

# High-response/proportional valves with Multi-Ethernet interface

4WRPD(H)

5WRPF10

4WRPQ(H)

5WRPQ10

4WRPF(H)

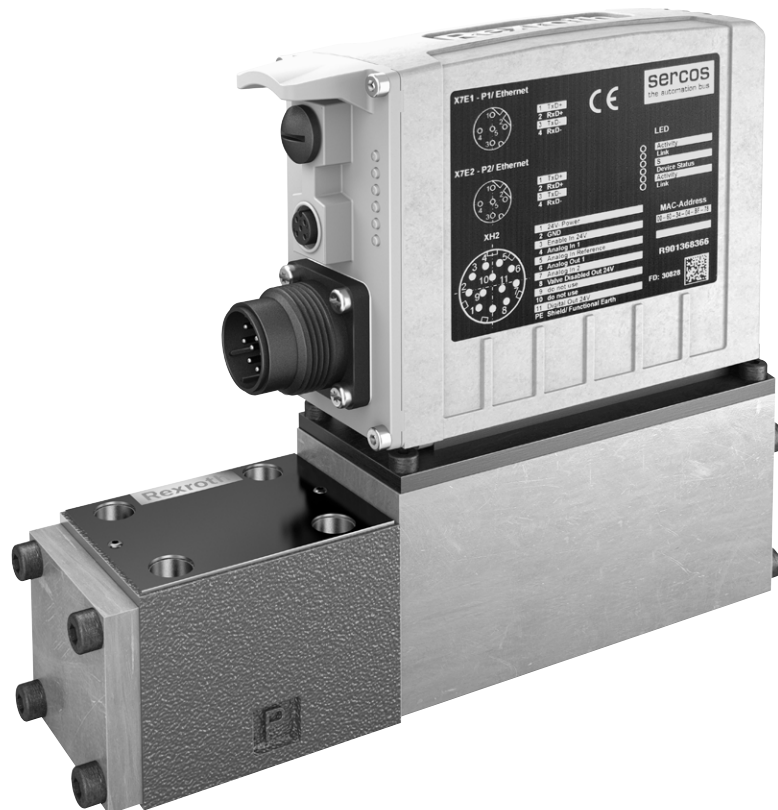
4WRLD

4WRLF

4WRLQ

**Operating instructions**  
**RE 29391-B/08.2021**

Replaces: 05.2021  
English



The data specified only serve to describe the product. If information on the use of the product is given, it is only to be regarded as application examples and recommendations. Catalog specifications do not constitute assured characteristics. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.

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The cover shows an example configuration. The product supplied may differ from the solution shown here.

The original operating instructions were prepared in German.

# Content

<b>1</b>	<b>About this documentation</b>	<b>5</b>
1.1	Validity of the documentation	5
1.2	Required and supplementary documentation	5
1.3	Representation of information	6
<b>2</b>	<b>Safety instructions</b>	<b>8</b>
2.1	About this chapter	8
2.2	Intended use	8
2.3	Improper use	9
2.4	Qualification of personnel	9
2.5	General safety instructions	10
2.6	Product-specific safety instructions	11
2.7	Safety equipment	14
2.8	Personal protective equipment	23
2.9	Obligations of the machine end-user	23
<b>3</b>	<b>General information on damage to property and damage to the product</b>	<b>24</b>
<b>4</b>	<b>Scope of delivery</b>	<b>25</b>
<b>5</b>	<b>About this product</b>	<b>26</b>
5.1	Performance description	26
5.2	Product description	26
5.3	Identification of the product	27
<b>6</b>	<b>Transport and storage</b>	<b>30</b>
6.1	Storage of the valve on Multi-Ethernet basis	30
<b>7</b>	<b>Installation</b>	<b>31</b>
7.1	Unpacking	31
7.2	Installation conditions	31
7.3	Required tools	31
7.4	Recommended accessories	31
7.5	Before the installation	32
7.6	Place of installation	32
7.7	Mounting of the valve on Multi-Ethernet basis	32
<b>8</b>	<b>Commissioning</b>	<b>37</b>
8.1	Initial commissioning	37
8.2	Installation requirements	38
<b>9</b>	<b>Operation</b>	<b>38</b>
<b>10</b>	<b>Maintenance and repair</b>	<b>39</b>
10.1	Cleaning and care	39
10.2	Inspection and maintenance	40
10.3	Repair	40
<b>11</b>	<b>Demounting and replacement</b>	<b>41</b>
11.1	Required tools	41
11.2	Preparing demounting	41
11.3	Demounting	41
11.4	Preparations for storage and further use	42
<b>12</b>	<b>Disposal</b>	<b>43</b>
12.1	Environmental protection	43
12.2	Return to Bosch Rexroth AG	43

12.3	Packaging	43
12.4	Materials used	43
12.5	Recycling	43
<b>13</b>	<b>Extension and modification</b>	<b>44</b>
<b>14</b>	<b>Troubleshooting</b>	<b>44</b>
14.1	How to proceed for troubleshooting	44
14.2	Fault table	45
<b>15</b>	<b>Technical data</b>	<b>45</b>
<b>16</b>	<b>Annex</b>	<b>46</b>
16.1	List of addresses	46
<b>17</b>	<b>Alphabetical index</b>	<b>47</b>

# 1 About this documentation

## 1.1 Validity of the documentation

This documentation applies to the following valves with Multi-Ethernet interface:


- 4WRPD(H) (direct operated high-response valve with Ethernet interface and axis control function, IAC Multi-Ethernet)
- 4WRLD (pilot-operated high-response valve with Ethernet interface and axis control function, IAC Multi-Ethernet)
- 4/5 WRPQ... (direct operated high-response valve with Ethernet interface and integrated electronic pressure compensator, IAC Multi-Ethernet and IFB Multi-Ethernet)
- 4/5 WRPF... (direct operated high-response valve with Ethernet interface, IAC Multi-Ethernet and IFB Multi-Ethernet)
- 4WRLF (pilot-operated high-response valve with Ethernet interface, IFB Multi-Ethernet)
- 4WRLQ (direct operated high-response valve with Ethernet interface and integrated electronic pressure compensator, IAC Multi-Ethernet and IFB Multi-Ethernet)

This documentation is intended for fitters, operators, service technicians and plant operators.


This documentation contains important information on the safe and proper mounting, transport, commissioning, operation, use, maintenance, demounting and simple troubleshooting of the product.




- Read this documentation thoroughly and in particular chapter 2 “Safety instructions” and chapter 3 “General information on damage to property and damage to the product“, before working with the product.

## 1.2 Required and supplementary documentation

- The product must not be commissioned until you have been provided with the documentation marked with the book symbol  and you have understood and observed it. Bosch Rexroth data sheets are available online at [www.boschrexroth.com/mediadirectory](http://www.boschrexroth.com/mediadirectory)

**Table 1: Required and supplementary documentation**

Title	Document number	Document type
 System documentation from the system manufacturer		
Directional control valve, direct operated, with integrated digital axis controller (IAC Multi-Ethernet), type 4WRPDH	29391	Data sheet
Directional control valve, direct operated, with integrated digital axis controller (IAC Multi-Ethernet), type 4WRPQ	29133	Data sheet
Directional control valve, direct operated, with integrated fieldbus (IFB Multi-Ethernet), type 4WRPFH	29395	Data sheet
Directional control valves, direct operated, with electrical position feedback and integrated fieldbus (IFB Multi-Ethernet), type 4WRPF	29131	Data sheet
Directional control valve, pilot operated, with integrated digital axis controller (IAC Multi-Ethernet), type 4WRLD	29289	Data sheet

Title	Document number	Document type
Directional control valve, pilot operated, with integrated fieldbus (IFB Multi-Ethernet), type 4WRLF	29293	Data sheet
 Rexroth HydraulicDrive HDS-16, HDx17 to HDx-20 Parameters	30330-PA	Reference book
 Rexroth HydraulicDrive HDS-16, HDx17 to HDx-20 Diagnostic Messages	30330-WA	Reference book
 Rexroth HydraulicDrive HDx-20 Functions	30338-FK	Application manual
Declaration of conformity of the complete valves on Multi-Ethernet basis		Available from Bosch Rexroth on request
General product information on hydraulic products	07008	
Hydraulic valves for industrial applications	07600-B	Operating instructions
Reliability characteristics MTTF <sub>D</sub> regarding functional safety according to EN ISO 13849	08012	Data sheet

### 1.3 Representation of information

Consistent safety instructions, symbols, terms and abbreviations are used in this documentation so that you can quickly and safely work with the valve described. For a better understanding, they are explained in the following sections.

#### 1.3.1 Safety instructions




In this documentation, safety instructions are included in chapter 2.6 “Product-specific safety instructions” and in chapter 3 “General information on damage to property and damage to the product” and whenever sequences of actions or instructions are explained which bear the risk of personal injury or damage to property. The described hazard avoidance measures must always be observed.

Safety instructions are structured as follows:

 <b>SIGNAL WORD</b>
<b>Type and source of danger!</b> Consequences in case of non-compliance ▶ Hazard avoidance measures ▶ <Enumeration>

- **Warning symbol:** draws attention to a hazard
- **Signal word:** identifies the degree of hazard
- **Type and source of danger:** Specifies the type and source of danger
- **Consequences:** describes the consequences in case of non-observance
- **Precaution:** specifies how the hazardous situation can be prevented



**Table 2: Hazard Classifications according to ANSI Z535.6-2011**

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

### 1.3.2 Symbols

The following symbols indicate notices which are not safety-relevant but increase the comprehensibility of the documentation.

**Table 3: Meaning of the symbols**

Symbol	Meaning
	If this information is disregarded, the product cannot be used or operated in an optimum manner.
	Individual, independent action
1.	Numbered instruction:
2.	The numbers indicate that the actions must be carried out one after the other.
3.	

### 1.3.3 Designations

The following terms are used in this documentation:

**Table 4: Designations**

Designation	Meaning
IAC Multi-Ethernet	Integrated axis controller based on a high-response valve
IndraWorks	Operating software
RE xxxxx	Rexroth document in English language
Sercos	Interface for motion control applications

### 1.3.4 Abbreviations

The following abbreviations are used in this documentation:

**Table 5: Abbreviations**

Abbreviation	Meaning
CCF	Common Cause Failure
DC <sub>avg</sub>	Average Diagnostic Coverage according to EN ISO 13849-1
FC	Frequency converter
IAC	Integrated Axis Controller
IFB	Integrated Field Bus
I/O	Inputs/outputs
MTTF <sub>d</sub>	Mean time to dangerous failure
PC	Personal Computer
PELV	Protective Extra Low Voltage
PFH	Probability of dangerous failure per hour

Abbreviation	Meaning
PL	Performance Level according to EN ISO 13849-1
SELV	Separated extra-low voltage
PLC	Programmable Logic Control

## 2 Safety instructions

### 2.1 About this chapter

The valves on Multi-Ethernet basis described below have been manufactured according to good engineering practice. However, there is still a risk of personal injury and/or damage to property if you do not observe this chapter and the safety instructions in this documentation.

