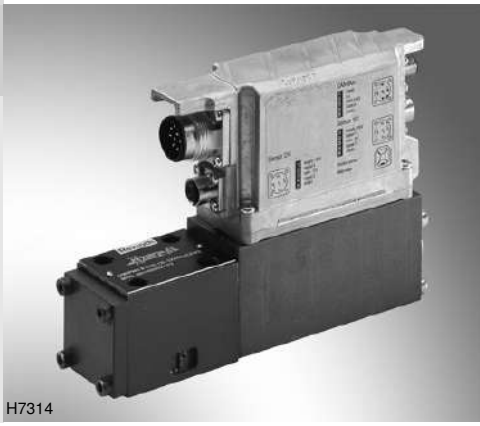
Rexroth
Bosch Group

High-response valve with integrated digital axis controller (IAC-R) and field bus interface

RE 29191/09.10 1/22
Replaces: 06.05

Type 4WRPNH.../24C...
Type 4WRPNH.../24P...


H7314

Size 6 and 10
Component series 2X
Maximum operating pressure 315 bar
Maximum flow 100 l/min (Δp = 70 bar)

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Features

- Direct operated high-response valves size 6 and size 10 with control spool and sleeve in servo quality
- Single-side operated, 4/4 fail-safe position in deactivated state
- Integrated digital axis control functionality (IAC-R) for:
  - Flow control
  - Position control
  - Pressure control
  - p/Q function
  - Substitutional position/pressure and position/ force control
  - NC functionality (stand-alone operation possible)
- Analog and digital interfaces for command and actual values
  - 4 x analog sensors (+/–10 V or 4..20 mA) or
  - 1 x length measurement system (1Vss or SSI) and 2 analog sensors
- Command value provision/actual value response analog (current or voltage) or via field bus
- Analog/digital inputs/outputs configurable
- Field bus connection
  - CAN bus with CANopen protocol DS408
  - Profibus-DP V0/V1
- Quick commissioning via PC and commissioning software

Ordering code

4WRP	N	H			B		−2X/	M/	24				*

Further details in the plain text

Sensor interfaces [4]
- **A =** X4, M12-5, ±10 V; X7, M12-5, ±10 V
- **B =** X4, M12-5, ±10 V; X7, M23-12, SSI [5]
- **C =** X4, M12-5, ±10 V; X7, M23-12, 1 Vss [6]
- **G =** X4, M12-5, 4...20 mA; X7, M12-5, 4...20 mA
- **H =** X4, M12-5, 4...20 mA; X7, M23-12, SSI [5]

Command value inputs
- **A6 =** ±10 VDC
- **F6 =** 4...20 mA

Field bus interface
- **C =** CANopen [7]
- **P =** Profibus DP V0/V1

24 = Supply voltage 24 V

Seal material
- **M =** NBR seals suitable for mineral oils (HL; HLP) according to DIN 51524

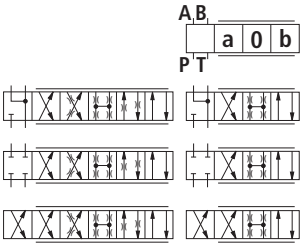
2X = Component series 20 to 29 (20 to 29: Identical installation and connection dimensions)

with integrated digital axis controller and NC functionality **= N**

Control spools / sleeve **= H**

Size 6 **= 6**
Size 10 **= 10**

Spool symbols
4/4-directional design



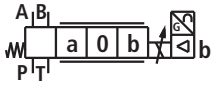
= C3, C5

= C4, C1

= C

With symbols C5 and C1:
P → A: q_v B → T: q_v/2
P → B: q_v/2 A → T: q_v

Mounting side of the inductive position transducer



(standard) **= B**

Rated flow at 70 bar valve pressure differential (35 bar / control edge)

Size 6

2 l/min	**= 02**
4 l/min	**= 04**
12 l/min [8]	**= 12**
15 l/min [1]	**= 15**
24 l/min [8]	**= 24**
25 l/min [1]	**= 25**
40 l/min [2]	**= 40**

Size 10

50 l/min	**= 50**
100 l/min	**= 100**

Flow characteristics

Linear	**= L**
Inflected characteristic curve [3]	**= P**

[1] Only in connection with flow characteristics **"P"**

[2] q_v 2:1 only with rated flow = 40 l/min

[3] Inflection 60 % at size 6 with rated flow **"15"** and **"25"**, otherwise inflection 40 %

[4] For sensor interfaces **"A"**, **"B"** or **"C"** only command value input **"A6"** is possible.
For sensor interface **"G"** and **"H"** only command value input **"F6"** is possible.

[5] Gray code or binary

[6] Adjustable interpolation

[7] Field bus interface CANopen with sensor interface **"B"**, **"C"**, **"G"** or **"H"** only upon request

[8] Only in connection with flow characteristics **"L"**

Note:

Ordering codes for and technical information on the control valve with integrated digital axis controller (IAC-R) and clock-synchronized PROFIBUS DP/V2 (PROFIdrive profile) can be seen on data sheet 29291.

Standard types

Size 6 with CANopen

Material no.	Type
R901124262	4WRPNH 6 C4 B40P-2X/M/24CA6A
R901131590	4WRPNH 6 C4 B15P-2X/M/24CA6A
0811403540	4WRPNH 6 C3 B24L-2X/M/24CF6G
0811403548	4WRPNH 6 C4 B40L-2X/M/24CA6A
0811403541	4WRPNH 6 C3 B04L-2X/M/24CA6A

Size 10 with CANopen

Material no.	Type
R901125645	4WRPNH 10 C3 B100P-2X/M/24CA6A
0811403361	4WRPNH 10 C3 B100L-2X/M/24CA6A
R901243764	4WRPNH 10 C3 B100L-2X/M/24CA6B
R901243769	4WRPNH 10 C3 B100P-2X/M/24CA6B

Size 6 with Profibus DP

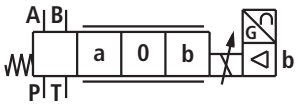
Material no.	Type
0811403552	4WRPNH 6 C3 B04L-2X/M/24PA6A
0811403575	4WRPNH 6 C3 B40L-2X/M/24PA6B
0811403550	4WRPNH 6 C3 B40L-2X/M/24PA6A
0811403573	4WRPNH 6 C3 B25P-2X/M/24PA6B
0811403559	4WRPNH 6 C3 B04L-2X/M/24PF6G
0811403531	4WRPNH 6 C3 B40L-2X/M/24PF6G
R901224758	4WRPNH 6 C1 B24L-2X/M/24PF6G

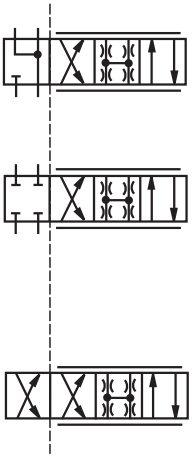
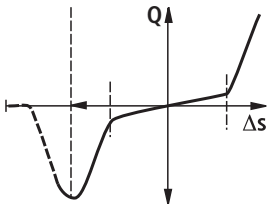
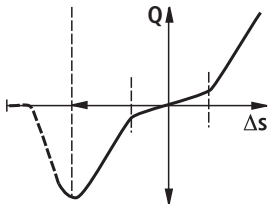
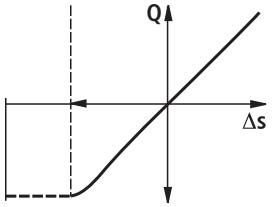
Size 10 with Profibus DP

Material no.	Type
0811403358	4WRPNH 10 C3 B100L-2X/M/24PF6G
0811403359	4WRPNH 10 C4 B100L-2X/M/24PF6G
R901232766	4WRPNH 10 C4 B100P-2X/M/24PF6G

Symbols

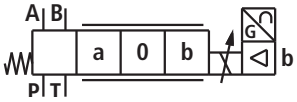
Size 6

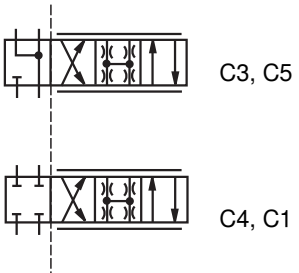
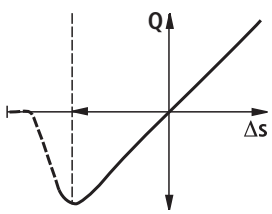
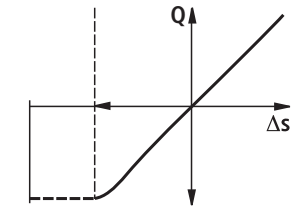
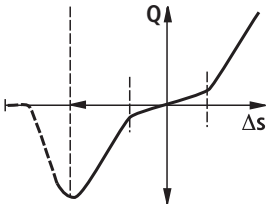


