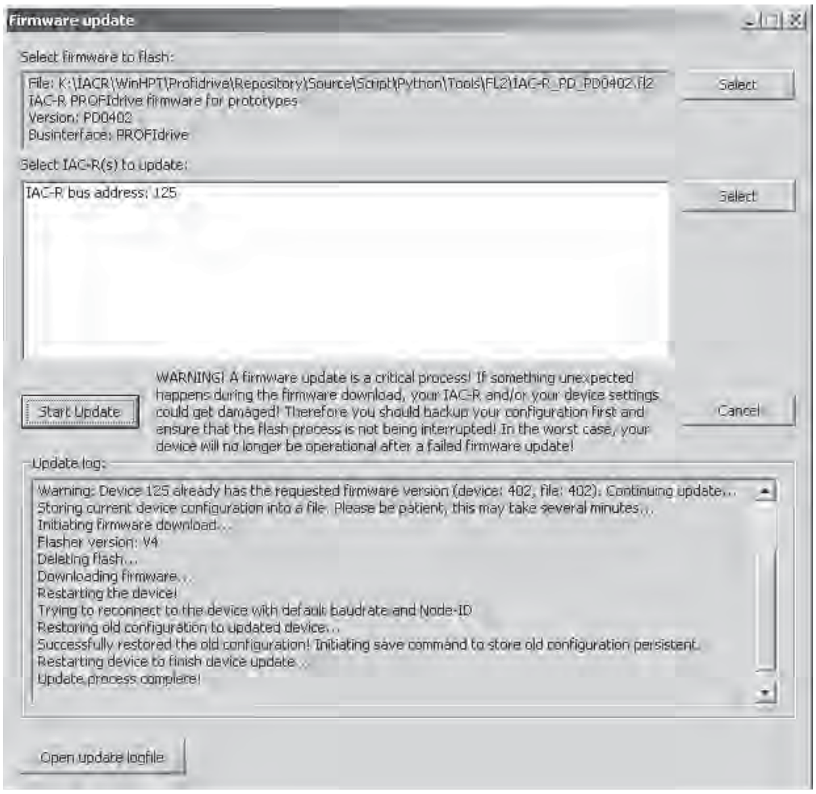

Fig. 63: Firmware update

5.2.8.6.5 Notes on the updating procedure

Before carrying out any device updates, WinHPT® saves the device settings to a backup file. After the new firmware was transferred, the file is reloaded to the device and the original configuration restored.

While reloading this file, a list of parameters that could no more reloaded might be issued in the “Update log“. This problem can occur whenever certain parameters are no longer used in another firmware version or if an older firmware version was installed and the saved parameters did not exist in this old firmware.

Normally, this should not have any effects on the configuration implemented during an update. Nevertheless, we recommend checking if the list contains parameters that may be relevant for the relevant application of the IAC-R valve. These may have to be configured manually afterwards.

After completion of the update procedure, all IAC-R valve should be de-energized first. When the power supply is re-connected, the new firmware version can be used without any restrictions.

5.3 Identification of the product

Details on the nameplate

The meaning of the details on the nameplate can be found on the basis of the numbered fields from the following figures and the table.

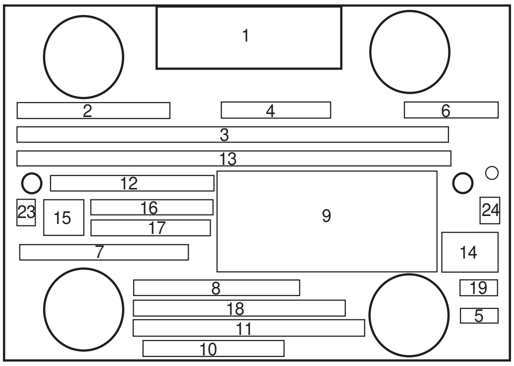

Fig. 64: Nameplate NG6

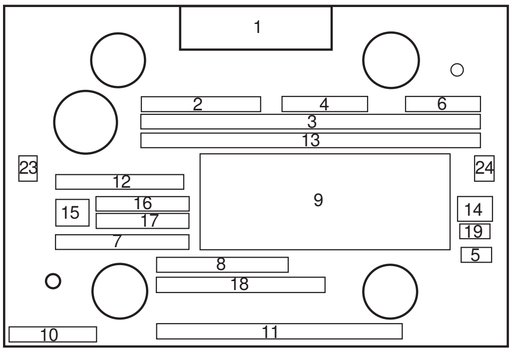

Fig. 65: Nameplate NG10

Table 33: Details on the nameplate

No.	Type of detail	Detail or example
1	Manufacturer's logo	**Rexroth**
2	Material No. of the valve (= order No.)	e.g.: **R901133646**
3	Type designation overall valve	e.g.: **4WRPNH6 C3 B15P-2x/M/24FA6C**
4	---	---
5	Number of the manufacturing plant	e.g.: **7920**
6	Manufacturing date (year and week)	e.g.: **FD: 08W01**
7	Maximum operating pressure	e.g.: **Pmax = 315 bar**
8	Ambient temperature range	**-20°C ≤ Ta ≤ +50°C**
9	Hydraulic symbol according to ISO 1219	Graphics
10	Designation of origin	**Made in Germany**

No.	Type of detail	Detail or example
11	Name and address of the manufacturer	**BOSCH REXROTH AG** **D-97816 LOHR**
12	Customer or job order number	e.g.: 123456789012345678
13	Customer material number or additional details	e.g.: **CNR: 1234567890**
14	CE mark	**CE**
15	---	---
16	---	---
17	---	---
18	---	---
19	---	---
23	Solenoid designation 1	**a**
24	Solenoid designation 2	**b**

6 Transport and storage

For storing and transporting the product always observe the ambient conditions specified in the technical data (see data sheet 29291).

7 Installation

NOTICE

Wear and malfunction!
The cleanliness of the hydraulic fluid has a major influence on the cleanliness and the service life of the hydraulic system. Contamination of the hydraulic fluid causes wear and malfunction. Especially foreign particles such as welding beads and metal cuttings in the hydraulic lines can damage the IAC-R valve.

- Observe strictest cleanliness.
- Install the IAC-R valve under clean conditions.
- Make sure that ports, hydraulic lines and connected parts (e.g. measuring instruments) are free from contaminants.
- Make sure that when ports are closed no contaminants can enter.
- Make sure that no detergents can get into the hydraulic system.
- Do not use linty cleaning cloths for cleaning.

7.1 Unpacking

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

7.2 Installation conditions

For the installation, adhere in any case to the ambient conditions specified in the technical data (see data sheet 29291).

7.2.1 Installation orientation

The IAC-R valve can be installed in any optional position.

7.2.2 Painting the valve prior to its installation

If the IAC-R valve is to be paint-coated prior to its installation, please observe the following:

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

Nameplates are protected against paint application by means of a detachable that is provided in the factory and can be removed after paint-coating.
When removing the threaded plastic plugs please see to it that no paint chips enter the valve.

7.3 Required tools

To install the IAC-R valve you merely require standard tools.

For details with regard to screws, see Table 34 and Table 35 on page 99 and 100, respectively.

7.3.1 Requirements for the valve subplate

Please observe the prescribed minimum distance (see data sheet 29291 under "unit dimensions"), especially when mounting several valves to form a valve battery, to allow individual valves to be demounted and to prevent overheating of the solenoids. For recommended subplates, see Chapter 14.1 "Optional accessories" on page 123.

7.3.2 System overview

The IAC-R valve is to be integrated into an overall system as follows:

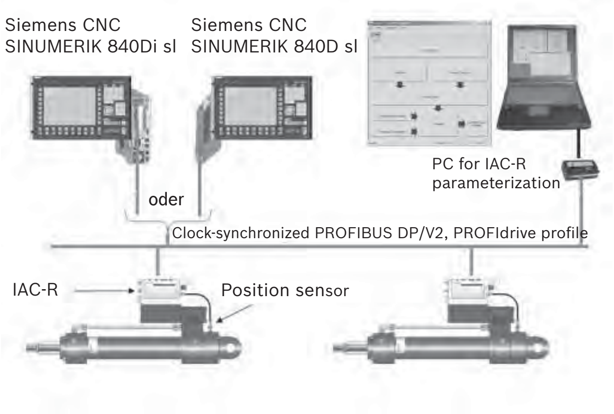

Fig. 66: System overview of NC control system and IAC-R with clock-synchronized PROFIBUS connection for interpolating hydraulic axes

7.4 Prior to the installation

Before installing the IAC-R valve in a unit or system you have to flush the system. Only then is the proper valve function ensured. Please also observe the operating instructions of the unit respectively the system the valve is installed in.

WARNING! Improperly mounted flushing plate!
Risk of injury caused by ejected hydraulic fluid!

- Mount the flushing plate properly using all of the 4 mounting screws.
- Use exclusively the valve mounting screws listed in Chapter 14.1 "Optional accessories" on page 123.

For flushing the system, into which the valve is to be installed, we offer flushing plates with FKM seals and porting pattern according to ISO 4401-03-02-0-05 (for NG6 valves) and according to ISO 4401-05-04-0-05 (for NG10 valves).

Fig. 67: Flushing plate according to ISO 4401-03-02-0-05 for valves NG6, representation of the internal ports

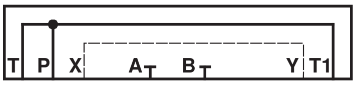

Fig. 68: Flushing plate according to ISO 4401-05-04-0-05 for valves NG10, representation of the internal ports

▶ Install the flushing plate instead of the IAC-R valve in the system and flush the same afterwards.

When using the subplates mentioned in table 58 or when installing the valve on comparable gray cast iron mounting surfaces tighten all four mounting screws of the flushing plate with a torque wrench to the specified torque, see table below.
This tightening torque refers to the admissible maximum operating pressure.

Table 34: Screw dimensions and tightening torque with admissible tolerance for mounting screws of the flushing plate

Size	Screw dimensions	Tightening torque
NG6	M5 × 40	6 + 2 Nm
NG10	M6 × 50	11 + 3 Nm

Even better suitable than a flushing plate is the use of a directional valve with ports to ISO 4401-03-02-0-05 (for NG6 valves) or to ISO 4401-05-04-0-05 (for NG10 valves). With such a valve you can also flush the actuator ports.

As a guideline, the following formula can be applied to establish the required 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 is decisive for flushing and can be monitored by means of continuous measurement with a particle counter.

▶ Install a differential pressure-resistant pressure filter without bypass and, if possible, with integrated clogging indicator directly upstream of the IAC-R valve. During the flushing procedure, check all filters at short intervals and replace clogged filter elements as required.

7.5 Installing the IAC-R valve

NOTICE

Exchanged ports!

Damage to the IAC-R valve.

- Never exchange the P and T ports.

Missing seals and plugs!

Loss of protection class IP65! Fluid and foreign particles can enter and destroy the IAC-R valve.

- Before installing the valve, make sure that all seals and plugs of the plug-in connections are tight.

To ensure proper operation, the pressure chamber of the solenoid must always be filled with hydraulic fluid, and running empty of the tank line has to be avoided. If the installation situation allows, a pre-load valve that ensures a pre-load pressure of about 2 bar must be installed in the tank line.

Switching off the valve solenoid abruptly results in a voltage peak due to the induction effect. As suppressor circuit, the valve solenoid coil already contains a suppressor diode with 47 V threshold voltage, which attenuates these voltage peaks. However, if required, additional external circuit measures may have to be taken to avoid connected circuits being influenced by the remaining residual voltage peak.

- Before mounting or removing the valve, make sure that the surroundings are clean in order that no contamination can get into the oil circuit. Use only non-linty fabric or special paper for cleaning.
- Check the valve connection surface for the required surface quality (see data sheet 29291, unit dimensions). Remove the protective plate from the IAC-R valve and keep it for return shipments in case a repair may be necessary.
- Check the seal rings at the valve connection surface for completeness. Other sealants are not permitted.
- Check that the pressure supply line is connected to P and the return line is connected to T at the subplate.
- Place the IAC-R valve onto valve connection surface.
- When using the subplates mentioned in Chapter 14.1 “Optional accessories“ on page 123 or when installing the valve on comparable gray cast iron mounting surfaces, tighten all mounting screws with a torque wrench to the specified torque, see Table 35 below.

This tightening torque refers to the admissible maximum operating pressure.
If the IAC-R valve is to be used at reduced maximum pressure and installed on valve connection surfaces made of another material (observe minimum heat conductivity!) a lower tightening torque may have to be applied to rule out damage.

Table 35: Screw dimensions and tightening torques with permissible tolerance

Type	Screw dimension	Tightening torque[1)]
4WRPNH6	M5 × 30	6 +2 Nm
4WRPNH10	M6 × 40	11 +3 Nm

[1)] Please use a torque wrench with a tolerance of ≤10 % for tightening purposes.

For details on valve mounting screws, see data sheet 29291.
Make sure that pipes or hoses are connected to all ports or that the ports are plugged with plug screws.

- Check that cap nuts and flanges are tightened properly on pipe fittings and flanges.

Mark all checked fittings, e.g. using a permanent marker.

- Ensure that a technical expert inspects all pipes and hose lines and any combination of connection pieces, couplings, and connection points for a condition that is safe for working purposes.

7.5.1 Connecting the IAC-R valve hydraulically

The connections and mounting threads are rated for the operating pressures given in the data sheet. The machine or plant manufacturer must see to it that connecting elements and lines were dimensioned with the required safety factors to suit the provided operating conditions (pressure, flow, hydraulic fluid, temperature).

1. Depressurize the relevant system section.
2. Connect all ports, observe the operating instructions for the system.
3. Make sure that pipes or hoses are connected to all ports or that the ports are plugged with plug screws.
4. Check that cap nuts and flanges are tightened properly on pipe fittings and flanges.
5. Ensure that a technical expert inspects all pipes and hose lines and any combination of connection pieces, couplings, and connection points for a condition that is safe for working purposes.

7.5.2 Connecting the IAC-R valve electrically

The lines used must be suitable for operating temperatures of -20 °C...+100 °C and meet the requirements in terms of clamping lengths of connection terminals. For information on suitable connection cables, see data sheet 29291. Use only the mating connectors specified in the data sheet or mating connectors of the same type. Observe the mounting instructions printed on the packaging of the mating connector and the tightening torques given.

- Disconnect the connection line from the power supply before installing the valve.
- Properly connect the protective earth conductor and the grounding cable.
- Prevent sharp bending of the connection cables and litz wires to avoid short-circuits and interruptions.
- Route the connection line(s) using strain relief. The first attachment point must be located at a distance to the cable entry of 15 cm at most.
- Use fine-wired conductors with pressed-on wire end sleeves only.
- Cut heat shrinkable tubings to length and push the same over the litz wires of the control line to insulate solder joints and uncovered parts at a later point in time.
- Solder the litz wires of the control line to the solder buckets of the mating connector's contact sockets according to the specified connection wiring (see data sheet).

- Check for proper assignment of the litz wires to the contact sockets with the help of a continuity tester.
- Position heat shrinkable tubings over solder joints and uncovered parts and shrink the same on.
- Check the mutual insulation of the contact sockets by means of a continuity tester.
- Assemble the mating connector according to the installation instructions, plug the mating connector on the plug-in connector of the IAC-R valve's on-board electronics and tighten the cap nut.
- The supply voltage of the on-board electronics has to be protected with a fuse or with a protective motor switch with short-circuit and thermal instantaneous tripping for protection in the case of a short-circuit. The rated value of the fuse depends on the components of the IAC-R valve. For notes on the rated values of the fuse, see Chapter 7.5.2.5, Table 37 on page 106. The disconnection threshold of this fuse has to be equal to or higher than the possible short-circuit current of the supply voltage source. The fuse may be located in the related power supply unit or has to be connected upstream separately.

The seal elements of the cable glands are provided for single use only.
Switching off the valve solenoid abruptly results in a voltage peak due to the induction effect. Additional external circuit measures may have to be taken to avoid connected electrical circuits being influenced by the remaining residual voltage peak.
Upon completion of the installation provide a permanently legible sign with the following lettering in the direct vicinity of the valve solenoid:
Do not disconnect while circuit is live!
Bosch Rexroth recommends the installation of a protection against accidental contact on solenoids to prevent unintended contact with the hot surface.

7.5.2.1 Electrical connection and interfaces

7.5.2.1.1 Overview

For the electrical connection, the wiring diagrams of the machine manufacturer and his work instructions are binding at all times!
Necessary components such as emergency stop circuits, mains switches, etc., have to be designed and planned by the project planner of the system in conformity with recognized state of the art taking account of best possible safety.

7.5.2.2 Protective earthing conductor (PE) and shields

⚠ CAUTION

Hazardous shock currents due to insufficient protective earth conductor!
Risk of personal injury!
- Protective earthing connections must not be impaired by mechanical, chemical, or electrochemical influences. The connection has to be attached permanently.

CAUTION

Insufficient equipotential bonding or insufficient shielding!