- ▶ Read this documentation 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 include the required documentation when you pass the valve on to third parties.

### 2.2 Intended use

A valve on Multi-Ethernet basis is a valve with electrical control for use in two-channel safety applications (cat. 3, PL d and cat. 4, PL e according to EN 13849-1) as switch-off element for one channel.

Depending on the application and the requirements of work equipment-related standards according to EN 13849-1, the user must provide appropriate monitoring/plausibility checks which comply with the required diagnostic coverage  $DC_{avg}$  using a higher-level control.

The valve is exclusively intended for integration into a machine or system or to be assembled with other components to form a machine or system. The product may be commissioned only if it is integrated in the machine/system for which it is designed.

The operating conditions and the performance limits specified in the technical data sheet must be observed.

The valve on Multi-Ethernet basis may be used as follows:

- For open and closed-loop (alternating) control of position, pressure, force, velocity, pressure differential and flow

For operation of the device, a higher-level control logic with appropriate I/O components is additionally required, which, in conjunction with the valve on Multi-Ethernet basis, holistically controls the motion sequence of the machine and also monitors it in terms of safety.



The valve must not be used in potentially explosive atmospheres. The product is intended exclusively for professional use and not for private usage. Intended use includes having read and understood this documentation completely, especially chapter 2 “Safety instructions“.

### 2.3 Improper use

Any use deviating from the intended use is improper and thus not admissible. Improper use voids any warranty claims. It is also regarded as improper use if the valve is operated outside the indicated performance limits and operating conditions, especially the prescribed ambient conditions. Bosch Rexroth AG does not assume any liability for damage caused by improper use. The user assumes all risks involved with improper use.

### 2.4 Qualification of personnel

The activities described in this documentation require basic knowledge of electrical installation, control technology, programming and hydraulics as well as knowledge of the appropriate technical terms. In order to ensure safe use, these activities may only be carried out by an expert in the respective field or an instructed person under the direction and supervision of an expert. Experts are those who are able to recognize potential hazards and apply the appropriate safety measures due to their professional training, knowledge and experience, as well as their understanding of the relevant requirements pertaining to the work to be undertaken. An expert must observe the relevant specific professional rules and have the necessary hydraulic expert knowledge. Hydraulic expert knowledge means, amongst others:

- Reading and completely understanding hydraulic circuit diagrams,
- in particular, completely understanding the correlations regarding safety equipment and
- knowledge of the function and structure of hydraulic components.

The operation of the digital IAC Multi-Ethernet axis control requires that the operator is familiar with the IndraWorks Ds PC program. For a description on handling the program as well as first steps for operation, please refer to <https://www.boschrexroth.com>.

We recommend that users attend a product-specific training by Bosch Rexroth.



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

## 2.5 General safety instructions

- Observe the valid regulations on accident prevention and environmental protection.
- Observe the safety regulations and provisions of the country in which the product is used/applied.
- Exclusively use Rexroth products in technically perfect condition.
- Observe all notices 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 genuine Rexroth accessories and spare parts in order to exclude any hazard to persons due to unsuitable spare parts.
- Comply with the technical data and ambient conditions specified in the product documentation.
- The installation or use of inappropriate products in safety-relevant applications could result in unintended operating states in the application which in turn could cause personal injuries and/or damage to property. Therefore, only use a product for safety-relevant applications if this use is expressly specified and permitted in the documentation of the product, or if the safe suitability of the product in the application is confirmed by a separate conformity assessment procedure, e.g. in explosion protection zones or in safety-related parts of control systems (functional safety).
- Do not commission the product until you can be sure that the end product (for example a machine/system) where the Rexroth products are installed comply with the country-specific provisions, safety regulations and standards of the application.
- Please observe the safety-relevant information and risk specifications in the operating instructions of the manufacturer of the connected hydraulic system before commissioning the control with a hydraulic system.
- Please observe the general installation and safety regulations when working on electrical systems.
- The information given in the product documentation with regard to the use of the supplied components represents only application examples and recommendations. The machine manufacturer and system installer must check the suitability of the supplied components and the information given in this documentation with regard to their use self-dependently for his individual application and adjust it to the safety regulations and standards valid for his application, and carry out the required measures, changes and amendments.
- Technical data as well as connection and installation conditions are available in the product documentation and must be imperatively observed.
- In case of faults impairing the safety and changes in the operating behavior, shut down the valve immediately and report the faults to the responsible personnel.
- Generally, you may not modify or convert the product, except for the pilot oil supply of the pilot-operated valves 4WRLD, 4WRLF and 4WRLQ.

## 2.6 Product-specific safety instructions

### **WARNING**

#### **Non-compliance with functional safety!**

Valves control movements in machines or systems. In the case of mechanical and electrical faults, e.g. failure of the power supply, persons may get caught, hurled or crushed by the installation.

- ▶ When setting up your circuit, observe functional safety, e.g. according to EN ISO 13849.

#### **Hazardous movements!**

It is not allowed for persons to stay within the range of motion of machines and machine parts. The following are examples of possible measures against unintended access of persons:

- Protective fences
- Protective grids
- Protective covers
- Light barriers
- ▶ If persons have to enter the hazard zone while the control is active, provide superordinate monitoring functions on the system side or measures for personal safety. These measures must be provided according to the specific data of the system and on the basis of the risk and error analysis of the system manufacturer/user. In this connection, the safety provisions applied for the system must be taken into account.
- ▶ In case of faults impairing the safety and changes in the operating behavior, shut down the valve immediately and report the faults to the responsible personnel.

#### **System parts under pressure and ejecting hydraulic fluid!**

When working at hydraulic systems with stored pressure energy (accumulator or cylinders working under gravity), valves may even be pressurized after the pressure supply has been switched off. During installation and demounting, the valves or parts may be hurled around and cause personal injuries and/or damage to property. There is moreover the risk of serious injury caused by a powerful, ejecting hydraulic fluid jet.

- ▶ Before working on the valve, ensure that the hydraulic system is depressurized and the electrical control is de-energized.
- ▶ Completely depressurize machines and systems before working on hydraulic products.



## WARNING

### High electrical voltage by incorrect connection!

Danger to life, risk of injury by electric shock!

- ▶ The valve may only be connected by or under the supervision of a specialized electrician.
- ▶ Switch off the voltage supply before all maintenance, repair or installation work and secure it against restarting.
- ▶ Provide for proper, safe PE connection.
- ▶ As supply voltage of the valve on Multi-Ethernet basis, functional low voltages with electric separation (PELV or SELV) according to VDE0100, part 410 must be applied.
- ▶ For the external voltage supply, it must be ensured that, even in error cases, the voltage limitation defined for the valve is not exceeded. PELV power supply units according to EN 60204, section 6.4.2 comply with these requirements.
- ▶ Only connect voltages and power circuits that feature safe isolation from dangerous voltages. Secure separation is achieved for example by means of isolation transformers, secure optocouplers or mains-free battery operation.

#### Notice:

When calculating the PFH (probability of dangerous failure per hour) of the safety function, the PFH of the external voltage supply must also be taken into account.

### Faulty fastening!

Mounting of valves with mounting screws of reduced stability, improper mounting, or fastening at blocks and plates with insufficient stability may lead to components becoming loose and falling down. Consequently, hydraulic fluid may leak and lead to personal injuries and/or damage to property. Heavy weight valves may cause bruises or fatal injury. Particular caution applies to valves with suspended installation.

- ▶ Completely mount the valve according to the mounting specifications using suitable mounting aids.
- ▶ Only mount the valve to blocks or plates suitable for the weight of the valve.
- ▶ Observe the tightening torques and bolt strengths.

### Missing equipotential bonding!

Electrostatic processes, an incorrect earthing concept or missing equipotential bonding may lead to malfunctions or uncontrolled movements at the machine and thus cause injuries.

- ▶ Provide for correct earthing and provide for proper equipotential bonding.

## **WARNING**

### **Penetrating water and humidity!**

In case of use in humid or wet environments, water or humidity may penetrate at electrical plug-in connectors or the valve electronics. This case may lead to malfunctions at the valve and to unexpected movements in the hydraulic system which may result in personal injury and damage to property.

- ▶ Do not use the valve on Multi-Ethernet basis outside or below its intended IP protection class.
- ▶ Ensure before the installation that all seals and caps of the plug-in connections are present and intact.

### **Easily inflammable hydraulic fluid!**

In connection with fire or other hot heat sources, leaking hydraulic fluid mist, which results from defective or incompletely mounted valves and their connections, may lead to fire or explosions.

- ▶ Do not use the valve in areas with open fire and only at a sufficient distance to hot heat sources.

## **CAUTION**

### **Contaminated hydraulic fluid!**

Contamination in the hydraulic fluid may cause functional failures e.g. jamming or blocking of nozzles of the valve. In the worst case, this may result in unexpected system movements and thus constitute a risk of injury.

- ▶ Ensure adequate hydraulic fluid cleanliness according to the cleanliness classes of the valve over the entire operating range.

### **Hot surfaces!**

Valves may heat up considerably during operation. This may cause burns when you touch the surfaces or, when the surface gets into contact with non-heat-resistant or combustible material, this may result in damage to property or fire.

- ▶ Avoid contact with the valve during operation.
- ▶ Allow the valve to cool down sufficiently before touching it or wear protective gloves.
- ▶ Keep non-heat-resistant or combustible material away from hydraulic valves.
- ▶ If necessary, attach protective covers.

### **Exceedance of the maximum temperatures!**

Use of the valve outside the intended temperature may lead to functional failures like e.g. due to overheating of the valve solenoids. In the worst case, this may result in unexpected system movements and thus constitute a risk of injury.

- ▶ Only use the safety valve within the intended ambient and fluid temperatures.

## ! CAUTION

### Leakage in case of incorrect working temperatures!

Use of the valve outside the intended temperature range may lead to permanent leakage at the valve. Thus, hydraulic fluid in the form of an ejecting hydraulic fluid jet may injure persons, lead to damage to property and endanger the environment.

- ▶ Only use the safety valve within the intended ambient and fluid temperatures.
- ▶ In case of leakage, immediately exchange damaged seal rings or the valve.

