RE 29289
Edition: 2021-05
Replaces: 2017-09

rexroth
A Bosch Company

Directional control valve, pilot-operated, with integrated digital axis controller (IAC-Multi-Ethernet)

Type 4WRLD

H8073

- Sizes 10 ... 35
- Component series 4X
- Maximum operating pressure of 350 bar (ports P, A, B)
- Rated flow 60 ... 1500 l/min (***Δp*** = 10 bar)

CE

Features

- Open
  - Integrated digital axis control functionality (IAC-Multi-Ethernet)
  - Bus connection/service interface (Sercos, EtherCAT, EtherNet/IP, PROFINET RT, POWERLINK, VARAN)
- Scalable
  - 2 configurable analog sensor inputs
  - 1 input for linear position measurement system (SSI, 1Vpp or EnDat 2.2)
- Precise
  - Best-in-class hydraulic controller
  - High response sensitivity and low hysteresis
- Safe
  - Internal safety function (can be used up to category 4/PL e according to EN 13849-1)
  - CE conformity according to EMC Directive 2014/30/EU

Contents

Ordering code

01	02	03	04	05	06	07	08		09		10	11		12	13	14	15	16
4	**WRL**	**D**						**–**	**4X**	**/**			**/**	**24**		**D6**		*****

01	4 main ports	**4**
02	Directional control valve, pilot-operated	**WRL**
03	With integrated digital axis controller	**D**
04	Size 10	**10**
	Size 16	**16**
	Size 25	**25**
	Size 27	**27**
	Size 35	**35**
05	Symbols; possible version see page 4	

Rated flow at 10 bar pressure differential (5 bar/control edge)

06	**– Size 10**	
	60 l/min (only symbol E, E1-, W6-, W8-, V and V1-)	**60**
	100 l/min	**100**
	– Size 16	
	200 l/min (only symbol W6- and W8-)	**200**
	250 l/min (only symbol E, E1-, V, V1- and Q3)	**250**
	– Size 25	
	350 l/min (only symbol W6- and W8-) [1]	**350**
	400 l/min (only symbol E, E1-, V, V1- and Q3)	**400**
	– Size 27	
	430 l/min (only symbol W6- and W8-) [1]	**430**
	600 l/min (only symbol E, E1-, V, V1- and Q3)	**600**
	– Size 35	
	1000 l/min (only symbol E, E1-, V and V1-)	**1000**
	1200 l/min (only symbol W6- and W8-) [1]	**1200**
	1500 l/min (only symbol E, E1-, V, V1- and Q3-)	**1500**

Flow characteristic

07	Linear	**L**
	Linear with fine control range (only NG10; other sizes on request)	**P**
	Progressive with linear fine control range (only symbols Q3-)	**M**
08	**Without** overlap jump (only symbols V, V1- and Q3)	**no code**
	With overlap jump (opening point 5% with covered valve; only symbols E, E1-, W6-, W8-)	**J**
09	Component series 40 ... 49 (40 ... 49: unchanged installation and mounting dimensions)	**4X**

Seal material (observe compatibility of seals with hydraulic fluid used, see page 10)

10	NBR seals	**M**
	FKM seals	**V**

Pilot oil flow

11	External pilot oil supply, external pilot oil return	**XY**
	Internal pilot oil supply, external pilot oil return	**PY**
	Internal pilot oil supply; internal pilot oil return	**PT**
	External pilot oil supply, internal pilot oil return	**XT**
12	Supply voltage 24 V	**24**

[1] Higher rated flow upon request

Ordering code

01	02	03	04	05	06	07	08		09		10	11		12	13	14	15	16
4	**WRL**	**D**						**–**	**4X**	**/**			**/**	**24**		**D6**		*****

Ethernet interface

13	EtherNET/IP	**E**
	PROFINET RT	**N**
	Sercos	**S**
	EtherCAT (CANopen profile)	**T**
	POWERLINK (CANopen profile)	**W**
	VARAN	**V**

Electrical interface

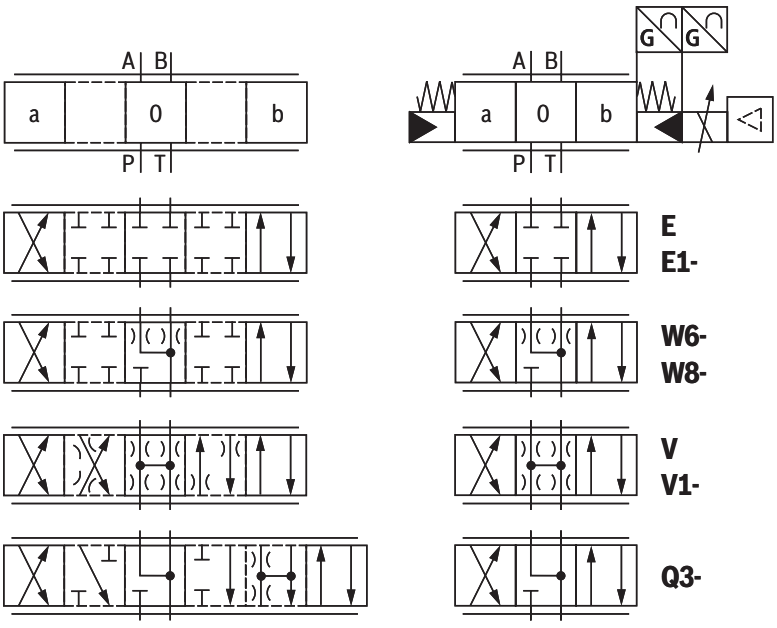
14	±10 VDC or 4 ... 20 mA	**D6**

Sensor interfaces

15	0 ... 10 V/4 ... 20 mA/EnDat 2.2	**S**
	0 ... 10 V/4 ... 20 mA/SSI	**T**
	0 ... 10 V/4 ... 20 mA/1Vpp	**U**

16	Further details in the plain text	*****

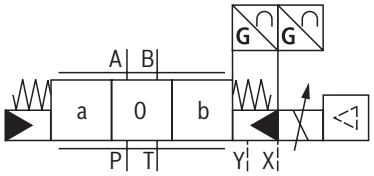
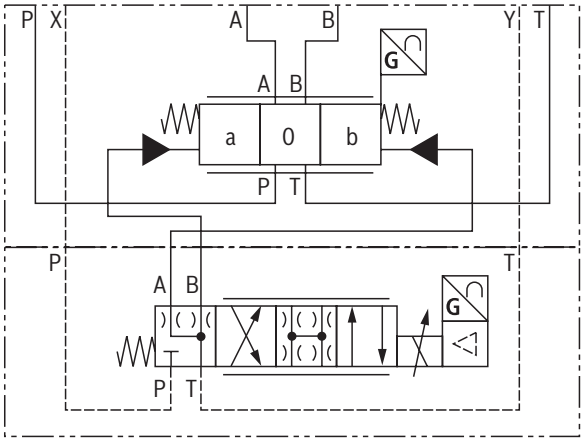
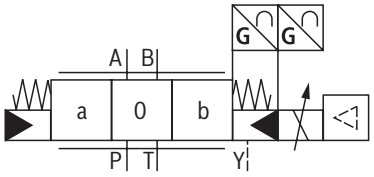
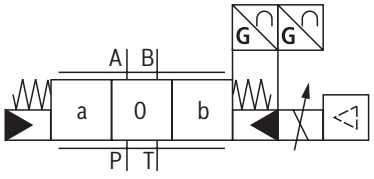
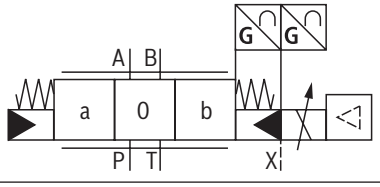
Symbols



With symbol E1–, V1– and W8–:

P → A: $q_{V\,max}$ B → T: $q_V/2$

P → B: $q_V/2$ A → T: $q_{V\,max}$

Version	simple	detailed
"XY"		
"PY"		
"PT"		
"XT"		

Notice:

- Representation according to DIN ISO 1219-1.Hydraulic interim positions are shown by dashes.
- For information on the "switch-off behavior", refer to "Technical data" on page 10.
- Symbols V and V1 are not suitable for use in safety applications (no overlap).

Function

General

The pilot-operated **IAC-Multi-Ethernet** valve (**I**ntegrated **A**xis **C**ontroller based on directional control valves) is a digital directional control valve with integrated axis controller and the following functionalities:

- Position control
- Pressure/force control
- Closed-loop speed control
- Substitutional closed-loop control (position - pressure/force)
- Substitutional control (flow - pressure/force)
- pQ function (flow-controlled)

Among others, the following operating modes are possible:

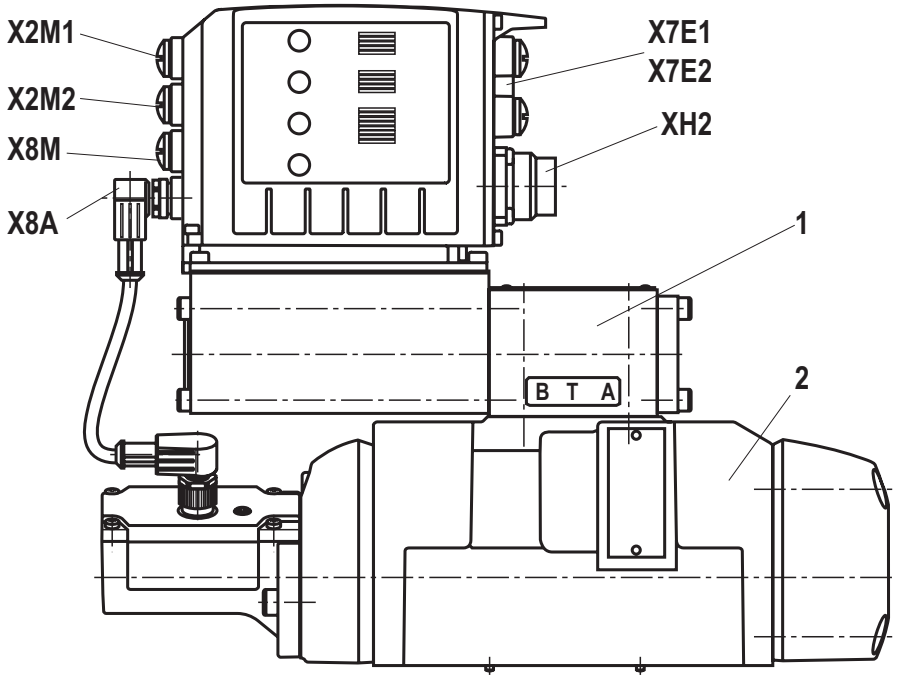
- Valve direct control
- Drive-controlled position control
- Drive-controlled positioning
- Positioning block operation

- The command values are preset via the Ethernet interface (X7E1 or X7E2) or, alternatively, via the analog/digital interface (XH2)
- The feedback information of the actual value signals to the superior control system is provided optionally either via the Ethernet interface (X7E1 or X7E2) or the analog/digital interface (XH2)
- The controller parameters are set via the Ethernet interface (X7E1 or X7E2)

Set-up

The directional control valve with IAC-Multi-Ethernet electronics mainly consists of:

- Pilot control valve (1) with control spool and sleeve in servo quality
- Main stage (2) with centering springs and position feedback
- Integrated digital axis controller (3) with:
  - analog/digital interface (XH2)
  - Ethernet interfaces (X7E1, X7E2)
  - analog sensor interfaces (X2M1, X2M2)
  - digital sensor interface (X8M)
  - interface for the position transducer of the main stage (X8A)



Function

Function (symbol V, V1- and Q3)
When the control solenoid of the pilot control valve is de-energized, its spring-operated control spool is in the "fail safe" position. The control spool of the main valve is in the spring-centered offset position at approx. 6% of the stroke in direction P→B/A→T.
The integrated electronics (OBE) compare the specified command value to the position actual value of the control spool of the main stage. In case of a control deviation, the control solenoid of the pilot control valve is activated and its control spool is adjusted.
The flow which is activated via the control cross-sections at the pilot control valve leads to an adjustment of the control spool of the main valve. The stroke/control cross-section of the main valve is regulated proportionally to the command value. In case of a command value presetting of 0%, the electronics adjust the control spool of the main valve to central position.
The pilot oil supply in the pilot control valve is either internal via port P or external via port X. The feedback can be internal via port T or external via port Y to the tank.