Hazardous situations, malfunction and damage to property.

▶ Equipotential bonding currents must not flow through the shield of interface cables.

▶ Earthing connections have to be implemented in a mesh-shaped manner. Ground all components, cabinet housings/doors, and the subplate.

▶ Equipotential bonding conductors/PE lines of all system components have to be as short as possible and feature as low a resistance as possible.

▶ Ensure sufficient cable cross-sections for wiring protective earthing conductors. In this context, observe EN 60204 Part 1 (max. electrical resistance and test of protective conductor wiring).

▶ Whenever possible, connect the shields on both ends.

▶ Please ensure that equipotential bonding currents do not run through the shields of interface cables. Therefore, provide for proper equipotential bonding between the devices to be connected even before initial start-up. In doing so, also consider such interfaces used to interconnect devices at different locations (independent of the distance or supply network).

7.5.2.3 24 V_{DC} supply

WARNING

Improper switch-on sequence.

Uncontrolled drive movements. Risk of injury!

▶ Design the system circuit so that the IAC-R valve and all connected components are always switched on simultaneously.

CAUTION

Insufficient electrical insulation from the mains voltage!

Hazardous shock currents! Risk of personal injury!

▶ The 24 V_{DC} input voltage must beet the requirements of “safe separation”.

The required supply voltages for output stage U_B and electronics U_S are +24 V (min 21 V, max 36 V) at the connector of the IAC-R valve.

A ripple of 2 V_{pp} is admissible at a nominal voltage of 23 V to 34 V. The electronic system is equipped with an integrated inverse-polarity protection for U_B and U_S. The two mass connections of U_B and U_S (pin 2 and pin 10) are connected by means of two anti-parallel diodes.

From the existing supply voltage, the IAC-R valve uses DC/DC converters to generate all internally required system voltages for:

- Logic
- CPU
- Sensors

Characteristic values:
- at U_S >26 V: U_{Sensor} = 24 V
- at U_S <26 V: U_{Sensor} = U_S minus 2 V
- Current withdrawal: max 360 mA
  Current withdrawal: max 200 mA with 5 V sensor supply
- Conductor cross-section and max. cable length, see Chapter 7.5.2.8.1 “Cable connector for X1“ on page 113.

Cross-sections depending on current consumption, but at least 4 mm[2]. In case of higher current consumption 2 x 4 mm[2].

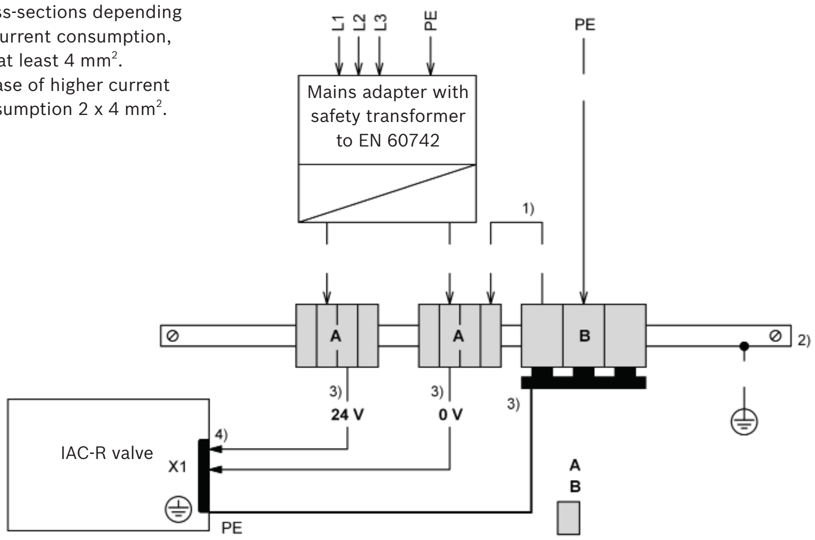

Fig. 69: Example of an IAC-R valve with 24 V supply

1] Easily visible and removable.

2] PE bars preferably have to be attached to the subplate to ensure conductivity. Insulated PE bars have to be attached to the mounting surface on both ends with max 20 cm long copper strips. The cross-section of the copper strips has to be at least equal to the cross-section of the supply line.

3] For cross-sections, see Chapter 7.5.2.8.1 “Cable connector for X1“ on page 113.

4] 2 power supplies: Power supply PIN 1 (24 V) PIN 2 (⊥), signal supply PIN 9 (24 V), PIN 10 (⊥)

7.5.2.4 Overview of interfaces

The IAC-R valve is equipped with the interfaces X1, X2 X3, X4, and X7. X2 is reserved for future extensions and is not connected!
The following overview shows the arrangement of the IAC-R interfaces:

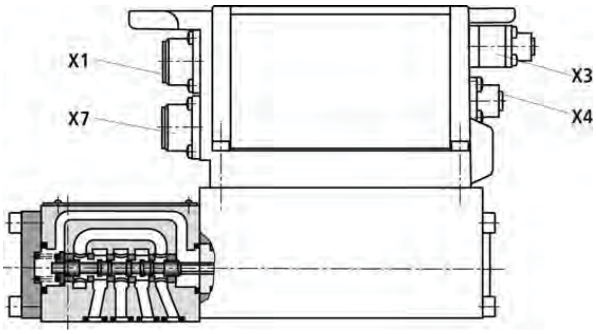

Fig. 70: Location of the IAC-R interfaces

The following table describes the interfaces, the installed connector types of the IAC-R valve, as well as the mating connectors of the same.

Table 36: Interfaces

Des.	Function	Use	Application	Comments	Connector type (integrated)	Mating connector	Chapter
X1	Supplies		Supply of output stage & logic Error signaling output & switching output		Central connector, M23x1,12-pin male contacts	M23x1, 12-pin female contacts	7.5.2.5 7.5.2.8.1
X3	Communication with control over field bus	PROFIBUS DP	Control commands Command value provision Actual value output		2 connectors M12x1, 5-pin inversely coded female and male contacts	2x M12x1, 5-pin inversely coded male and female contacts	7.5.2.6 7.5.2.8.2
X4	Connection for analog position sensors	Max 2 analog sensors with voltage interface (V)	Analog position sensors	All sensor inputs on X4 and X7 are designed either as voltage or as current interface.	Female contacts M12x1, 5-pin	M12x1, 5-pin connector contacts	7.5.2.7 7.5.2.7.2 7.5.2.8.3
		Max 2 analog sensors with current interface (mA)					
X7	Connection for position sensor (hardware variant)	1 sensor with 1 V_{pp} (incremental)	Heidenhain position sensor (incremental)		Connector M23x1, 12-pin female contacts	M23x1, 12-pin male contacts	7.5.2.7 7.5.2.7.2 7.5.2.8.4
		1 sensor with EnDat 2.2 (absolute)	Heidenhain position sensor (absolute)		Connector M12x1, 8-pin female contacts	M12x1, 8-pin male contacts	
		1 sensor with SSi interface	Digital position sensor (absolute)		Connector M23x1, 12-pin female contacts	M23x1, 12-pin male contacts	
		Max 2 analog sensors with voltage interface (V)	Analog position sensors	All sensor inputs on X4 and X7 are designed either as voltage or as current interface.	Socket contact M12x1, 5-pin	M12x1, 5-pin male contacts	
		Max 2 analog sensors with current interface (mA)					

Interface X2 of the IAC-R valve may be connected exclusively by Bosch Rexroth. It is inadmissible to use this interface for other purposes.

7.5.2.5 Device interface X1

The device interface X1 supplies the IAC-R valve. The reserved pins of the device interface are not connected!

Supply X1

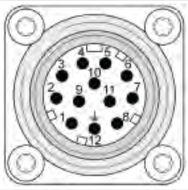

Fig. 71: Pinout of supply connections on X1, connector M23, 12-pin male contacts

Table 37: Pinout supply connections on X1

Pin	Assignment	Explanation
1	U_B +24 V	Supply for output stage and power switching signal
2	U_B 0 V	
3	reserved	
4	reserved	
5	reserved	
6	reserved	
7	reserved	
8	reserved	
9	U_S +24 V DC	Supply for signal processing
10	U_S 0 V	
11	Error signal output or power switching signal	Switching output to U_B 0 V (ground), max. 1.8 A
12	Protective earthing conductor	Directly connected to metal housing

The supplies for power and signal part of the IAC-R valve are separated, see Chapter 7.5.2.3 “24 VDC supply“ on page 103.

Table 38: Characteristic values: Current consumption for output stage and electronic system

Voltage	I_S max.	I_B max. valve NG6	I_B max. valve NG10
21 V	0.9 A	1.1 A	2.4 A
24 V	0.85 A	1.0 A	2.1 A
36 V	0.6 A	0.7 A	1.4 A

The rating for a fuse results from the sum I_s plus I_B of the relevant valve size and optionally the current consumption of pin 11.

If error output pin 11 is loaded with a current, the current consumption I_B increases accordingly.

Cable connectors and mating connectors, see Chapter 7.5.2.8.1 ”Cable connector for X1“ on page 113.

7.5.2.5.1 Error signal, power switching signal

This is a switching output with open collector to $+U_B$.
It can be used either to signal internal errors or to connect to an on/off valve.
The output is protected against short-circuit to $+U_B$ or mass and additionally against thermal overload situations.
Reverse voltages occurring when switching off inductive loads are limited to U_B -50 V by means of integrated terminal diodes.

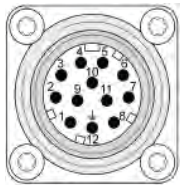

Fig. 72: Pinout of power switching signal to X1, connector M23, 12-pin male contacts

Table 39: Pinout power switching signal on X1

Pin	Allocation	Explanation
1	U_B +24 V	Supply for output stage and power switching signal
2	U_B 0 V	
3	reserved	
4	reserved	
5	reserved	
6	reserved	
7	reserved	
8	reserved	
9	U_S +24 V DC	Supply for signal processing
10	U_S 0 V	
11	Error signal output or power switching signal	Switching output to U_B 0V (ground), max 1.8 A
12	Protective earthing conductor	Directly connected to metal housing

7.5.2.5.2 Characteristic values of error signal, power switching signal

- No internal error: Operating voltage at U_B minus ca. 1 V, max. current 1.8 A
- Internal error: 0 V (via internal shunt resistor 100 kΩ)
- Voltage stability: Duty cycle 100 %, with reverse-polarity protection
- Ampacity: Typically 1.8 A (steady-state) with integrated thermal overload protection

7.5.2.6 Control bus X3

The IAC-R valve can be controlled completely as slave via X3 using the control bus. All data are transmitted digitally. Control functions, command value provision, actual value acquisition, statuses, parameterization online, etc. can be acquired, influenced, and evaluated comfortably over the bus (e.g. with the tool WinHPT®).

The device socket and the connector are equivalent as PROFIBUS connections. The electrically isolated +5 V_{ISO} at the socket allows for the passive termination of the PROFIBUS.
The IAC-R recognizes the transmission rate on the PROFIBUS while starting up. The baud rate is determined by the master. For cable lengths, see the recommendations of the PROFIBUS user organization PNO.

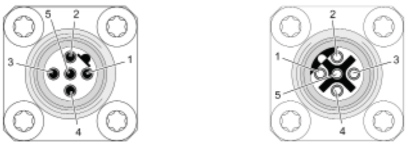

Fig. 73: Pinout of interface PROFIBUS DP via X3, connector M12, and 5-pin sockets.

Table 40: Pinout of interface PROFIBUS DP via X3 connector and X3 socket

Pin	Assignment connector X3	Assignment socket X3
1	not assigned	+5 V_{ISO}
2	RxD/TxD-N (A-line)	RxD/TxD-N (A-line)
3	Profi GND	Profi GND
4	RxD/TxD-P (B-line)	RxD/TxD-P (B-line)
5*)	Shield	Shield

*) We recommend connecting the shield on both ends using the metal housing of the plug-in connectors.
Using pin 5 is unfavorable as regards to high frequencies.

Ensure the correct termination of the bus line in terms of impedance. For this, use a terminating resistor as described in the technical data sheet 29291.

Table 41: Characteristic values PROFIBUS DP (baud rates)

Baud rate [kBit/s]
9.6
19.2
93.75
187
500
1500
3000
6000
12000

7.5.2.7 Measuring system and sensor interfaces X4 and X7

High-response valves or directional valves with IAC-R can be operated in conjunction with system control functions. The sensors required for this are connected to the interfaces of connections X4 and X7.

Depending on the hardware version, a measuring system either with 1 V_{pp}, with EnDat 2.2, with SSI, with voltage or with current interface is connected to connection X7 of the IAC-R valve.
The 24 V supply of the SSI and analog measurement systems is provided from the IAC-R valve. However, the current load at X7 must not exceed 360 mA.
The 5 V supply of the 1 V_{pp} or EnDat 2.2 measuring system is provided from the IAC-R valve as well. The max current must not exceed 200 mA.

7.5.2.7.1 Digital position measuring systems at interface X7

For use with machine tools, the IAC-R valve supports quasi-analog measuring systems (e.g. from Heidenhain).
Equipment variants:
- 1 V_{pp} incremental measuring system (make: Heidenhain)
- EnDat 2.2 absolute measuring system (make: Heidenhain)
- SSI (binary and Gray code)
- Voltage and current interface for analog sensors (see Chapter 7.5.2.7.2 “Analog sensors at interfaces X4 and X7“ on page 99)

Connections:
M23 socket, 12-pin (1V_{ss}, SSI)
M12 socket, 8-pin (EnDat 2.2)
M12 socket, 5-pin (analog)

1 V_{pp}- and SSI measuring system interface

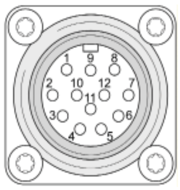

Fig. 74: Pinout 1 $V_{pp}$and SSI measuring system interface

Table 42: Pinout of 1 V_{pp} measuring system interface

Pin	Assignment	Explanation
1	$\overline{B}$	Incremental signal B inverted
2	+5 V	Provides the supply voltage in parallel to pin 12
3	R	Reference mark signal R
4	$\overline{R}$	Reference mark signal R inverted
5	A	Incremental signal A
6	$\overline{A}$	Incremental signal A inverted
7	not assigned	
8	B	Incremental signal B
9	not assigned	
10	0 V	Reference potential for supply voltage
11	0 V	Provides the reference potential in parallel to pin 10
12	+5 V	IAC-R valve provides supply voltage for the measuring system.

External shield connected on both sides using metal housing of the plug-and-socket-connection, internal shields not required.

Table 43: Pinout of SSI measuring system interface

Pin	Assignment	Explanation
1	0 V	Reference potential for supply voltage
2	Data	Data
3	Clock	Clock
4-8	not assigned	
9	24 V	IAC-R valve provides supply voltage for the measuring system.
10	Data	Data inverted
11	Clock	Clock inverted
12	not assigned	

External shield connected on both sides using metal housing of the plug-and-socket-connection, internal shields not required.

Characteristic values:
- Data rate during transmission approx. 200 kbaud
- The transmission quality depends on the cable length, which should not exceed 200 m.

Please observe the manufacturer-specific characteristic values!
Use mating connectors as specified in the technical data sheet 2929!

EnDat 2.2 measuring system interface

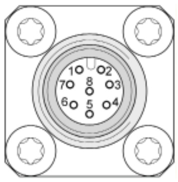

Fig. 75: Pinout of EnDat 2.2 measuring system interface, connector M12, 8-pin socket

Table 44: Pinout of EnDat 2.2 measuring system interface

Pin	Assignment	Explanation
1	0 V	Provides the supply voltage in parallel to pin 5
2	+5 V	Provides the supply voltage in parallel to pin 8
3	Data	Data
4	$\overline{\text{Data}}$	Data inverted
5	0 V	Reference potential for supply voltage
6	$\overline{\text{Clock}}$	Clock inverted
7	Clock	Clock
8	+5 V	IAC-R valve provides supply voltage for the measuring system

External shield connected on both sides on the metal housing of the plug-and-socket-connection. Internal shields not required.

Characteristic values:
- Data rate during transmission approx. 200 kbaud
- The transmission quality depends on the cable length, which must not exceed 150 m.

Please observe the manufacturer-specific characteristic values!
Use extension line as detailed in technical data sheet 29291!

7.5.2.7.2 Analog sensors at interfaces X4 and X7

High-response valves or directional valves with IAC-R can be operated in conjunction with system control functions. The sensors required for this are to be connected to the interfaces of connections X4 and X7.
Generally, X4 of the IAC-R is provided for connecting max. 2 analog sensors with voltage or current interfaces.
Depending on the hardware version, either max. 2 analog sensors with voltage or current interfaces or a measuring system with 1 V_{pp} or with SSI interface can be connected to connection X7.
The analog sensors and the SSI measuring system are supplied by the IAC-R valve with nominal 24 V. However, the total ampacity of all sensors at X4 and X7 must not exceed 360 mA.
The supply of the 1 V_{pp} respectively EnDat 2.2 measuring system with 5 V is provided by the IAC-R valve as well. The max current must not exceed 200 mA.