### Corrosion!

If the valve is used in humid environments or water, the valve and mounting screws may corrode. Thus, the mounting screws and the valves lose their stability and may become loose and thus constitute a risk of injury.

- ▶ Use mounting screws with adequate corrosion protection and exchange mounting screws that show serious corrosion damage.
- ▶ Provide for adequate corrosion protection and exchange valves with serious corrosion damage at an early stage.



Contact with salt water leads to increased corrosion at the valve. Thus, mounting screws and plug screws as well as moveable components such as hand levers may be chemically corroded and damaged. You should therefore take suitable corrosion protection measures.

## 2.7 Safety equipment

## ! WARNING

### Hazardous movements!

Danger to life, risk of injury or damage to property!

- ▶ Only use the approved spool types specified in the corresponding valve data sheet. Otherwise, secure shutdown of the valve and the related safety functionality are no longer provided.

### 2.7.1 Valve on Multi-Ethernet basis use according to EN13849-1

The valve on Multi-Ethernet basis can be used in systems up to PL e, category 4 according to EN13849-1. The valve can be used as shut-down element to ensure compliance with the requirements of a secure start inhibitor according to EN 60204 stop category 0.

In two-channel applications, i.e. applications with PL d, cat. 3 and PL e, cat. 4 according to EN 13849-1, the valve can be used as shut-off channel.

As a precondition, appropriate monitoring/plausibility checks with the required  $DC_{avg}$  for the entire application must be provided by the user or programmed into a higher-level control system.

Regarding valve monitoring, the valve only provides feedback signals which must be evaluated by a higher-level control system in order to calculate the diagnostic coverage according to EN 13849-1 and prove that the requirements are complied with.

In the higher-level control system, the two signals "enable" (sent to the valve) and "enable acknowledgement" (fed back by the valve) have to be logically connected and checked for plausibility according to the required safety level (cat., PL). In case of a negative plausibility check or error, the higher-level control system has to initiate immediate shut-off/safety function.

The 24 V supply voltage at the valve may be applied permanently as long as no error is detected by the higher-level control system.

**Safety functionality of valves type 4WRPDH, 4WRPD...EA/EB, 4WRPFH, 4WRPF...EA/EB, 4WRPQH, 5WRPF10, 5WRPQ10 (direct operated valves with one control solenoid)**

By removal of the enable signal at the valve electronics, the output stage is disconnected from the supply voltage by means of a high-side switch. The Multi-Ethernet electronics link the supply voltage disconnection of the output stage to the respective failsafe switching position of the spool and generate the "enable acknowledgement" signal.

Additionally, the signals "enable" (sent to the valve) and "enable acknowledgement" (fed back by the valve) or a change of these signals have to be logically interconnected by a higher-level control system and checked for plausibility. Every change of the enable signal ("L" or "H") must lead to a prompt reaction of the related enable acknowledgement signal (inverted to enable signal "H" or "L").

If this reaction on the signal change does not occur in time, the higher-level control system must immediately initiate the emergency shut-down of the system.

**Safety function of valve types 4WRLD, 4WRLF and 4WRLQ (pilot operated valves, pilot valve with one control solenoid)**

By removal of the enable signal at the valve electronics, the output stage of the pilot valve is disconnected from the supply voltage by means of a high-side switch. The Multi-Ethernet electronics link a disconnection of the supply voltage of the pilot valve's output stage with safe reaching of the central position of the main stage spool and generate the "enable acknowledgement" signal.

Additionally, the signals "enable" (sent to the valve) and "enable acknowledgement" (valve response) or a change of these signals have to be logically interconnected by a higher-level control system and checked for plausibility.

Every change of the enable signal ("L" or "H") must lead to a prompt reaction of the related enable acknowledgement signal (inverted to enable signal "H" or "L").

If this reaction on the signal change does not occur in time, the higher-level control system must immediately initiate the emergency shut-down of the system.

**Safety functionality of valve types 4WRPD, 4WRPF, 4WRPQ (direct operated valves with two control solenoids)**

By removal of the direction-dependent enable signal ( $P \rightarrow A$  or  $P \rightarrow B$ ) at the valve electronics, the respective output stage is disconnected from the supply voltage by means of a high-side switch.

The Multi-Ethernet electronics links the supply voltage disconnection of the output stage to the relevant failsafe position of the spool and generate the "enable acknowledgement" signal from this.

Additionally, the signals "direction-dependent enable" (sent to the valve) and "direction-dependent enable acknowledgement" (valve response) or a change of these signals have to be logically connected by a higher-level control system and checked for plausibility.

Every change of the direction-dependent enable signal ("L" or "H") must lead to a prompt reaction of the related direction-dependent enable acknowledgement signal (inverted to direction-dependent enable signal "H" or "L").

If this reaction on the signal change does not occur in time, the higher-level control system must immediately initiate the emergency shut-down of the system.

An application with two valves including two-channel control and monitoring ( $DC_{avg}$  99 %) fulfills the necessary requirements to achieve a PL e, cat. 4 according to EN 13849-1.

With the exception of "enable" and "enable acknowledgement", all other signals do not form part of the safety function and must therefore not be used for safety-relevant functions.

Despite all measures taken in terms of plausibility check and monitoring, the use of the valve involves a certain residual risk, which must not be neglected. It must in any case be evaluated by the machine integrator depending on the individual application. For appropriate evaluation, Bosch Rexroth provides the safety parameters of the valve on Multi-Ethernet basis according to EN 13849-1. See chapter 2.7.4 "MTTFd, DC, CCF".

### 2.7.2 Limits of the safety-related parts

Assessment of the valve on Multi-Ethernet basis according to ISO 13849-2:

- A valve on Multi-Ethernet basis is suitable for channel shut-off according to EN 13849-1. An appropriate control system must be provided which ensures plausibility checks between the direction-dependent enable input of the valve and the direction-dependent "enable acknowledgement" signal issued by the valve (see chapter 2.7.1).
- Potential failures or unidentified error states of the valve on Multi-Ethernet basis always require application-dependent and suitable system-related measures according to EN 13849-1 (see chapter 2.7.1).
- A valve on Multi-Ethernet basis is not suitable as shut-off element according to category 1 if merely the enable is used without a cyclic evaluation of the enable acknowledgement. The requirements for the cyclic evaluation must be observed depending on the specific application.

### 2.7.3 Residual risks/error states

The following residual risks or error states may occur and must be taken into account on the system side by providing appropriate measures:

- Complete failure of the electronics of the valve
- Faulty output of operating states
- Failure of the enable inputs or enable acknowledgement outputs
- Delayed reaction to signal changes
- Uncontrolled movement of the valve spool (may lead to uncontrolled movement of the cylinder, for example)
- Undefined behavior of the electronics of the valve on Multi-Ethernet basis if signals "enable P-A" or "enable P-B" are provided in the overlap area (5...15 V according to IEC 61131-2:2008, type 1)
- Difficult level recognition of enable acknowledgement and thus no activation of the safety function if the enable acknowledgement outputs are not connected to current sinking inputs according to IEC 61131-2:2008 (types 1, 2 or 3).
- Fuse protection in the case of short-circuits in the electronics of the valve on Multi-Ethernet basis by means of appropriate protection and design of the supply line (fuse protection against currents > 4 A).



### 2.7.4 MTTF<sub>d</sub>, DC, CCF

For valves on Multi-Ethernet basis, MTTF<sub>d</sub> valves can be calculated according to the information specified in the table using the following formula:

$$MTTF_{dTotal} = \frac{1}{\frac{1}{MTTF_{dHydraulic\ part}} + \frac{1}{MTTF_{dSwitch-off\ path}} + \frac{1}{MTTF_{dMains\ adaptor}}}$$

**Table 6: Information for calculation of the MTTF<sub>d</sub> value**

Type of actuation	Valve type	MTTF <sub>d</sub> values		SELV/PELV power supply unit	MTTF <sub>d</sub> value Valve and switch-off path electronics (w/out power supply unit)	Example of total MTTF <sub>d</sub> value (for power supply unit with MTTF <sub>d</sub> value of 1 million h)
		Hydraulic components	Switch-off path			
Direct operated valves	4WRPFH 4WRPDH 4WRPQH 4WRPF...EA/EB 5WRPF10 5WRPQ10 (single-solenoid valves)	150 years	1000 years	MTTF <sub>d</sub> value depending on power supply unit manufacturer (MTTF <sub>d</sub> = approx. 2 x MTBF)	130 years	60
	4WRPD 4WRPF 4WRPQ (double-solenoid valves)	150 years	1000 years (only one switch-off path regarded as safety-relevant)	e.g. MTBF = 500000 h → MTTF <sub>d</sub> value = approx. 1 million h (114 years)	130 years	60
Pilot operated valves	4WRLD 4WRLF, 4WRLQ	75 years	1000 years		69 years	43

For the MTTF<sub>d</sub> values given, the restrictions apply that are described in RE 08012 (see “Exceptions/limitations” regarding “Admissible spool designs; maximum longitudinal spool acceleration” in the chapter “Proportional directional valves” on page 5).

The DC depends on the system and on the use of a safety PLC (see chapter 2.2 “Intended use”).

By using the valves as intended, a CCF of at least 65 points can be reached.

### 2.7.5 Limits for operation

The following operating conditions apply to the valve, see data sheet.

- Ambient temperature range: -20...60 °C
- Supply voltage range 18...36 VDC, see data sheet.
- Voltage range of the enable inputs 0...+36 VDC. Additional external precautionary measures must be taken against overvoltage, e.g. in the form of fuses and varistors.
- Level recognition of the enable inputs according to IEC 61131-2:2008, type 1
- The enable acknowledgement outputs must be connected to switching inputs according to IEC 61131-2:2008 (types 1, 2 or 3; current sinking).



Variations may occur depending on the valve used. They can be found in the corresponding valve data sheet. There, you also find the valve-related operating conditions.

### 2.7.6 Independence of operating modes

The safety function of the valve with Multi-Ethernet electronics is independent of the operating modes. However, the safety function can only be used if the Multi-Ethernet electronics are combined with suitable valve functions (e.g. spool overlap). The relevant information can be found in the corresponding valve data sheet. The data sheets also list, which operation modes are supported by the Multi-Ethernet electronics together with the valve.

### 2.7.7 Switch-off time

The switch-off time generally depends on the valve type used and the hydraulic operating state. The following table lists typical values below the power limit. The min. switch-on time results from linking of solenoid enable and position. For this reason, only the electrical part is relevant.