Linear	*p*: Inflection 60 % [q_n 15.25 l/min]	*p*: Inflection 40 % [q_n 40 l/min]
 C3, C5, C4, C1	 C3, C5, C4, C1	
C	 C	

Standard = 1:1, from q_n = 40 l/min also 2:1

Size 10



Linear	*p*: Inflection 40 %
 C3, C5 C4, C1  C	 C3, C5, C4, C1  C
	 C3, C5, C4, C1

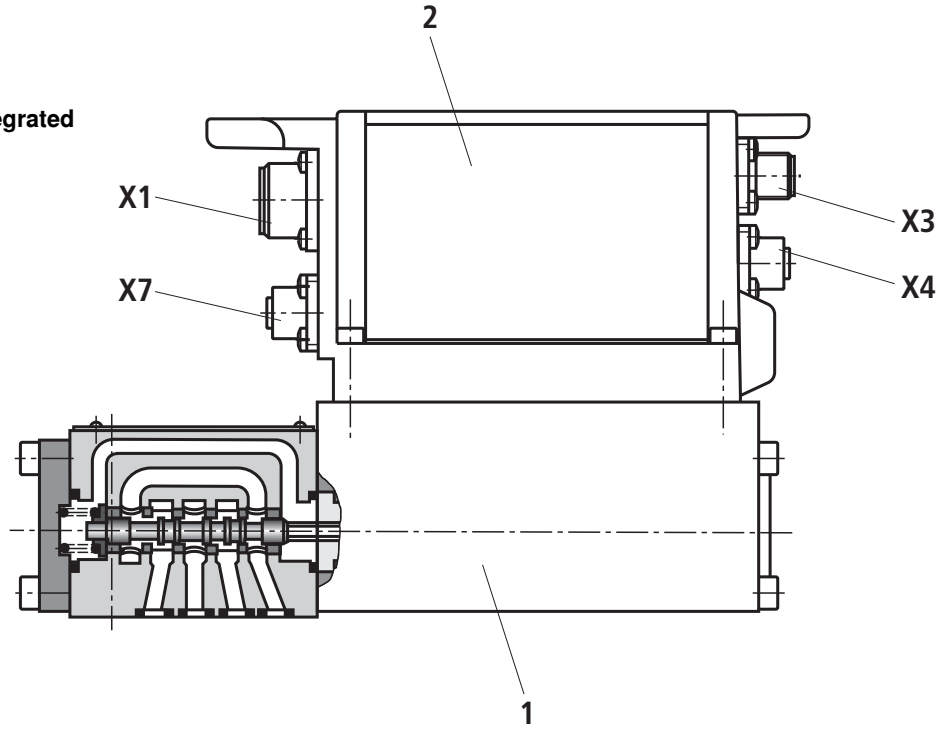
Function, section

Structure

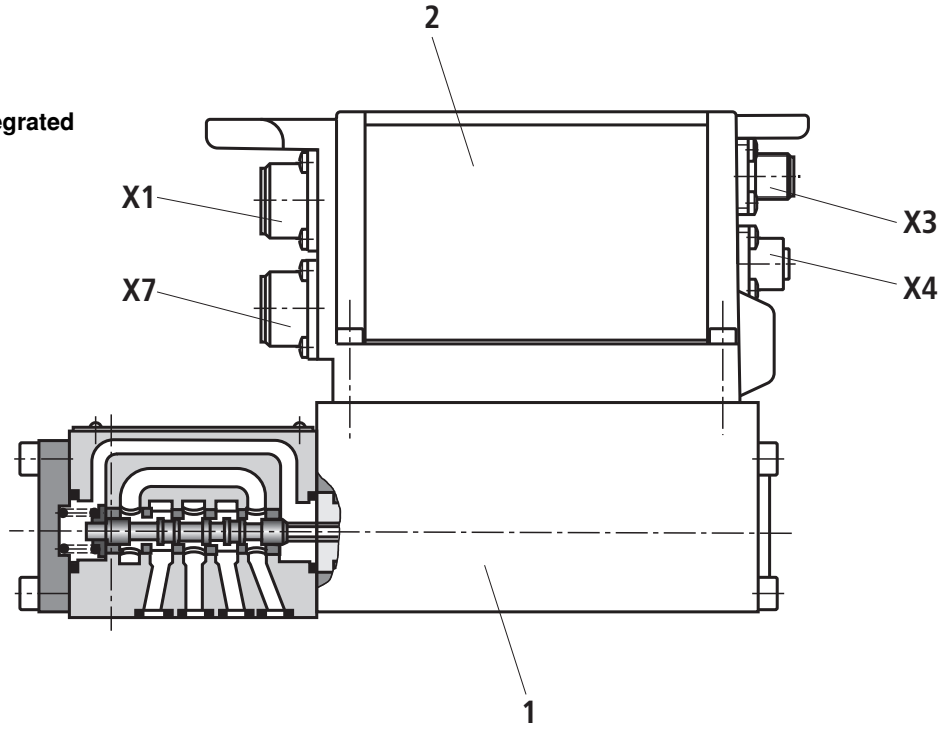
The IAC-R valve mainly consists of:

- Direct operated high-response valve (1) with control spool in servo quality
- Integrated digital axis controller (2) with analog and digital sensor interfaces and field bus connection (X3)

High-response valve with integrated axis controller with analog interfaces (X1, X4, X7)



High-response valve with integrated axis controller with analog interfaces (X1, X4) and digital sensor interface (X7)



Function, section

Functional description

The **IAC-**R valve (**I**ntegrated **A**xis **C**ontroller on the basis of high-response valves) is a digital high-response valve with integrated axis controller with the following functionalities:

- Flow control
- Position control
- Pressure control
- p/Q function
- Substitutional position/pressure and position/ force control
- NC functionality

- The command value can alternatively be provided via an analog interface (X1) or via the field bus interface (X3)
- The actual value signals are provided via an analog interface (X1) and can additionally be read out via the field bus (X3).
- The controller parameters are set via the field bus.
- Separate supply voltage for bus/controller and power part (output stage) for safety reasons

PC program WinHPT

To implement the project planning task and to parameterize the IAC-R valves, the user may use the commissioning software WinHPT (see accessories).

- Parameterization
- Programming of NC functionality
- Diagnosis
- Comfortable data management on a PC
- PC operating systems: Windows 2000 or Windows XP

The digital integrated control electronics enables the following fault detection:

- Cable break sensors
- Undervoltage
- Temperature of the integrated electronics
- Communication errors
- Watchdog

The following additional functions are available:

- Ramp generator
- Internal command value profile
- Release function analog/digital
- Error output 24 V (e.g. as switching signal to PLC/logic and further valves), max. 1.8 A
- Control output adjustment
  - Deadband compensation
  - Zero point correction
  - Valve inflection compensation
  - Friction compensation
  - Direction-dependent gain

Technical Data (For applications outside these parameters, please consult us!)

general				Size 6			Size 10		
Type				Gate valve, directly operated, with steel sleeve					
Actuation				Proportional solenoid with position control, OBE					
Type of connection				Plate connection, porting pattern according to ISO 4401					
Installation position				Any					
Ambient temperature range			°C	–20 … +50					
Weight			kg	2.7			7.5		
hydraulic (measured with HLP46, $\vartheta_{ÖL}$ = 40 °C ± 5 °C)									
Hydraulic fluid				Hydraulic oil according to DIN 51524…535, other media upon request					
Viscosity range	Recommended		mm^2/s	20 … 100					
	Max admissible		mm^2/s	10 … 800					
Hydraulic fluid temperature range			°C	–20 … +60					
Maximum permitted degree of contamination of the hydraulic fluid cleanliness class according to ISO 4406 (c)				Class 18/16/13 [1]					
Direction of flow				According to symbol					
hydraulic, size 6									
Rated flow at Δp = 35 bar per edge [2]			l/min	2	4	12	15	24/25	40
Max. operating pressure	Ports P, A, B		bar	315					
	Port T		bar	250					
Limitation of use with regard to the transition to failsafe	Spool symbols C3, C5		bar	315	315	315	315	315	160
	Spool symbols C1, C4		bar	315	315	315	280	250	100
Leakage oil at 100 bar	Linear characteristic curve L		cm^3/min	< 150	< 180	< 300	-	< 500	< 900
	Inflected characteristic curve P		cm^3/min	-	-	-	< 180	< 300	< 450
hydraulic, size 10									
Rated flow at Δp = 35 bar per edge [2]			l/min	50 (1:1)		50 (2:1)	100 (1:1)		100 (2:1)
Max. operating pressure	Ports P, A, B		bar	315					
	Port T		bar	250					
Limitation of use with regard to the transition to failsafe	Spool symbols C3, C5			315		315	160		160
	Spool symbols C1, C4			250		250	100		100
Leakage oil at 100 bar	Linear characteristic curve L		cm^3/min	< 1200		< 1200	< 1500		< 1500
	Inflected characteristic curve P		cm^3/min	< 600		< 500	< 600		< 600
static / **dynamic**				Size 6			Size 10		
Hysteresis			%	≤ 0.2					
Manufacturing tolerance q_{max}			%	< 10					
Actuating time for signal step 0 … 100 %			ms	≤ 10			25		
Temperature drift				Zero shift < 1 % at Δϑ = 40 °C					
Zero compensation				ex factory ±1 %					
Conformity				CE according to EMC directive 2004/108/EC					

The footnotes are explained on the following page.