Switching off the release (symbol V and V1-)
If the supply voltage fails or in case of cable break, the integrated electronics will de-energize the control solenoid, the pilot control spool will move to the fail-safe position and will unload the pilot oil chambers of the main valve. Operated by the spring, the main valve control spool will move to the offset position (approx. 6% P→B/A→T).

Function (symbol E. and W.)
When the control solenoid of the pilot control valve is de-energized, its spring-operated control spool is in the "fail safe" position. The control spool of the main valve is in spring-centered central position.
The integrated electronics (OBE) compare the specified command value to the position actual value of the control spool of the main stage. In case of a control deviation, the control solenoid of the pilot control valve is activated and its control spool is adjusted.
The flow which is activated via the control cross-sections at the pilot control valve leads to an adjustment of the control spool of the main valve. The stroke/control cross-section of the main valve is regulated proportionally to the command value.
The pilot oil supply in the pilot control valve is either internal via port P or external via port X. The feedback can be internal via port T or external via port Y to the tank.

Switching off the release (symbol E. and W.)
If the supply voltage fails or in case of cable break, the integrated electronics will de-energize the control solenoid, the pilot control spool will move to the fail-safe position and will unload the pilot oil chambers of the main valve. Operated by the spring, the main valve control spool will move to the central position.

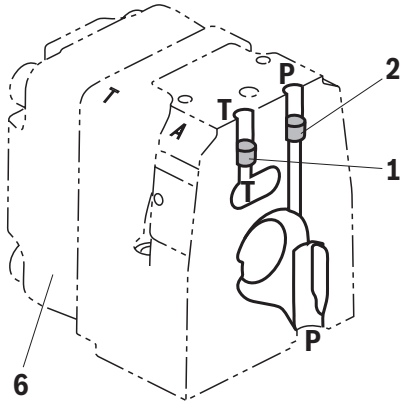
Monitoring
The digital control electronics enable comprehensive monitoring functions/error detection including:
- Undervoltage
- Communication error
- Cable break for analog sensor inputs and digital position measurement system
- Short-circuit monitoring for analog/digital outputs
- Monitoring of the microcontroller (watchdog)
- Temperature of the integrated electronics

IndraWorks DS PC program
To implement the project planning task and to parameterize the IAC-Multi-Ethernet valves, the user may use the IndraWorks DS engineering tool (see accessories):
- Project planning
- Parameterization
- Commissioning
- Diagnosis
- Comfortable administration of all data on a PC
- PC operating systems: Windows XP (SP3), Windows 7-10

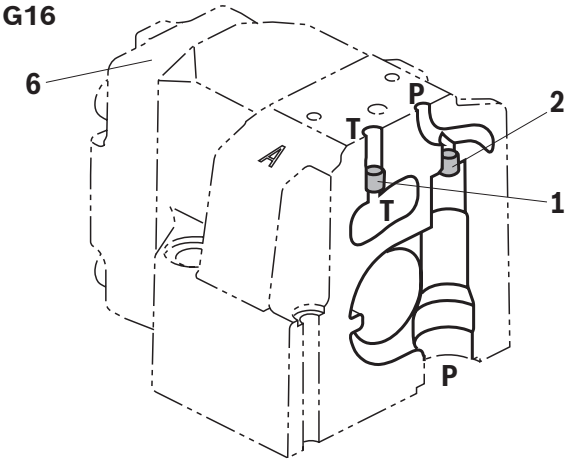
☞ **Notices:**
- Symbol V and V1-:
  Pilot-operated 4/3 directional control valves are only functional in the active control loop and do not have a locking basic position when deactivated.
  Consequently, "external isolator valves" are required in many applications and must be taken into account regarding the switch-on/switch-off order.
  While the electrical supply voltage is being switched off, the drive may be accelerated for a short time in functional direction P → B.
- Symbol E. and W.:
  Pilot-operated 4/3 directional control valves with positive overlap are functional in controlled or regulated axes. The overlap in the de-energized state is approx. 20% of the control spool stroke.
  While the release is being switched off, the drive may be accelerated for a short time in functional direction P → B. (For further details, please refer to operating instructions 29391-B)

Pilot oil supply (schematic illustration)

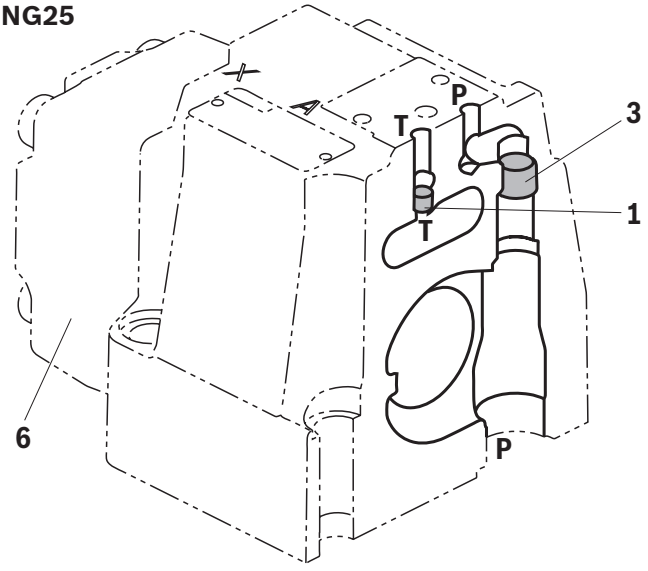
NG10



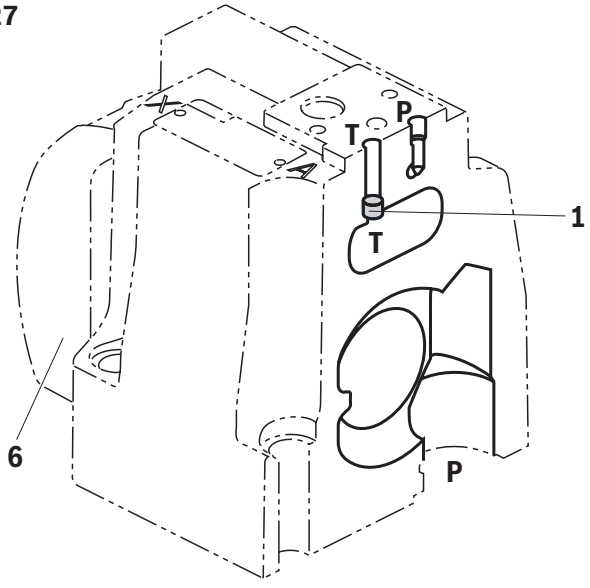
NG16



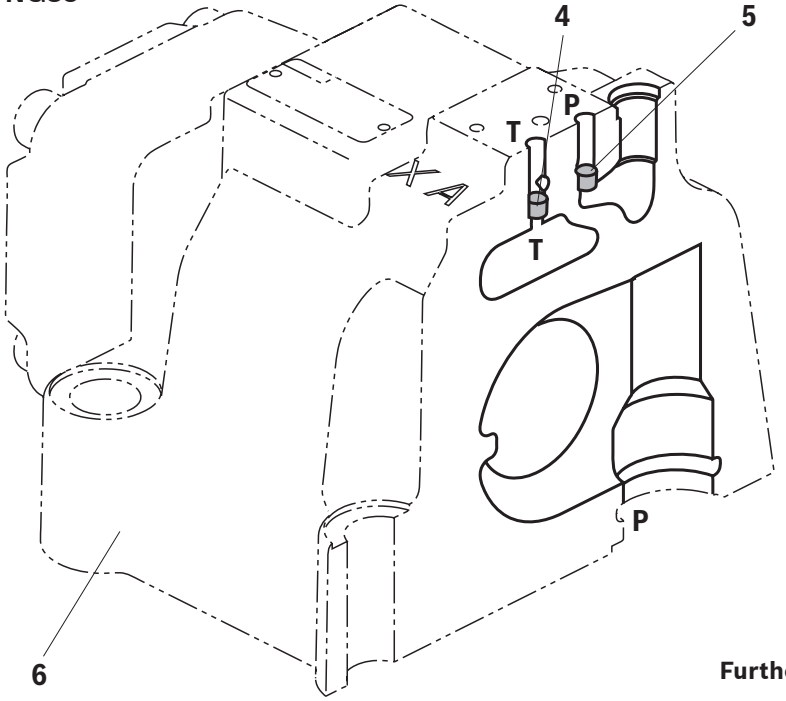
NG25



NG27



NG35



1 Plug screw M6 according to DIN 906, wrench size 3 – pilot oil return

2 Plug screw M6 according to DIN 906, wrench size 3 –pilot oil supply

3 Plug screw M12 x 1.5 according to DIN 906, wrench size 6 –pilot oil supply

4 Plug screw 1/16-27 NPTF, SW4 – pilot oil return

5 Plug screw 1/16-27 NPTF, SW4 –pilot oil supply

6 Housing cover main stage (position transducer side)

Pilot oil supply
External: **2, 3, 5** closed
Internal: **2, 3, 5** open

Pilot oil return
External: **1, 4** closed
Internal: **1, 4** open

Further explanations on page 8.

Pilot oil supply

Version "XY"
External pilot oil supply
External pilot oil return
In this version, the pilot oil is supplied from a separate control circuit (external).
The pilot oil return is not directed into channel T of the main valve but is separately directed to the tank via port Y (external).

Version "PY"
Internal pilot oil supply
External pilot oil return
With this version, the pilot oil is supplied from channel P of the main valve (internal).
The pilot oil return is not directed into channel T of the main valve but is separately directed to the tank via port Y (external).
In the subplate, port X is to be closed.

Version "PT"
Internal pilot oil supply
Internal pilot oil return
With this version, the pilot oil is supplied from channel P of the main valve (internal).
The pilot oil is directly returned to channel T of the main valve (internal).
In the subplate, ports X and Y are to be closed.

Version "XT"
External pilot oil supply
Internal pilot oil return
In this version, the pilot oil is supplied from a separate control circuit (external).
The pilot oil is directly returned to channel T of the main valve (internal).
In the subplate, port Y is to be closed.

Technical data
(For applications outside these values, please consult us!)

General							
Size		NG	10	16	25	27	35
Weight		kg	9	12	19	21	80
Installation position			any				
Ambient temperature range		°C	–20 ... +60				
Maximum solenoid surface temperature		°C	120 (individual operation)				
Maximum storage time		Years	1 (if the storage conditions are observed; refer to the operating instructions 07600-B)				
$MTTF_d$ value according to EN ISO 13849	▶ Hydraulic (category 1)	Years	75 (for further details, see operating instructions 29391-B)				
	▶ Hydraulic and electric (category 3 and 4, without power supply unit)	Years	70 (for further details, see operating instructions 29391-B)				
Vibration resistance	▶ Sine test according to DIN EN 60068-2-6		10 ... 2000 Hz/maximum of 10 g/10 cycles/3 axes				
	▶ Noise test according to DIN EN 60068-2-64		20 ... 2000 Hz / 10 g_{RMS} / 30 g peak / 30 min. / 3 axes				
	▶ Transport shock according to DIN EN 60068-2-27		15 g / 11 ms / 3 axes				
Maximum relative humidity (no condensation)		%	95				

Technical data

(For applications outside these values, please consult us!)