**Table 7: Typical switch-on and switch-off times**

Valve type	Min. switch-on time	Typical switch-off time
4WRPFH6	0.2 ms	< 40 ms
4WRPFH10	0.2 ms	< 50 ms
4WRPDH6	0.2 ms	< 40 ms
4WRPDH10	0.2 ms	< 50 ms
4WRPF6	0.2 ms	< 50 ms
4WRPF10	0.2 ms	< 60 ms
4WRPF10EA/EB	0.2 ms	< 60 ms
4WRLF16	0.2 ms	125 ms (with command value -100 %), 60 ms (with command value +100 %) (@ p = 280 bar operating pressure)
4WRLF25/27	0.2 ms	210 ms (with command value -100 %), 140 ms (with command value +100 %) (@ p = 280 bar operating pressure)
4WRDL16	0.2 ms	125 ms (with command value -100 %), 60 ms (with command value +100 %) (@ p = 280 bar operating pressure)
4WRDL25/27	0.2 ms	210 ms (with command value -100 %), 140 ms (with command value +100 %) (@ p = 280 bar operating pressure)

**2.7.8 Notice on the operation of enable inputs with a safety PLC**

For some safety PLCs the switching outputs are subjected to light and dark tests. Our dynamic high-response valves respond very quickly to signal changes at the enable inputs. This may result in unintended valve movements. The test duration should not exceed times of 100 µs.

### 2.7.9 Connection example/block diagram for direct operated valves with one solenoid

For type III according to EN 201:2009, two separate switch-off paths are required. The following overview illustrates a realization example of a switch-off path for an injection molding machine with direct operated valve with one solenoid on Multi-Ethernet basis. For the second switch-off path, an additional suitable valve is required. For this application, the specific requirements of EN 201:2009 are to be complied with.

The connection example only shows the safety-relevant signals of the Multi-Ethernet electronics. For all other signals and interfaces, refer to the valve-specific data sheets.

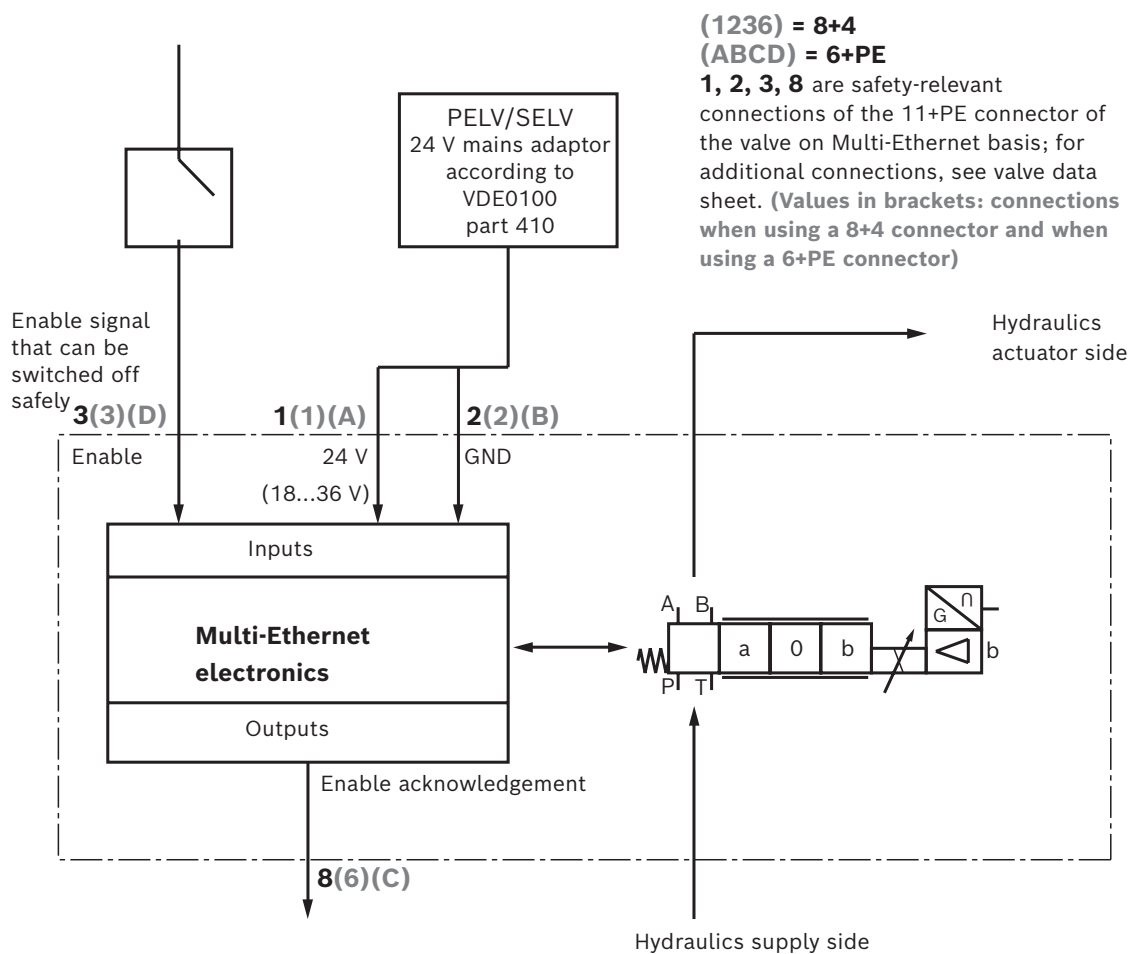


Fig. 1: Block diagram for direct operated valves with one solenoid

### 2.7.10 Connection example/block diagram for direct operated valves with two solenoids

For type III according to EN 201:2009, two separate switch-off paths are required. The following overview illustrates an example realization of a switch-off path for an injection molding machine with direct operated valve with 2 solenoids on Multi-Ethernet basis. For the second switch-off path, an additional suitable valve is required. For this application, the specific requirements of EN 201:2009 are to be complied with.

The connection example only shows the safety-relevant signals of the Multi-Ethernet electronics. For all other signals and interfaces, refer to the valve-specific data sheets.

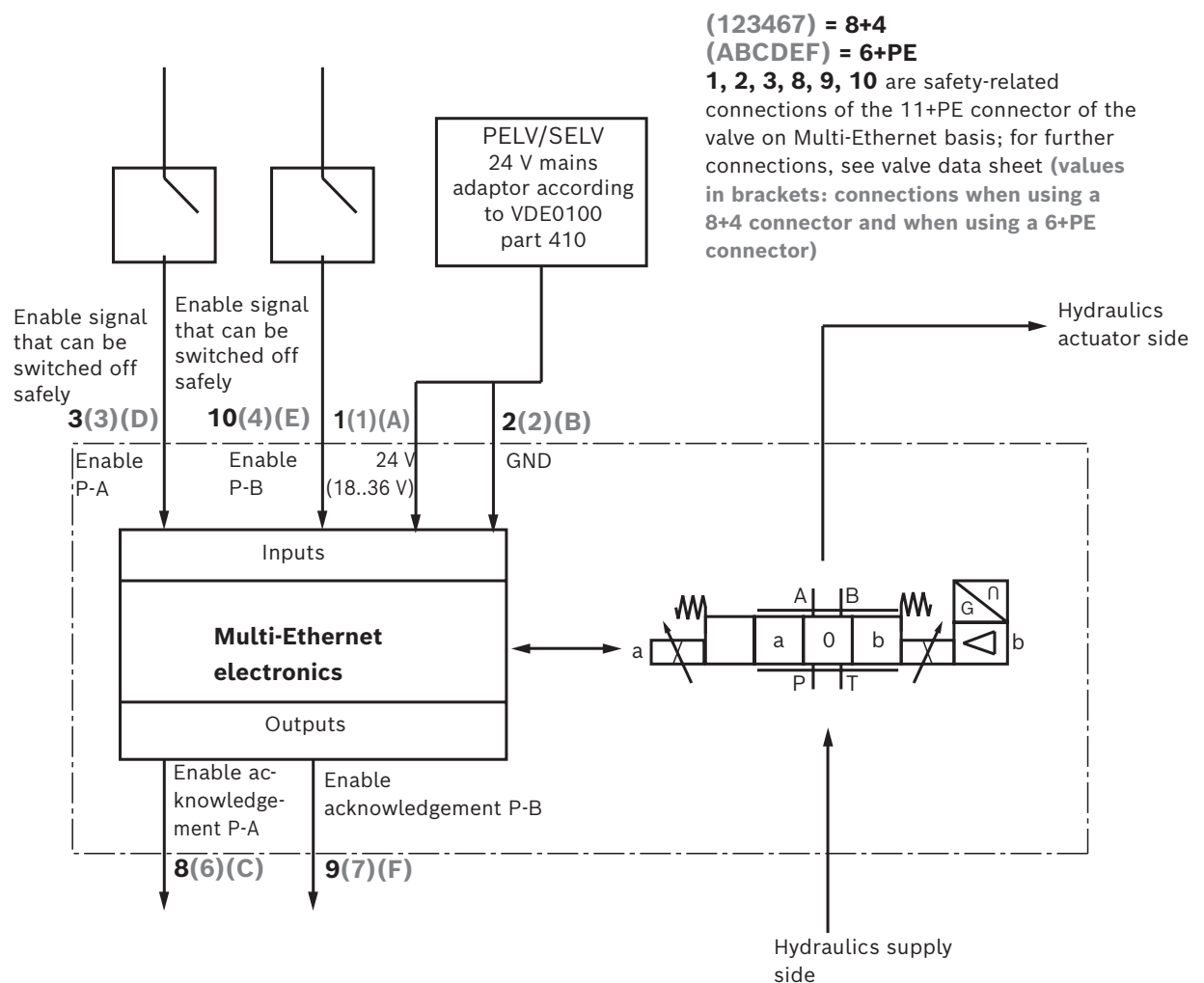


Fig. 2: Block diagram for direct operated valves with two solenoids

### 2.7.11 Connection example/block diagram for pilot-operated valves (pilot valve with one solenoid)

For type III according to EN 201:2009, two separate switch-off paths are required. The following overview illustrates a realization example of a switch-off path for an injection molding machine with pilot operated valve (pilot valve with one solenoid) on Multi-Ethernet basis. For the second switch-off path, an additional suitable valve is required. For this application, the specific requirements of EN 201:2009 are to be complied with.

The connection example only shows the safety-relevant signals of the Multi-Ethernet electronics. For all other signals and interfaces, refer to the valve-specific data sheets.