Technical Data (For applications outside these parameters, please consult us!)

electric				
Relative duty cycle			%	100 (continuous operation)
Protection class according to EN 60529				IP 65 with mounted and locked plug-in connectors
Supply voltage	Nominal voltage		VDC	24
	Lower limit value		VDC	21
	Upper limit value		VDC	36
	Max admissible residual ripple		Vss	2 (at supply voltage of 23 V … 34 V)
Power consumption		Size 6	W	Max. 40
		Size 10	W	Max. 60
AD/DA resolution			Analog inputs Analog outputs	12 bit 10 bit
Protective earthing conductor and shielding				See pin assignment (CE-compliant installation)
Adjustment				Calibrated ex factory, see valve characteristic curve

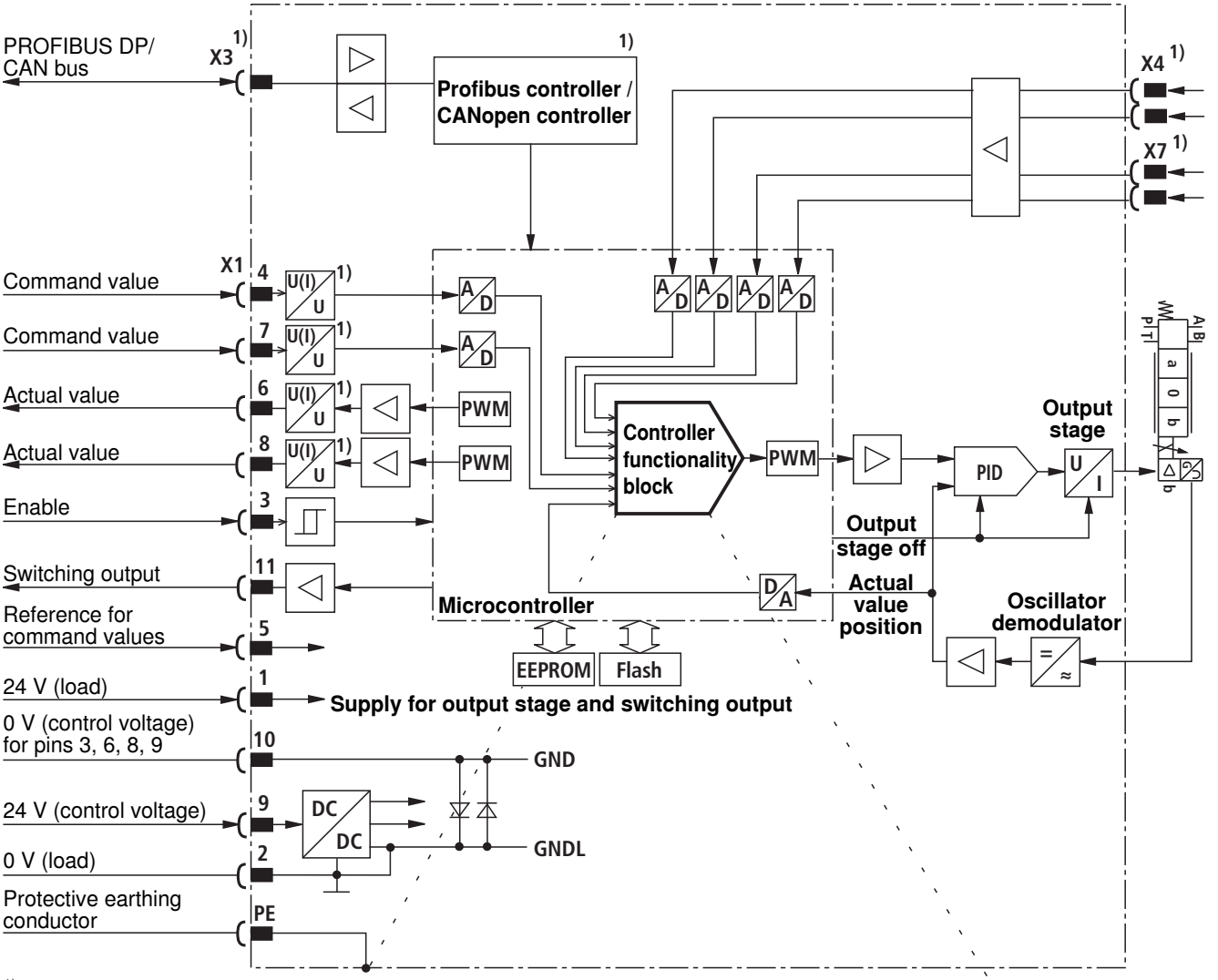
[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems.

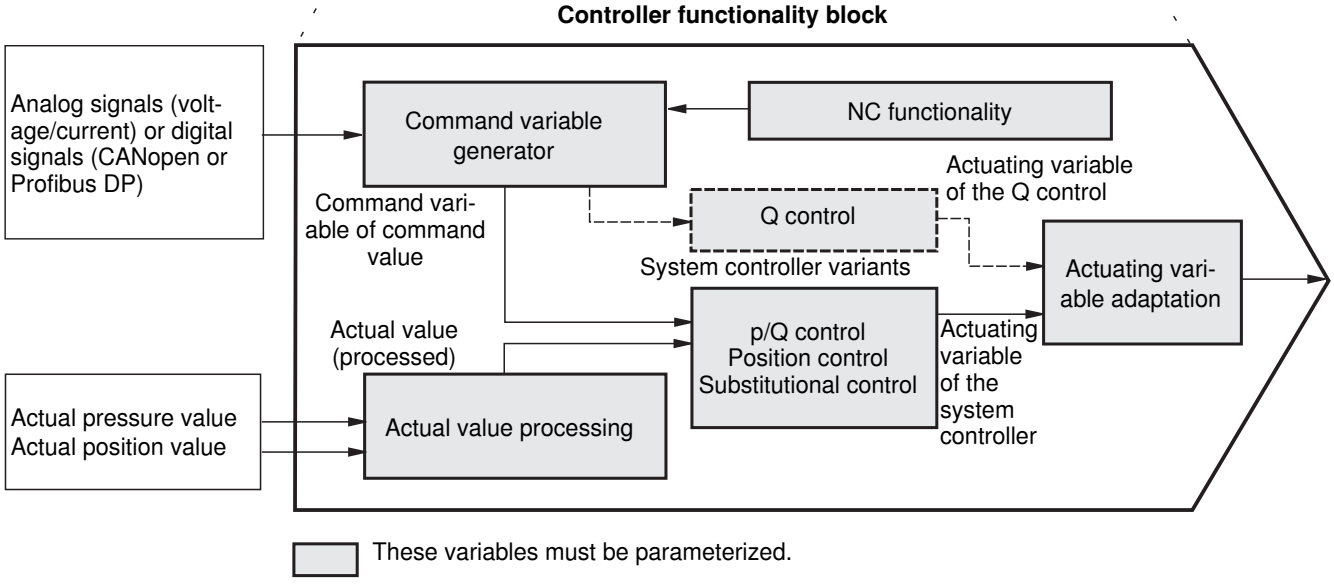
Effective filtration prevents faults and at the same time increases the service life of the components.

For the selection of the filters see www.boschrexroth.de/filter.