Hydraulic										
Size		NG	10	16	25	27	35			
Maximum operating pressure	▶ Ports A, B, P									
	– External pilot oil supply	bar	350			270	350			
	– Internal pilot oil supply	bar	280			270	280			
	▶ Port X	bar	280			270	280			
	▶ Ports T, Y	bar	250			210	250			
Hydraulic fluid			see table page 10							
Hydraulic fluid temperature range (flown-through)		°C	–20 ... +70							
Viscosity range	▶ recommended	mm^2/s	30 ... 45							
	▶ maximum admissible	mm^2/s	20 ... 380							
Rated flow (***Δp*** = 5 bar/control edge) [1]		l/min	60/100	200/250	350/400	430/600	1000/1200/1500			
Maximum flow		l/min	300	800	1250	1850	4700			
Maximum leakage flow (inlet pressure 100 bar)	▶ Symbol E, E1-									
	– Main valve	l/min	0.06	0.13	0.17		0.61			
	– Main valve + pilot control valve	l/min	0.14	0.28	0.42		1.01			
	▶ Symbol W6-, W8-									
	– Main valve	l/min	0.12	0.26	0.35		1.23			
	– Main valve + pilot control valve	l/min	0.2	0.41	0.6		1.63			
Maximum zero flow (inlet pressure 100 bar)	▶ Symbol V, V1-									
	– Main valve	l/min	1.7	2.3	2.8	3.3	7.2			
	– Main valve + pilot control valve	l/min	1.85	2.6	3.2	3.7	7.65			
	▶ Symbol Q3-									
	– Main valve	l/min	0.4	1.6	1.8	2.2	1.6			
	– Main valve + pilot control valve	l/min	0.55	1.9	2.2	2.6	2.05			
Minimum pilot pressure (pilot control valve)		bar	10							
Pilot flow [2]	▶ Symbol E, W	l/min	2.4	3.5	7.5		23			
	▶ Symbol V, Q3-	l/min	4.5	11.5	22		29			
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [3]							
Flow unloading central position Δ***p*** = 5 bar/control edge			A→T	B→T	A→T	B→T	A→T	B→T	A→T	B→T	A→T	B→T
	▶ Symbol W6-	l/min	2.8	2.8	4	4	6	6	6	6	25	25
	▶ Symbol W8-	l/min	2.8	1.4	4	2	6	3	6	3	25	12.5

[1] Flow for deviating ***Δp*** (valve pressure differential):

$$q_x = q_{Vnom} \times \sqrt{\frac{\Delta p_x}{10}}$$

[2] At port X and Y with stepped input signal from 0 ... 100% (100 bar)

[3] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and simultaneously increases the life cycle of the components.
Available filters can be found at www.boschrexroth.com/filter.

Technical data
(For applications outside these values, please consult us!)

Hydraulic fluid		Classification	Suitable sealing materials	Standards	Data sheet
Mineral oils		HL, HLP, HLPD, HVLP, HVLPD	NBR, FKM	DIN 51524	90220
Bio-degradable	▶ Insoluble in water	HETG	FKM	ISO 15380	90221
		HEES	FKM		
	▶ Soluble in water	HEPG	FKM	ISO 15380	
Flame-resistant	▶ Water-free	HFDU (glycol base)	FKM	ISO 12922	90222
		HFDU (ester base)	FKM		
		HFDR	FKM		
	▶ Containing water	HFC (Fuchs: Hydrotherm 46M, Renosafe 500; Petrofer: Ultra Safe 620; Houghton: Safe 620; Union: Carbide HP5046)	NBR	ISO 12922	90223

☞ **Important information on hydraulic fluids:**
- For further information and data on the use of other hydraulic fluids, please refer to the data sheets above or contact us.
- There may be limitations regarding the technical valve data (temperature, pressure range, life cycle, maintenance intervals, etc.).
- The ignition temperature of the hydraulic fluid used must be 50 K higher than the maximum surface temperature.
- **Bio-degradable and flame-resistant – containing water:** If components with galvanic zinc coating (e.g. version "J3" or "J5") or parts containing zinc are used, small amounts of dissolved zinc may get into the hydraulic system and cause accelerated aging of the hydraulic fluid. Zinc soap may form as a chemical reaction product, which may clog filters, nozzles and solenoid valves – particularly in connection with local heat input.
- **Flame-resistant – containing water:**
  - Due to the increased cavitation tendency with HFC hydraulic fluids, the life cycle of the component may be reduced by up to 30% as compared to the use with mineral oil HLP. In order to reduce the cavitation effect, it is recommended – if possible specific to the installation – backing up the return flow pressure in ports T to approx. 20% of the pressure differential at the component.
  - Dependent on the hydraulic fluid used, the maximum environment and hydraulic fluid temperature must not exceed 50 °C. In order to reduce the heat input into the component, the command value profile is to be adjusted for proportional and high-response valves.

Static/dynamic							
Size		NG	10	16	25	27	35
Hysteresis		%	< 0.1				
Range of inversion		%	< 0.08				
Response sensitivity		%	< 0.05				
Manufacturing tolerance q_{Vmax}		%	≤ 10				
Temperature drift (temperature range 20 °C ... 80 °C)		%/10 °C	Zero shift < 0.25				
Zero compensation (ex plant)		%	±1				
Actuating time for 0 ... 100% at X=100 bar	▶ Symbols E, E1-, W6-, W8-	ms	40	60	60	60	90
Switch-off behavior (after electric shut-off)	▶ Symbols E, E1-, W6-, W8-		Pilot control valve in fail-safe position, main valve moves to overlapped spring-centered central position				
	▶ Symbol V, V1-		Pilot control valve in fail-safe position, main valve moves to spring-centered "offset position" (approx. 6%, P→B/A→T)				
	▶ Symbol Q3		Pilot control valve in fail-safe position, main valve moves to spring-centered "offset position" (P blocked, A/B to port T open)				

Technical data

(For applications outside these values, please consult us!)

Electrical, integrated electronics (OBE)			
Supply voltage [4; 5]	▶ Nominal voltage	VDC	24
	▶ Lower limit value	VDC	18
	▶ Upper limit value	VDC	36
Maximum admissible residual ripple		Vpp	2.5 (comply with absolute supply voltage limit values)
Current consumption	▶ Maximum [6]	A	2.5
	▶ Impulse current	A	4
Maximum power consumption		W	40
Relative duty cycle		%	100 (continuous operation)
Protection class according to EN 60529			IP 65 with mounted and locked plug-in connectors
Required fuse protection, external		A	4, time-lag
Protective grounding conductor and screening			see connector pin assignment (CE-compliant installation) page 15 and 16
Adjustment			calibrated in the plant, see characteristic curves page 18 ... 30
Booting time		s	< 15
Scan time pressure and force controller (minimum)		ms	0.5
Scan time position controller (minimum)		ms	1
AD/DA resolution	▶ Analog inputs	Bit	12
	▶ Analog output	Bit	12
Parameterization interface			Ethernet
Conformity			CE according to EMC directive 2004/108/EC tested according to EN 61000-6-2 and EN 61000-6-3
Digital inputs XH2	▶ Quantity		optionally up to 2, configurable (analog inputs are omitted)
	▶ Low level	V	–3 ... 5
	▶ High level	V	15 ... U_B
	▶ Current consumption at high level	mA	< 1
	▶ Reference potential		Pin 5
Digital outputs XH2	▶ Quantity		1
	▶ Low level	V	0 ... 3
	▶ High level	V	15 ... U_B
	▶ Current carrying capacity	A	1.5 (short-circuit-proof)
	▶ Signal delay time	ms	< 2 (depending on set scan time)
	▶ Reference potential		GND
Analog inputs XH2	▶ Number (current and voltage input parameterizable)		optionally up to 2, configurable (digital inputs are no longer required)
	▶ AD resolution	bit	12
	▶ Voltage inputs (differential inputs)		
	– Measurement range	V	–10 ... +10
	– Input resistance	kΩ	80 +10%
	– Temperature drift		< 14 mV / 10 K
	▶ Current inputs (reference to AGND)		
	– Input current		4 ... 20 (0 ... 20 physically)
	– Input resistance	Ω	200, measuring resistance plus FET
	– Temperature drift		< 25 µA / 10 K

[4] Supply voltage is used directly for sensor connections X2M1, X2M2 and X8M (no internal voltage limitation)

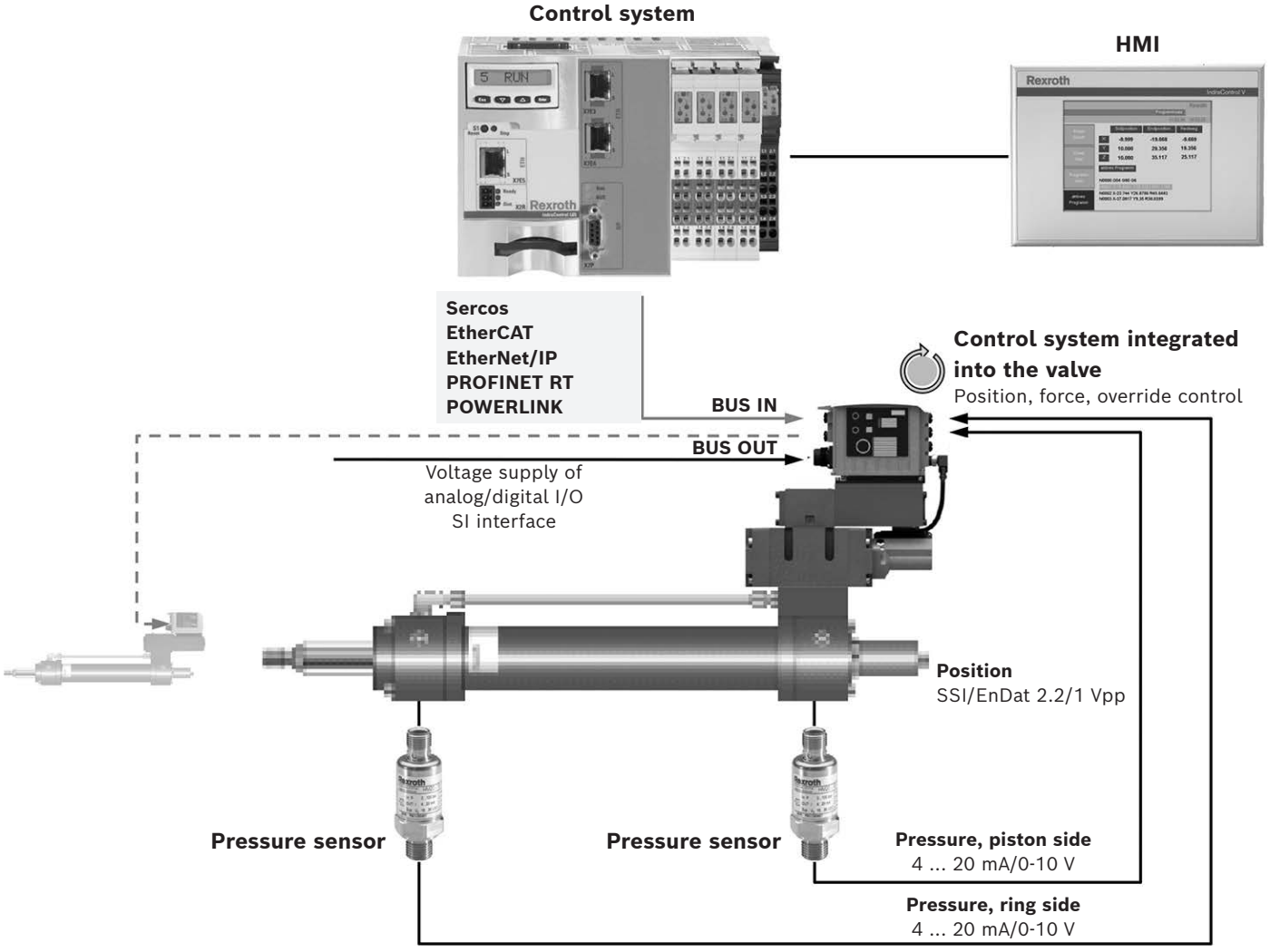
[5] Voltage limit values must be observed directly at the connector of the valve (observe line length and cable cross-section!)