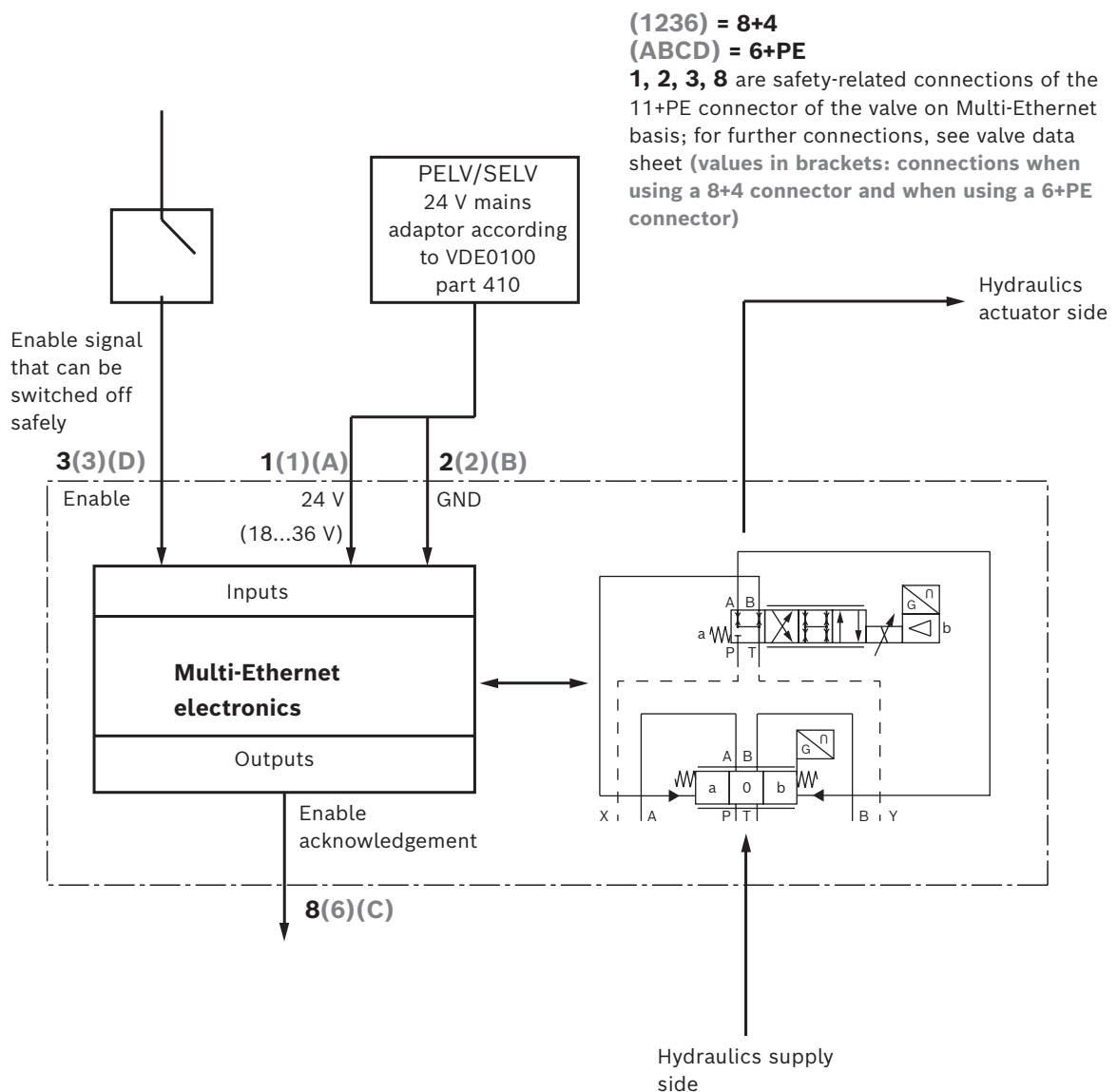


Fig. 3: Block circuit diagram for pilot operated valves (pilot valve with one solenoid)

## **2.8 Personal protective equipment**

Check determined personal protective equipment for completeness and protective effect and wear it (observe customer regulations and list of personal protective equipment).

## **2.9 Obligations of the machine end-user**

The operation of installations, systems and machines basically requires the implementation of a holistic IT security concept which is state-of-the-art in terms of technology. Accordingly, Bosch Rexroth products and their properties must be considered as components of installations, systems and machines for their holistic IT security concept.

Unless otherwise documented, Bosch Rexroth products are designed for operation in local, physically and logically secured networks with access restrictions for authorized persons, and they are not classified according to IEC 62443-4-2.

### 3 General information on damage to property and damage to the product

#### **NOTICE**

**Impermissible mechanical loading!**

Impact or shock forces on the valve may damage or even destroy it.

- ▶ Never use hydraulic components as a handle or step. Do not place/put any objects on top of it.

**Dirt and foreign particles in hydraulic components!**

Penetrating dirt and foreign particles lead to wear and malfunctions. Safe functioning of the hydraulic components is no longer ensured.

- ▶ When installing the punching system, observe strictest cleanliness to prevent foreign bodies such as welding beads or metal chips from entering hydraulic lines.
- ▶ Do not use linty cloth for cleaning.
- ▶ Take care that no cleaning agents enter the hydraulic system.

**Environmentally harmful hydraulic fluid!**

Leaking hydraulic fluid leads to environmental pollution.

- ▶ Immediately remedy any leakage.
- ▶ Dispose of the hydraulic fluid in accordance with the national regulations in your country.

**Uncontrolled disconnection and connection of plug-in connectors!**

Device might be destroyed!

- ▶ Before installation work, disconnect the device from the mains or from the voltage source or de-energize it reliably.
- ▶ Do not plug in or pull the electric plug-in connector as long as the voltage supply is activated.

The warranty only applies to the delivered configuration.

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:

- Valve on Multi-Ethernet basis

Accessories such as mating connectors, interface cables and cable sets are not included in the scope of delivery and must be ordered separately.

Software is not covered by the scope of delivery.

Download commissioning software online at: [www.boschrexroth.com/iac](http://www.boschrexroth.com/iac)

- Check the scope of delivery for completeness.
- Check the scope of delivery for possible transport damage, see chapter 6 “Transport and storage”.



In case of complaints, please contact Bosch Rexroth AG, see chapter 16.1 “List of addresses”.

## 5    About this product

### 5.1    Performance description

**Table 8: Functionality of valves on IAC/IFB Multi-Ethernet basis**

Function	IAC - Integrated Axis Controller	IFB - Integrated Field Bus
Axis control function	X	-
Safety function	X	X
Ethernet communication	X	X

Valves on Multi-Ethernet basis can be connected to higher-level control systems via Ethernet-capable bus systems (Sercos III, EtherCAT, EtherNet/IP, PROFINET RT, POWERLINK or VARAN) and programmed using the IndraWorks Ds PC program. The Ethernet-capable bus system must not be used to transfer safety-related signals. These are to be provided or evaluated directly at the connector. Valves based on Multi-Ethernet (with axis control) offer a wide range of functionalities and operating modes like position/pressure/force/speed/flow control and alternating controls (e.g. p/Q function). For additional information, please refer to the valve-specific data sheets.

### 5.2    Product description

The valve on Multi-Ethernet basis is designed for use in harsh industrial environments in terms of interference, mechanical vibration, shock and climate resistance.

The valve provides freely configurable controller variants:

- E.g. position / pressure / force / velocity / flow controller
- Alternating control (e.g. flow/pressure, position/pressure)

Parameterization and diagnosis are handled using the PC software IndraWorks Ds, which can be downloaded from <https://www.boschrexroth.de/iac>. This enables individual parameterizing of the valve according to axis requirements. For process connection, the valve is equipped with digital and analog encoder interfaces and up to two freely configurable digital inputs/outputs. Communication with the higher-level control is realized via an Ethernet-capable bus system. For operation of the device, a higher-level control logic with appropriate I/O components is additionally required, which, in conjunction with the valve, holistically controls the motion sequence of the machine and also monitors it in terms of safety. The bus system must not be used to transfer safety-related signals. These are to be provided or evaluated directly at the connector.

The preparation of application-specific data sets forms the basis for the function of the valve on Multi-Ethernet basis. These data sets are generated on the PC and sent to the valve via Ethernet. The combination of user program and data sets is called project.

The valve covers a wide range of controller functions which are described in the respective valve-specific data sheet.

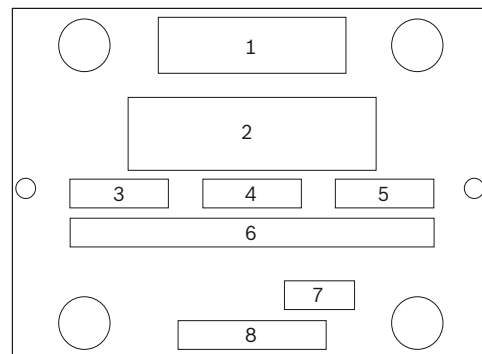
### 5.2.1 Displays

The LED displays and their meaning can be found in the data sheet.

## 5.3 Identification of the product

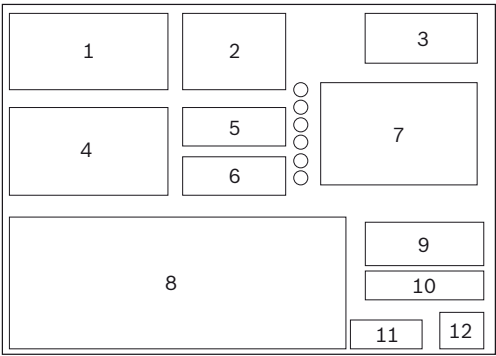
### 5.3.1 Information on the nameplate of the valve and Multi-Ethernet electronics

For the meaning of the information on the nameplates of the valve and Multi-Ethernet electronics, please refer to the numbered fields in the following table.