[2] Flow at different Δp: $q_x = q_{nom} \cdot \sqrt{\frac{\Delta p_x}{35}}$

Block diagram/controller functionality





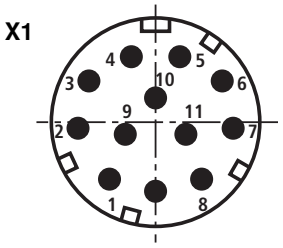
Electrical connections, assignment

Unit connector pin assignment X1, 11-pole + PE according to EN 175201-804

Pin	Core marking [1]	Assignment of interface A6	Assignment of interface F6
1	1	24 VDC (supply for output stage and power switching signal)	
2	2	0 V ≙ load zero (for output stage)	
3	3	Release input 8.5 … 24 VDC = function, R_e ~10 kΩ	
4	4	Command value ±10 V; R_e ~130 kΩ or dig. Input (from PLC) [2]	4 … 20 mA command value; R_e = 200 Ω or dig. Input (from PLC) [2]
5	5	Reference for command values	
6	6	±10 V actual value or dig. Output (to PLC) [2]	4 … 20 mA actual value, load resistance ~330 Ω or dig. Output (to PLC) [2]
7	7	Command value ±10 V; R_e ~130 kΩ or dig. Input (from PLC) [2]	4 … 20 mA command value; R_e = 200 Ω or dig. Input (from PLC) [2]
8	8	±10 V actual value or dig. Output (to PLC) [2]	4 … 20 mA actual value, load resistance ~330 Ω or dig. Output (to PLC) [2]
9	9	24 VDC (control voltage for signal part and bus)	
10	10	0 V reference potential for pin 3, 6, 8 and 9	
11	11	Switching output 24 V (error signal or power switching signal) max 1.8 A	
PE	Green-yellow	Protective earthing conductor (connected directly to metal housing)	

[1] Core marking of the connection lines for line socket with cable set (see accessories)

[2] Selection via commissioning software



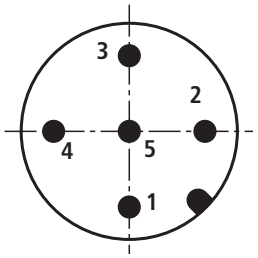
Unit connector pin assignment for CAN bus "X3" (code A), M12, 5-pole, pins

Pin	Assignment
1	n.c.
2	n.c.
3	CAN_GND
4	CAN_H
5	CAN_L

External screen on both sides of the metallic housing of the plug-in connection.

Internal screens are not required.

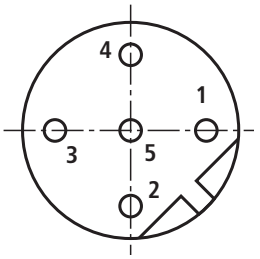
Transmission rate kbit/s	20 to 1000
Bus address	1 to 127



Unit connector pin assignment for Profibus DP "X3" (code B), M12, 5-pole, socket

Pin	Assignment
1	VP
2	RxD/TxD-N (A line)
3	D GND
4	RxD/TxD-P (B line)
5	Shield

Transmission rate	up to 12 MBaud
Bus address	1 to 126



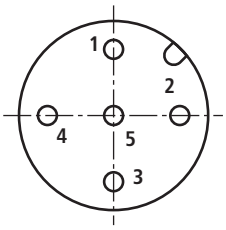
The galvanically separated voltage +5 V (pin 1 - VP) at the socket allows for passive termination of the profibus.

Electrical connections, assignment

Analog sensor interfaces, connection "X4" and "X7" (code A), M12, 5-pole, socket

Pin	Assignment of voltage interface	Assignment of current interface
1	Supply 24 VDC	Supply 24 VDC
2	Signal 3 (X4) / 4 (X7), (–10 … +10 V)	Signal 3 (X4) / 4 (X7), (4 … 20 mA)
3	Zero 0 V	Zero 0 V [1]
4	Signal 1 (X4) / 2 (X7), (–10 … +10 V)	Signal 1 (X4) / 2 (X7), (4 … 20 mA)
5	Shield	Shield

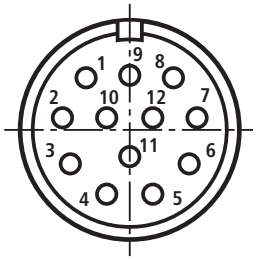
[1] Do not connect to 2-wire pressure transducer



Attention: The analog sensor interfaces at the connections X4 and X7 are not coded.
Danger of confusing the same! The user has to ensure proper wiring!

Digital sensor interface 1Vss or SSI measurement system "X7", M23, 12-pole, socket

Pin	Assignment 1Vss	Assignment SSI
1	$\overline{B}$	0 V
2	Sense +5 V [1]	Data
3	R	Clock
4	$\overline{R}$	n.c.
5	A	n.c.
6	$\overline{A}$	n.c.
7	n.c.	n.c.
8	B	n.c.
9	n.c.	24 V
10	0 V [1]	$\overline{Data}$
11	Sense 0 V [1]	$\overline{Clock}$
12	+5 V [1]	n.c.



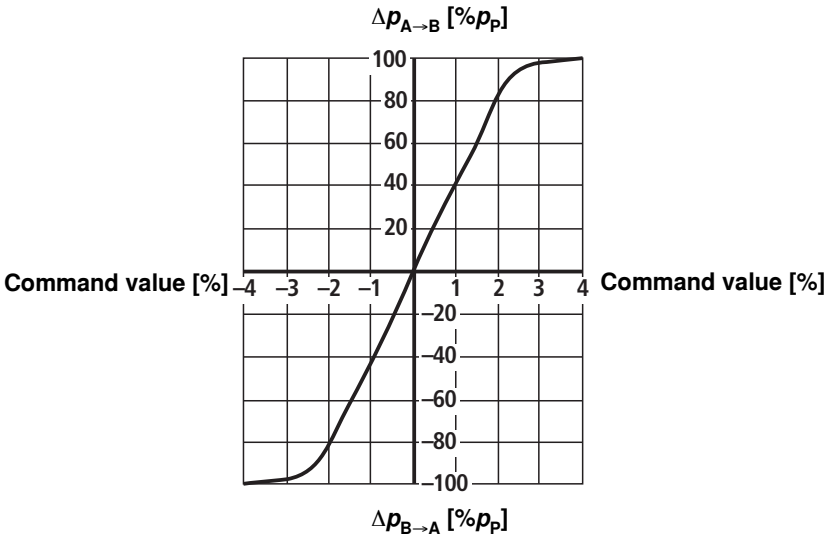
Note:
The sense signal is not analyzed.

[1] **Recommendation**:
Connect the voltages +5 V (pin 12) and +5 V-Sense (pin 2), as well as 0 V (pin 10) and 0 V-Sense (pin 11) for transducer supply.

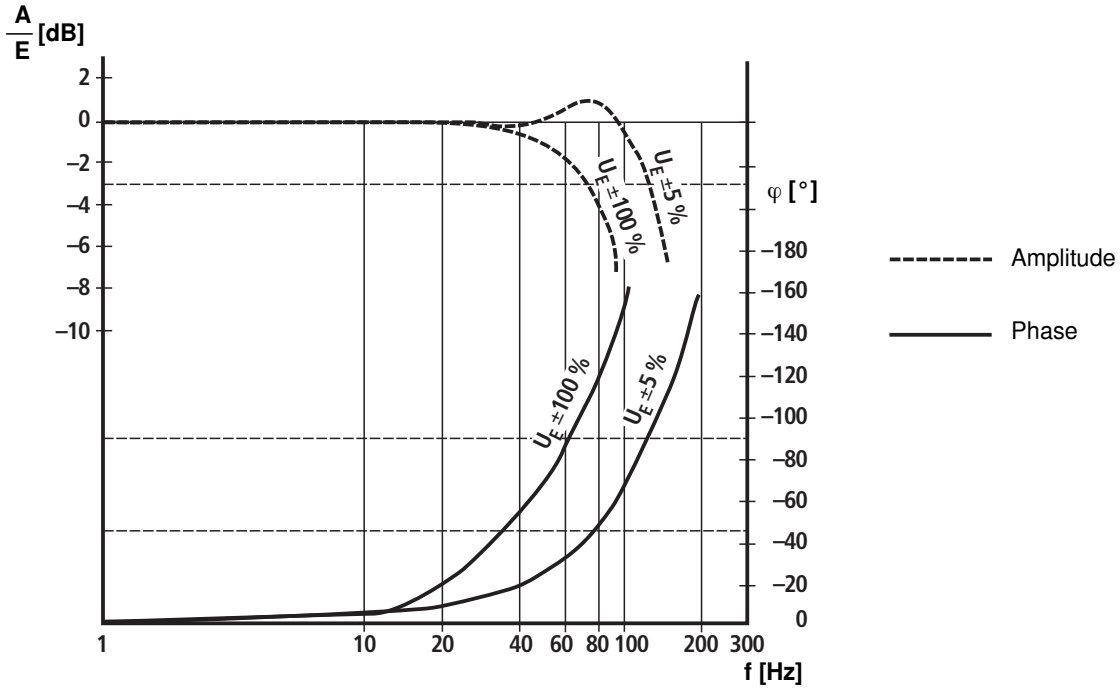
Note:
We recommend connecting the screens on both sides over the metallic housings of the plug-and-socket-connectors.
Using connector pins will affect the effectiveness of the screen!
Internal screens are not required.