For use of analog sensors, the interfaces X4 and X7 are designed either as voltage interfaces for ±10 V or as current interfaces for 4...20 mA on the individual hardware versions of the IAC-R valve. Mixed interfaces are not available!

Please observe the possible hardware configurations as detailed in technical data sheet 29291!

Voltage interface

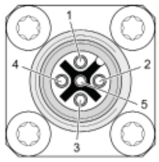

Fig. 76: Pinout of sensor voltage interface X4, connector M12, 5-pin socket

Pinout of sensor voltage interface X4

Pin	Assignment	Explanation
1	Supply +24 V DC	IAC-R valve provides power supply
2	Signal 3	Signal input sensor 3 (-10...+10 V)
3	Zero 0 V	Reference potential for the signal inputs
4	Signal 1	Signal input sensor 1 (-10...+10 V)
5	Shield	Shield connection according to standard *)

*) We recommend connecting the shield on both ends on the metal housing of the plug-in connectors.
Using pin 5 is unfavorable as regards to high frequencies.

Fig. 77: Pinout of sensor voltage interface X7, connector M12, 5-pin socket

Table 45: Pinout of sensor voltage interface X7

Pin	Assignment	Explanation
1	Supply +24 V DC	IAC-R provides power supply
2	Signal 4	Signal input sensor 4 (-10...+10 V)
3	Zero 0 V	Reference potential for signal 2 and 4
4	Signal 2	Signal input sensor 2 (-10...+10 V)
5	Shield	Shield connection according to standard*)

*) We recommend connecting the shield on both ends on the metal housing of the plug-in connectors.
Using pin 5 is unfavorable with regard to high frequencies.

Characteristic values:

- Rated current supply +24 V (min 19 V)
  Deactivation upon short-circuit
- Max. current withdrawal 360 mA (totalized across all sensors at X4 and X7)
- Useful signal range: -10 V to +10 V
- Input resistance: approx. 13 kΩ at -15 V
- Voltage stability: ±40 V
- Internal resolution: 14 bit

For mating connectors, see data sheet 29291!

Current interface

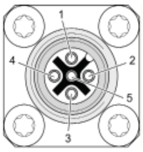

Fig. 78: Pinout of sensor current interface X4, connector M12, 5-pin socket

Table 46: Pinout of sensor current interface X4

Pin	Assignment	Explanation
1	Supply +24 V DC	IAC-R valve provides sensor supply
2	Signal 3	Signal input sensor 3 (4...20 mA)
3	Zero 0 V	Reference potential for signals 1 + 3
4	Signal 1	Signal input sensor 1 (4...20 mA)
5	Shield	Shield connection according to standard*)

*) We recommend connecting the shield on both ends on the metal housing of the plug-in connectors.
Using pin 5 is unfavorable with regard to high frequencies.

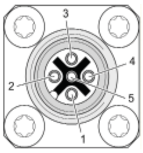

Fig. 79: Pinout of sensor current interface X7, connector M12, 5-pin socket

Table 47: Pinout of current interface

Pin	Assignment	Explanation
1	Supply +24 V DC	IAC-R valve provides sensor supply
2	Signal 4	Signal input sensor 4 (4...20 mA)
3	Zero 0 V	Reference potential for signals 2 + 4
4	Signal 2	Signal input sensor 2 (4...20 mA)
5	Shield	Shield connection according to standard*)

*) We recommend connecting the shield on both ends on the metal housing of the plug-in connectors.
Using pin 5 is unfavorable with regard to high frequencies.

Characteristic values:

- Rated current supply +24 V (min 19 V)
  Deactivation upon short-circuit
- Max current withdrawal 360 mA (totalized across all sensors at X4 and X7)
- Useful signal range 4 to 20 mA
- Input resistance: approx. 200 ohm (internal load referred to pin 3)
- Voltage stability: ±40 V
- Internal resolution: 14 bit

For mating connectors, see data sheet 29291!

7.5.2.8 Cable connectors for IAC-R valve interfaces

PROFIBUS products such as ready-to-use cables and connectors, modules, etc., are available from, among others, Woodhead Connectivity Brad Harrison.

7.5.2.8.1 Cable connector for X1

Table 48: Cable connector M23

Cable connector M23, 12-pin sockets	
Version	Multi-wire cable
	Litz wire structure, finely stranded according to VDE 0295, class 6
	Protective earthing conductor yellow-green
	Cu braided shield
Number of conductors	6
Line cross-section	0.75 mm² up to a length of 20 m
	1.0 mm² up to a length of 40 m
Outer diameter	10.3 mm with line cross-section 0.75 mm²
	11 mm with line cross-section 1 mm²
Type	See data sheet 29291

In order to achieve the required sealing effect, cable connectors with suitable seals have to be used, depending on the external diameter of the connecting cable.

For a description of the interface, see Chapter 7.5.2.5 "Device interface X1" on page 106!

7.5.2.8.2 Cable connector for X3

Table 49: Cable connector M12

Cable connector M12, 5-pin male and female contacts, inversely coded	
Version	Two-wire cable with shield
Line cross-section	Cross-section and admissible length in accordance with system requirements for PROFIBUS
Type	See data sheet 29291

For a description of the interface, see Chapter 7.5.2.6 “Control bus X3“ on page 107.

7.5.2.8.3 Cable connector for X4

Table 50: Cable connector M12

Cable connector M12, 5-pin contacts	
Version	Multi-wire cable, twisted pair with shield
Number of wires	4
Line cross-section	Cross-section and permissible length according to the sensor manufacturer‘s specification
Type	See data sheet 29291

For the description of the interface, see Chapter 7.5.2.7 “Measuring system and sensor interfaces X4 and X7“ on page 108.

7.5.2.8.4 Cable connector and extension cable for X7

Table 51: Cable connector M23

Cable connector M23, 12-pin male contacts, for interfaces 1 V_{pp} and SSI	
Version	Multi-wire cable, twisted pair with shield
Number of wires	1V_{ss}: 10, SSI: 6
Line cross-section	Cross-section and permissible length according to the sensor manufacturer‘s specification
Type	See data sheet 29291

Table 52: Extension cable M12

Extension cable M12, 8-pin male contacts, for EnDat 2.2 interface	
Version	Multi-wire cable, twisted pair with shield
Number of wires	8
Line cross-section	Cross-section and permissible length according to the sensor manufacturer‘s specification
Type	See data sheet of the sensor manufacturer

Table 53: Cable connector M12

Version	Multi-wire cable, twisted pair with shield
Number of wires	4
Line cross-section	Cross-section and permissible length according to the sensor manufacturer's specification
Type	See data sheet 29291

For the description of the interface, see Chapter 7.5.2.7 "Measuring system and sensor interfaces X4 and X7" on page 108.

8 Commissioning

WARNING

Improper installation, escaping hydraulic fluid!

- Improperly or incorrectly mounted hydraulic valves can loosen during operation and fall down and cause injuries. Strong fluid jets can escape through incompletely installed hydraulic connections and connection lines and cause severe injuries.
- Only commission your system after all hydraulic connections and the hydraulic valve were completely and properly installed according to the instructions.
- Pay attention to defective sealing points and replace defective real rings immediately.

Impermissibly high operating pressure!

In hydraulic applications with different area ratios, the hydraulic pressure is intensified and can, when the system is improperly engineered, exceed the permissible maximum operating pressure. As a result, hydraulic valves can burst or closing elements be ejected and cause serious injuries.

- Prior to commissioning of the hydraulic system make sure that the permissible maximum pressure of the valve can in no case be exceeded in the hydraulic system.
- Ensure that the permissible maximum operating pressure is limited by a pressure relief element.

Excessive pressure!

Pressure relief valves that are incorrectly set or are not unloaded to tank can cause the operating pressure to exceed the permitted maximum level. As a result, hydraulic valves can burst or closing elements be ejected and cause serious injuries.

- Before commissioning the hydraulic system, check the correct setting and reliable unloading of these pressure relief valves.

8.1 Initial commissioning

To commission the IAC-R valve, proceed as follows:

8.1.1 Inspecting the electrical connections

- Before carrying out initial or re-commissioning, have electrical connections inspected for proper condition by a specialized electrician or under the supervision of a specialized electrician. Observe Chapter 7.5.2.1 “Electrical connection and interfaces“ on page 102!

8.1.2 Venting the hydraulic system

Observe the operating instructions for the equipment or system, in which the IAC-R valve is installed.

- Before operating the IAC-R valve in the real application, switch it several times under operating pressure. This presses out any air that has remained in the valve. This prevents mechanical damage resulting from impermissibly high acceleration of the fluid and the valve spool and increases the service life of the IAC-R valve.

8.1.3 Carrying out a leakage test

- Check that no hydraulic fluid leaks from the IAC-R valve and from the connections.

8.1.4 Commissioning tool and aids

If commissioning is not carried out directly in conjunction with the control, the commissioning software WinHPT® must be available to allow the setting and transmission of parameters over the bus.
The system requirements for software are listed in Chapter 5.2.8.2 “System requirements“ on page 78.
Another precondition is the presence of a PROFIBUS DP interface on the PC that is supported by WinHPT®.

8.1.5 Hardware requirements for commissioning

For initial commissioning of PROFIBUS DP (coding B) you require the following hardware equipment:

Table 54: Hardware requirements

	Designation	Hardware equipment
1	Interface converter (USB/PROFIBUS DP)	VT-ZKO-USB/P1-1X/VO/0 Material number R901071962
2	Commissioning software	WinHPT® (version 2.1 or higher) Download at `www.boschrexroth.com/IAC`
3	Connection cable 3 m	D-Sub/M12 Material number R901078053
4	24 V supply voltage	-

Fig. 80: Example: Setup for parameterization

By connecting the bus interface the PC is provided with a PROFIBUS DP interface. After having started the program WinHPT® you can establish communication with the valve. Then, parameters can be altered individually or complete parameter sets can be read or written.
Once the sensors required for operation are connected to the IAC-R valve, they have to be configured.

8.1.5.1 Bus, nodes, baud rate

The data transmission over a bus requires a working field bus connection. For the documentation of bus-specific settings, see the description of the PROFIBUS DP communication in Chapter 5.2.7 “Communication over PROFIBUS DP“ from page 56 on.

9 Operation

See operating instructions for the hydraulic system, in which the IAC-R valve is installed.

10 Maintenance and repair

10.1 Cleaning and care

NOTICE

Solvents and aggressive detergents!
Aggressive detergents may damage the seals on the IAC-R valve and cause them to age faster.
- Never use solvents or aggressive detergents.

Ingress of contaminants and fluids!
The reliable operation of the IAC-R valve is no longer ensured.
- Observe utmost cleanliness when carrying out any work on the IAC-R valve.
- Do not use high-pressure cleaners.

- Check that all seals and plugs of plug-in connections are tightly in place in order that no humidity can get into the IAC-R valve while being cleaned.
- Clean the IAC-R valve exclusively with water and, if required, a mild detergent.
- Remove external coarse dirt and keep the sensitive solenoids and the valve clean.

10.2 Maintenance

The following inspection, test, and maintenance work has to be carried out regularly. The intervals for the same have to be selected in a way - also depending on the operating conditions - that deficiencies that have to be anticipated are identified timely. However, the inspection has to be carried out at least every three years starting from the manufacturing date of the IAC-R valve.

The manufacturing date of the IAC-R valve can be found on the nameplate, see Chapter 5.3 “Identification of the product“ on page 95.

Ordering details for seal kits can be found in Chapter 10.6 “Spare parts” on page 119.

10.3 Maintenance schedule

Table 55: Maintenance schedule

Work to be carried out		Interval
Hydraulic system	Check operating temperature (under comparable load conditions).	Weekly
	Analyze quality of the hydraulic fluid.	Annually or every 2000 h (the earlier of both)
IAC-R valve	Inspect IAC-R valve for leakage. Eliminate external leakage immediately. See “change of seals”.	Daily
	Inspect IAC-R valve for the generation of noise.	Daily
	Check mounting elements for proper seating. All mounting elements are to be checked while the system is switched off, depressurized and cooled down.	Monthly
	Inspect IAC-R valve for deposited dust. Remove contamination.	Weekly
	Check plug-in and terminal connections of the integrated axis controller IAC-R for proper connection and damage. Check cables for rupture and squashing. Should damage be visible, replace connection cable.	At least once a year

10.4 Replacing wear parts

External leakage on the valve connection face can be eliminated on site. Internal leakage must be eliminated by specialist personnel of the manufacturer.

To replace seals, proceed as follows:

- Demount IAC-R valve, see Chapter 12 “Demounting and replacement“ on page 121.
- Inspect the recesses for seal rings on the valve connection face for cleanliness and integrity.
- Install the new seals.

10.5 Repair

The IAC-R valve must not be disassembled for repairing purposes. Only complete units may be replaced.

Bosch Rexroth offers a comprehensive range of services for repairing the hydraulic valve.

Use exclusively genuine spare parts from Bosch Rexroth for repairing Rexroth products.

Partially tested and pre-assembled genuine Rexroth assemblies allow successful repairs to be carried out within a minimum of time.

10.6 Spare parts

When ordering spare parts, please indicate the material numbers of the parts.

For the IAC-R valve, the following spare parts are available:

Table 56: Seals

Valve type	Seal	Material no.
4WRPNH6	9,25 × 1,78	4 × 1810210120
4WRPNH10	12,0 × 2,0	Set 1817010230

The material numbers for mating connectors and plug-in connectors can be found in the data sheet under "Accessories".
Please address queries with regard to spare parts to the relevant Rexroth service department.

Bosch Rexroth AG
Service Hydraulics
Bgm.-Dr.-Nebel-Str. 8
97816 Lohr am Main
Tel: +49 (0) 9352 - 40 50 60
spareparts.bri@boschrexroth.de

The addresses of our national units can be found at
`www.boschrexroth.com/addresses`

- Please indicate the following data, which can be found on the nameplate, in your order:
  - Material number
  - Serial number
  - Production job order number
  - Date of production

11 Decommissioning

The IAC-R valve is a component that needs not to be decommissioned. As a result, this chapter of the manual does not contain any information.
For details about how to disassemble or replace your IAC-R valve, please refer to Chapter 12 "Demounting and replacement".

11.1 Preparing the components for storage/further use

- Clean the IAC-R valves as described in Chapter 10.1 "Cleaning and care" on page 118.
- Please observe the notes in the technical data sheet.

12 Demounting and replacement

1. Depressurize the relevant system section and disconnect it from the power supply.
2. Loosen and remove the mating connector(s).
3. Provide for a container to collect draining hydraulic medium.
4. Loosen the mounting screws of the IAC-R valve with suitable tools only.
5. Remove the mounting screws and loosen IAC-R valve from the valve connection surface.
6. Collect draining hydraulic oil in the container mentioned above and dispose of the same properly.
7. If the IAC-R valve is to be returned to the manufacturer for repair purposes, close the valve connection surface with the protective plate, which is included in the scope of supply, or protect it by means of equivalent packaging to prevent contamination and damage.
8. Cover subplate to prevent contamination.

13 Disposal

Observe the following points when disposing of Rexroth products:

1. Drain the products completely.
2. Dispose of the hydraulic fluid in accordance with the national regulations of your country and in accordance with the safety data sheet for the hydraulic fluid.
3. Disassemble the products into its individual part for recycling.
4. Separate by:
   - Cast iron
   - Steel
   - Non-ferrous metal
   - Electronic scrap
   - Plastic
   - Seals

13.1 Environmental protection

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

- ▶ Dispose of the IAC-R valve, the hydraulic fluid and the packaging material in accordance with the national regulations of your country.
- ▶ Dispose of hydraulic fluid residues in accordance with the national regulations of your country and in accordance with the safety data sheet for these hydraulic fluids.

Hyquip Limited New Brunswick Street Horwich Bolton Lancashire BL6 7JB UK
Company Registered in England No: 4167649 VAT Registration No: 732 5692 25 BS EN ISO 9001:2008 No: LRQ 0964389

14 Extension and conversion

The IAC-R valve must not be converted.

14.1 Optional accessories

14.1.1 Valve mounting screws

For reasons of strength, use exclusively the following valve mounting screws.

Table 57: Valve mounting screws

Valve type	Hexagon socket head cap screw	Quantity	Material No.
4WRPNH6	ISO 4762 - M5 × 30 - 10.9	4	2910151166
4WRPNH10	ISO 4762 - M6 × 40 - 10.9	4	2910151209

14.1.2 Subplates

Table 58: Subplates

Valve type	Technical data sheet
4WRPNH6	45053
4WRPNH10	45055

Ordering address for accessories and valves

The addresses of our responsible sales companies can be found on the Internet at
`http://www.boschrexroth.com`
and in Chapter 17.4 “Address register“ on page 123.

▶ Only use genuine spare parts from Bosch Rexroth.