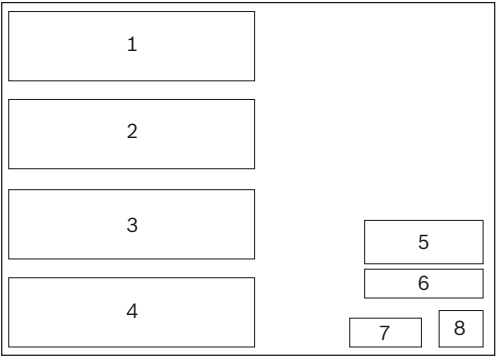
**Fig. 4: Nameplate of valve**

- |                                       |                                 |
|---------------------------------------|---------------------------------|
| <b>1</b> Word mark                    | <b>2</b> Symbol                 |
| <b>3</b> Material number of the valve | <b>4</b> Serial number          |
| <b>5</b> Date of production           | <b>6</b> Material short text    |
| <b>7</b> Production plant             | <b>8</b> Country of manufacture |



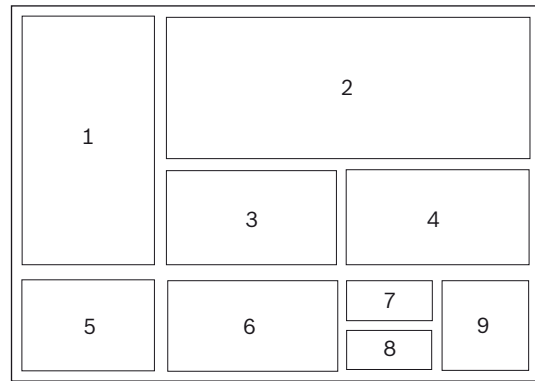
**Fig. 5: Nameplate of IAC Multi-Ethernet electronics (connector side)**

- |  |   |
|--|---|
| <b>1</b> Bus connector 1                           | <b>2</b> CE marking                             |
| <b>3</b> Bus logo                                  | <b>4</b> Bus connector 2                        |
| <b>5</b> Short-circuit information                 | <b>6</b> Documentation information              |
| <b>7</b> LED designation                           | <b>8</b> Connector                              |
| <b>9</b> 1st MAC address                           | <b>10</b> Material number of actuating solenoid |
| <b>11</b> Date of production of actuating solenoid | <b>12</b> Data matrix code                      |



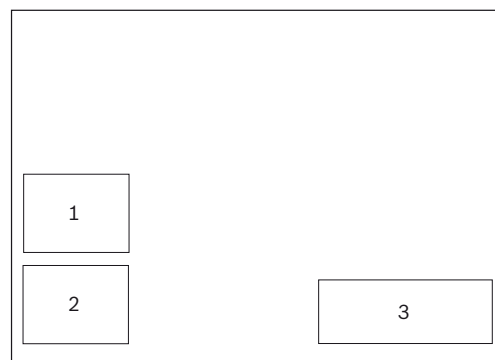
**Fig. 6: Nameplate of IAC Multi-Ethernet electronics (sensor side)**

- |   |  |
|---|--|
| <b>1</b> Sensor connector 1                       | <b>2</b> Sensor connector 2                    |
| <b>3</b> Sensor connector 3                       | <b>4</b> Valve main stage (if required)        |
| <b>5</b> Manufacturer                             | <b>6</b> Material number of actuating solenoid |
| <b>7</b> Date of production of actuating solenoid | <b>8</b> Data matrix code                      |



**Fig. 7: Nameplate of IFB Multi-Ethernet electronics (connector side)**

- |  |                           |
|--|---------------------------|
| <b>1</b> LED designation                       | <b>2</b> Connector        |
| <b>3</b> Bus connector                         | <b>4</b> Sensor connector |
| <b>5</b> Bus logo                              | <b>6</b> Bus connector 2  |
| <b>7</b> Material number of actuating solenoid | <b>8</b> SN OBE           |
| <b>9</b> Data matrix code                      |                           |



**Fig. 8: Nameplate of IFB Multi-Ethernet electronics (sensor side)**

- |                                    |                     |
|------------------------------------|---------------------|
| <b>1</b> Short-circuit information | <b>2</b> CE marking |
| <b>3</b> Manufacturer              |                     |

## 6 Transport and storage

There are no special transport instructions for this product. However, always observe chapter 2 “Safety instructions” and comply with the ambient conditions specified in the data sheet for storage and transport.

### 6.1 Storage of the valve on Multi-Ethernet basis

The valve is supplied in good order and condition.

Under the following conditions, the valve can be stored up to 12 months:

- ▶ Do not store the valve outdoors but in a well-ventilated room.
- ▶ Store the valves between +5 °C and +40 °C.
- ▶ For the purpose of short-time transportation, the ambient temperature range according to the data sheet shall apply.
- ▶ Protect the valve against humidity, particularly ground humidity. Store the valve on a shelf or on a pallet. The relative air humidity must not exceed 65 % and there must not be any condensation.
- ▶ Ensure that no ozone formation takes place near the storage location.
- ▶ Provide for 100 % UV protection.
- ▶ Store the valve in packaging in order to protect it from dust and dirt.
- ▶ All connections at the valve have to be closed with plug elements.
- ▶ After opening the transport packaging, it must be closed properly again for storage. Use the original packaging for storage.
- ▶ Do not remove the covers of the hydraulic ports of the valve before assembly.



In case of storage of more than six months or in case sea transport is necessary, please consult Bosch Rexroth.

## 7 Installation

### **NOTICE**

#### **Condensed water!**

Risk of short-circuit

- Allow the valve to acclimatize for several hours to prevent formation of condensed water in the valve electronics housing.

#### **Penetrating humidity!**

The housing of the valve electronics is closed. However, according to the applicable protection class, fluids may enter and lead to faults and short-circuit. Safe function of the valve can no longer be ensured.

- When working on the valve, always ensure that no fluids can enter the electronics housing.

#### **Major potential differences!**

Danger of destroying the valve electronics by connecting or disconnecting plug-in connectors under voltage.

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

### **7.1 Unpacking**

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

### **7.2 Installation conditions**

- For installing the product always observe the environmental conditions specified in the technical data sheet.

**NOTICE:** The environment must be free from aggressive substances (acids, bases, corrosive agents, salts, metal vapors, etc.) which may enter the device despite compliance with protection class IP 65.

- Before commissioning, make sure that all the seals and plugs of the plug-in connections are correctly installed to ensure that they are leak-proof and no fluids or foreign particles can enter the product.

### **7.3 Required tools**

No special tools are required for the assembly.

### **7.4 Recommended accessories**

To connect the valves, we recommend using the accessories listed on the corresponding valve data sheet.

## 7.5 Before the installation

- ▶ Before installing the valve, check compliance of the type designation on the nameplate with your order or order number.
- ▶ Observe the information on the maximum operating pressure on the nameplate.

## 7.6 Place of installation

The valve should not be installed next to power electronics (e.g. frequency converters, etc.).

## 7.7 Mounting of the valve on Multi-Ethernet basis

### 7.7.1 Mounting the valve mechanically



### WARNING

#### Faulty mounting of plug screws and lines!

Improperly fastened plug screws and lines may become loose during subsequent operation and fly around due to the pressure. This may cause serious injuries.

- ▶ Only pressurize your system after all plug screws and lines have been completely and properly mounted according to the specifications.



### CAUTION

#### Insufficient installation space!

Insufficient installation space may lead to jamming or abrasions in case of actuation and adjustment work on the valve.

- ▶ Provide for sufficient installation space.
- ▶ Ensure that actuation and adjustment elements and plug-in connectors are easily accessible.

#### Leaking hydraulic fluid!

Hydraulic fluid may leak during mounting and demounting of the valve. Consequently, persons may slip or fall.

- ▶ Only remove the protective caps of the valve directly before mounting.
- ▶ After mounting, provide the bores containing the hydraulic fluid with suitable plug elements.
- ▶ Immediately remove spilled hydraulic fluid.

#### Sharp edges!

Valves may have sharp edges at the valve openings. During transport or mounting/demounting, cutting or abrasive injuries may result.

- ▶ Wear suitable protective clothing during transport.
- ▶ Do not reach into valve openings!



Have sufficiently dimensioned collecting containers, non-linting cloth and medium-binding materials ready in order to collect or bind leaking hydraulic fluid.

The mounting face of the valve and the subplates must be clean and free from hydraulic fluid.

- ▶ Use non-linting fabric for cleaning the subplates.



1. Remove the protective cover from the valve.
2. Ensure correct orientation of the valve. Observe the porting pattern according to the symbol and connection labeling at the valve.
3. Check whether all seal rings are in place and intact.
4. Carefully place the valve on the mounting surface.
5. Use mounting screws according to the dimensions and property classes specified in the data sheet.
6. Ensure that the mounting screws are tightened by applying the specified tightening torque. For the tightening torques, please refer to the corresponding valve data sheets.
7. Please note that the tightening torques may change if other screw types are used.

#### 7.7.2 Connecting the valve hydraulically

1. Depressurize the relevant system part.
2. Establish all connections; in this context, observe the operating instructions of the system.
3. Make sure that pipes and/or hoses are connected to all ports and/or that the ports are closed with plug screws.
4. Check to make sure that the cap nuts and flanges are correctly tightened at the pipe fittings and flanges.
5. Make sure that all pipes and hose lines and every combination of connection pieces, couplings or connection points with hoses or pipes are checked for their operational safety by a person with appropriate knowledge and experience.

#### 7.7.3 Connecting the valve electrically

### CAUTION

#### **Faulty energy supply!**

Risk of damage to property and personal injuries! Faulty energy supply may lead to uncontrolled valve settings. These could result in malfunctions or failure of the valve and cause injuries.

- ▶ Always connect the earthing connection of the valve with the appropriate earthing system in your installation.
- ▶ Only use a power supply unit with safe separation.
- ▶ Always observe the relevant national regulations.



## CAUTION

### **Improper mounting of connectors and routing of cables!**

M12 connectors that are not properly fastened and cables that are not laid in accordance with the mounting instructions may loosen during operation or cause damage. This can result in a valve communication breakdown or failure of the valve function.

- ▶ Lay cables and lines so that they cannot be damaged and no one can trip over them.
- ▶ Tighten the M12 connector to 1 Nm using a torque wrench.
- ▶ Use M12 cables with self-locking mechanism.
- ▶ Make sure that the cable is installed without any transverse forces acting on it.
- ▶ Bind together all cables that are connected to XH1, X7E1 and X7E2 after at most 20 cm to form a cable harness.
- ▶ Fasten the cable harness as closely as possible to the valve, but after further 20 to 30 cm at most, and see to it that there is no relative movement between the fixation and the valve. No cable loops may be formed before the fixing point.
- ▶ Generally, observe the installation notes of the cable manufacturers.
- ▶ By analogy, fix the cables of X2M1, X2M2 and X8M, if used, according to the above description.
- ▶ If only one sensor is used, the cable has to be fixed after 30 cm.

### **Missing seals and plugs!**

Risk of short-circuit! Fluids may enter the valve and cause a short-circuit.

- ▶ Before commissioning, make sure that all seals and plugs of plug-in connections are tight.

### **Incorrect connection wiring!**

Risk of injury due to electric shock and malfunctions! The valve may only be connected by or under the supervision of a specialized electrician. The lines used have to be suitable for operating temperatures of -20 °C...+100 °C.