[6] When using the sensor inputs or the switching output, the maximum current consumption will increase according to the external load

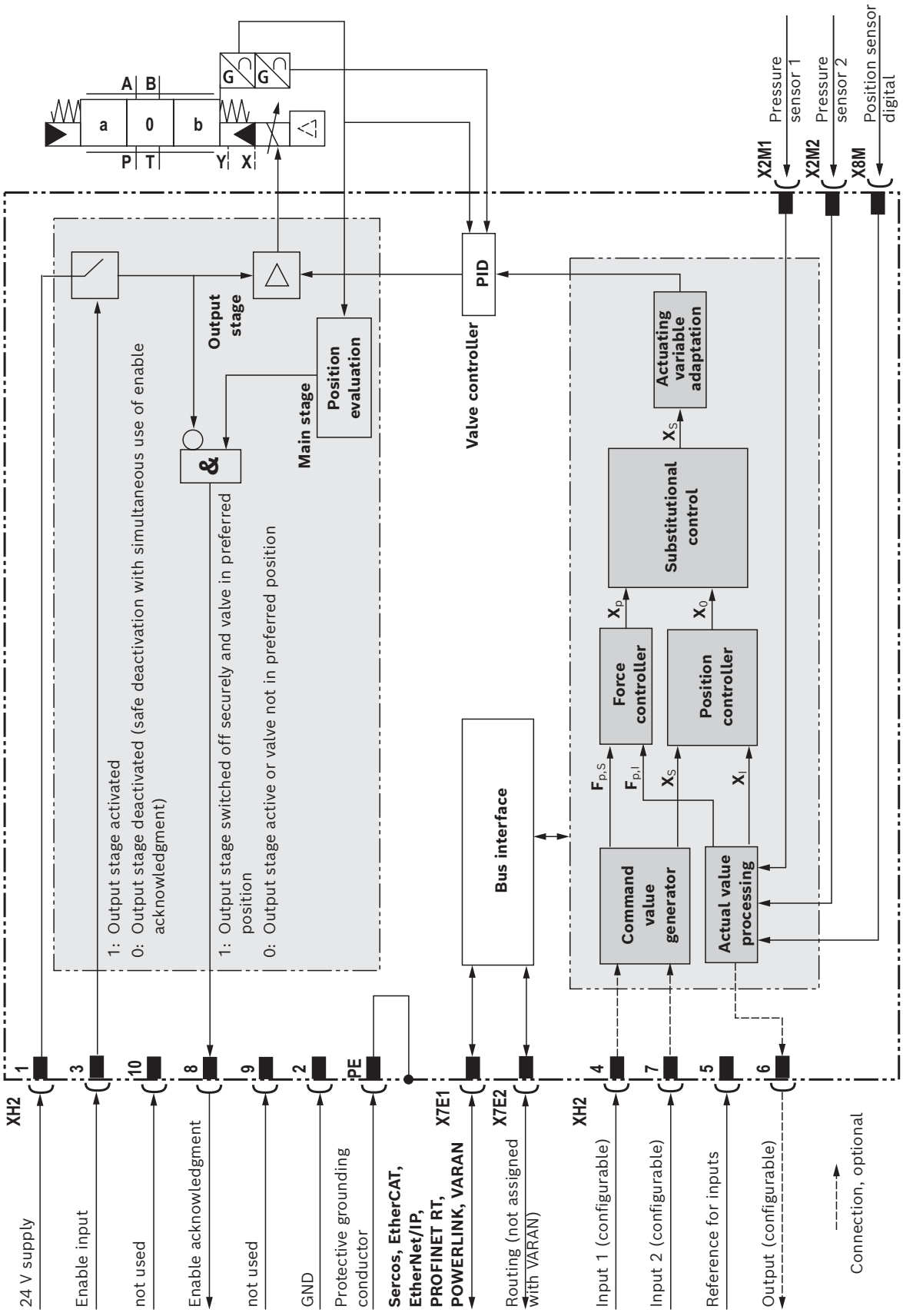
Technical data
(For applications outside these values, please consult us!)

Analog outputs XH2	▶ Number (current and voltage input parameterizable)			1
	▶ DA resolution		bit	12
	▶ Voltage outputs			
	– Output range		V	–10 ... +10 (0 ... 10 by software)
	– Minimum load impedance		kΩ	10
	– Temperature drift			< 5 mV / 10 K
	▶ Current outputs			
	– Output range		mA	0 ... 20 (4 ... 20 by software)
	– Maximum load		Ω	200
Analog sensors X2M1, X2M2	▶ Number (current and voltage input configurable)			1 per connector
	▶ Supply voltage		V	24 (corresponding to supply voltage applied to XH2)
	▶ Maximum supply current		mA	350 (sum X2M1, X2M2 and X8M)
	▶ AD resolution		bit	12
	▶ Voltage inputs			
	– Measurement range		V	0 ... 10
	– Input resistance		kΩ	80 +10%
	– Temperature drift			< 15 mV / 10 K
	▶ Current inputs (reference to AGND)			
	– Input current			4...20 (0...20 physically)
	– Input resistance		Ω	200, measuring resistance plus PTC
	– Temperature drift			< 10 µA / 10 K
Digital sensor X8M	▶ Supply voltage			24 V or 5 V
	▶ Maximum supply current	– 24 V	mA	350 (sum X2M1, X2M2 and X8M)
		– 5 V	mA	250
	▶ SSI transducer			
	– Coding			Gray
	– Data width			12 ... 28 bit
	– Transfer frequency			80 kHz ... 1 MHz
	– Line receiver / driver			RS485
	▶ Endat encoder			2.2
	– Line receiver / driver			RS485
	– Resolution			minimum 10 nm and multiple
	▶ 1Vpp-encoder			
	– Transfer frequency		kHz	250

Representation of the axis controller in the system network



Block diagram/controller function block



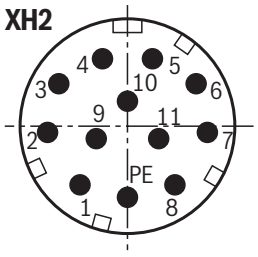
Detailed description of the safety function:
After the signal at the enable input has been removed, the output stage, and thus the solenoid of the valve, are internally separated from the available supply voltage. The enable acknowledgment will only be activated after the safe valve spool position has been achieved. For a detailed description of the safety function, refer to the operating instructions 29391-B.

Electrical connections, assignment

Connector pin assignment XH2, 11-pole + PE according to EN 175201-804

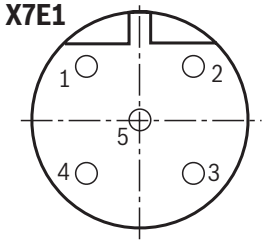
Pin	Core marking		Interface D6 assignment
	Cable, one-part [1]	Cable, split [2]	
1	1	1	24 V DC supply voltage
2	2	2	GND
3	3	white	Enable input 24 V DC (high ≥ 15 V; low < 2 V)
4	4	yellow	Command values 1 (4 ... 20 mA/±10 V) [3]
5	5	green	Reference for command values
6	6	violet	Actual value (4 ... 20 mA/±10 V) [3; 4]
7	7	pink	Command value 2 (4 ... 20 mA/±10 V) [3]
8	8	red	Enable acknowledgment 24 V DC (I_{max} 50 mA) [5]
9	9	brown	not used
10	10	black	not used
11	11	blue	Switching output 24 V, configurable (fault-free operation (24 V)/error (0V) or power circuit signal), maximum 1.5 A [3; 5]
PE	green-yellow	green-yellow	Functional ground (connected directly to metal housing)

1) Core marking of the connection lines for mating connector with cable set (see accessories, page 37, material numbers R901268000, R901272854, R901272852)
2) Core marking of the connection lines for mating connector with cable set (see accessories, page 37, material numbers R900884671, R900032356, R900860399)
3) Selection via commissioning software
4) For diagnostic purposes, precise actual value response via Ethernet interface
5) A load increases the current consumption on pin 1



Connector pin assignment for Ethernet interfaces "X7E1" and "X7E2" (coding D), M12, 4-pole, socket

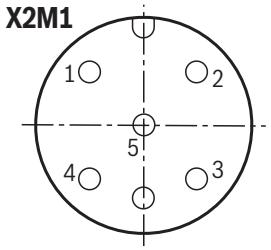
Pin	Assignment
1	TxD +
2	RxD +
3	TxD –
4	RxD –
5	not used



Analog configurable sensor interfaces, connections "X2M1", "X2M2" (coding A), M12, 5-pole, socket

Pin	Assignment
1	+24 V voltage output (sensor supply) [1; 2]
2	Sensor signal input current (4 ... 20 mA) [3]
3	GND
4	Sensor signal input voltage (0 ... 10 V) [3]
5	Negative differential amplifier input to pin 4 (optional)

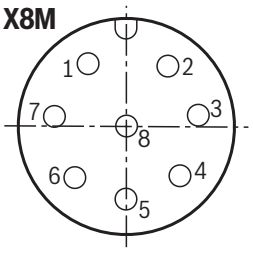
1) Voltage output same as voltage supply connected to input XH2. (Maximum load capacity see page 16)
2) A load increases the current consumption of the valve (pin 1 on the connector XH2)
3) Only one signal input per interface, configurable



Electrical connections, assignment

Digital sensor interface SSI, EnDat 2.2 or 1Vpp measurement system "X8M", M12, 8-pole, socket

Pin	SSI pin assignment [1]	EnDat 2.2 pin assignment [1; 2]	1Vpp pin assignment
1	GND	GND	GND
2	+24 V [3]	+5 V [3]	+5 V [3]
3	Data +	Data +	A +
4	Data –	Data –	A –
5	GND	GND	B +
6	Clock –	Clock –	B –
7	Clock +	Clock +	R +
8	+24 V [3]	+5 V [3]	R –

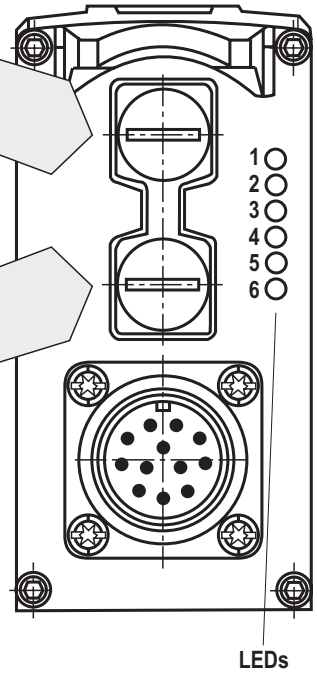


1) Pins 2, 8 and 1, 5 have the same assignment each
2) Supported resolution ≥ 10 nm
3) A load increases the current consumption of the valve (pin 1 on the connector XH2)

☞ **Notices:**
- Reference potential for all signals: GND
- We recommend connecting the shields on both sides via the metal housings of the plug-in connectors.
  Using connector pins will affect the shielding effect!
  Internal screens are not required.