15 Troubleshooting

In the event of an error or fault, the valve electronics signals the fault externally using the status word.
Errors and warnings that occurred are saved in a temporary diagnosis buffer. The written diagnosis is reset when the supply voltage has bee deactivated and re-activated.
Additionally, the last 100 errors that occurred are saved permanently to the internal EEPROM.

15.1 How to proceed for troubleshooting

- Always act systematically and targeted, even under pressure of time. Random and imprudent disassembling and the readjustment of settings might result in the inability to establish the original error cause.
- First get a general idea of how your product works in conjunction with the entire system.
- Try to find out whether the product has worked properly in conjunction with the entire system before the troubles occurred first.
- Try to localize any changes of the entire system in which the product is integrated:
  - Have the operating conditions or the operating range of the valve changed?
  - Have changes (e.g. conversions) been made or repairs carried out on the entire system (machine/system, electrical system, control) or on the valve? If yes: Which?
  - Was the valve or machine used as intended?
  - How does the fault manifest itself?
- Get a clear idea of the cause of fault. If required, ask the direct (machine) operator.
- Read out the fault log using WinHPT®. In this context, see Chapter 5.2.8.4 “General operating instructions“ on page 81.

15.1.1 Recognizing an erroneous state

Any faults present are signaled to the higher-level control as follows:

Via the error bit in the digital status word ZSW1

Bit 3 set in status word 1 (ZSW1) signals that at least one error has occurred in the IAC-R valve (see bit assignment in Chapter 5.2.7 “Communication over PROFIBUS DP“ on page 56). The error causes have to be established and eliminated in order that the error(s) can be acknowledged.

Via the error message counter in parameter PNU 944

This counter counts up by one with each error event (in and out).

15.1.2 Identifying the error code

To identify the error code, the diagnosis memory has to be read out. The procedure for reading out the diagnosis memory is described in the Chapter 5.2.7 “Communication over PROFIBUS DP” under 5.2.7.4.6 “Diagnosis options” on page 67.

ℹ The system states can be queried comfortably with the help of the user interface WinHPT®, see Chapter 5.2.8.4 “General operating instructions“ on page 81.

When drive alarm evaluation of the higher-level control SINUMERIK 840D(i) sl is activated (see exemplary project planning for SINUMERIK 840D(i) sl, Chapter 5.2.7.6 on page 70), the control cyclically reads out the error message counter.
If the counter reading has changed, the control automatically determines the error code and the error time and displays the information on the HMI.

15.1.3 Error response

Depending on the event type the following reactions are possible:

Warning No error response. An entry is made in the temporary diagnosis buffer.

Error The valve electronics switches to its internal state S1 ("activation blocked") and switches the valve output stage off.
Depending on the type of IAC-R valve, a certain response takes place (e.g. valve spool goes to failsafe position).
An entry is made in the temporary diagnosis buffer and in the permanent fault log (error history).

15.1.4 Acknowledging an error

Errors can only be acknowledged when the error cause has been eliminated!

All error causes have to be remedied before the errors can be acknowledged. Afterwards, bit 7 has to be set from 0 to 1 in control word 1 (STW1). If there are still errors present, the error bit (bit 3) is not reset in the status word 1 (ZSW1).
Proceeding:
• Eliminate all causes of error
• Level change of bit 7 in control word 1 (STW1) from 0 to 1

The NC control system SINUMERIK 840D(i) sl carries out the described error acknowledgement when the button "RESET" on the operator panel is pushed.

15.1.5 Error list

Format of a diagnosis entry in PNU 947:
0x + detail code + code
(e.g. 0x0002 for "Electronics temperature - temperature too high")

Table 59: Error list

Code hex	Detail code hex	WinHPT® error description
0x00	0x00	No error
0x01	0x00	Unspecified warning
0x02	0x00	Electronics temperature - temperature too high
0x03	0x00	General simple error
0x04	0x00	Invalid command value
0x05	0x00	Electronics temperature - thermal shutdown
0x06	0x00	Internal controller error
0x07	0x07	Control bus error
0x08	0x00	EEPROM not writable
0x09	0x01	No sensor parameterized
0x09	0x81	Wrong sensor interface
0x09	0x00	General major error

Code hex	Detail code hex	WinHPT® error description
0x0A	0x00	Voltage supply sensor bus - voltage too low
0x0B	0x00	Voltage supply output stage - voltage too low
0x0C	0x00	Voltage supply external sensor voltage too low
0x0D	0x00	Invalid sensor signal
0x0E	0x00	General most serious error
0x0F	0x00	Voltage supply output stage - voltage shutdown
0x10	0x00	Invalid signal main stage sensor
0x11	0x00	Invalid signal pilot stage sensor
0x12	0x00	Processor error
0x13	0x00	Internal voltage error
0x14	0x00	Flushing circuit pump
0x15	0x00	General most serious error without reset
0x16	0x00	Voltage supply external sensor - voltage shutdown
0x17	0x00	Current supply processor <> 3.3 V
0x18	0x00	Error sensor interface 1
0x19	0x00	Error sensor interface 2
0x1C	0x00	1 V_{pp} position transducer
0x1D	0x00	Drive not referenced
0x1E	0x00	Wrong interface
0x1F	0x00	Communication - warning
0x20	0x00	Communication - minor error
0x21	0x00	Communication - major error
0x22	0x00	Communication - most serious error
0x23	0x00	Error sensor interface 3
0x24	0x00	Error sensor interface 4
0x25	0x00	Error reference mark
0x25	0x01	Velocity too high
0x25	0x02	No reference mark found
0x25	0x03	Search interval exceeded
0x25	0x04	No end position reached
0x26	0x03	Target window monitoring setup error
0x26	0x04	Command value limitation setup error
0x26	0x01	Sensor type does not match selected controller mode
0x26	0x00	Wrong parameterization
0x26	0x02	Control error monitoring setup error
0x27	0x02	Short-circuit/overtemperature
0x27	0x01	Open output
0x2C	0x00	Cable rupture at input 1 (X1/E4)
0x2D	0x00	Cable rupture at input 2 (X1/E7)
0x2E	0x00	Cable rupture at SSI sensor
0x2F	0x00	Transducer jump at SSI sensor
0x30	0x00	Bus fault: missing sync messages
0x31	0x00	Bus fault: synchronization not within tolerance
0x32	0x00	PLL cannot snap in
0x33	0x00	Invalid DP/V2 timing parameters received
0x34	0x00	PLL module is in error state
0x35	0x00	Several master life sign errors detected
0x36	0x00	Error while saving the parameters

15.1.6 Malfunction table

The IAC-R valve is not susceptible to faults if the specified operating conditions are fulfilled, particularly the oil quality.

Table 60: Malfunction table

Fault	Possible cause	Remedy
IAC-R valve does not control	Electrical connection interrupted, no current continuity, cable rupture	Replace connection cable
	Short-circuit in connection cable/mating connector	Replace connection cable
	Operating voltage for on-board electronics not present or lower than 18 V	Check operating voltage and, if required, restore. See data sheet, electrical connection.
	On-board electronics faulty	Demount IAC-R valve and have it repaired
	No pressure at P	Check pressure at P and, if required, restore
External leakage	Seal on connection face defective	Demount IAC-R valve and replace seals
	Other leakage	Demount IAC-R- and replace by new valve

In case of faults due to contamination, in addition to the repair or servicing, the oil quality has to be checked and, where required, improved by suitable measures such as flushing or the installation of additional filters.

If you are not able to remedy a defect, please contact one of the addresses that you can find at `www.boschrexroth.com` or in Chapter 17.4. “Address register” on page 129.

16 Technical data

For details about the technical data of your IAC-R valve please refer to the technical data sheet.

17 Annex

17.1 Project/installation drawings

See data sheet 29291.

17.2 Electrical wiring and circuit diagrams

See Chapter 7.5.2.1 "Electrical connection and interfaces" on page 102 and data sheet 29291.

17.3 Important parameters

Table 61: List of the most important parameters

PUN no.	Meaning	
1131	Current command value (100 % ≙ 100000)	
1278	Current position [μm]	
1539	Current actual velocity in [mm/min]	
3260	Control deviation (X_{err} from the control system)	
3263	Velocity feed value (N_{comm} from the control)	
3265	Velocity controller integrator value	
3268	Current command velocity in [mm/min]	
3250	Feature Mask Bits	
	0	DSC in the IAC-R on/off, 1 = activated (default)
	1	Not used
	2	If = 1: Valid AVC data (automatic valve compensation) present and used, instead of manual characteristic compensation
	3	Not used
	4	If = 1 (default): If AVC (measuring) active, the last actual position is sent to the control as current actual position. This means that the IAC-R simulates a non-moving axis. Reason: In the control system, the position monitoring function is not to respond during active AVC.
	5 to 31	Not used

17.4 Address register

The addresses of our country units can be found at
http://www.boschrexroth.com

Contact for service and spare parts

Bosch Rexroth AG
Service industrial hydraulics
Bürgermeister-Dr.-Nebel-Straße 8
97816 Lohr am Main
Germany

Phone +49 (93 52) 40 50 60
e-mail: service@boschrexroth.de
http://www.boschrexroth.com/service

Ordering address for accessories and valves

Headquarters:
Bosch Rexroth AG
Zum Eisengießer 1
97816 Lohr am Main
Germany
Phone +49 (93 52) 18-0

The addresses of our sales companies can be found on the Internet at:
http://www.boschrexroth.com.

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_ unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attribute	BI	Param-eter sets
0	209	918	Profibus address	125			0	126		UNSIGNED16	2	RW	N	2
0	0	922	PROFIdrive telegram selection	5					5; 105; 116	UNSIGNED16	2	RW	N	
0	0	923	PROFIdrive list of all signals	0,0,0,3354,3352,0,0,3100, 3103,0,0,3104,0,0,0,0,0,0, 0,0,0,0,0,0,3101,3102,0, 0,0,0,0,0,0,0,0						UNSIGNED16	2	C_R	V	36
0	0	924	PROFIdrive Info STW2 where to find Bit Pulses Enable	4,11						UNSIGNED16	2	C_R	V	2
0	0	925	PROFIdrive number of tolerated M-LS errors	6			1	10		UNSIGNED16	2	RW	N	
0	0	927	PROFIdrive parameter operating priority	1						UNSIGNED16	2	RW	N	
0	0	928	PROFIdrive control priority pzd	1						UNSIGNED16	2	RW	V	
0	0	930	PROFIdrive operating mode	3						UNSIGNED16	2	RW	N	
0	0	944	PROFIdrive fault-message counter	0						UNSIGNED16	2	R	V	
0	0	947	PROFIdrive fault number	0						UNSIGNED16	2	R	V	64
0	0	948	PROFIdrive fault time	0						TIMEDIFFERENCE	4	R	V	64
0	0	949	PROFIdrive fault value	0						UNSIGNED16	2	R	V	64
0	0	950	PROFIdrive scaling of fault buffer	8,8						UNSIGNED16	2	R		2
0	0	951	PROFIdrive fault number list	0						UNSIGNED16	2	R		10
0	0	952	PROFIdrive fault situation counter	0			0	0		UNSIGNED16	2	RW	V	
0	0	953	PROFIdrive Warning Word 0	0						UNSIGNED16	2	R	V	
0	0	954	PROFIdrive Warning Word 1	0						UNSIGNED16	2	R	V	
0	0	955	PROFIdrive Warning Word 2	0						UNSIGNED16	2	R	V	
0	0	956	PROFIdrive Warning Word 3	0						UNSIGNED16	2	R	V	
0	0	957	PROFIdrive Warning Word 4	0						UNSIGNED16	2	R	V	

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_ unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
0	0	958	PROFIdrive Warning Word 5	0						UNSIGNED16	2	R	V	
0	0	959	PROFIdrive Warning Word 6	0						UNSIGNED16	2	R	V	
0	0	960	PROFIdrive Warning Word 7	0						UNSIGNED16	2	R	V	
0	0	964	PROFIdrive device identification	259, 1, 1, 2005, 107, 1						UNSIGNED16	2	C_R		6
0	0	965	PROFIdrive profile id number	03, 40						OCTET_ STRING	2	C_R		
0	0	972	PROFIdrive drive reset	0			0	2		UNSIGNED16	2	RW	V	
0	0	975	PROFIdrive drive object identification	259, 1 , 1 , 2005 , 108 , 1 , 0x80 , 1						UNSIGNED16	2	C_R		8
0	0	979	PROFIdrive sensor format	0x5111, 0x80000001,0x3E8,0x8,0x4, 0x10,0,0,0,0,0						UNSIGNED32	4	R	V	11
0	0	980	PROFIdrive parameter list 1	918, 922, 923, 924, 925, 927, 928, 930, 944, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 964, 965, 972, 975, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 1000, 1001, 1002, 1003, 1004, 1005, 1006, 1007, 1008, 1009, 1010, 1011, 1012, 1014, 1015, 1016, 1017, 1018, 1019, 1020, 1021, 1022, 1023, 1025, 1026, 1027, 1034, 1035, 1036, 1037, 1038, 1039, 1040, 1041, 1042, 1043, 1044, 1045, 1046, 1047, 1048, 1049, 1050, 1051, 1052, 1053, 1055, 1056, 1057, 1058, 1059, 1060, 1061, 1062, 1063, 1064, 1065, 1066, 1067, 1068, 1069, 1073, 981, 0						UNSIGNED16	2	C_R		102

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_ unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	Bl	Param-eter sets
0	0	981	PROFIdrive parameter list 2	1074, 1075, 1076, 1077, 1078, 1079, 1080, 1081, 1082, 1083, 1084, 1085, 1086, 1087, 1088, 1089, 1090, 1091, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1101, 1102, 1103, 1104, 1105, 1106, 1107, 1108, 1109, 1110, 1111, 1112, 1113, 1114, 1115, 1116, 1117, 1118, 1119, 1120, 1121, 1122, 1123, 1124, 1125, 1126, 1127, 1128, 1129, 1130, 1131, 1132, 1133, 1134, 1135, 1136, 1137, 1138, 1139, 1140, 1141, 1142, 1143, 1144, 1145, 1146, 1147, 1148, 1149, 1150, 1151, 1152, 1153, 1154, 1155, 1156, 1157, 1158, 1159, 1160, 1161, 1162, 1163, 1164, 1165, 1166, 1167, 1168, 1169, 1170, 1171, 1172, 1173, 1174, 1175, 1176, 1177, 1178, 1179, 1180, 1181, 1182, 1183, 1184, 1185, 1186, 1187, 1188, 1189, 1190, 1191, 1192, 1193, 1194, 1195, 1196, 1197, 1198, 1199, 1200, 1201, 1202, 1203, 1204, 1205, 1206, 1207, 1208, 1209, 1210, 1211, 1212, 1213, 1214, 1215, 1216, 1217, 1218, 1219, 1220, 1221, 1222, 1223, 1224, 1225, 1228, 1241, 1243, 1250, 1251, 1252, 1278, 1279, 1280, 1281, 1282, 1283, 1294, 1295, 1297, 1298, 1299, 1315, 1316, 1317, 1318, 1331, 1332, 1333, 1352, 1353, 1375, 1376, 1377, 1378, 1379, 1380, 1382, 1383, 1384, 1385, 1386, 1388, 1402, 1403, 1404, 1408, 1409, 1410, 1411, 1412, 1413, 1414, 1415, 1416, 1417, 1418, 1419, 1420, 1421, 1422, 1423, 1424, 1426, 1427, 1429, 1430, 1432, 1433, 1435, 1436, 1438, 1439, 1441, 1442, 1444, 1445, 1447, 1448, 1452, 1461, 1462, 1470, 1471, 1472, 1473, 1474, 1511, 1512, 1513, 1514, 1515, 1516, 1533, 1534, 1536, 1537, 1538, 1539, 1540, 1541, 1564, 1565, 1566, 1567, 1568, 1569, 1570, 1571, 1573, 1593, 1599, 1600, 1601, 1602, 1603, 1604, 1605, 1608, 1609, 1611, 1613, 1672, 1673, 1674, 1675, 1676, 1677, 1678, 1679, 1680, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1743, 1744, 1747, 1763, 1764, 1765, 1766, 1767, 1768, 1770, 1771, 1780, 1781, 1782, 1783, 1784, 1785, 1786, 1787, 1788, 1789, 1800, 1801, 1802, 2003, 2004, 2999, 3010, 3080, 3082, 3084, 3086, 3087, 3090, 3091, 3092, 3093, 3094, 3095, 3096, 3097, 3100, 3101, 3102, 3103, 3104, 3105, 3106, 3140, 3145, 3200, 3201, 3202, 3203, 3204, 3205, 3206, 3207, 3208, 3209, 3210, 3211, 3212, 3213, 3220, 3221, 3222, 3223, 3224, 3225, 3226, 3227, 3228, 3236, 3237, 3240, 3241, 3242, 3243, 3244, 3245, 3246, 3247, 3250, 3251, 3260, 3261, 3262, 3263, 3264, 3265, 3266, 3267, 3268, 3269, 3270, 3271, 3290, 3291, 3292, 3293, 3294, 3295, 3296, 3297, 3350, 3351, 3352, 3353, 3354, 3355, 3356, 3360, 3361, 3363, 3440, 3441, 3450, 3451, 3452, 3453, 3454, 3460, 3520, 3524, 3525, 3540, 3550, 3551, 3552, 3553, 3554, 3555, 3556, 3557, 3558, 3559, 3560, 3561, 3562, 3563, 3570, 3571, 3572, 5100, 5101, 5102, 5103, 5104, 0						UNSIGNED16	2	C_R		435