Characteristic curves size 6 (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Pressure gain



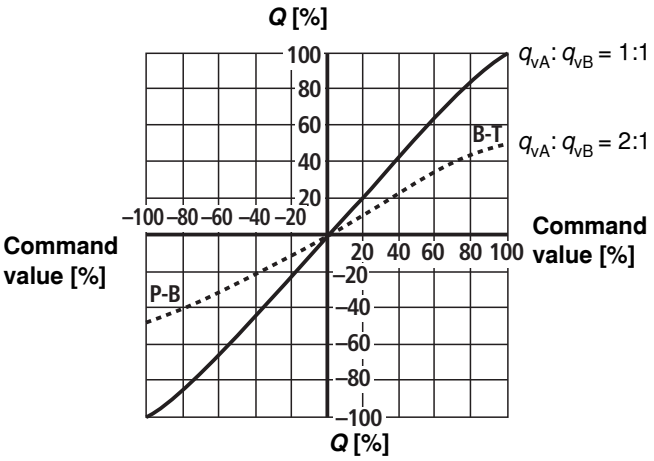
Bode diagram



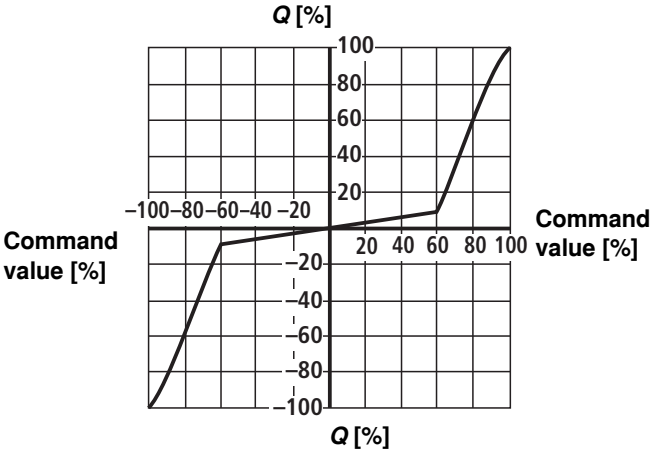
Characteristic curves size 6 (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Flow - signal function

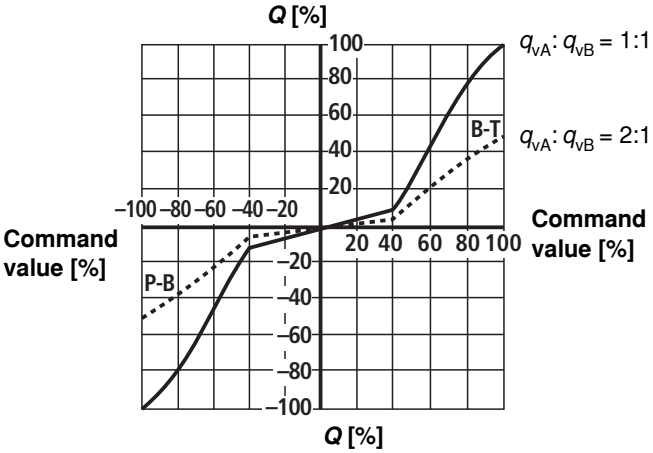
L: Linear



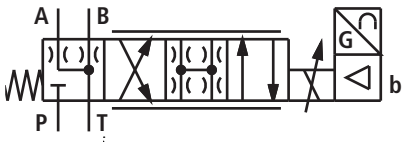
P: Inflection 60 %



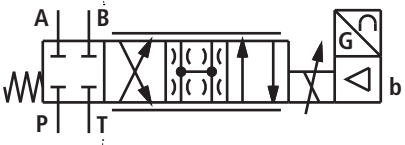
P: Inflection 40 %



Fail-safe position



Leakage oil at	100 bar	P → A	50 cm³/min
		P → B	70 cm³/min
Flow at	Δp = 35 bar	A → T	10 ... 20 l/min
		B → T	7 ... 20 l/min

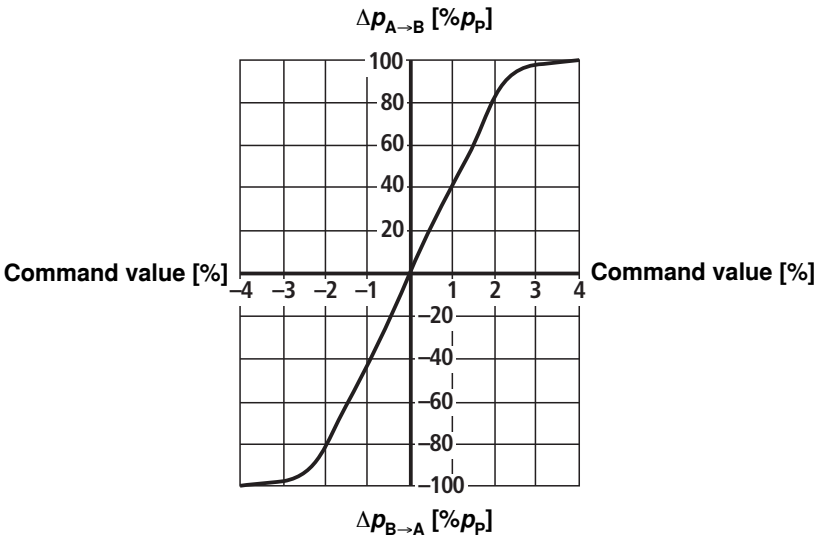


Leakage oil at	100 bar	P → A	50 cm³/min
		P → B	70 cm³/min
		A → T	70 cm³/min
		B → T	50 cm³/min

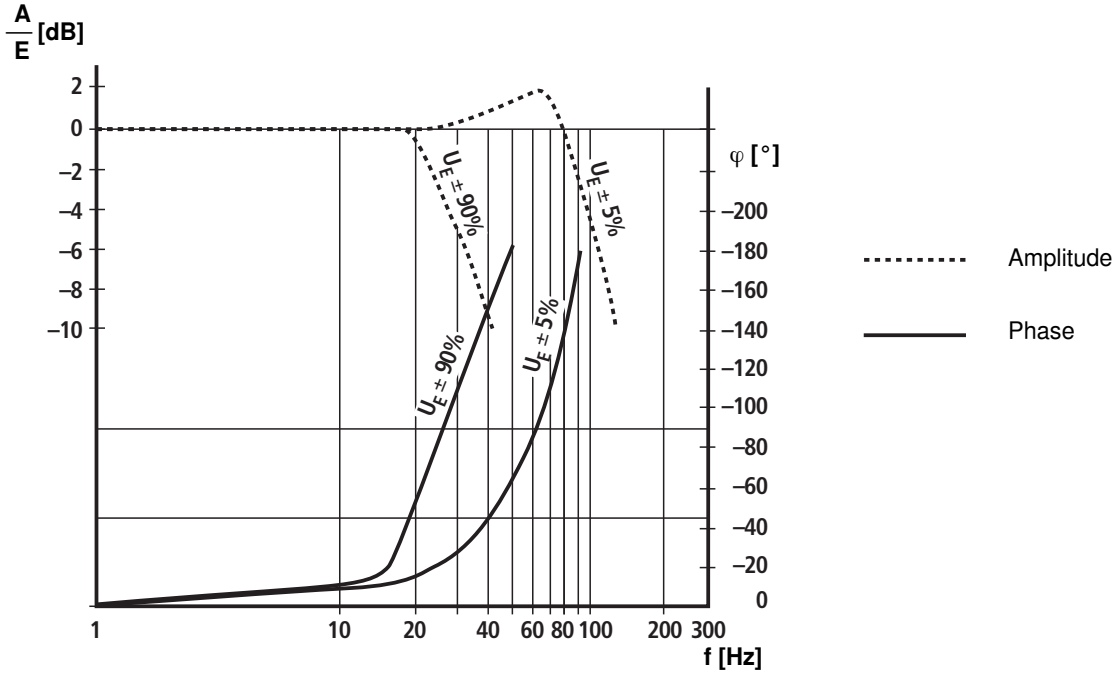
Fail-safe	p = 0 bar => 7 ms	Enable "off" or internal shut-off in case of error
	p = 100 bar => 10 ms	U_B ≤ 18 V or I ≤ 2 mA (at 4…20 mA signal)

Characteristic curves size 10 (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Pressure gain