- ▶ De-energize the connection line before the installation.
- ▶ Correctly connect the protective earthing conductor and the earthing.
- ▶ Ensure that there are no sharp bends in the connection line and litz wires to avoid short-circuits and interruptions.
- ▶ Cable and line entries must always be assembled according to the assembly instructions.
- ▶ During the installation, ensure tightness between the cable, cable entry and line entry.
- ▶ Only use connection lines which comply with the requirements specified in the data sheet.

## NOTICE

### Missing seals and plugs!

Loss of protection class IP65 and risk of short-circuit. Liquids and foreign particles may penetrate and damage the valve.

- ▶ Before assembly, ensure that all seals and caps of the plug-in connections are tight.

### Plugging or unplugging live connectors!

The valve might be destroyed.

- ▶ Switch off the power supply to the relevant system part before mounting the valve or when connecting or pulling connectors.

- ▶ Ensure maintenance-friendly installation, i.e. simple access to the connection lines. Free access to the connection sides must be guaranteed.
- ▶ Before installation note down the information on the nameplate. If nameplates are no longer visible or legible after installation you will have the data at hand at any time.

### Mounting of M12 connectors

- ▶ Mount M12 connectors according to the instructions (see mounting instructions under "Caution" on page 34) and fix the associated cables.

Fig. 9 shows an example of optimum mounting in the case of exposure to strong vibration loads. Mounting in the real system may differ from this example. However, it is in any case important to observe the notes given under "Caution".

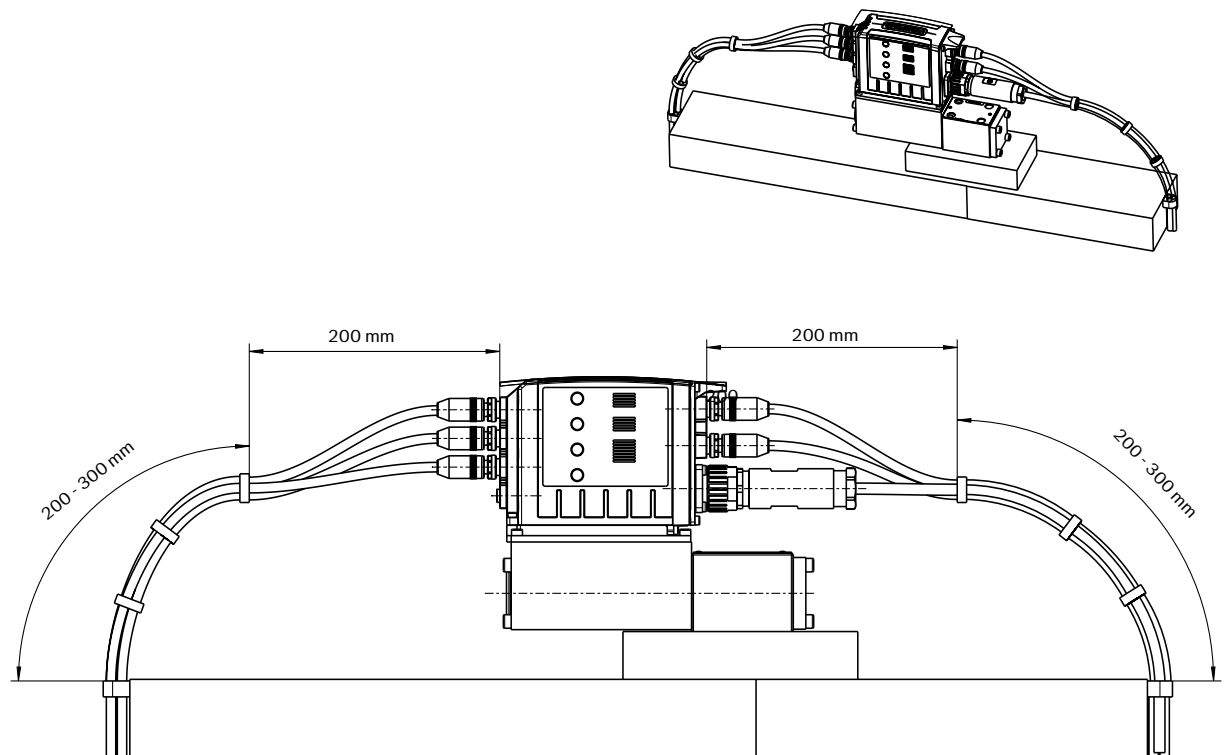


Fig. 9: Example of mounting and fixing of M12 connectors and cables

**Voltage supply**

As supply voltage of the valve, functional low voltages with electric separation (PELV or SELV) according to VDE0100, Part 410 have to be used.

For the external voltage supply, it must be ensured that, even in error cases, the voltage limitation defined for the valve is not exceeded. PELV power supply units according to EN 60204, section 6.4.2 comply with these requirements.

- ▶ Only connect voltages and electric circuits provided with safe isolation from dangerous voltages. Safe isolation can be achieved with isolation transformers, safe optocouplers or mains-free battery operation.



When calculating the PFH (probability of dangerous failure per hour) of the safety function, the PFH of the external voltage supply must also be taken into account.

- ▶ Keep the connection as short as possible. Please observe the detailed information on voltage supply in the respective valve data sheet.

**Supply of external components**

When supplying a 24 V encoder, the input voltage of the valve with IAC Multi-Ethernet must comply with the encoder requirements (e.g. 24 V  $\pm 5\%$ , residual ripple <500 mV). With IAC Multi-Ethernet, analog components such as pressure cells can be supplied directly via the sockets X2M1 or X2M2 - and with IFB Multi-Ethernet, via X2M (optional).

Precondition: The supply of the valve complies with the requirements of the pressure cell. Further notes with regard to currents, etc. are available in the valve-specific data sheet.

**Shielding**

- ▶ For signal cables, use only cables with a copper braid shield. Connect the cable shield extensively with the metallized connector housing and only on the Multi-Ethernet electronics side.
- ▶ The Ethernet cable must at least comply with the CAT5e standard.

**General notes on wiring**

- ▶ Do not route signal cables through strong magnetic fields.
- ▶ Lay signal lines as continuously as possible. If intermediate terminals are required, use a terminal block with shield busbar. Load lines consisting of two individual wires (e.g. voltage supply) must be laid in parallel or twisted.
- ▶ Cables should only have the actually required number of wires. If this is not possible, the wires have to be connected with each other and then to the earth on one side in the control cabinet.

**Suppressing interference of the system**

In case of faulty IAC Multi-Ethernet signals, please refer to troubleshooting of other electrical IAC/IFB components, e.g. as follows:

- Switched inductance:
  - DC: antiparallel free-wheeling diode over actuator winding
  - AC: type-related R/C combination over actuator winding.
- Electric motors
  - R/C combination from each motor winding to earth.
- Frequency converter
  - Inlet filter in the voltage supply of the frequency converter
  - Motor control line shielded and laid separately from other lines, and/or output filter for motor lines.

- Large-area contact of the frequency converter housing to the rear wall of the control cabinet

#### 7.7.4 Altitude of the valve on Multi-Ethernet basis

For safety-relevant applications, the intended altitude of the valve is limited to 2000 m. Higher altitudes are not admissible.

## 8 Commissioning

### **WARNING**

#### **Incorrect installation, leaking hydraulic fluid!**

Carelessly or incorrectly mounted valves may become loose during operation, fall down and cause serious injuries. A powerful hydraulic fluid jet may be ejected at incompletely connected hydraulic ports and connection lines and cause serious injuries.

- ▶ Only commission the system after all hydraulic connections and the valve have been completely and properly mounted according to the specifications.
- ▶ Look out for defective sealing points and replace defective seals immediately.
- ▶ Wear personal protective equipment during initial commissioning.

#### **Inadmissibly high operating pressure!**

In hydraulic applications with different area ratios, the hydraulic pressure is intensified and may - in case of incorrect dimensioning - lead to exceedance of the maximum admissible operating pressure. Thus, the valve may burst or the plug elements may be hurled away and cause serious injuries.

- ▶ Before commissioning the hydraulic system ensure that the maximum admissible pressure of the valve in the system is not exceeded by any means.
- ▶ Ensure that in your system, the maximum admissible operating pressure is secured by means of a pressure relief valve.

#### **Commissioning by persons without the required knowledge!**

Danger of damage to property and personal injuries. Commissioning of the valve requires basic hydraulic and electrical/electronic knowledge.

- ▶ The valve may only be commissioned by qualified staff.

### 8.1 Initial commissioning

- ▶ Prior to commissioning, make sure that all electrical and hydraulic connections are either used or covered. Only commission a completely installed product.
- ▶ Make sure that only hydraulic fluid specified in the valve data sheet is used.
- ▶ Allow the valve to acclimatize for some time prior to commissioning as the electronics might be damaged by the formation of condensed water.
- ▶ Immediately depressurize the system if hydraulic fluid still leaks despite proper mounting and continue with chapter 14 "Troubleshooting".

**Bleeding the hydraulic system**

Bleeding of the valve is usually not necessary. However, Bosch Rexroth recommends bleeding the entire hydraulic system. In this context, the following has to be observed:

- Before actual operation, switch the valve several times at reduced pressure (50 % operating pressure). This will press out any remaining air from the valve.

**NOTICE!** Damage to the valve and the system! Do not switch the valve under operating pressure as long as the system has not been bled.

**Leakage test**

Check that during operation no hydraulic fluid leaks at the valve or at the connections.

**Functional test**

If possible, check hydraulic functions in a controlled way and at low pressure. Observe the operating instructions of the hydraulic system into which the valve is installed.

**8.2 Installation requirements**

The PC program IndraWorks Ds has the following system requirements:

- Windows PC (Windows 7 or higher for IndraWorks Ds 14)
- RAM (2 GB or more recommended)
- 1 GB or more hard disk capacity
- Ethernet interface, e.g. RJ45 port

## 9 Operation

During normal operation, no interventions are required on the part of the operator. In case of power failure during operation, the valve may be switched on again without any further measures. Is it immediately ready for operation again.

# 10 Maintenance and repair

Bosch Rexroth valves are usually maintenance-free.

The valve seals are subject to a process of natural wear and aging. It is therefore recommended that the valves be replaced at appropriate time intervals. The intervals are mainly determined by the operating conditions and the cleanliness of the hydraulic fluid.

- ▶ Regularly check the product and mounting surfaces for leak-tightness!
  - ▶ Replace the seals at reasonable intervals as a precautionary measure.
- Preventive maintenance (e.g. hydraulic fluid care) as well as compliance with the pressure and temperature specifications extend the lifecycle of the valve, the system and the hydraulic fluid.