LED displays

LED	Interface	Sercos	EtherNET/IP	EtherCAT	PROFINET RT	POWERLINK	VARAN
1	**X7E1**	Activity	Activity	not used	Activity	not used	Active
2		Link	Link	Link/activity	Link	Link/data activity	Link
3	**Electronics module**	S	Network status	Network status	Network status	Status/error	Network status
4		Module status	Module status	Module status	Module status	Module status	Module status
5	**X7E2**	Activity	Activity	not used	Activity	not used	not used
6		Link	Link	Link/activity	Link	Link/data activity	not used



Displays of the status LEDs

Module status LED (LED 4)	Display status
Aus	No voltage supply
Green-red, flashing	Initialization
Green, flashing	Drive ready for operation
Green	Drive active
Orange, flashing	Warning
Red, flashing	Error

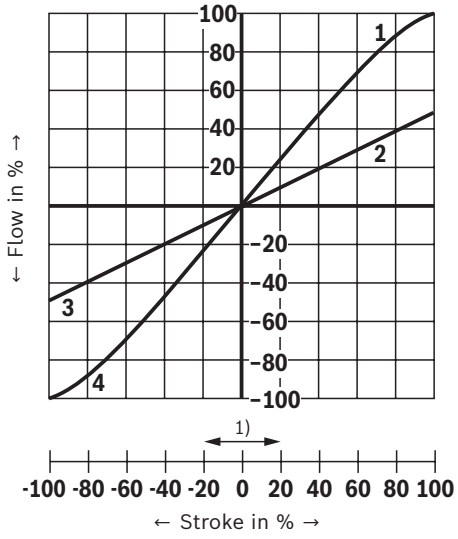
Network status LED (LED 3)	Display status
Aus	No voltage supply
Green	Operation

☞ **Notices:**
- ▶ LEDs 1, 2, 5 and 6 relate to interfaces "X7E1" and "X7E2"
  - – Link: Cable plugged in, connection established (permanently lit)
  - – Activity: Data sent/received (flashing)
- ▶ Module status LEDs 3 and 4 relate to the electronics module
- ▶ For a detailed description of the diagnosis LEDs, please refer to the functional description Rexroth HydraulicDrive HDx.

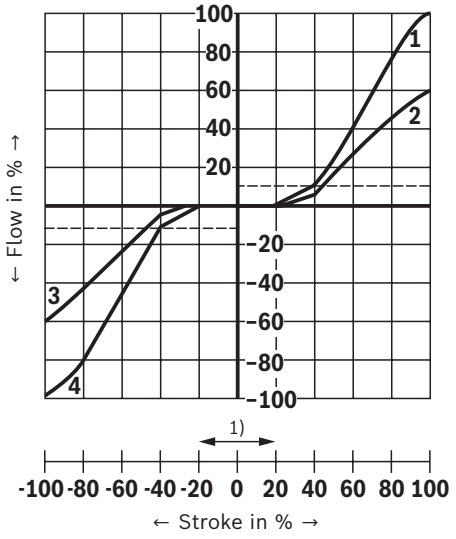
Characteristic curves: Flow characteristic "L" and "P" (measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Flow/signal function – Version "L"

Symbol V, V1-

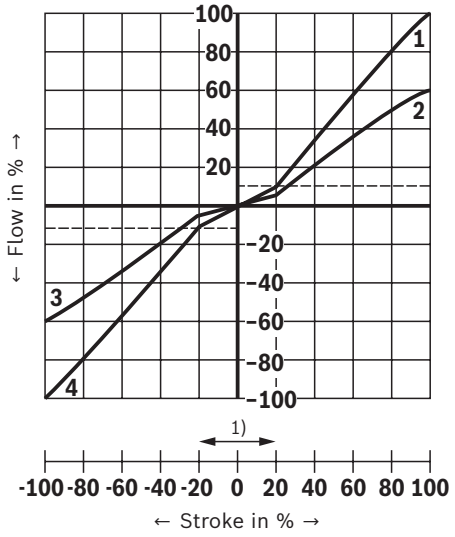


Symbols E, E1-, W6-, W8-

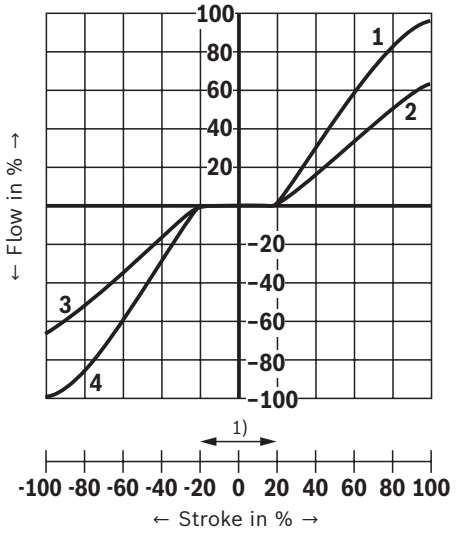


Flow/signal function – Version "P"

Symbol V, V1-



Symbols E, E1-, W6-, W8-

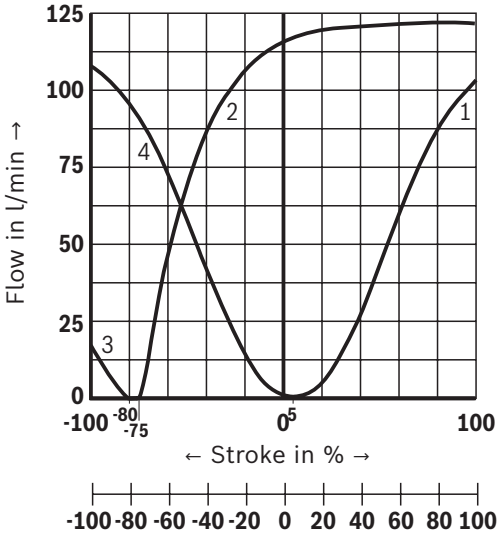


1 P–A; B–T (1:1)
2 B–T (2:1)
3 P–B (2:1)
4 P–B; A–T (1:1)
––– 10 % q_V

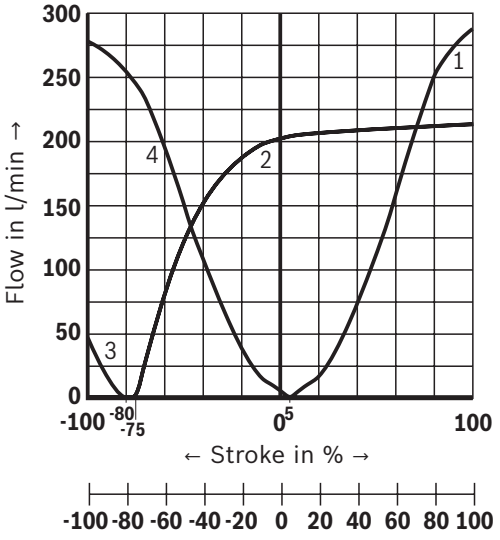
[1] Step compensation (opening at 5%)

Characteristic curves: Flow characteristic "M"
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

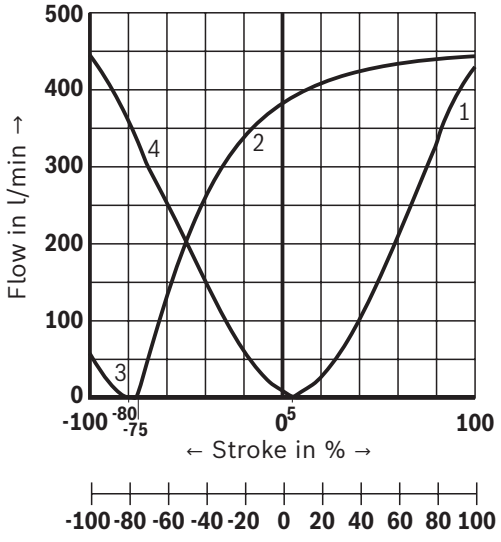
Symbol Q3, version "100"



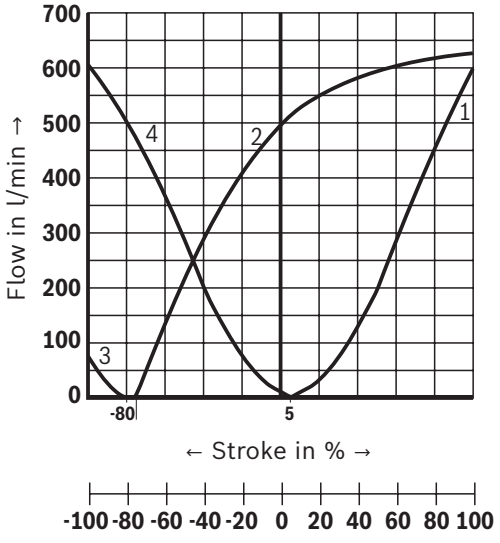
Symbol Q3, version "250"



Symbol Q3, version "400"



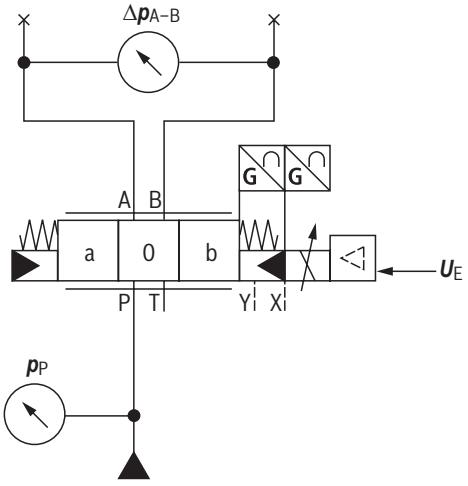
Symbol Q3, version "600"

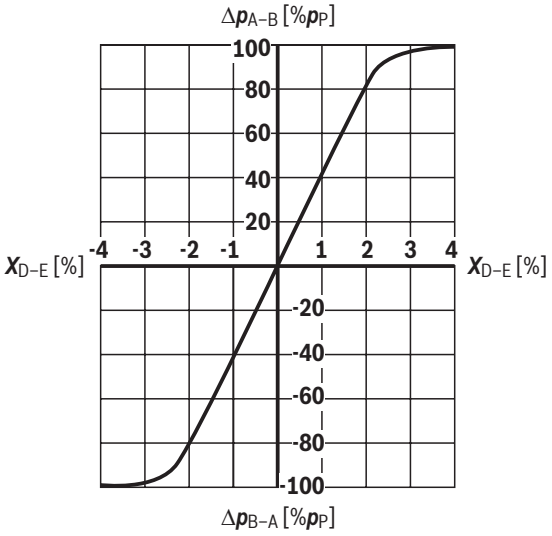


1 P–A
2 B–T
3 P–B
4 A–T

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

Pressure amplification

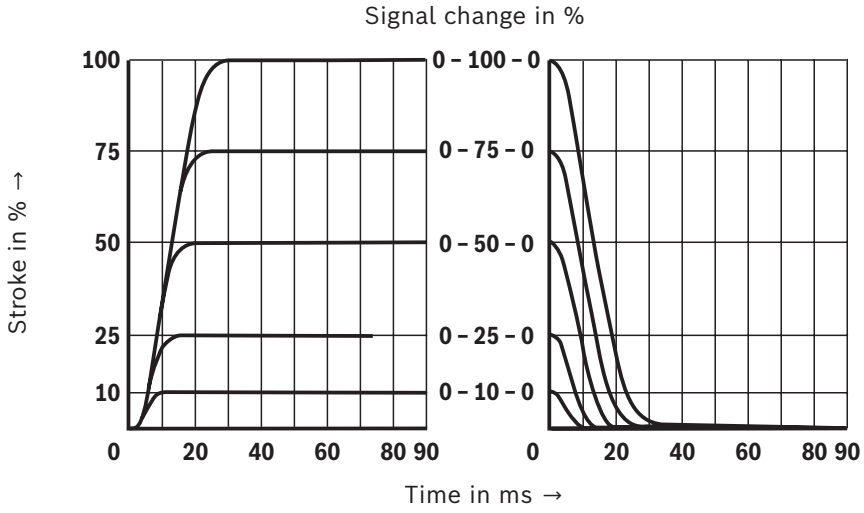




Characteristic curves: Size 10
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Transition function with stepped electric input signals