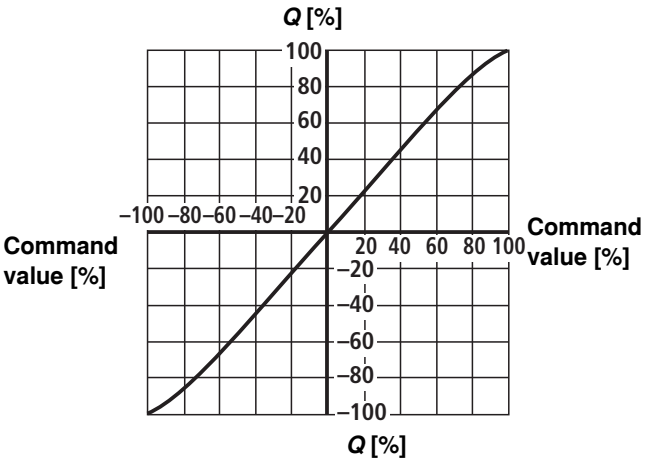
Bode diagram



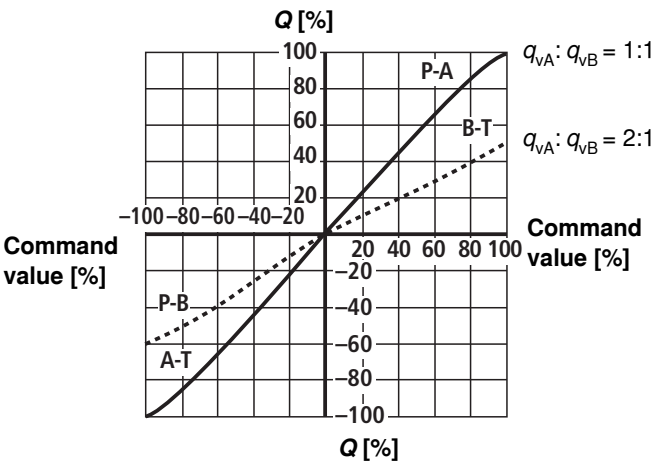
Characteristic curves size 10 (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Flow - signal function

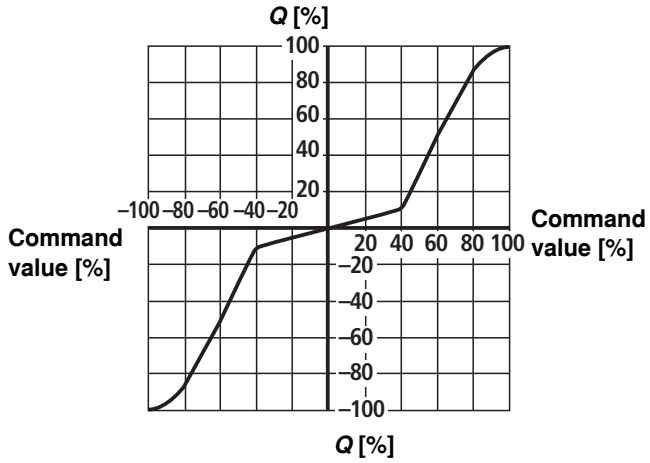
L: Linear 1:1



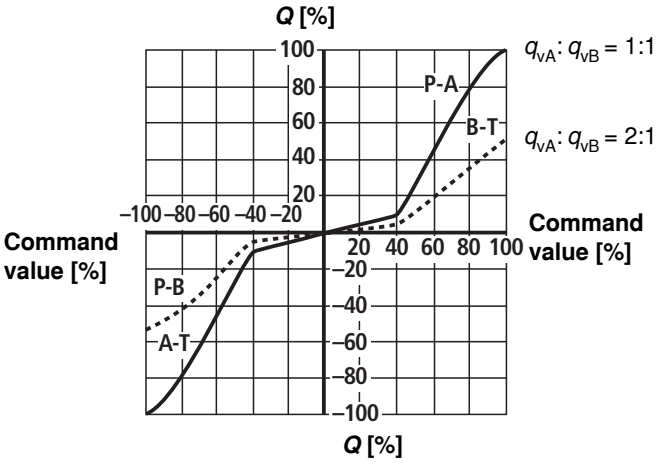
L: Linear 2:1



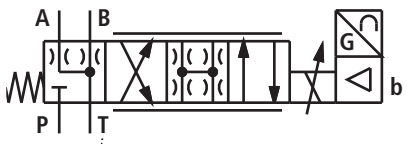
P: Inflection 40 % 1:1



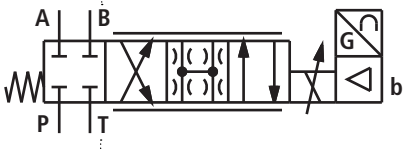
P: Inflection 40 % 2:1



Fail-safe position



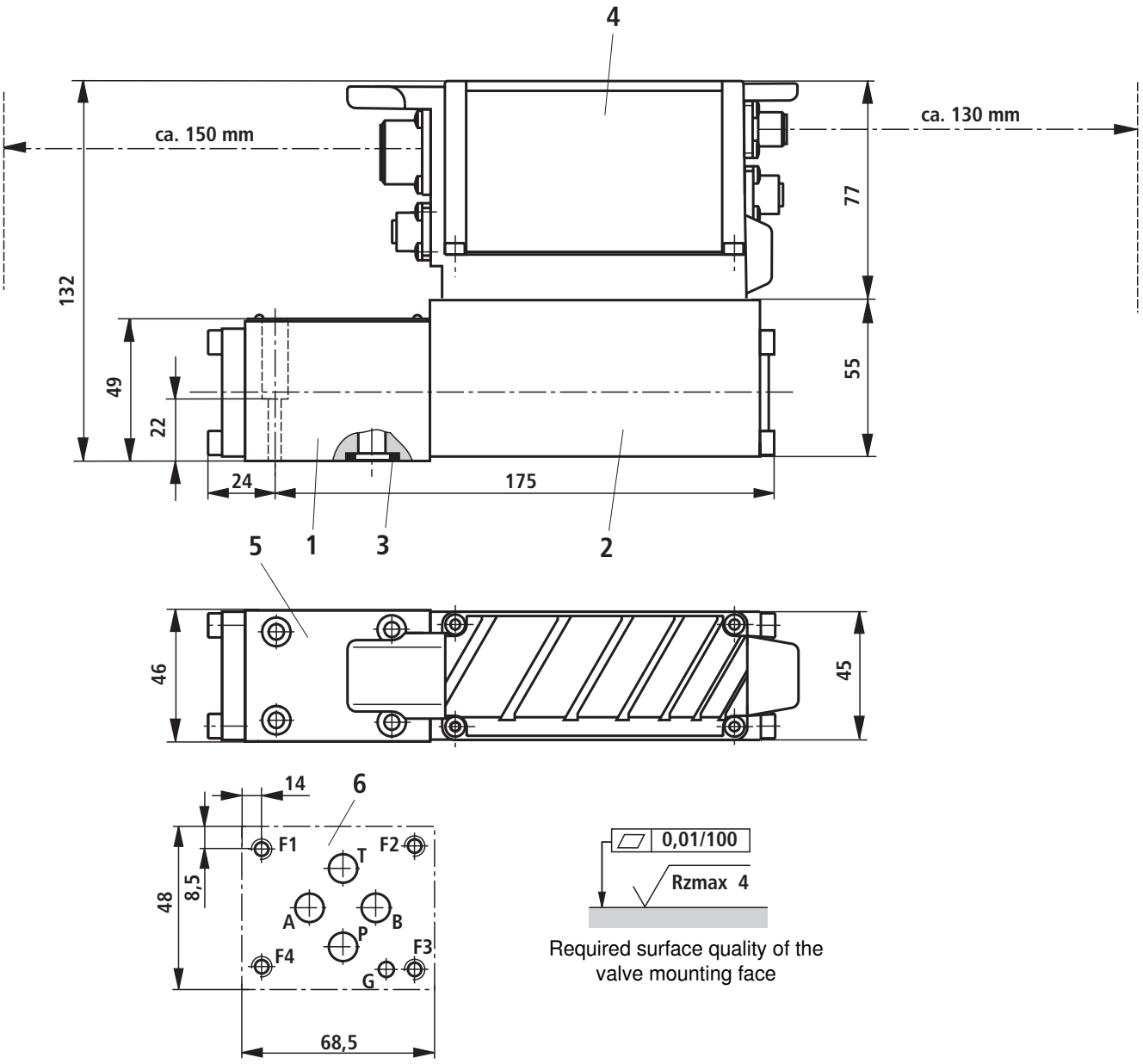
Leakage oil at	100 bar	P → A	50 cm³/min
		P → B	70 cm³/min
Flow at	Δp = 35 bar	A → T	10 ... 20 l/min
	q_n = 50/100 l/min	B → T	7 ... 20 l/min



Leakage oil at	100 bar	P → A	50 cm³/min
		P → B	70 cm³/min
		A → T	70 cm³/min
		B → T	50 cm³/min

Fail-safe	p = 0 bar => 12 ms	Enable "off" or internal shut-off in case of error
	p = 100 bar => 16 ms	$U_B \leq 18$ V or $I \leq 2$ mA (at 4…20 mA signal)

Unit dimensions size 6 (dimensions in mm)