## 10.1 Cleaning and care

### **NOTICE**

#### **Ingress of contaminants and humidity!**

Malfunction.

- ▶ Always ensure absolute cleanliness when working on the valve!
- ▶ Only use a dry and dust-free cloth for cleaning.

#### **Solvents and aggressive cleaning agents!**

Damage and accelerated aging of the valve.

- ▶ Do not use aggressive cleaning agents for cleaning, but only a dry and dust-free cloth.

Proceed as follow for cleaning and care:

- ▶ Carry out a visual inspection and check that all screws are tightened and hoses fit properly.
- ▶ Check all plug-in and clamping connections of the valve for correct seat and damage at least once a year.
- ▶ Check cables for rupture and crushes. Have damaged or defective cables replaced immediately!
- ▶ Clean housing parts with a dry and dust-free cloth.

## 10.2 Inspection and maintenance



### WARNING

#### **Dirt and foreign particles in the valve!**

Penetrating dirt and foreign particles in the valve lead to wear and malfunctions. Safe functioning of the valve is therefore no longer ensured.

- ▶ During installation, ensure utmost cleanliness in order to prevent foreign particles such as welding beads or metal chips from getting into the hydraulic lines.
- ▶ Do not use linty cloth for cleaning.
- ▶ Ensure that no cleaning agents mix with the hydraulic fluid.
- ▶ Flush the hydraulic system if necessary. Replace the fluid filter or the hydraulic fluid.

## 10.3 Repair

The valve on Multi-Ethernet basis may only be replaced as complete unit. For safety reasons, unauthorized modification of the valve is not allowed! Repairs may only be carried out by Bosch Rexroth AG. For repair and maintenance work, send the device to the service address specified in chapter 16.1.

Devices returned to Bosch Rexroth for repair have to be shipped in the original packaging, if possible.

Repaired devices are returned with default settings.

User-specific settings are not maintained. The operator has to transmit the relevant user parameters and programs again.

#### **Correcting leakage at the mounting surface**

- ▶ Dismount the valve, see chapter 11 “Demounting and replacement”.
- ▶ Check the seal ring recesses on the connection surface for cleanliness and intactness.
- ▶ Dry the component connection surface and the component contact surface using suitable cleaning materials.
- ▶ Install new seals.
- ▶ Remount the valve at the contact surface, see chapter 7 “Installation”.



# 11 Demounting and replacement

## 11.1 Required tools

No special tools are required for demounting.

## 11.2 Preparing demounting

### **WARNING**

#### **Risk of injury by demounting parts under pressure and electric voltage!**

If you do not de-pressurize and de-energize the system before starting demounting, you may get injured and the product or system parts may be damaged!

- ▶ Decommission the entire system as described in the general instructions for the system.
- ▶ The system and all connected components must be brought to a safe state. In addition, the components must be switched off, de-pressurized, de-energized and secured against restarting.

### **CAUTION**

#### **Incompletely mounted valve parts falling down!**

Incompletely demounted valve components may fall down and cause injuries.

- ▶ During disassembly, secure the valve against falling.

## 11.3 Demounting



Have sufficiently dimensioned collecting containers, non-linting cloth and medium-binding materials ready in order to collect or bind leaking hydraulic fluid.

1. Disconnect your system from the power supply and depressurize it.
2. Unload hydraulic accumulators, if provided.
3. Before carrying out any demounting work, switch your system off, disconnect it from the power supply and secure the system against restarting.
4. Make sure that the surroundings are clean for demounting.
5. Prepare a container or a pan for collecting the leaking hydraulic fluid.
6. Only use suitable tools to loosen the mounting screws of the valve.
7. Remove the mounting screws and remove the valve from the valve contact surface.
8. Collect the escaping hydraulic fluid in the provided container and dispose of it properly.
9. Lift the valve from the installation position.
10. If the valve is to be returned to the manufacturer for repair, close the valve connection surface using the protective plate supplied or protect it using equivalent packaging in order to avoid contamination and damage.
11. Plug the subplate in order to avoid contamination of your system.

In case of new installation and/or replacement of the hydraulic valve, please refer to chapter 7 "Installation".

#### **11.4 Preparations for storage and further use**

To prepare the valve for storage and further use, proceed as follows:

- ▶ Only use the original packaging for storage.
- ▶ Observe the permissible storage temperature range given in chapter 6.1 "Storage of the valve on Multi-Ethernet basis"
- ▶ Protect the valve from dust and humidity.

## 12 Disposal

### 12.1 Environmental protection

Careless disposal of the valve may cause environmental pollution.

- ▶ Dispose of the product therefore in accordance with the currently applicable national provisions in your country.
- ▶ Please observe the following information for the environmentally friendly disposal of the valve.

### 12.2 Return to Bosch Rexroth AG

Products manufactured by us can be returned to us free of charge for disposal.

When returned, the products must not contain any inappropriate foreign substances or third-party components. The components have to be sent carriage paid to the following address:

Bosch Rexroth AG  
Service Industriehydraulik  
Bürgermeister-Dr.-Nebel-Strasse 8  
97816 Lohr am Main  
Germany

### 12.3 Packaging

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

The materials for disposable packaging are mostly cardboard, wood, and expanded polystyrene. They can be recycled without any problems. For ecological reasons, disposable packaging should not be used for returning products to Bosch Rexroth.

### 12.4 Materials used

Hydraulic components from Bosch Rexroth do not contain any hazardous materials that could be released during intended use. In the normal case, no negative effects on human beings and on the environment have to be expected.

The valve basically consists of:

- Cast iron
- Steel
- Aluminum
- Copper
- Plastics
- Electronics components and assemblies
- Elastomers

### 12.5 Recycling

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

## 13 Extension and modification

The valve on Multi-Ethernet basis must not be extended or modified. Modification of the valve will lead to expiry of warranty.

## 14 Troubleshooting

### 14.1 How to proceed for troubleshooting

- ▶ Always work systematically and purposefully, even when under time pressure. Random and imprudent disassembly and readjustment of settings can, in the worst-case scenario, result in the inability to determine the original cause of error.
- ▶ First, get an overview of the functions of the valve in conjunction with the overall system.
- ▶ Try to find out whether the valve has functioned properly in conjunction with the overall system before the error occurred first.
- ▶ Try to determine any changes of the overall system in which the valve is integrated:
  - Were there any changes to the application conditions or area of application of the valve?
  - Were there any changes (e.g. retrofit) or repairs carried out on the complete system (machine/system, electrics, control) or on the valve? If yes, which?
  - Was the valve or machine used as intended?
  - How did the fault become apparent?
- ▶ Try to get a clear idea of the cause of error. If possible, ask the direct (machine) operator.

## 14.2 Fault table

The valve is usually not sensitive to faults if the prescribed application conditions and hydraulic fluid quality are complied with.

### 14.2.1 Mechanical faults

**Table 9: Mech. Fault table**

Fault	Possible cause	Remedy
Valve does not switch	Insufficient pilot pressure	Check and/or reapply pressure at the ports.
	Control spool is jammed due to contamination	Remove valve and replace it with a new one.
	Electrical connection is disconnected	Check whether the electrical connectors are correctly and completely mounted.
		Check the error memory (see electrical errors)
	Cable break	Replace connection line
	Connector defective or damaged	Replace the connector
External leakage	Seal at valve connection surface damaged	Remove the valve and replace the seals, see chapter 10.3 "Repair"
	Other leakage	Replace the valve

### 14.2.2 Electrical faults

#### Error memory

The Multi-Ethernet electronics is equipped with an Ethernet-based bus connection. For operation, a Windows PC or an appropriate control system has to be connected. Via the Ethernet interface, the valve provides the information required for troubleshooting. The valve has a ring buffer for storage of the last 80 errors.

#### Indicators and alarms

The valve on Multi-Ethernet basis is not equipped with safety-relevant indicators or alarms. The LED displays only serve to evaluate bus traffic which is not safety-relevant.

## 15 Technical data

For the technical data of the valve on Multi-Ethernet basis, please refer to the valve data sheet.

## 16 Annex

### 16.1 List of addresses

#### **Contacts for transport damage, repair and spare parts**

Bosch Rexroth AG  
Service Industriedraulik  
Bürgermeister-Dr.-Nebel-Strasse 8  
97816 Lohr am Main  
Germany

Telephone +49 (0) 93 52/40 50 60  
Email [service@boschrexroth.de](mailto:service@boschrexroth.de)

#### **Address for ordering accessories and valves**

Headquarters:  
Bosch Rexroth AG  
Zum Eisengiesser 1  
97816 Lohr am Main  
Germany

Telephone +49 (0) 93 52/40 30 20  
Email [my.support@boschrexroth.com](mailto:my.support@boschrexroth.com)

The addresses of our sales and service network and sales organizations can be found at [www.boschrexroth.com/addresses](http://www.boschrexroth.com/addresses)

# 17 Alphabetical index

► <b>A</b>		Mounting	31
Abbreviations	7	Mounting and fixing of M12 connectors and cables	35
► <b>C</b>		MTTFd, DC, CCF	17
Cleaning and care	39	► <b>P</b>	
Commissioning	37	PE connection	12
Connection examples	20	Performance description	26
► <b>D</b>		PFH	12
Damage to property	24	Product description	26
Demounting and replacement	41	► <b>Q</b>	
Designations	7	Qualification	9
Diagnostic coverage	8, 14	► <b>R</b>	
Disposal	43	Repair	40
► <b>E</b>		Required documentation	5
Encoder interface	26	Residual risks/error states	16
Equipotential bonding	12	► <b>S</b>	
Error memory	45	Safety equipment	14
Extension and modification	44	Safety functionality	15
► <b>F</b>		Safety instructions	8
Fault table	45	– General	10
Functional low voltage	12	– Product-specific	11
Functional test	38	– Signal word	6
► <b>H</b>		Safety level	15
Higher-level control logic	8	Safety-related applications	8
► <b>I</b>		Scope of delivery	25
Identification of the product	27	Stop category	14
Improper use	9	Switch-off element	8
Indicators and alarms	45	Switch-off time	18
IndraWorks	9	Symbols	7
Installation conditions	31	► <b>T</b>	
Intended use	8	Technical data	45
IP protection class	13	Transport and storage	30
► <b>L</b>		Troubleshooting	44
Leakage test	38	► <b>W</b>	
Limits for operation	18	Warranty	24
Limits of the safety-related parts	16		
List of addresses	46		
► <b>M</b>			
Maintenance	39		

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