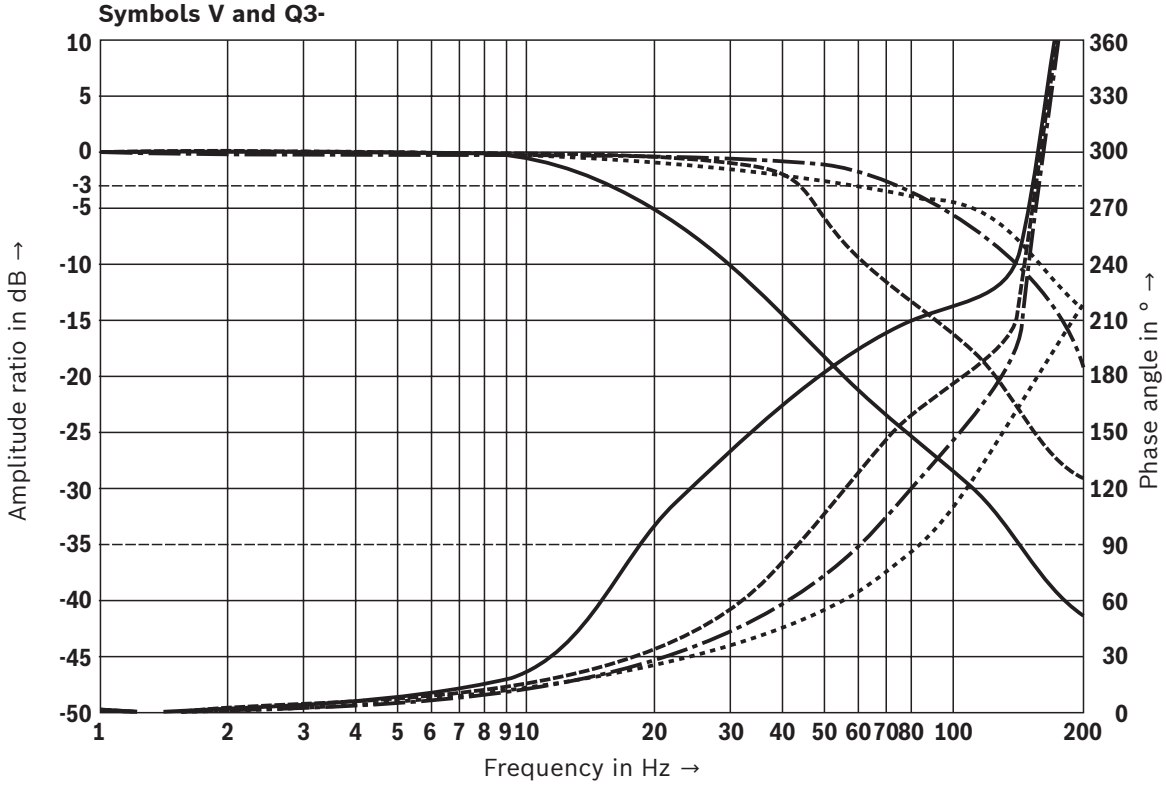
Symbols V and Q3-



- ▶ Pilot control valve, port X = 100 bar
- ▶ Main valve, port P = 10 bar

Frequency response

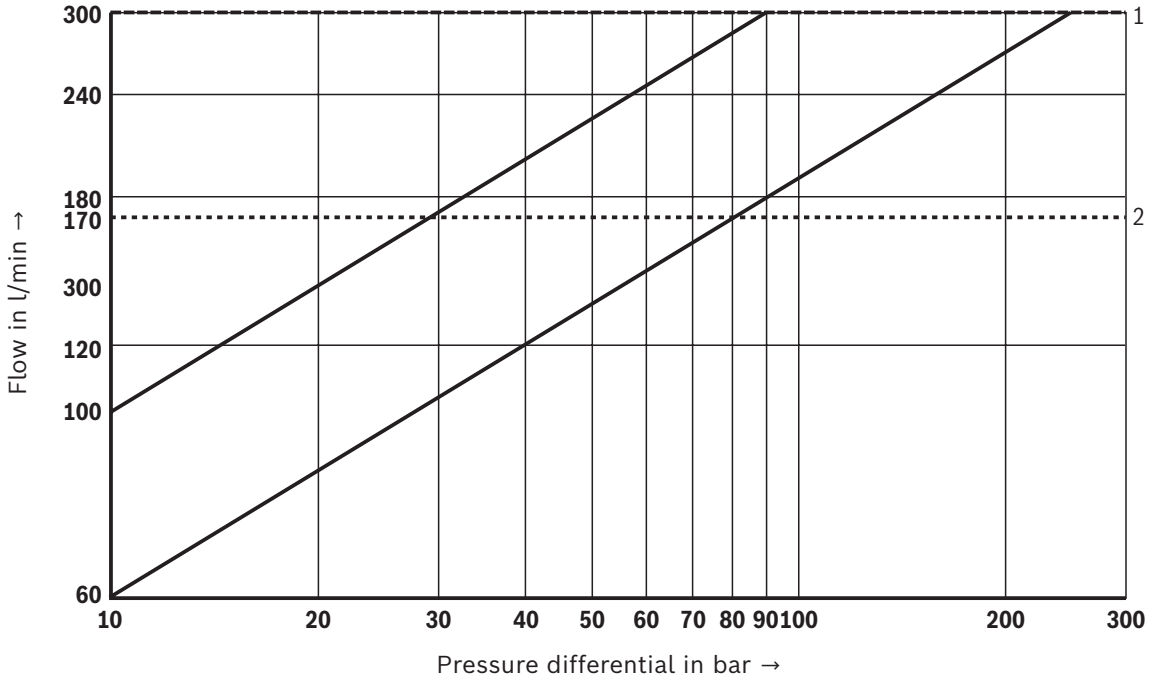
Symbols V and Q3-



- Signal ±1%
- Signal ±5%
- Signal ±25%
- Signal ±100%

Characteristic curves: Size 10
(valid for HLP46, ϑ_{oil} = 40 ±5 °C)

Flow/load function (with maximum valve opening; tolerance ±10%)

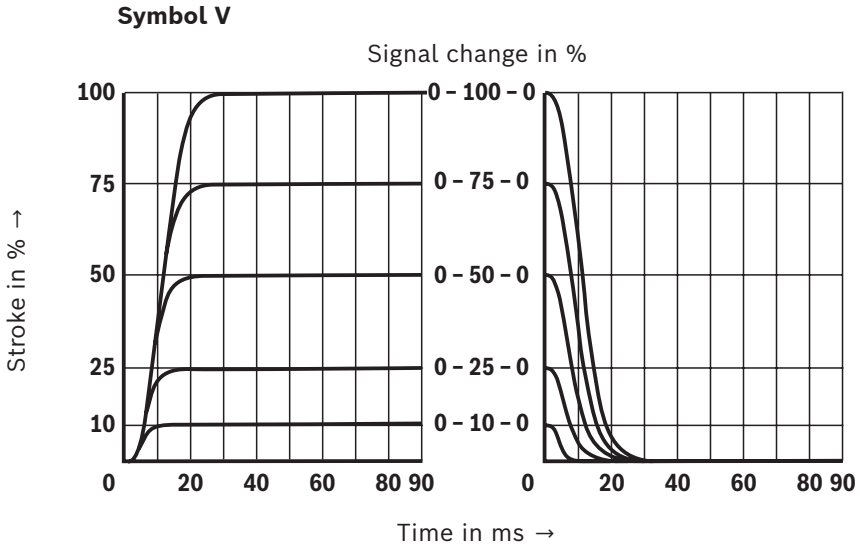


1 Maximum flow

2 Recommended flow
(flow velocity 30 m/s)

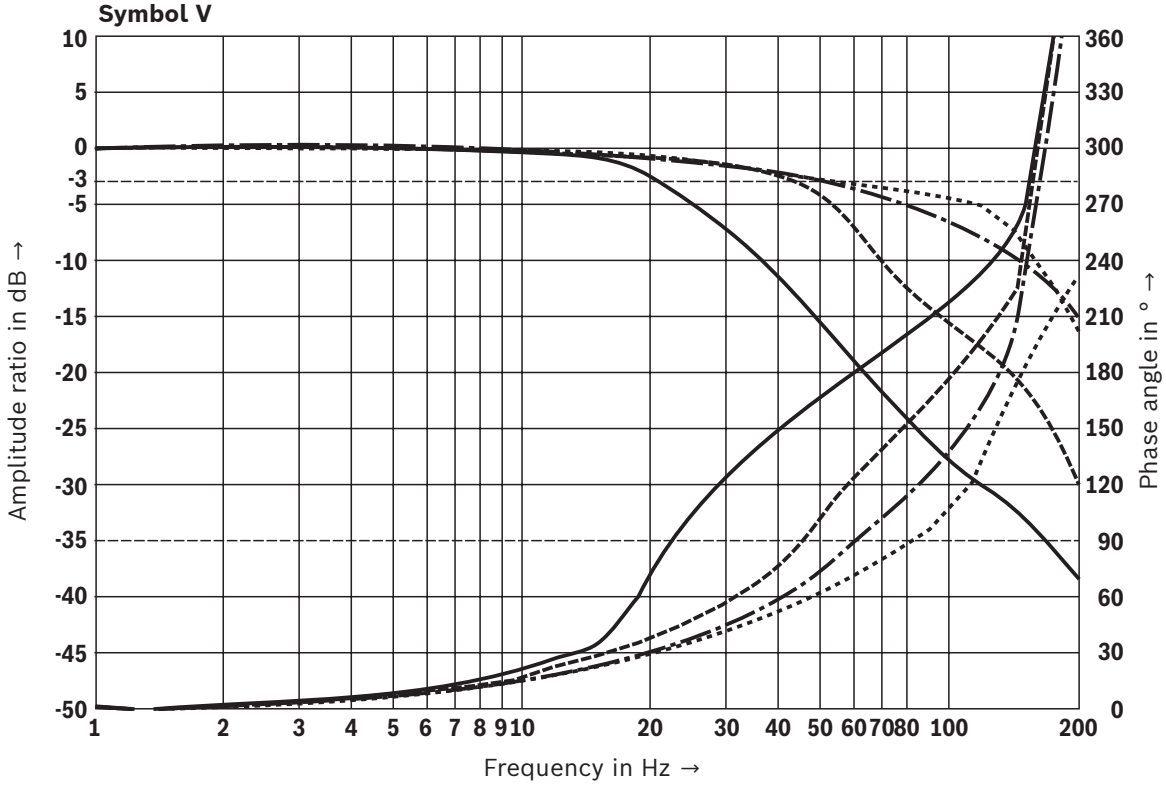
Characteristic curves: Size 16
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Transition function with stepped electric input signals



- ▶ Pilot control valve, port X = 100 bar
- ▶ Main valve, port P = 10 bar

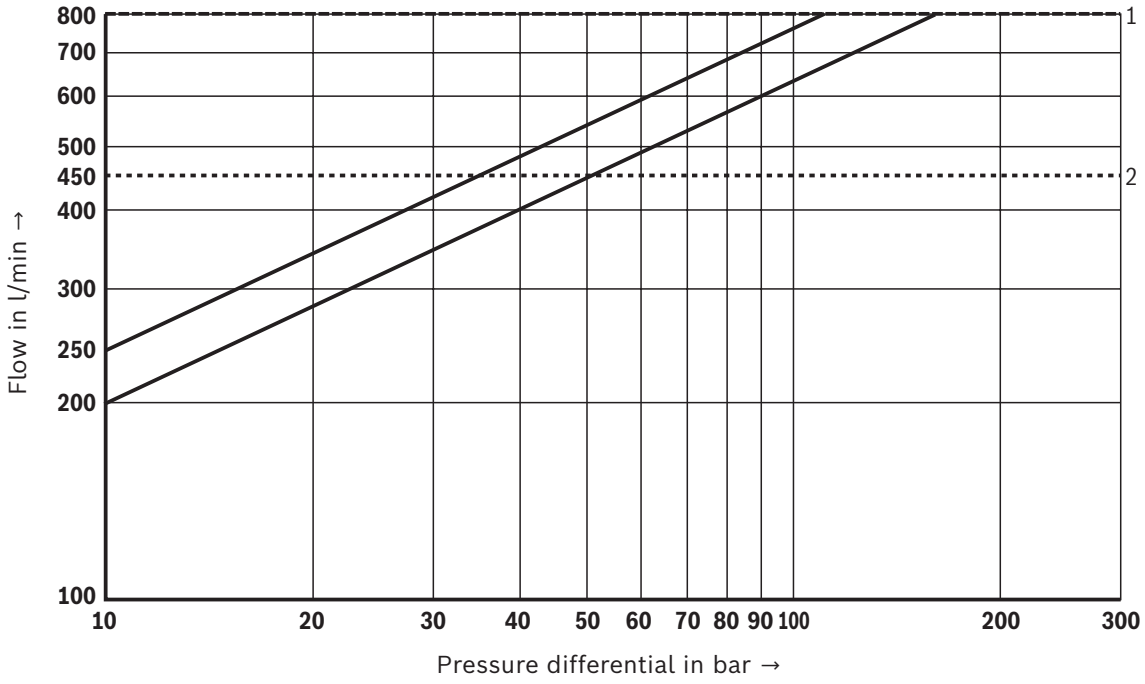
Frequency response



- Signal ±1%
- Signal ±5%
- Signal ±25%
- Signal ±100%

Characteristic curves: Size 16
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Flow/load function (with maximum valve opening; tolerance ±10%)