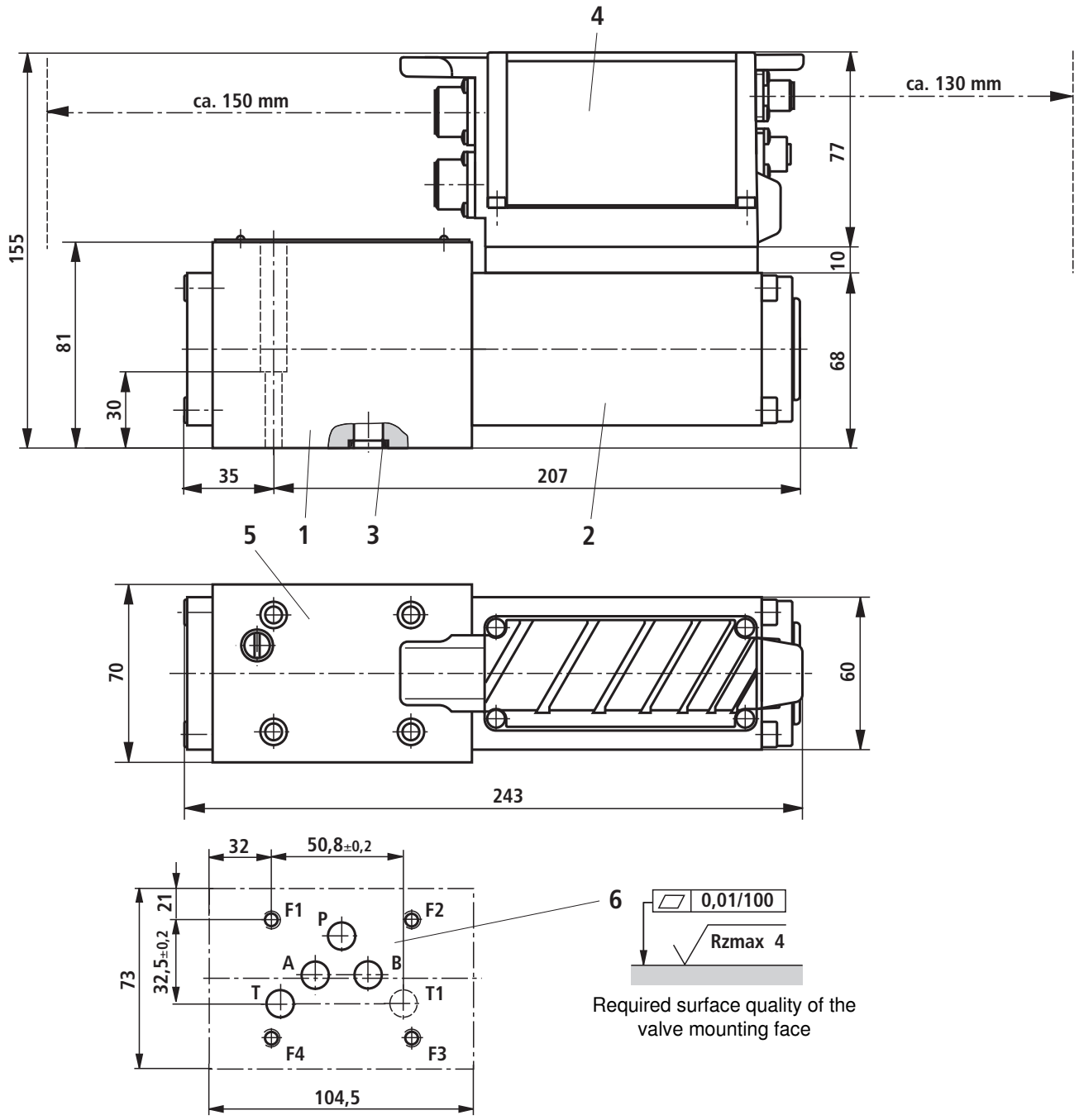


Required surface quality of the valve mounting face

1 Valve housing
2 Control solenoid with position transducer
3 O-ring 9.25 x 1.78 (ports P, A, B, T)
4 Integrated digital control electronics
5 Name plate
6 Machined valve mounting face, porting pattern according to ISO 4401-03-02-0-05

Valve mounting screws
(not included in scope of delivery)
4 units of hexagon socket head cap screws according to ISO4762-M5x30-10.9-N67F 821 70
(galvanized according to Bosch standard N67F 821 70)
M_A = 6+2 Nm
Mat. no. **2910151166**

Unit dimensions size 10 (dimensions in mm)



Required surface quality of the valve mounting face

1 Valve housing

2 Control solenoid with position transducer

3 O-ring 12.0 x 2.0 (ports P, A, B, T, T1)

4 Integrated digital control electronics

5 Name plate

6 Machined valve mounting face, porting pattern according to ISO 4401-05-04-0-05

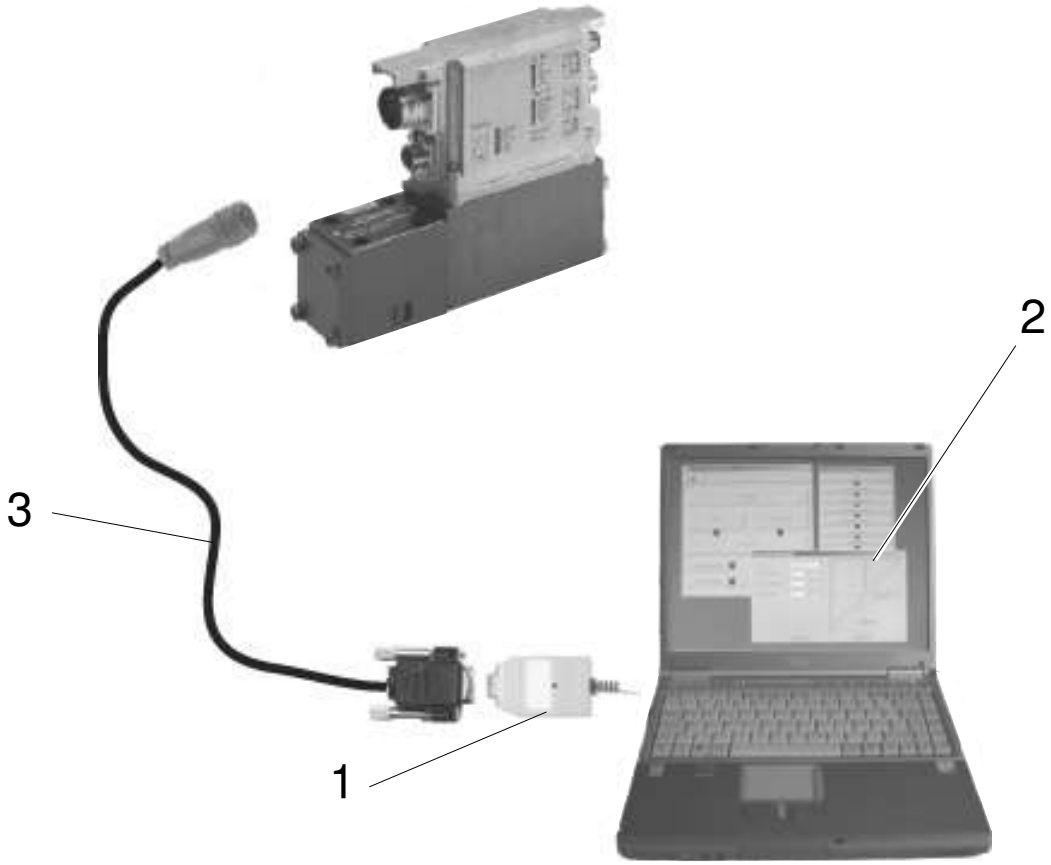
Deviating from the standard:
– Port T1 is provided additionally

Valve mounting screws
(not included in scope of delivery)
4 units of hexagon socket head cap screws according to ISO4762-M6x40-10.9-N67F 821 70
(galvanized according to Bosch standard N67F 821 70)
M_A = 11+3 Nm

Mat. no. **2910151209**

Accessories for parameterization (not included in scope of delivery)

The following is required for the parameterization with PC:	CANopen	Profibus DP
1 Interface converter (USB)	VT-ZKO-USB/CA-1-1X/V0/0 Mat. no. **R901071963**	VT-ZKO-USB/P-1-1X/V0/0 Mat. no. **R901071962**
2 Start-up software	WinHPT Download from www.boschrexroth.com/IAC	
3 Connecting cable, 3 m	D-Sub / M12 (coding A), Mat. no. **R900751271**	D-Sub / M12 (coding B), Mat. no. **R901078053**