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_unit	Range min	Range max	Range selec- tion	Data type	Length in byte	Attri- bute	BI	Param- eter sets
0	0	982	PROFIdrive parameter list 3	0						UNSIGNED16	2	C_R		2
0	0	983	PROFIdrive parameter list 4	0						UNSIGNED16	2	C_R		2
0	0	984	PROFIdrive parameter list 5	0						UNSIGNED16	2	C_R		2
0	0	985	PROFIdrive parameter list 6	0						UNSIGNED16	2	C_R		2
0	0	986	PROFIdrive parameter list 7	0						UNSIGNED16	2	C_R		2
0	0	987	PROFIdrive parameter list 8	0						UNSIGNED16	2	C_R		2
0	0	988	PROFIdrive parameter list 9	0						UNSIGNED16	2	C_R		2
0	0	989	PROFIdrive parameter list 10	0						UNSIGNED16	2	C_R		2
0	20	1000	device vendor name	"BOSCH REXROTH AG"						VISIBLE_STRING	64	RPW	N	
0	21	1001	vendor name ID	0x0117						INTEGER16	2	C_R		
0	24	1002	software version	"PTxxxx"						VISIBLE_STRING	6	C_R		
0	26	1003	hardware version	"HVxxxx"						VISIBLE_STRING	6	RPW	N	
0	28	1004	nameplate serial number	"00000000000000000"						VISIBLE_STRING	64	RPW	N	
0	30	1005	model description	"Valve with Integrated Axis Controller"						VISIBLE_STRING	64	RPW	N	
0	33	1006	customer description	"\0"						VISIBLE_STRING	64	RW	N	
0	35	1007	parameter set code	1			1	4		UNSIGNED8	1	RW	N	
0	37	1008	control word							UNSIGNED16	2	RW	V	
0	38	1009	status word							UNSIGNED16	2	R	V	
0	39	1010	device mode	0x01					1; 2; 3; 4; 5; 6	INTEGER8	1	RW	N	
0	40	1011	control mode	6						INTEGER8	1	RW	N	
0	41	1012	local control	0x00			0	1		INTEGER8	1	RW	N	
0	51	1014	store parameters	0						UNSIGNED32	4	RW	V	
0	52	1015	restore default parameters	0						UNSIGNED32	4	RW	V	
0	201	1016	fault masking	0						UNSIGNED16	2	RW	N	
0	202	1017	parameter checking for dependent parameters	1			0	1		UNSIGNED8	1	RW	V	
0	203	1018	sensor interface 5 description	"Sensor Interface 5 not defined"						VISIBLE_STRING	64	RPW	N	
0	204	1019	type code	"4WRPN ..."						VISIBLE_STRING	64	RPW	N	
0	205	1020	change error type	0			0	1		UNSIGNED8	1	RW	N	
0	206	1021	sensor interface 3 description	"Sensor Interface 3 not defined"						VISIBLE_STRING	64	RPW	N	
0	207	1022	sensor interface 4 description	"Sensor Interface 4 not defined"						VISIBLE_STRING	64	RPW	N	

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0	208	1023	sensor bus description	"Sensor bus not defined"						VISIBLE_STRING	64	RPW	N	
0	210	1025	Profibus address control word	1			1	2		UNSIGNED8	1	RW	N	
0	211	1026	output pin 6 parameter selection	0						UNSIGNED32	4	RW	N	
0	214	1027	output pin 8 parameter selection	0						UNSIGNED32	4	RW	N	
0	226	1034	output pin 8 resolution mult	1						INTEGER16	2	RW	N	
0	227	1035	output pin 6 resolution mult	1						INTEGER16	2	RW	N	
0	228	1036	customer identification	0						UNSIGNED8	1	RW	N	
0	229	1037	material number firmware	"R901xxxxxx"						VISIBLE_STRING	10	RPW	N	
0	230	1038	output selection pin 6	1			0	11		UNSIGNED8	1	RW	N	
0	231	1039	output selection pin 8	1			0	11		UNSIGNED8	1	RW	N	
0	232	1040	output signal pin 6	11						INTEGER8	1	RW	N	
0	233	1041	output signal pin 8	51						INTEGER8	1	RW	N	
0	234	1042	input selection pin 4	1			0	7		UNSIGNED8	1	RW	N	
0	235	1043	input selection pin 7	1			0	7		UNSIGNED8	1	RW	N	
0	236	1044	output pin 6 resolution div	1						INTEGER32	4	RW	N	
0	237	1045	output pin 6 offset	0						INTEGER16	2	RW	N	
0	238	1046	output pin 8 resolution div	1						INTEGER32	4	RW	N	
0	239	1047	output pin 8 offset	0						INTEGER16	2	RW	N	
0	240	1048	device interface code	0x00000000						UNSIGNED32	4	RPW	N	
0	241	1049	material number valve	"R901xxxxxx"						VISIBLE_STRING	10	RPW	N	
0	243	1050	control bus interface	"Control Bus not defined"						VISIBLE_STRING	64	RPW	N	
0	245	1051	sensor interface 1 description	"Sensor Interface 1 not defined"						VISIBLE_STRING	64	RPW	N	
0	246	1052	material number electronic	"R901xxxxxx"						VISIBLE_STRING	10	RPW	N	
0	247	1053	serial number electronic	"0000000000"						VISIBLE_STRING	10	RPW	N	
0	249	1055	module number	"0000000000"						VISIBLE_STRING	10	RPW	N	
0	250	1056	sensor interface 2 description	"Sensor Interface 2 not defined"						VISIBLE_STRING	64	RPW	N	
0	251	1057	software level	"1"						VISIBLE_STRING	1	RPW	N	
0	252	1058	parameter set identifier	"xxxxxxxxxxxxxxxxxxxx"						VISIBLE_STRING	20	RPW	N	
0	253	1059	parameter set version	"PVxxxx"						VISIBLE_STRING	6	RPW	N	
0	254	1060	device code	13						UNSIGNED8	1	RPW	N	
1	20	1061	actual value conditioning interface number	1			1	8		UNSIGNED8	1	RW	V	
1	21	1062	actual value conditioning maximum interface number	5			1	8		UNSIGNED8	1	RPW	N	

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Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_unit	Range min	Range max	Range selec- tion	Data type	Length in byte	Attri- bute	BI	Param- eter sets
1	22	1063	actual value conditioning interface type	0					0; 2; 64; 67; 65; 66; 69	INTEGER8	1	RW	N	5
1	23	1064	pressure sensor minimum pressure value	0	milli	bar				INTEGER32	4	RW	N	5
1	24	1065	pressure sensor minimum pressure unit	bar		bar				UNSIGNED8	1	RPW	N	5
1	25	1066	pressure sensor minimum pressure prefix	-3	milli					INTEGER8	1	RPW	N	5
1	26	1067	pressure sensor maximum pressure value	100000	milli	bar				INTEGER32	4	RW	N	5
1	27	1068	pressure sensor maximum pressure unit	bar		bar				UNSIGNED8	1	RPW	N	5
1	28	1069	pressure sensor maximum pressure prefix	-3	milli					INTEGER8	1	RPW	N	5
1	35	1073	pressure sensor minimum transducer signal value	0	milli	-				INTEGER32	4	RW	N	5
1	36	1074	pressure sensor minimum transducer signal unit	dimensionless		-				UNSIGNED8	1	RPW	N	5
1	37	1075	pressure sensor minimum transducer signal prefix	-3	milli					INTEGER8	1	RPW	N	5
1	38	1076	pressure sensor maximum transducer signal value	10000	milli	-				INTEGER32	4	RW	N	5
1	39	1077	pressure sensor maximum transducer signal unit	dimensionless		-				UNSIGNED8	1	RPW	N	5
1	40	1078	pressure sensor maximum transducer signal prefix	-3	milli					INTEGER8	1	RPW	N	5
1	41	1079	position sensor resolution value	200	micro	m				INTEGER32	4	RW	N	
1	42	1080	position sensor resolution unit	m		m				UNSIGNED8	1	R	N	
1	43	1081	position sensor resolution prefix	-6	micro					INTEGER8	1	R	N	
1	44	1082	position sensor position offset value	0	micro	m				INTEGER32	4	RW	N	
1	45	1083	position sensor position offset unit	m		m				UNSIGNED8	1	R	N	
1	46	1084	position sensor position offset prefix	-6	micro				-6; -3	INTEGER8	1	RW	N	
1	47	1085	position sensor zero offset resolution value	0	micro	m				INTEGER32	4	RW	N	
1	48	1086	position sensor zero offset resolution unit	m		m				UNSIGNED8	1	RPW	N	
1	49	1087	position sensor zero offset resolution prefix	-6	micro					INTEGER8	1	RPW	N	

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Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
1	50	1088	position sensor analog minimum reference value value	0	micro	m				INTEGER32	4	RW	N	5
1	51	1089	position sensor analog minimum reference value unit	m		m				UNSIGNED8	1	RPW	N	5
1	52	1090	position sensor analog minimum reference value prefix	-6	micro					INTEGER8	1	RPW	N	5
1	53	1091	position sensor analog maximum reference value value	100000	micro	m				INTEGER32	4	RW	N	5
1	54	1092	position sensor analog maximum reference value unit	m		m				UNSIGNED8	1	RPW	N	5
1	55	1093	position sensor analog maximum reference value prefix	-6	micro					INTEGER8	1	RPW	N	5
1	56	1094	position sensor analog low pass filter T1 value	0	micro	s	0	2000000		UNSIGNED32	4	RW	N	5
1	57	1095	position sensor analog low pass filter T1 unit	s		s				UNSIGNED8	1	RPW	N	5
1	58	1096	position sensor analog low pass filter T1 prefix	-6	micro					INTEGER8	1	RPW	N	5
1	59	1097	position sensor analog minimum interface value value	-10000	milli	-				INTEGER32	4	RW	N	5
1	60	1098	position sensor analog minimum interface value unit	dimensionless		-				UNSIGNED8	1	RPW	N	5
1	61	1099	position sensor analog minimum interface value prefix	-3	milli					INTEGER8	1	RPW	N	5
1	62	1100	position sensor analog minimum interface value value	10000	milli	-				INTEGER32	4	RW	N	5
1	63	1101	position sensor analog minimum interface value unit	dimensionless		-				UNSIGNED8	1	RPW	N	5
1	64	1102	position sensor analog minimum interface value prefix	-3	milli					INTEGER8	1	RPW	N	5
1	69	1103	position sensor bit size	24			1	32		UNSIGNED8	1	RW	N	
1	83	1104	actual value conditioning actual value value	0		0				INTEGER32	4	R	V	8
1	84	1105	actual value conditioning actual value unit	0		-				UNSIGNED8	1	R	V	8
1	85	1106	actual value conditioning actual value prefix	0	-					INTEGER8	1	R	V	8
1	86	1107	actual value conditioning sign	1					1;-1	INTEGER8	1	RW	N	5

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Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri- bute	Bl	Param- eter sets
1	87	1108	actual value conditioning actual value 1 value	0		0				INTEGER32	4	R	V	
1	88	1109	actual value conditioning actual value 2 value	0		0				INTEGER32	4	R	V	
1	89	1110	actual value conditioning actual value 3 value	0		0				INTEGER32	4	R	V	
1	90	1111	actual value conditioning actual value 4 value	0		0				INTEGER32	4	R	V	
1	91	1112	actual value conditioning actual value 5 value	0		0				INTEGER32	4	R	V	
1	92	1113	actual value conditioning actual value 6 value	0		0				INTEGER32	4	R	V	
1	93	1114	actual value conditioning actual value 7 value	0		0				INTEGER32	4	R	V	
1	94	1115	actual value conditioning actual value 8 value	0		0				INTEGER32	4	R	V	
1	200	1116	actual value conditioning actual value signal value	0		-				INTEGER32	4	R	V	8
1	201	1117	actual value conditioning actual value signal unit	dimensiion-less		-				UNSIGNED8	1	R	N	8
1	202	1118	actual value conditioning actual value signal prefix		milli					INTEGER8	1	R	N	8
1	240	1119	actual value conditioning interpolation factor	2048					16; 20; 32; 40; 64; 80; 100; 128; 200; 256; 400; 512; 800; 1000; 1024; 2048;	UNSIGNED16	2	RW	N	
1	241	1120	actual value conditioning interface oversampling	1			1	10		UNSIGNED8	1	RW	N	5
2	20	1121	valve actual value conditioning interface number	1			1	2		UNSIGNED8	1	RW	V	
2	21	1122	valve actual value conditioning maximum interface number	2			1	2		UNSIGNED8	1	RPW	N	
2	83	1123	valve actual value conditioning actual value value	0		-				INTEGER16	2	R	V	2
2	84	1124	valve actual value conditioning actual value unit	dimension-less		-				UNSIGNED8	1	R	V	2
2	85	1125	valve actual value conditioning actual value prefix	0	-					INTEGER8	1	R	V	2
2	87	1126	valve actual value conditioning actual value pilot stage value	0		-				INTEGER16	2	R	V	
2	88	1127	valve actual value conditioning actual value main stage value	0		-				INTEGER16	2	R	V	

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
2	200	1128	actual value conditioning actual value 32bit value	0		m/min				INTEGER32	4	R	V	2
2	201	1129	actual value conditioning actual value 32bit unit	m/min		m/min				UNSIGNED8	1	R	V	2
2	202	1130	actual value conditioning actual value 32bit prefix	0	-					INTEGER8	1	R	V	2
2	203	1131	actual value conditioning actual value pilot stage value	0		m/min				INTEGER32	4	R	V	
2	204	1132	actual value conditioning actual value pilot stage unit	m/min		m/min				UNSIGNED8	1	C_R		
2	205	1133	actual value conditioning actual value pilot stage prefix	0	-					INTEGER8	1	C_R		
2	206	1134	actual value conditioning actual value main stage value	0		m/min				INTEGER32	4	R	V	
2	207	1135	actual value conditioning actual value main stage unit	m/min		m/min				UNSIGNED8	1	C_R		
2	208	1136	actual value conditioning actual value main stage prefix	0	-					INTEGER8	1	C_R		
3	21	1137	controller output filter type	0					0; 1; 2; -3; -4	INTEGER8	1	RW	N	
3	22	1138	controller output filter time constant T1 value	0	micro	s				UNSIGNED32	4	RW	N	
3	23	1139	controller output filter time constant T1 unit	s		s				UNSIGNED8	1	C_R		
3	24	1140	controller output filter time constant T1 prefix	-6	micro					INTEGER8	1	C_R		
3	25	1141	controller output filter attenuation D value	1000	milli	-	0	2000		UNSIGNED32	4	RW	N	
3	26	1142	controller output filter attenuation D unit	dimensionless		-				UNSIGNED8	1	C_R		
3	27	1143	controller output filter attenuation D prefix	-3	milli					INTEGER8	1	C_R		
3	28	1144	controller output filter natural frequency f0 value	2000000	milli	Hz	1000	10000000		UNSIGNED32	4	RW	N	
3	29	1145	controller output filter natural frequency f0 unit	Hz		Hz				UNSIGNED8	1	C_R		
3	30	1146	controller output filter natural frequency f0 prefix	-3	milli					INTEGER8	1	C_R		
3	52	1147	controller output direction dependent gain type	0					0; 1	INTEGER8	1	RW	N	
3	53	1148	controller output direction dependent gain factor	65537						UNSIGNED32	4	RW	N	