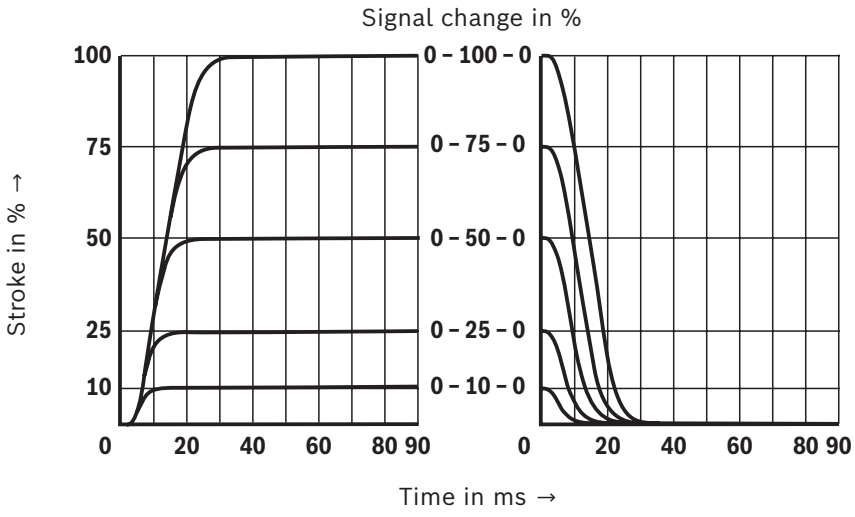
1 Maximum admissible flow

2 Recommended flow limitation
(flow velocity 30 m/s)

Characteristic curves: Size 25
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Transition function with stepped electric input signals

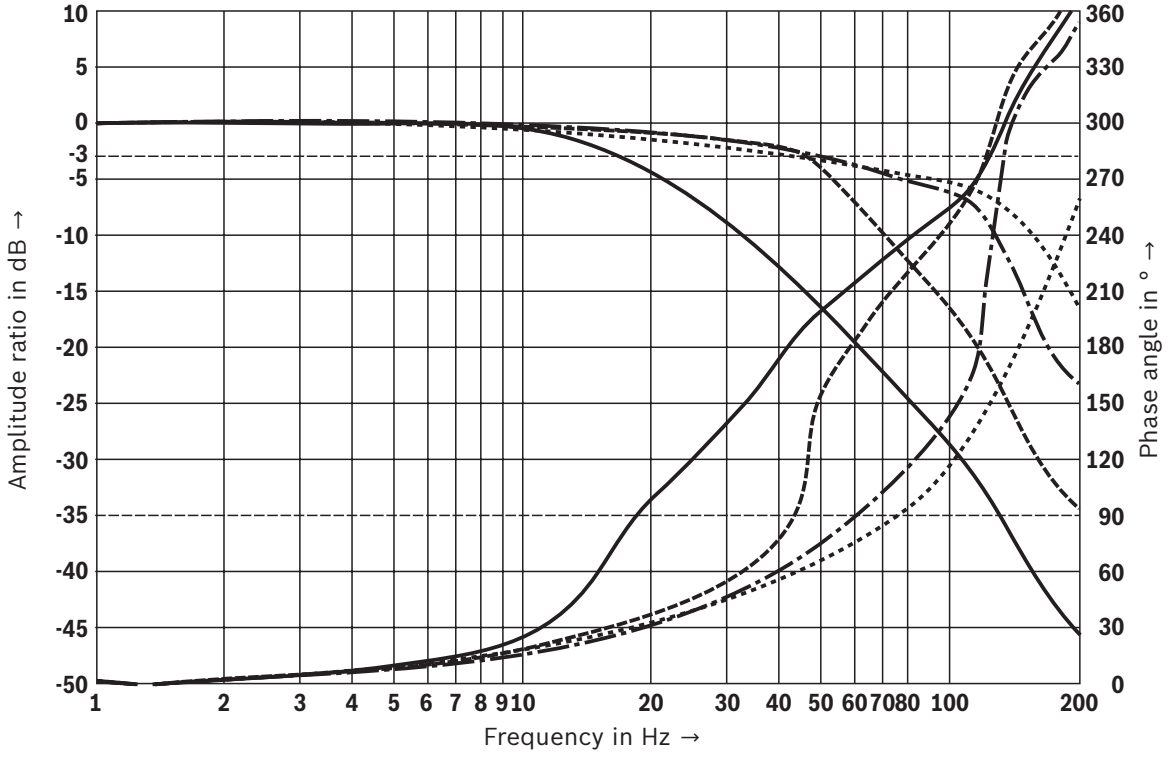
Symbol V



- ▶ Pilot control valve, port X = 100 bar
- ▶ Main valve, port P = 10 bar

Frequency response

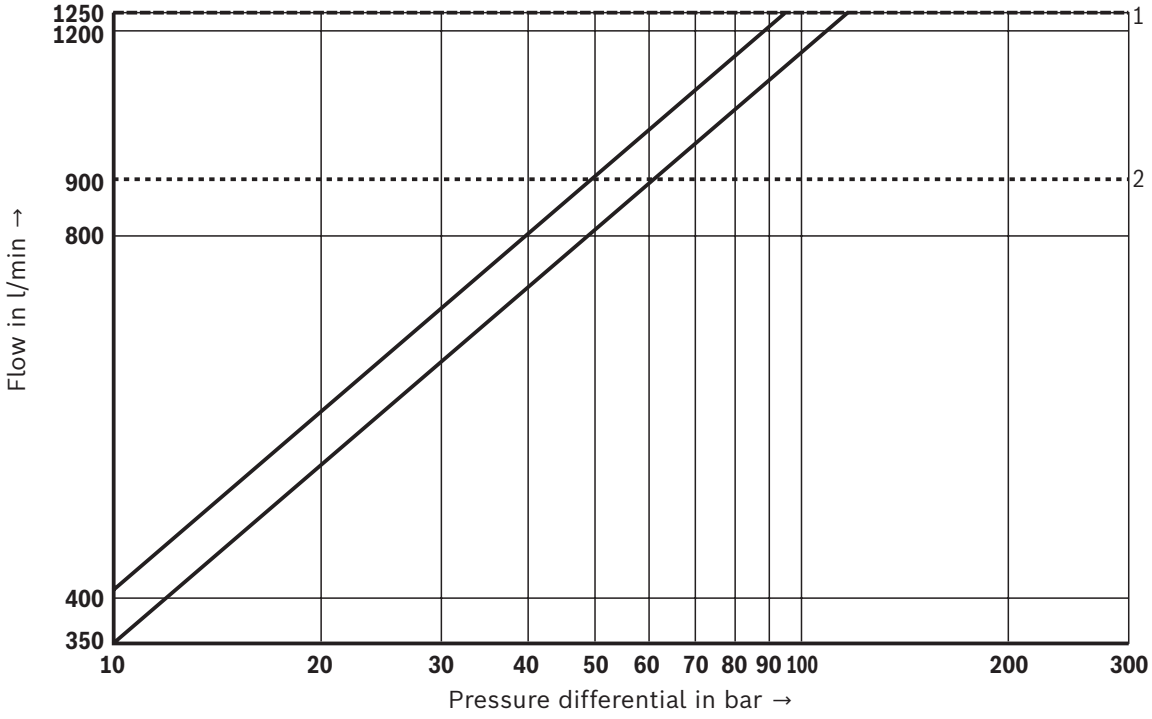
Symbol V



- Signal ±1%
- Signal ±5%
- Signal ±25%
- Signal ±100%

Characteristic curves: Size 25
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

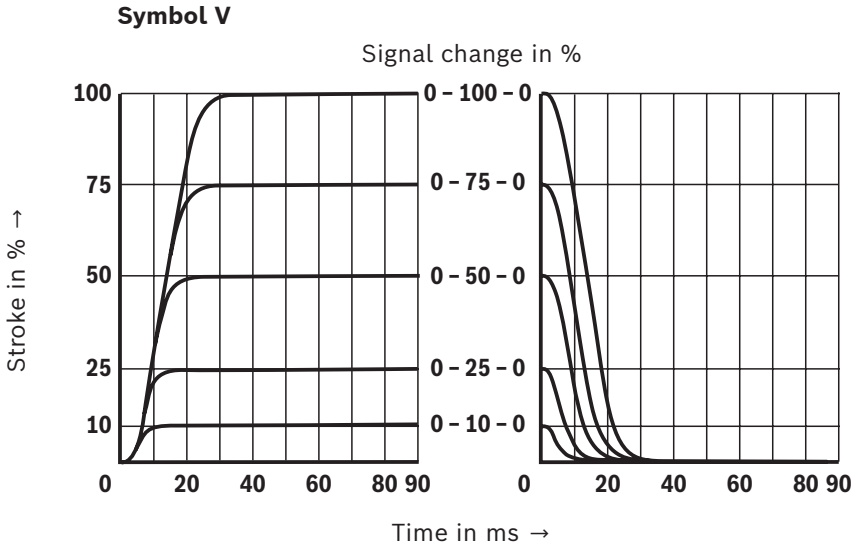
Flow/load function (with maximum valve opening; tolerance ±10%)



1 Maximum flow
2 Recommended flow limitation (flow velocity 30 m/s)

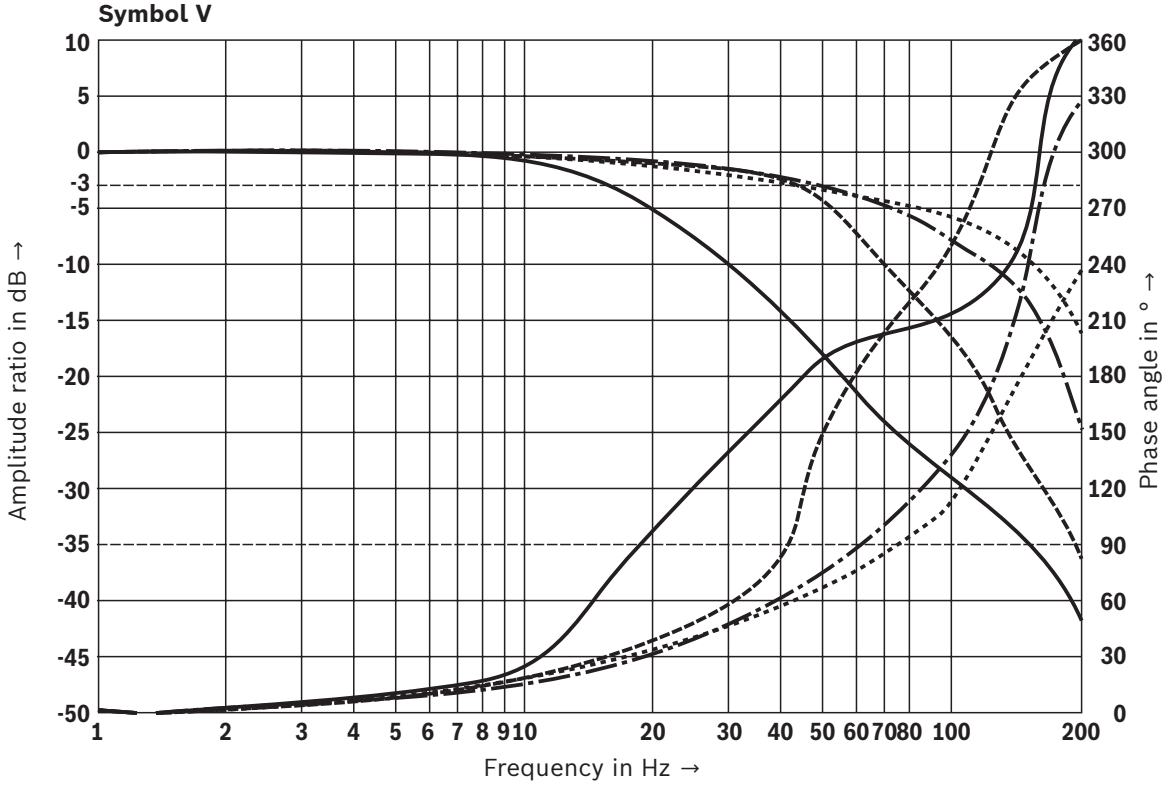
Characteristic curves: Size 27
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Transition function with stepped electric input signals