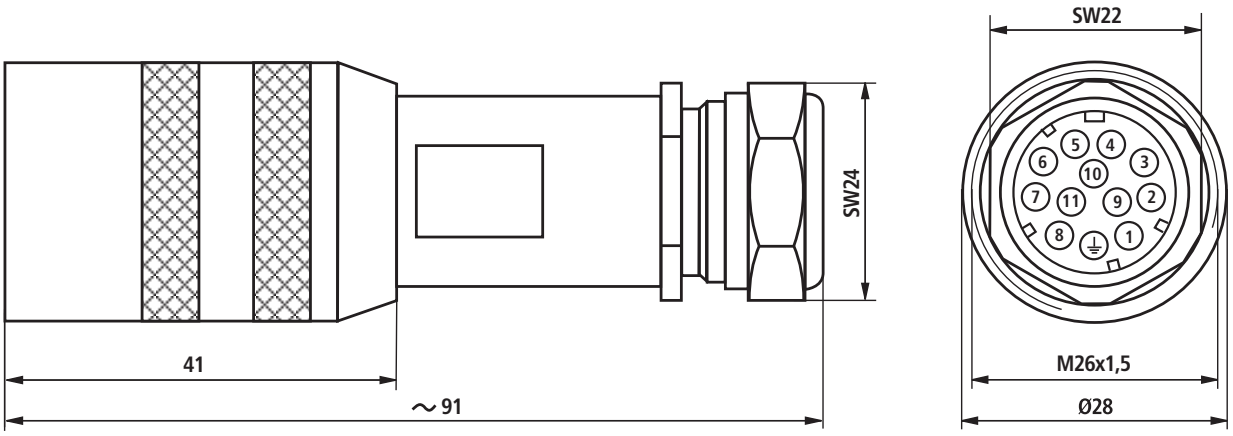


Accessories, port X1 (not included in scope of delivery)

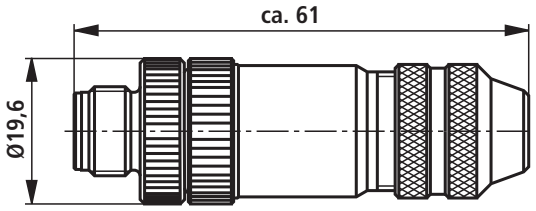
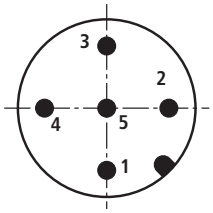
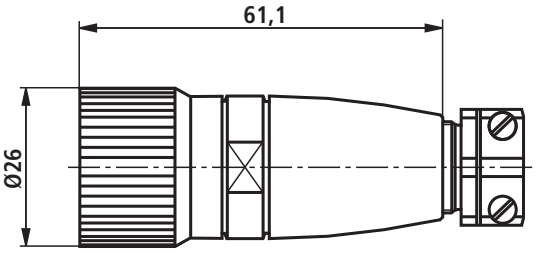
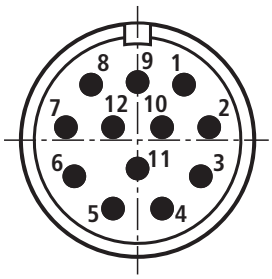
Mating connector for X1

Mating connector according to EN 175201-804 (12-pole, metal design)

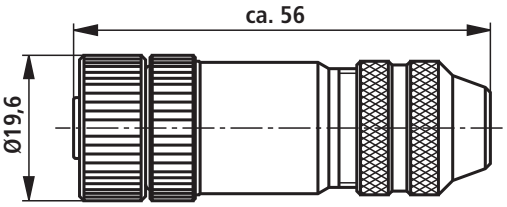
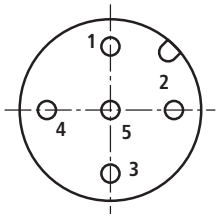
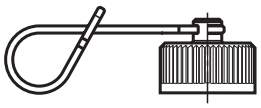
- Mating connector (construction set) for a cable diameter of 12-15 mm — Material no. **R901268000**
- Mating connector with 5 m cable, 12 x 0.75 mm² with cable shield, assembled — Material no. **R901272854**
- Mating connector with 20 m cable, 12 x 0.75 mm² with cable shield, assembled — Material no. **R901272852**



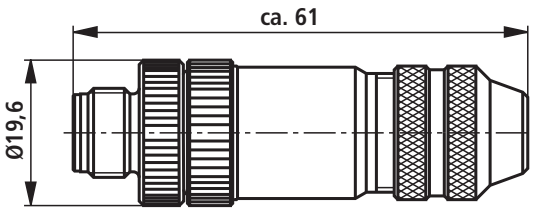
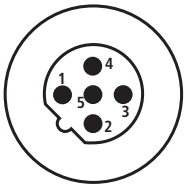
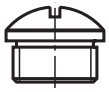
Accessories, sensor connections (not included in scope of delivery)

Description	View, dimensions	Pole image, order details
X4, X7 (analog sensors) Plug-in connector, 5-pole, M12 x 1, pins, A coding, metal design		 Mat. no.: **R901075542** (cable diameter 4 … 6 mm)
X7 (digital sensors, 1 Vss and SSI) Plug-in connector, 12-pole, M23, pins, soldered joint, metal design with cap nut		 Mat. no.: **R901076284** (cable diameter up to 10.5 mm)

Accessories, CAN bus (A coding) (not included in scope of delivery)

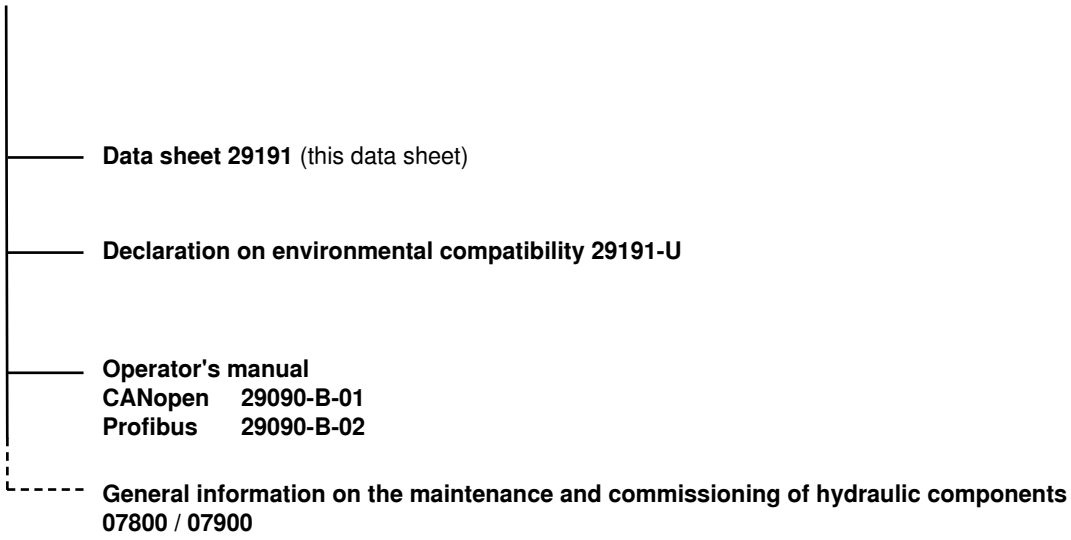
Description	View, Dimensions	Pole image, order details
X3 Round plug-in connector, processible, 5-pole, M12 x 1 Straight mating connector from metal.		 Mat. no.: **R901076910** (cable diameter 6-8 mm)
M12 cap Dust protection		Mat. no.: **R901075564**

Accessories, profibus (B code) (not included in scope of delivery)

Description	View, Dimensions	Pole image, order details
X3 Round plug-in connector, processible, 5-pole, M12 x 1 Straight line coupling plug from metal.		 Mat. no.: **R901075545** (cable diameter 6-8 mm)
Further profibus participants can be connected e.g. with a Y cable (can be ordered at HARTING, Mat. no. TB61042030039).		
M12 protective cap		Mat. no.: **R901075563**

Project Planning / Maintenance Instructions / Additional Information

Product documentation for IAC-R



Commissioning software and documentation on the Internet: www.boschrexroth.com/IAC

Maintenance instructions:

- The devices have been tested in the plant and are supplied with default settings.
- Only complete units can be repaired. Repaired devices are returned with default settings.
  User-specific settings are not maintained. The operator will have to retransfer the corresponding user parameters.

Notes:

- Connect the valve to the supply voltage only when this is required for the functional processes of the machine.
- Electric signals taken out via control electronics (e.g. signal "ready for operation") may not be used for the actuation of safety-relevant machine functions! (See also the European standard "Safety requirements for fluid power systems and their components - Hydraulics", EN 982.)
- If electromagnetic interference is to be anticipated, suitable measures must be taken to ensure the function (depending on the application, e.g. shielding, filtration)!

Notes

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