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3	62	1149	controller output characteristic compensation type	0					0; -1	INTEGER8	1	RW	N	
3	72	1150	controller output deadband compensation type	0			-2	2		INTEGER8	1	RW	N	
3	73	1151	controller output deadband compensation side A value	0	milli	-	0	500		UNSIGNED32	4	RW	N	
3	74	1152	controller output deadband compensation side A unit	dimensionless		-				UNSIGNED8	1	C_R		
3	75	1153	controller output deadband compensation side A prefix	-3	milli					INTEGER8	1	C_R		
3	76	1154	controller output deadband compensation side B value	0	milli	-	0	500		UNSIGNED32	4	RW	N	
3	77	1155	controller output deadband compensation side B unit	dimensionless		-				UNSIGNED8	1	C_R		
3	78	1156	controller output deadband compensation side B prefix	-3	milli					INTEGER8	1	C_R		
3	79	1157	controller output deadband compensation threshold value	0	milli	-	0	500		UNSIGNED32	4	RW	N	
3	80	1158	controller output deadband compensation threshold unit	dimensionless		-				UNSIGNED8	1	C_R		
3	81	1159	controller output deadband compensation threshold prefix	-3	milli					INTEGER8	1	C_R		
3	94	1160	controller output zero correction offset value	0	milli	-	-200	200		INTEGER32	4	RW	N	
3	95	1161	controller output zero correction offset unit	dimensionless		-				UNSIGNED8	1	C_R		
3	96	1162	controller output zero correction offset prefix	-3	milli		-3	-3		INTEGER8	1	RW	N	
3	113	1163	controller output limiting upper limit value	1000	milli	-	-1000	1000		INTEGER32	4	RW	N	
3	114	1164	controller output limiting upper limit unit	dimensionless		-				UNSIGNED8	1	C_R		
3	115	1165	controller output limiting upper limit prefix	-3	milli					INTEGER8	1	C_R		
3	116	1166	controller output limiting lower limit value	-1000	milli	-	-1000	1000		INTEGER32	4	RW	N	
3	117	1167	controller output limiting lower limit unit	dimensionless		-				UNSIGNED8	1	C_R		
3	118	1168	controller output limiting lower limit prefix	-3	milli					INTEGER8	1	C_R		
3	119	1169	controller output inverter sign	1					-1; 1	INTEGER8	1	RW	N	
3	200	1170	controller output filter block frequency fs value	2000000	milli	Hz	1000	10000000		UNSIGNED32	4	RW	N	
3	201	1171	controller output filter block frequency fs unit	Hz		Hz				UNSIGNED8	1	C_R		

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
3	202	1172	controller output filter block frequency fs prefix	-3	milli					INTEGER8	1	C_R		
3	203	1173	controller output filter bandwidth bw value	500000	milli	Hz	0	10000000		UNSIGNED32	4	RW	N	
3	204	1174	controller output filter bandwidth bw unit	Hz		Hz				UNSIGNED8	1	C_R		
3	205	1175	controller output filter bandwidth bw prefix	-3	milli					INTEGER8	1	C_R		
3	206	1176	controller output filter bandwidth counter bwn value	0	milli	Hz	0	10000000		UNSIGNED32	4	RW	N	
3	207	1177	controller output filter bandwidth counter bwn unit	Hz		Hz				UNSIGNED8	1	C_R		
3	208	1178	controller output filter bandwidth counter bwn prefix	-3	milli					INTEGER8	1	C_R		
3	209	1179	controller output filter f0 value	1000	milli	-	10	1410		UNSIGNED32	4	RW	N	
3	210	1180	controller output filter f0 unit	dimensionless		-				UNSIGNED8	1	C_R		
3	211	1181	controller output filter f0 prefix	-3	milli					INTEGER8	1	C_R		
3	220	1182	controller output friction compensation type	0					0; -1; -2; -3; -4	INTEGER8	1	RW	N	
3	221	1183	controller output friction compensation threshold value	0	milli	-	0	100		UNSIGNED32	4	RW	N	
3	222	1184	controller output friction compensation threshold unit	dimensionless		-				UNSIGNED8	1	C_R		
3	223	1185	controller output friction compensation threshold prefix	-3	milli					INTEGER8	1	C_R		
3	224	1186	controller output friction compensation slope value	1000	milli	-	1000	1000000		UNSIGNED32	4	RW	N	
3	225	1187	controller output friction compensation slope unit	dimensionless		-				UNSIGNED8	1	C_R		
3	226	1188	controller output friction compensation slope prefix	-3	milli					INTEGER8	1	C_R		
3	227	1189	controller output friction compensation slope side A value	1000	milli	-	1000	1000000		UNSIGNED32	4	RW	N	
3	228	1190	controller output friction compensation slope side A unit	dimensionless		-				UNSIGNED8	1	C_R		
3	229	1191	controller output friction compensation slope side A prefix	-3	milli					INTEGER8	1	C_R		
3	230	1192	controller output friction compensation slope side B value	1000	milli	-	1000	1000000		UNSIGNED32	4	RW	N	
3	231	1193	controller output friction compensation slope side B unit	dimensionless		-				UNSIGNED8	1	C_R		

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
3	232	1194	controller output friction compensation slope side B prefix	-3	milli					INTEGER8	1	C_R		
3	233	1195	controller output characteristic compensation flow value	115	milli	-	1	950		UNSIGNED32	4	RW	N	
3	234	1196	controller output characteristic compensation flow unit	dimensionless		-				UNSIGNED8	1	C_R		
3	235	1197	controller output characteristic compensation flow prefix	-3	milli					INTEGER8	1	C_R		
3	236	1198	controller output characteristic compensation signal value	600	milli	-	1	950		UNSIGNED32	4	RW	N	
3	237	1199	controller output characteristic compensation signal unit	dimensionless		-				UNSIGNED8	1	C_R		
3	238	1200	controller output characteristic compensation signal prefix	-3	milli					INTEGER8	1	C_R		
3	239	1201	controller output characteristic compensation transition area value	20	milli	-	0	100		UNSIGNED32	4	RW	N	
3	240	1202	controller output characteristic compensation transition area unit	dimensionless		-				UNSIGNED8	1	C_R		
3	241	1203	controller output characteristic compensation transition area prefix	-3	milli					INTEGER8	1	C_R		
3	242	1204	controller output dead band compensation side A value	1000	milli	-	0	5000		UNSIGNED32	4	RW	N	
3	243	1205	controller output dead band compensation side A unit	dimensionless		-				UNSIGNED8	1	C_R		
3	244	1206	controller output dead band compensation side A prefix	-3	milli					INTEGER8	1	C_R		
3	245	1207	controller output dead band compensation side B value	1000	milli	-	0	5000		UNSIGNED32	4	RW	N	
3	246	1208	controller output dead band compensation side B unit	dimensionless		-				UNSIGNED8	1	C_R		
3	247	1209	controller output dead band compensation side B prefix	-3	milli					INTEGER8	1	C_R		
3	248	1210	controller output valve position disabled value	0	milli	-	-1000	1000		INTEGER32	4	RW	N	
3	249	1211	controller output valve position disabled unit	dimensionless		-				UNSIGNED8	1	C_R		
3	250	1212	controller output valve position disabled prefix	-3	milli					INTEGER8	1	C_R		

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+44 (0)1204 699959
enquiries@hyquip.co.uk
www.hyquip.co.uk
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Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
11	21	1213	open loop setpoint value	0	milli	m/min				INTEGER32	4	RW	V	
11	22	1214	open loop setpoint unit	m/min		m/min				UNSIGNED8	1	C_R		
11	23	1215	open loop setpoint prefix	-3	milli					INTEGER8	1	C_R		
11	24	1216	open loop demand value value	0	milli	m/min				INTEGER32	4	R	V	
11	25	1217	open loop demand value unit	m/min		m/min				UNSIGNED8	1	C_R		
11	26	1218	open loop demand value prefix	-3	milli					INTEGER8	1	C_R		
11	27	1219	open loop reference value value	100000	milli	m/min				INTEGER32	4	RW	N	
11	28	1220	open loop reference value unit	m/min		m/min				UNSIGNED8	1	C_R		
11	29	1221	open loop reference value prefix	-3	milli					INTEGER8	1	C_R		
11	33	1222	open loop hold setpoint value	0	milli	m/min				INTEGER32	4	RW	N	
11	34	1223	open loop hold setpoint unit	m/min		m/min				UNSIGNED8	1	C_R		
11	35	1224	open loop hold setpoint prefix	-3	milli					INTEGER8	1	C_R		
11	36	1225	open loop limiting upper limit value	100000	milli	m/min				INTEGER32	4	RW	N	
11	39	1228	open loop limiting lower limit value	-100000	milli	m/min				INTEGER32	4	RW	N	
11	205	1241	open loop setpoint input	1			0	2		INTEGER8	1	RW	N	
12	20	1243	position control interface reference	1			1	8		UNSIGNED8	1	RW	N	
12	27	1250	position control reference value value	100000	micro	m				INTEGER32	4	RW	N	
12	28	1251	position control reference value unit	m		m				UNSIGNED8	1	C_R		
12	29	1252	position control reference value prefix	-6	micro					INTEGER8	1	C_R		
12	100	1278	position control actual value value	0	micro	m				INTEGER32	4	R	V	
12	101	1279	position control actual value unit	m		m				UNSIGNED8	1	C_R		
12	102	1280	position control actual value prefix	-6	micro					INTEGER8	1	C_R		
12	103	1281	position control control deviation value	0	micro	m				INTEGER32	4	RW	N	
12	104	1282	position control control deviation unit	m		m				UNSIGNED8	1	C_R		
12	105	1283	position control control deviation prefix	-6	micro					INTEGER8	1	C_R		
12	129	1294	position control condition feedback velocity unit	dimensionless		-				UNSIGNED8	1	C_R		
12	130	1295	position control condition feedback velocity prefix	-6	micro					INTEGER8	1	C_R		
12	132	1297	position control condition feedback acceleration unit	dimensionless		-				UNSIGNED8	1	C_R		
12	133	1298	position control condition feedback acceleration prefix	-6	micro					INTEGER8	1	C_R		
12	140	1299	position control control monitoring type	0					0; 3	INTEGER8	1	RW	N	
12	177	1315	position control target window monitoring type	0					0;1;2	INTEGER8	1	RW	N	
12	178	1316	position control target window monitoring threshold value	0	micro	m				INTEGER32	4	RW	N	

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Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
12	179	1317	position control target window monitoring threshold unit	m		m				UNSIGNED8	1	C_R		
12	180	1318	position control target window monitoring threshold prefix	-6	micro					INTEGER8	1	C_R		
12	205	1331	position control setpoint input	1			0	2		INTEGER8	1	RW	N	
12	206	1332	position control setpoint signal range	0			0	1		INTEGER8	1	RW	N	
12	207	1333	position control setpoint oversampling	10			1	10		UNSIGNED8	1	RW	N	
12	230	1352	position control referencing mode	-1					-1; -2; -4	INTEGER8	1	RW	N	
12	231	1353	position control referencing control word	0						UNSIGNED16	2	RW	N	
12	253	1375	position control override	100			0	255		UNSIGNED8	1	RW	V	
14	20	1376	force pressure control interface reference	2			1	8		UNSIGNED8	1	RW	N	
14	21	1377	force pressure control setpoint value	0	milli	bar				INTEGER32	4	RW	V	
14	22	1378	force pressure control setpoint unit	bar		bar				UNSIGNED8	1	C_R		
14	23	1379	force pressure control setpoint prefix	-3	milli					INTEGER8	1	C_R		
14	24	1380	force pressure control demand value value	0	milli	bar				INTEGER32	4	R	V	
14	26	1382	force pressure control demand value prefix	-3	milli					INTEGER8	1	C_R		
14	27	1383	force pressure control reference value value	100000	milli	bar	1	1000000		INTEGER32	4	RW	N	
14	28	1384	force pressure control reference value unit	bar		bar				UNSIGNED8	1	C_R		
14	29	1385	force pressure control reference value prefix	-3	milli					INTEGER8	1	C_R		
14	33	1386	force pressure control hold setpoint value	0	milli	bar				INTEGER32	4	RW	N	
14	35	1388	force pressure control hold setpoint prefix	-3	milli					INTEGER8	1	C_R		
14	100	1402	force pressure control actual value value	0	milli	bar				INTEGER32	4	R	V	
14	101	1403	force pressure control actual value unit	bar		bar				UNSIGNED8	1	C_R		
14	102	1404	force pressure control actual value prefix	-3	milli					INTEGER8	1	C_R		
14	203	1408	pressure hold setpoint select	0			0	1		INTEGER8	1	RW	N	
14	205	1409	pressure setpoint input	2			0	2		INTEGER8	1	RW	N	
14	206	1410	pressure setpoint signal range	1			1	2		INTEGER8	1	RW	N	
14	207	1411	pressure setpoint oversampling	10			1	10		UNSIGNED8	1	RW	N	
21	21	1412	valve position control setpoint value	0		-				INTEGER16	2	RW	V	
21	22	1413	valve position control setpoint unit	dimensionless		-				UNSIGNED8	1	C_R		
21	23	1414	valve position control setpoint prefix	0	-					INTEGER8	1	C_R		
21	144	1415	valve position control actual value value	0		-				INTEGER16	2	R	V	
21	145	1416	valve position control actual value unit	dimensionless		-				INTEGER8	1	C_R		
21	146	1417	valve position control actual value prefix	0	-					INTEGER8	1	C_R		
22	21	1418	valve pressure control setpoint value	0	deci	bar				INTEGER16	2	RW	V	
22	22	1419	valve pressure control setpoint unit	bar		bar				UNSIGNED8	1	C_R		

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
22	23	1420	valve pressure control setpoint prefix	-1	deci					INTEGER8	1	C_R		
22	144	1421	valve pressure control actual value value	0	deci	bar				INTEGER16	2	R	V	
22	145	1422	valve pressure control actual value unit	bar		bar				UNSIGNED8	1	C_R		
22	146	1423	valve pressure control actual value prefix	-1	deci					INTEGER8	1	C_R		
70	21	1424	pQ control filter natural frequency value	1500000	milli	Hz				UNSIGNED32	4	RW	N	4
70	23	1426	pQ control filter natural frequency prefix	-3	milli					INTEGER8	1	C_R		
70	24	1427	pQ control gain Kp value	1000	milli	-				UNSIGNED32	4	RW	N	4
70	26	1429	pQ control gain Kp prefix	-3	milli					INTEGER8	1	C_R		
70	27	1430	pQ control gain integral action coefficient Ti value	17000	micro	s				UNSIGNED32	4	RW	N	4
70	29	1432	pQ control gain integral action coefficient Ti prefix	-6	micro					INTEGER8	1	C_R		
70	30	1433	pQ control positive lead time pressure build-up value	15000	micro	s				UNSIGNED32	4	RW	N	4
70	32	1435	pQ control positive lead time pressure build-up prefix	-6	micro					INTEGER8	1	C_R		
70	33	1436	pQ control negative lead time pressure build-up value	15000	micro	s				UNSIGNED32	4	RW	N	4
70	35	1438	pQ control negative lead time pressure build-up prefix	-6	micro					INTEGER8	1	C_R		
70	36	1439	pQ control delay time T value	12000	micro	s	200	2147483647		UNSIGNED32	4	RW	N	4
70	38	1441	pQ control delay time T prefix	-6	micro					INTEGER8	1	C_R		
70	39	1442	pQ control characteristic curve Ka value	0	milli	-	0	1000		UNSIGNED32	4	RW	N	4
70	41	1444	pQ control characteristic curve Ka prefix	-3	milli					INTEGER8	1	C_R		
70	50	1445	pQ control lower limit pressure signal value	-1000	milli	-	-1000	1000		INTEGER32	4	RW	N	4
70	52	1447	pQ control lower limit pressure signal prefix	-3	milli					INTEGER8	1	C_R		
70	54	1448	pQ control open loop switch	1			0	1		UNSIGNED8	1	RW	N	4
70	200	1449	pQ control integral bind Kr value	10000	milli	-				INTEGER32	4	PRPW	N	4
70	202	1451	pQ control integral bind Kr prefix	-3	milli					INTEGER8	1	C_PR		
70	204	1452	pQ control integral bind flag	0						UNSIGNED8	1	RW	N	
100	37	1461	control word 2	0						UNSIGNED16	2	RW	V	
100	38	1462	status word 2	0						UNSIGNED16	2	R	V	
0	0	1470	error history 2 index	1			1	100		UNSIGNED8	1	RW	V	
0	0	1471	error history 2 error code	0						UNSIGNED16	2	R	V	
0	0	1472	error history 2 powerups	0						UNSIGNED16	2	R	V	
0	0	1473	error history 2 timer	0						UNSIGNED32	4	R	V	
0	0	1474	error history 2 history event type	0						UNSIGNED8	1	R	V	

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_ unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
113	26	1511	position control integrator minimum limiting value	-1000	milli	-				INTEGER32	4	RW	N	
113	27	1512	position control integrator minimum limiting unit	dimensionless		-				UNSIGNED8	1	C_R		
113	28	1513	position control integrator minimum limiting prefix	-3	milli					INTEGER8	1	C_R		
113	29	1514	position control integrator maximum value	1000	milli	-				INTEGER32	4	RW	N	
113	30	1515	position control integrator maximum unit	dimensionless		-				UNSIGNED8	1	C_R		
113	31	1516	position control integrator maximum prefix	-3	milli					INTEGER8	1	C_R		
113	48	1533	position control actual velocity calculated unit	s		s				UNSIGNED8	1	C_R		
113	49	1534	position control actual velocity calculated prefix	-6	micro					INTEGER8	1	C_R		
113	51	1536	position control velocity actual value value	0	milli	m/ min				INTEGER32	4	R	V	
113	52	1537	position control velocity actual value unit	m/min		m/ min				UNSIGNED8	1	C_R		
113	53	1538	position control velocity actual value prefix	-3	milli					INTEGER8	1	C_R		
113	54	1539	position control acceleration actual value value	0	micro	m/ (s*s)				INTEGER32	4	R	V	
113	55	1540	position control acceleration actual value unit	m/(s*s)		m/ (s*s)				UNSIGNED8	1	C_R		
113	56	1541	position control acceleration actual value prefix	-6	micro					INTEGER8	1	C_R		
119	10	1564	local mode destination state	0x0b					0x0b; 0x08; 0x09	UNSIGNED8	1	RW	N	
119	20	1565	Profibus communication error state	0x0004					0x0001; 0x0002; 0x0004; 0x0008	UNSIGNED16	2	RW	N	
119	21	1566	Profibus communication clear state	0x000b					0x0008; 0x0009; 0x000b; 0x000f	UNSIGNED16	2	RW	N	
120	30	1567	date of first installation	"dd.mm.yyyy"						VISIBLE_ STRING	10	RW	N	
120	32	1568	date of last service	"dd.mm.yyyy"						VISIBLE_ STRING	10	RW	N	
120	33	1569	date of next service	"dd.mm.yyyy"						VISIBLE_ STRING	10	RW	N	
120	40	1570	run hour counter							UNSIGNED32	4	RPW	V	

+44 (0)1204 699 959
enquiries@hyquip.co.uk
www.hyquip.co.uk

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_ unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
120	41	1571	power up counter							UNSIGNED32	4	RPW	V	
120	42	1572	service command	"Command?"						VISIBLE_ STRING	32	PRPW	V	
120	43	1573	live counter				0	255		UNSIGNED8	1	RW	V	
120	50	1574	memory service object address	0x00000000						UNSIGNED32	4	PRPW	V	
120	51	1575	memory service object data							UNSIGNED32	4	PR	V	
120	55	1576	firmware build code	"Mmm dd yyyy hh:mm:ss"						VISIBLE_ STRING	32	PR	N	
120	60	1577	test mode raw value channel 0	0						INTEGER16	2	PR	V	
120	61	1578	test mode raw value channel 1	0						INTEGER16	2	PR	V	
120	62	1579	test mode raw value channel 2	0						INTEGER16	2	PR	V	
120	63	1580	test mode raw value channel 3	0						INTEGER16	2	PR	V	
120	64	1581	test mode raw value channel 4	0						INTEGER16	2	PR	V	
120	65	1582	test mode raw value channel 5	0						INTEGER16	2	PR	V	
120	66	1583	test mode raw value channel 6	0						INTEGER16	2	PR	V	
120	67	1584	test mode raw value channel 7	0						INTEGER16	2	PR	V	
120	68	1585	test mode raw value SSI	0						UNSIGNED32	4	PR	V	
120	69	1586	test mode raw value 1Vss	0						INTEGER32	4	PR	V	
120	70	1587	test mode raw value P3V3	0						UNSIGNED16	2	PR	V	
120	71	1588	test mode raw value P_UB	0						UNSIGNED16	2	PR	V	
120	72	1589	test mode raw value PSEN	0						UNSIGNED16	2	PR	V	
120	73	1590	test mode raw value PN15V	0						UNSIGNED16	2	PR	V	
120	74	1591	test mode raw value PIMK1	0						UNSIGNED16	2	PR	V	
120	75	1592	test mode raw value PIMK2	0						UNSIGNED16	2	PR	V	
120	76	1593	test mode raw value temperature							UNSIGNED16	2	R	V	
120	77	1594	test mode raw value 1Vss reference	0						UNSIGNED16	2	PR	V	
120	80	1595	test mode raw value output A1	0						UNSIGNED16	2	PRPW	V	
120	81	1596	test mode raw value output A2	0						UNSIGNED16	2	PRPW	V	
120	90	1597	test mode status word	0						UNSIGNED32	4	PR	V	
120	91	1598	test mode control word	0						UNSIGNED32	4	PRPW	V	
124	100	1599	position control SSI transmitter jump control range value	100						INTEGER32	4	RW	N	
124	101	1600	position control SSI transmitter jump control range unit	m						UNSIGNED8	1	R	N	
124	102	1601	position control SSI transmitter jump control range prefix	-6						INTEGER8	1	R	N	
124	104	1602	position control SSI transmitter control enable flags	1						UNSIGNED16	2	RW	N	

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_ unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
124	110	1603	SSI clock frequency	125			80	200		UNSIGNED16	2	RW	N	
124	112	1604	SSI sensor raw value (after grey decoding)							UNSIGNED32	4	R	V	
124	114	1605	SSI resolution division factor	1			1	1000		UNSIGNED16	2	RW	N	
0	0	1608	Endat sensor raw value							UNSIGNED32	4	R	V	
0	0	1609	1Vss sensor raw value							UNSIGNED32	4	R	V	
250	66	1610	pilot stage parameter Setcode	1			1	2		UNSIGNED8	1	PRPW	V	
250	67	1611	enable pilot stage switch on parameters	0						UNSIGNED8	1	RW	N	
250	68	1612	pilot stage switch on parameters Timeout	0			0	600		UNSIGNED16	2	PRPW	N	
250	69	1613	switch pilot stage switch on parameters allowed	0						UNSIGNED8	1	R	V	
250	1	1617	gain proportional part	9						UNSIGNED16	2	PRPW	N	
250	2	1618	gain integral part	0						UNSIGNED16	2	PRPW	N	
250	3	1619	maximum limiting integral part	100						INTEGER16	2	PRPW	N	
250	4	1620	minimum limiting integral part	-100						INTEGER16	2	PRPW	N	
250	6	1621	maximum pulse width modulation	990						INTEGER16	2	PRPW	N	
250	7	1622	minimum pulse width modulation	10						INTEGER16	2	PRPW	N	
250	8	1623	current controller adjustment K	278						INTEGER16	2	PRPW	N	
250	9	1624	current controller adjustment A	278						INTEGER16	2	PRPW	N	
250	15	1625	pilot stage positon controller proportional gain 1	2816,0						UNSIGNED16	2	PRPW	N	2
250	16	1626	pilot stage positon controller proportional gain 2	928,0						UNSIGNED16	2	PRPW	N	2
250	17	1627	pilot stage positon controller proportional gain 3	704,0						UNSIGNED16	2	PRPW	N	2
250	18	1628	pilot stage positon controller proportional gain 4	390,0						UNSIGNED16	2	PRPW	N	2
250	19	1629	pilot stage positon controller proportional knee 1	47,0						INTEGER16	2	PRPW	N	2
250	20	1630	pilot stage positon controller proportional knee 2	245,0						INTEGER16	2	PRPW	N	2
250	21	1631	pilot stage positon controller maximum proportional limiting	40960,0						INTEGER32	4	PRPW	N	2
250	22	1632	pilot stage position controller minimum proportional limiting	-40960,0						INTEGER32	4	PRPW	N	2
250	23	1633	pilot stage position controller proportional additional parameter 1	0						INTEGER16	2	PRPW	N	2
250	24	1634	pilot stage position controller proportional additional parameter 2	0						INTEGER16	2	PRPW	N	2

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Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_ unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
250	27	1635	pilot stage position controller integral gain 1	7680,0						UNSIGNED16	2	PRPW	N	2
250	28	1636	pilot stage position controller integral gain 2	1280,0						UNSIGNED16	2	PRPW	N	2
250	29	1637	pilot stage position controller integral gain 3	320,0						UNSIGNED16	2	PRPW	N	2
250	30	1638	pilot stage position controller integral gain 4	160,0						UNSIGNED16	2	PRPW	N	2
250	31	1639	pilot stage position controller integral knee 1	31,0						INTEGER16	2	PRPW	N	2
250	32	1640	pilot stage position controller integral knee 2	458,0						INTEGER16	2	PRPW	N	2
250	33	1641	pilot stage position controller maximum integral limiting	24576,0						INTEGER32	4	PRPW	N	2
250	34	1642	pilot stage position controller minimum integral limiting	-22188,0						INTEGER32	4	PRPW	N	2
250	35	1643	pilot stage position controller proportional part of integral	185,0						INTEGER16	2	PRPW	N	2
250	36	1644	pilot stage position controller differential part of integral	54,0						INTEGER16	2	PRPW	N	2
250	37	1645	pilot stage position controller anti-wind-up part of integral	15,0						INTEGER16	2	PRPW	N	2
250	38	1646	pilot stage position controller maximum limiting integral part	16383,0			-32768	32767		INTEGER32	4	PRPW	N	2
250	39	1647	pilot stage position controller minimum limiting integral part	-16384,0			-32768	32767		INTEGER32	4	PRPW	N	2
250	44	1648	pilot stage position controller differential coefficient a0	33798,0						INTEGER32	4	PRPW	N	2
250	45	1649	pilot stage position controller differential coefficient a1	-31242,0						INTEGER32	4	PRPW	N	2
250	46	1650	pilot stage position controller differential coefficient a2	-33798,0						INTEGER32	4	PRPW	N	2
250	47	1651	pilot stage position controller differential coefficient a3	31242,0						INTEGER32	4	PRPW	N	2
250	50	1652	pilot stage position controller differential coefficient b1	-7561,0						INTEGER32	4	PRPW	N	2
250	51	1653	pilot stage position controller differential coefficient b2	872,0						INTEGER32	4	PRPW	N	2
250	52	1654	pilot stage position controller differential coefficient b3	0						INTEGER32	4	PRPW	N	2
250	58	1655	pilot stage position controller maximum limiting PD-coefficient	0						INTEGER16	2	PRPW	N	2
250	59	1656	pilot stage position controller minimum limiting PD-coefficient	0						INTEGER16	2	PRPW	N	2
250	60	1657	pilot stage position controller serial DAC	2968						UNSIGNED16	2	PRPW	N	

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_ unit	Range min	Range max	Range selec- tion	Data type	Length in byte	Attri- bute	Bl	Param- eter sets
250	70	1658	main stage position controller gain 1	0						UNSIGNED16	2	PRPW	N	
250	71	1659	main stage position controller gain 2	0						UNSIGNED16	2	PRPW	N	
250	72	1660	main stage position controller gain 3	0						UNSIGNED16	2	PRPW	N	
250	73	1661	main stage position controller gain 4	0						UNSIGNED16	2	PRPW	N	
250	74	1662	main stage position controller knee 1	0						INTEGER16	2	PRPW	N	
250	75	1663	main stage position controller knee 2	0						INTEGER16	2	PRPW	N	
250	76	1664	main stage position controller maximum limiting	0						INTEGER16	2	PRPW	N	
250	77	1665	main stage position controller minimum limiting	0						INTEGER16	2	PRPW	N	
250	82	1666	main stage position controller differential coefficient a0	0						INTEGER16	2	PRPW	N	
250	83	1667	main stage position controller differential coefficient a1	0						INTEGER16	2	PRPW	N	
250	85	1668	main stage position controller differential coefficient b0	0						INTEGER16	2	PRPW	N	
250	86	1669	main stage position controller differential coefficient b1	0						INTEGER16	2	PRPW	N	
250	88	1670	main stage position controller v-part max value	0						UNSIGNED32	4	PRPW	N	
250	89	1671	main stage position controller v-part gain	0						INTEGER16	2	PRPW	N	
250	90	1672	main stage position controller enable	0						UNSIGNED8	1	RPW	N	
250	100	1673	oscilloscope function enable	0			0	255		UNSIGNED8	1	RW	N	
250	101	1674	oscilloscope function identifier	0x7FF			1	4095		UNSIGNED16	2	RPW	N	
250	102	1675	oscilloscope function active	0			0	255		UNSIGNED8	1	RW	N	
250	103	1676	oscilloscope function filter	5			1	255		UNSIGNED8	1	RW	N	
0	0	1677	oscilloscope function index 1	1682			1	65535		UNSIGNED32	4	RW	N	
0	0	1678	oscilloscope function index 2	1684			1	65535		UNSIGNED32	4	RW	N	
0	0	1679	oscilloscope function index 3	1690			1	65535		UNSIGNED32	4	RW	N	
0	0	1680	oscilloscope function index 4	1691			1	65535		UNSIGNED32	4	RW	N	
250	140	1711	X2 gain trimming	-16384						INTEGER16	2	PRPW	N	
250	141	1712	X2 offset trimming	0						INTEGER16	2	PRPW	N	
250	142	1713	sensor interface gain trimming	-16384						INTEGER16	2	PRPW	N	5
250	143	1714	sensor interface offset trimming	0						INTEGER16	2	PRPW	N	5
250	144	1715	pin X1/4 gain trimming	-16384						INTEGER16	2	PRPW	N	
250	145	1716	pin X1/4 offset trimming	0						INTEGER16	2	PRPW	N	
250	146	1717	pin X1/7 gain trimming	-16384						INTEGER16	2	PRPW	N	
250	147	1718	pin X1/7 offset trimming	0						INTEGER16	2	PRPW	N	
250	148	1719	pin X1/6 gain trimming	1024						INTEGER16	2	PRPW	N	
250	149	1720	pin X1/6 offset trimming	0						INTEGER16	2	PRPW	N	

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_ unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
250	150	1721	pin X1/8 gain trimming	1024						INTEGER16	2	PRPW	N	
250	151	1722	pin X1/8 offset trimming	0						INTEGER16	2	PRPW	N	
250	152	1723	main stage interface tuned value	0						INTEGER16	2	PR	V	
250	153	1724	sensor interface tuned value	0						INTEGER16	2	PR	V	5
250	154	1725	pin X1/4 tuned value	0						INTEGER16	2	PR	V	
250	155	1726	pin X1/7 tuned value	0						INTEGER16	2	PR	V	
250	158	1727	disable error reaction mask 1	0						UNSIGNED32	4	PRPW	N	
250	159	1728	disable error reaction mask 2	0						UNSIGNED32	4	PRPW	N	
250	160	1729	position controller negator	1					-1;1	INTEGER8	1	PRPW	N	
250	190	1735	number of entries signal range setpoint input analog	2						UNSIGNED8	1	C_R		
250	191	1736	signal range setpoint 1	1			1	2		UNSIGNED8	1	RW	N	
250	192	1737	signal range setpoint 2	1			1	2		UNSIGNED8	1	RW	N	
250	200	1738	realtime oscilloscope channel selection	1			1	4		UNSIGNED8	1	RW	V	
250	201	1739	realtime oscilloscope channels	0						UNSIGNED32	4	RW	N	4
250	202	1740	realtime oscilloscope activate	0						UNSIGNED8	1	RW	V	
250	203	1741	realtime oscilloscope used buffer	0						UNSIGNED16	2	R	V	
250	205	1743	realtime oscilloscope timer	1						UNSIGNED32	4	RW	N	
250	206	1744	realtime oscilloscope status	0						UNSIGNED8	1	R	V	
250	210	1745	NTC cold value	0						INTEGER16	2	PR	V	
250	211	1746	NTC adjust value	0						INTEGER16	2	PRPW	N	
250	250	1747	password	0						UNSIGNED32	4	RW	V	
251	20	1748	test parameter 16 bit 1	0						INTEGER16	2	PRPW	N	
251	21	1749	test parameter 16 bit 2	0						INTEGER16	2	PRPW	N	
251	22	1750	test parameter 16 bit 3	0						INTEGER16	2	PRPW	N	
251	23	1751	test parameter 16 bit 4	0						INTEGER16	2	PRPW	N	
251	24	1752	test parameter 16 bit 5	0						INTEGER16	2	PRPW	N	
251	29	1753	test parameter 16 bit 6	0						INTEGER16	2	PRPW	N	
251	40	1754	test parameter 32 bit 1	0						INTEGER32	4	PRPW	N	
251	41	1755	test parameter 32 bit 2	0						INTEGER32	4	PRPW	N	
251	42	1756	test parameter 32 bit 3	0						INTEGER32	4	PRPW	N	
251	43	1757	test parameter 32 bit 4	0						INTEGER32	4	PRPW	N	
251	44	1758	test parameter 32 bit 5	0						INTEGER32	4	PRPW	N	
251	49	1759	test parameter 32 bit 6	0						INTEGER32	4	PRPW	N	
254	66	1763	bootloader control word	0						UNSIGNED32	4	RW	V	

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_ unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	Bl	Param-eter sets
254	100	1764	communication switch PROFIdrive profibus	0x70726472					0x70726472; 0x70726F66	UNSIGNED32	4	RW	V	
0	34	1765	customer description id	0						UNSIGNED32	4	RW	N	
0	0	1766	system delay time error output	1			0	5000		UNSIGNED16	2	RW	N	
0	0	1767	stop valve setup time	1			0	3000		UNSIGNED16	2	RW		
0	0	1768	stop valve setdown time	1			0	3000		UNSIGNED16	2	RW		
250	207	1770	realtime oscilloscope version	0						UNSIGNED8	1	R	V	
0	0	1771	realtime oscilloscope diffValues send buffer	0						UNSIGNED8	1	R	V	235
14	55	1780	second force pressure control interface reference	0			0	8		UNSIGNED8	1	RW	N	
1	32	1781	pressure sensor rod diameter value	0	micro	m				INTEGER32	4	RW	N	5
1	29	1782	pressure sensor cylinder diameter value	0	micro	m				INTEGER32	4	RW	N	5
1	30	1783	pressure sensor cylinder diameter unit	m		m				UNSIGNED8	1	RPW	N	5
1	33	1784	pressure sensor rod diameter unit	m		m				UNSIGNED8	1	RPW	N	5
1	31	1785	pressure sensor cylinder diameter prefix	-6	micro					INTEGER8	1	RPW	N	5
1	34	1786	pressure sensor rod diameter prefix	-6	micro					INTEGER8	1	RPW	N	5
14	60	1787	force control reference value value	100000		N	1	1000000		INTEGER32	4	RW	N	
14	61	1788	force control reference value unit	N		N				UNSIGNED8	1	C_R		
14	62	1789	force control reference value prefix	0						INTEGER8	1	C_R		
0	0	1800	EnDat transducer start autoconfiguration	0						UNSIGNED8	1	RW	V	
0	0	1801	EnDat transducer sensor resolution							UNSIGNED32	4	R	V	
0	0	1802	EnDat transducer position bit length							UNSIGNED16	2	R	V	
0	0	2003	PROFIdrive reference force			N				INTEGER32	4	R	V	
0	0	2004	PROFIdrive reference power	100000		Watt	1	10000000		INTEGER32	4	RW	N	
0	0	2999	PROFIdrive dummy paraset pointer	1			1	1		UNSIGNED8	1	RW	V	
0	0	3080	Device SVN Revision No			600				INTEGER32	4	RPW	N	512
0	0	3082	PROFIdrive Valve Compensation Data	10,5						UNSIGNED16	2	R	N	2
0	0	3084	PROFIdrive Valve Comp Valve Array Properties	0						UNSIGNED32	4	RW	V	
0	0	3086	PROFIdrive Valve Compensation command & state word	200						INTEGER16	2	RW	N	
0	0	3087	PROFIdrive Valve Comp Valve setpoint Automode	100000			0	1000000		INTEGER32	4	RW	N	
0	0	3090	PROFIdrive Valve Comp Valve max allowed axis speed	0						INTEGER32	4	R	V	
0	0	3091	PROFIdrive Valve Compensation Cyl. Pos. A	0						INTEGER32	4	R	V	
0	0	3092	PROFIdrive Valve Compensation Cyl. Pos. B	0						INTEGER16	2	RW	N	
0	0	3093	PROFIdrive Valve Comp Measure Start Freq	0						INTEGER16	2	RW	N	

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0	0	3094	PROFIdrive Valve Comp Measure Kv	0						INTEGER16	2	RW	N	
0	0	3095	PROFIdrive Valve Comp Measured Time Delay	0						INTEGER32	4	R	V	
0	0	3096	PROFIdrive Valve Compensation Cyl. Pos. Middle							INTEGER32	4	RW	V	
0	0	3097	PROFIdrive Valve Comp Valve max measured positive position							INTEGER32	4	RW	V	
0	0	3100	PROFIdrive Valve Comp Valve max measured negative position	0						TYP_N4	4	RW	V	
0	0	3101	PROFIdrive speed setpoint 32 bit	0						INTEGER32	4	RW	V	
0	0	3102	PROFIdrive system deviation	0						TYP_X4	4	RW	V	
0	0	3103	PROFIdrive position controller gain factor	0						TYP_N4	4	R	V	
0	0	3104	PROFIdrive actual speed 32 bit	0						INTEGER32	4	R	V	
0	0	3105	PROFIdrive sensor 1 actual value 32 bit	0						INTEGER32	4	R	V	
0	0	3106	PROFIdrive sensor 2 actual value 32 bit							UNSIGNED16	2	RW	V	
0	0	3140	PROFIdrive torque reduction	1000			1	10000000		INTEGER32	4	RW	N	
0	0	3145	force pressure max value for DPV2	100		0.1 %	0	1000		UNSIGNED16	2	RW	N	
			relative Force threshold to switchoff Ka											
0	0	3200	PROFIdrive DSC position controller K-vol value	1000						INTEGER32	4	RW	N	
0	0	3201	PROFIdrive DSC position controller K-v value	0	1000	mm/ min				INTEGER32	4	RW	N	
0	0	3202	PROFIdrive DSC position controller K-a value	0						INTEGER32	4	RW	N	
0	0	3203	PROFIdrive DSC position controller K-p value	0						INTEGER32	4	RW	N	
0	0	3204	PROFIdrive DSC position controller K-iv value	60000						INTEGER32	4	RW	N	
0	0	3205	PROFIdrive DSC position controller T-i value	0	micro	s				INTEGER32	4	RW	N	
0	0	3206	PROFIdrive DSC position controller T1-v value	2000	micro	s				INTEGER32	4	RW	N	
0	0	3207	PROFIdrive DSC position controller T1-a value	2000	micro	s				INTEGER32	4	RW	N	
0	0	3208	PROFIdrive DSC position controller K-nsoll value	0						INTEGER32	4	RW	N	
0	0	3209	PROFIdrive DSC position controller PT1 value	0	micro	s				INTEGER32	4	RW	N	
0	0	3210	PROFIdrive DSC PosCtrl Ti minimum Speed	0		mm/ min				INTEGER32	4	RW	N	
0	0	3211	PROFIdrive normalized filtered actual force	0						INTEGER16	2	R	V	
0	0	3212	PROFIdrive normalized filtered actual Power	0						INTEGER16	2	R	V	
0	0	3213	PROFIdrive normalized actual force utilisation	0						INTEGER16	2	R	V	
0	0	3220	PROFIdrive DSC position controller SpeedDiff K value	0						INTEGER32	4	RW	N	
0	0	3221	PROFIdrive DSC position controller K-i value	1000						INTEGER32	4	RW	N	

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
0	0	3222	PROFIdrive DSC position controller Nsoll PT1 value	0	micro	s				INTEGER32	4	RW	N	
0	0	3223	PROFIdrive DSC position controller Vsoll I PT1 value	0	micro	s				INTEGER32	4	RW	N	
0	0	3224	PROFIdrive DSC position controller Acc. clipping	0						INTEGER32	4	RW	N	
0	0	3225	PROFIdrive DSC position controller Vsoll P PT1 value	1000	micro	s				INTEGER32	4	RW	N	
0	0	3226	PROFIdrive DSC position controller Vsoll time delay	1	milli	s				UNSIGNED8	1	RW	N	
0	0	3227	PROFIdrive DSC position controller Vist P PT1 value	0	micro	s				INTEGER32	4	RW	N	
0	0	3228	PROFIdrive DSC position controller Vist time delay	0	milli	s				UNSIGNED8	1	RW	N	
0	0	3236	PROFIdrive measured max axis speed			mm/min				INTEGER32	4	R	V	
0	0	3237	PROFIdrive measured min axis speed							INTEGER32	4	R	V	
0	0	3240	PROFIdrive cylinder area side A	405			1	1000000		UNSIGNED32	4	RW	N	
0	0	3241	PROFIdrive cylinder area side B	405			1	1000000		UNSIGNED32	4	RW	N	
0	0	3242	valve Q-Max	15000	milli	Liter	1	1000000		UNSIGNED32	4	RW	N	
0	0	3243	valve overlap [%]	20		-				UNSIGNED16	2	RW	N	
0	0	3244	supply pressure	105		bar				UNSIGNED16	2	RW	N	
0	0	3245	Axis weight	50		Kg				UNSIGNED16	2	RW	N	
0	0	3246	PROFIdrive Pos. Model max. speed	10000		mm/min				INTEGER32	4	RW	N	
0	0	3247	PROFIdrive Pos. Model min. speed	10000		mm/min				INTEGER32	4	RW	N	
0	0	3250	PROFIdrive Feature Mask Bits	0x11						UNSIGNED32	4	RPW	N	
0	0	3251	PROFIdrive DPV2 Poscontrol Version ID	10						UNSIGNED8	1	R	V	
0	0	3260	PROFIdrive DSC position controller Test Xerr actual Value							INTEGER32	4	R	V	
0	0	3261	PROFIdrive DSC position controller Test PosDiff actual Value							INTEGER32	4	R	V	
0	0	3262	PROFIdrive DSC position controller Test DscPos actual Value							INTEGER32	4	R	V	
0	0	3263	PROFIdrive DSC position controller Test Nsoll actual Value							INTEGER32	4	R	V	
0	0	3264	PROFIdrive DSC position controller Test Help actual Value							INTEGER32	4	R	V	
0	0	3265	PROFIdrive DSC position controller Test Integrator Sum Value							INTEGER32	4	R	V	
0	0	3266	PROFIdrive DSC position controller Test Vist_K Value							INTEGER32	4	R	V	
0	0	3267	PROFIdrive DSC position controller Test 1Vss Raw Value							INTEGER32	4	R	V	

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0	0	3268	PROFIdrive DSC position controller Test speed setpoint [mm/min]							INTEGER32	4	R	V	
0	0	3269	PROFIdrive DSC position controller Test position control output							INTEGER32	4	R	V	
0	0	3270	PROFIdrive DSC position controller Test act. Acc/ Dec							INTEGER32	4	R	V	
0	0	3271	PROFIdrive p/F control output							INTEGER32	4	R	V	
0	0	3290	test data start index	0						UNSIGNED16	2	RPW	V	
0	0	3291	PROFIdrive test data	0						UNSIGNED32	4	R	V	64
0	0	3292	PROFIdrive test data mode	0						UNSIGNED8	1	RPW	V	
0	0	3293	PROFIdrive test data trigger	10						INTEGER32	4	RPW	N	
0	0	3294	PROFIdrive test data factor	10000,10000, 10000,10000, 10000,10000, 10000,10000						INTEGER32	4	RPW	N	8
0	0	3295	PROFIdrive test data time	1						UNSIGNED8	1	RPW	N	
0	0	3296	PROFIdrive test data pre trigger Time	50						INTEGER16	2	RPW	N	
0	0	3297	PROFIdrive test data trigger mode	0						UNSIGNED8	1	RPW	V	
0	0	3350	PROFIdrive State machine actual State							UNSIGNED16	2	R	V	
0	0	3351	PROFIdrive State machine actual ZSW1							UNSIGNED16	2	RW	V	
0	0	3352	PROFIdrive State machine actual ZSW2							UNSIGNED16	2	RW	V	
0	0	3353	PROFIdrive State machine actual STW1							UNSIGNED16	2	RW	V	
0	0	3354	PROFIdrive State machine actual STW2							UNSIGNED16	2	RW	V	
0	0	3355	PROFIdrive State machine actual SubState							UNSIGNED16	2	R	V	
0	0	3356	PROFIdrive State machine actual MeldW							UNSIGNED16	2	RW	V	
0	0	3360	PROFIdrive old State machine Init State	0						UNSIGNED8	1	RW	N	
0	0	3361	PROFIdrive pos RampStop Deceleration Value	10			0	1000		UNSIGNED32	4	RW	N	
0	0	3363	PROFIdrive actual Ti mult. factor							INTEGER16	2	R	V	
0	0	3390	PROFIdrive enable internal pos. loopback	0						UNSIGNED8	1	PRPW	N	
0	0	3391	PROFIdrive enable internal valvepos. loopback	0						UNSIGNED8	1	PRPW	N	
0	0	3392	PROFIdrive internal pos. loopback Kp	100						INTEGER32	4	PRPW	N	
0	0	3393	PROFIdrive internal pos. loopback PT1	5						INTEGER32	4	PRPW	N	
0	0	3440	controller output characteristic negative compensation flow value	115			1	950		UNSIGNED32	4	RW	N	
0	0	3441	controller output characteristic negative compensation signal value	600			1	950		UNSIGNED32	4	RW	N	
0	0	3450	PROFIdrive Sensor State machine actual State							UNSIGNED16	2	R	V	
0	0	3451	PROFIdrive Sensor State machine actual ZSW							UNSIGNED16	2	RW	V	

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_ unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
0	0	3452	PROFIdrive Sensor State machine actual STW							UNSIGNED16	2	RW	V	
0	0	3453	PROFIdrive SensorState actual ref Value							INTEGER32	4	RW	V	
0	0	3454	PROFIdrive SensorState actual ref PoIst value at ref. marker							INTEGER32	4	RW	V	
0	0	3460	PROFIdrive Sensor State machine reference drive Mode	0						UNSIGNED8	1	RW	N	
0	0	3520	actual filtered 1Vss Signal Level							UNSIGNED16	2	R	V	
0	0	3524	Endat sensor error register							UNSIGNED16	2	R	V	
0	0	3525	Endat sensor warning register							UNSIGNED16	2	R	V	
0	0	3540	PROFIdrive pll tdp error threshold	3						UNSIGNED16	2	RW	N	
0	0	3550	PROFIdrive PLL actual State							UNSIGNED16	2	R	V	
0	0	3551	PROFIdrive PLL actual Info Bits							UNSIGNED16	2	R	V	
0	0	3552	PROFIdrive PLL set Time Ti							UNSIGNED16	2	R	V	
0	0	3553	PROFIdrive PLL set Time To							UNSIGNED16	2	R	V	
0	0	3554	PROFIdrive PLL set Time Tdx							UNSIGNED16	2	R	V	
0	0	3555	PROFIdrive PLL set Time Mapc							UNSIGNED16	2	R	V	
0	0	3556	PROFIdrive PLL set Time Tpc							UNSIGNED16	2	R	V	
0	0	3557	PROFIdrive PLL set Time Tdp							UNSIGNED16	2	R	V	
0	0	3558	PROFIdrive PLL actual Jitter value							INTEGER32	4	R	V	
0	0	3559	PROFIdrive PLL actual Timing correction							INTEGER32	4	R	V	
0	0	3560	PROFIdrive PLL measured Time Ti							UNSIGNED16	2	R	V	
0	0	3561	PROFIdrive PLL measured Time To							UNSIGNED16	2	R	V	
0	0	3562	PROFIdrive PLL measured Ti-To Time difference							UNSIGNED16	2	R	V	
0	0	3563	PROFIdrive DSC internal coll. counter							UNSIGNED32	4	RW	V	
0	0	3570	PROFIdrive communication state machine							UNSIGNED8	1	R	V	
0	0	3571	PROFIdrive lifesign error counter							UNSIGNED8	1	R	V	
0	0	3572	PROFIdrive saving state machine							UNSIGNED8	1	R	V	
250	220	3580	IRQ FctL1 actual measured duration [in 0,1us steps]							UNSIGNED32	4	PR	V	
250	221	3581	IRQ FctL1 maximum measured duration [in 0,1us steps]							UNSIGNED32	4	PRPW	V	
250	222	3582	IRQ FctL1 filtered measured duration [in 0,1us steps]							UNSIGNED32	4	PR	V	
250	223	3583	IRQ FctL2 actual measured duration [in 0,1us steps]							UNSIGNED32	4	PR	V	
250	224	3584	IRQ FctL2 maximum measured duration [in 0,1us steps]							UNSIGNED32	4	PRPW	V	

Block no.	ID	PNU	Name	Init value	Doc_ prefix	Doc_ unit	Range min	Range max	Range selec-tion	Data type	Length in byte	Attri-bute	BI	Param-eter sets
250	225	3585	IRQ FctL2 filtered measured duration [in 0,1us steps]							UNSIGNED32	4	PR	V	
250	226	3586	IRQ FctL3 actual measured duration [in 0,1us steps]							UNSIGNED32	4	PR	V	
250	227	3587	IRQ FctL3 maximum measured duration [in 0,1us steps]							UNSIGNED32	4	PRPW	V	
250	228	3588	IRQ FctL4 actual measured duration [in 0,1us steps]							UNSIGNED32	4	PR	V	
250	229	3589	IRQ FctL4 maximum measured duration [in 0,1us steps]							UNSIGNED32	4	PRPW	V	
0	0	5100	PROFIdrive speed setpoint pzd refpara	100			1	1000		INTEGER32	4	RW	N	
0	0	5101	PROFIdrive system deviation pzd refpara	100			1	1000		INTEGER32	4	RW	N	
0	0	5102	PROFIdrive gain factor pzd refpara	100			0	1000		INTEGER32	4	RW	N	
0	0	5103	PROFIdrive speed actual value pzd refpara	100			1	1000		INTEGER32	4	RW	N	
0	0	5104	PROFIdrive sensor 1 actual value pzd refpara	10			1	1000		INTEGER32	4	RW	N	
0	0	5200	PROFIdrive Test SetErrorCode	0						UNSIGNED16	2	PRPW	V	
0	0	5201	PROFIdrive Test ResetErrorCode	0						UNSIGNED16	2	PRPW	V	

HYQUIP
+44 (0)1204 699 959
enquiries@hyquip.co.uk
www.hyquip.co.uk
Rexroth Bosch Group Sales partner
Hyquip Limited New Brunswick Street Horwich Bolton Lancashire BL6 7JB UK
Company Registered in England No: 4167649 VAT Registration No: 732 5692 25 BS EN ISO 9001:2008 No: LRQ 0964389

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