- ▶ Pilot control valve, port X = 100 bar
- ▶ Main valve, port P = 10 bar

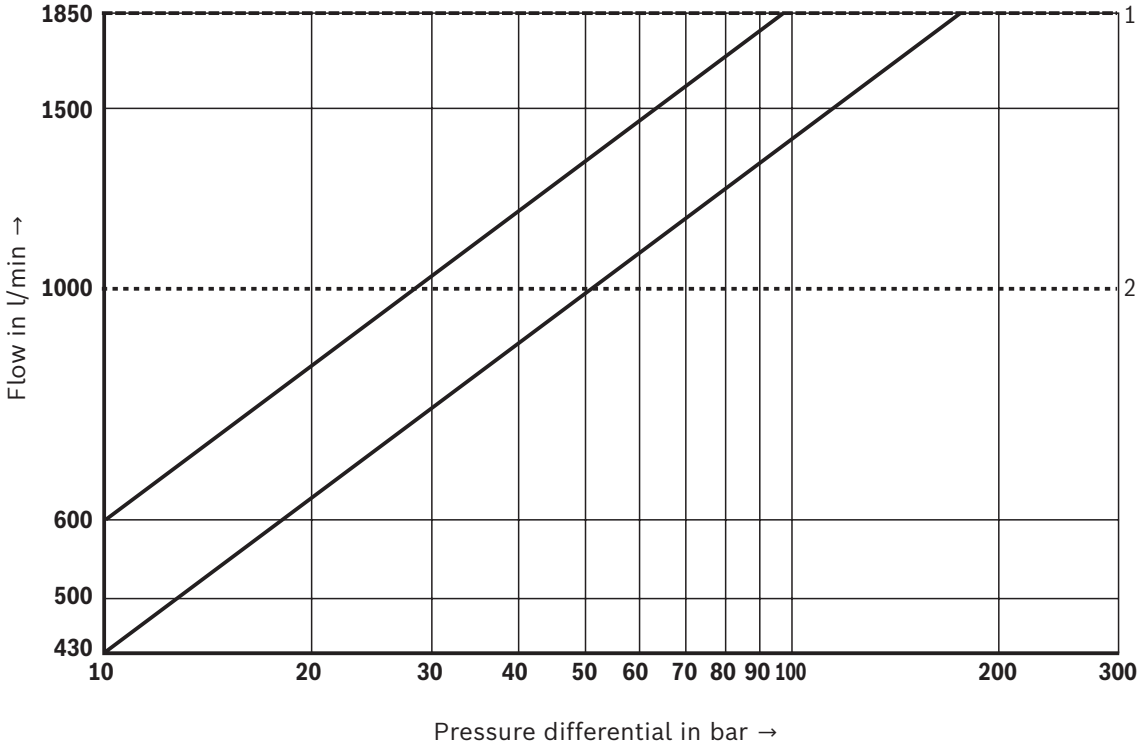
Frequency response



- ------- Signal ±1%
- —·— Signal ±5%
- – – – – Signal ±25%
- ——— Signal ±100%

Characteristic curves: Size 27
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Flow/load function (with maximum valve opening; tolerance ±10%)



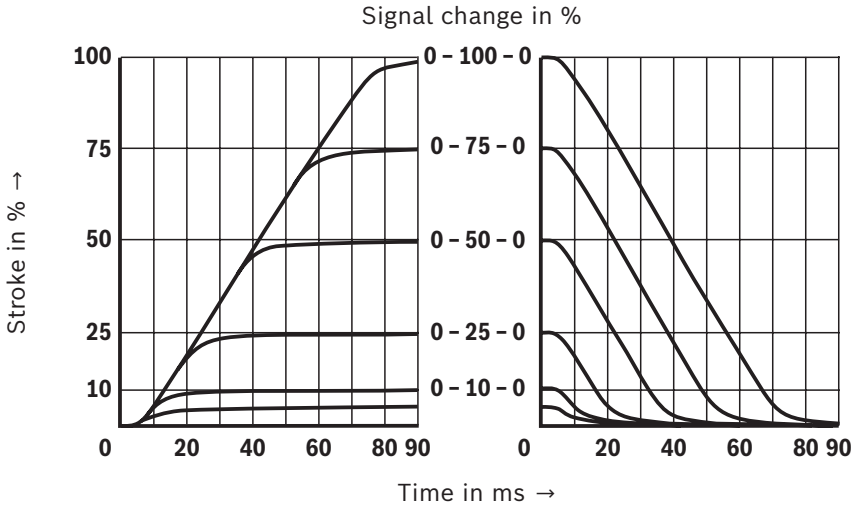
1 Maximum flow

2 Recommended flow limitation
(flow velocity 30 m/s)

Characteristic curves: Size 35
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Transition function with stepped electric input signals

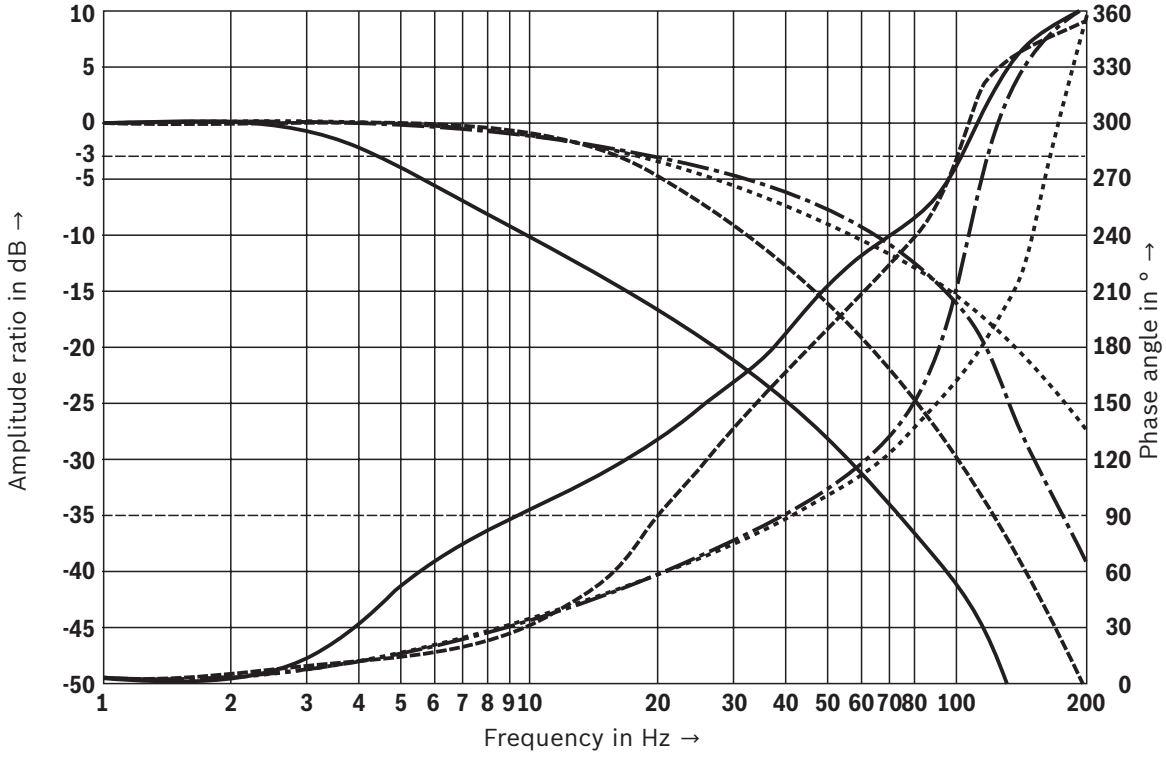
Symbols V and Q3-



- Pilot control valve, port X = 100 bar
- Main valve, port P = 10 bar

Frequency response characteristic curves

Symbols V and Q3-



Signal ±1%

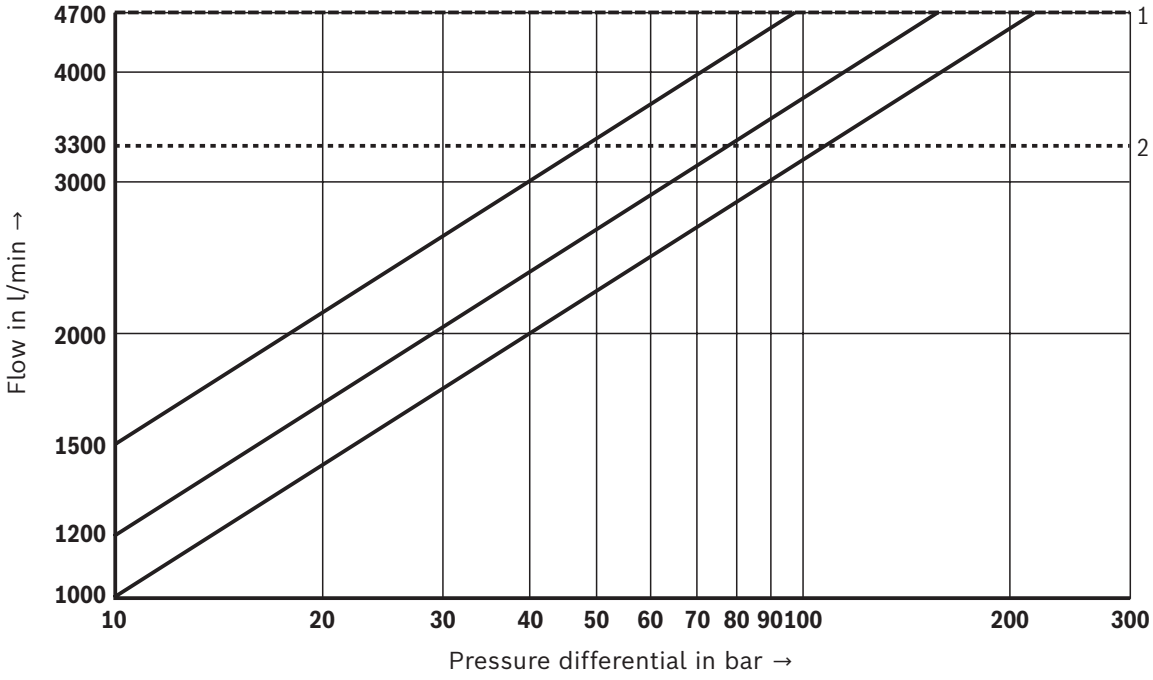
Signal ±5%

Signal ±25%

Signal ±100%

Characteristic curves: Size 35
(valid for HLP46, ϑ_{oil} = 40 ±5 °C)

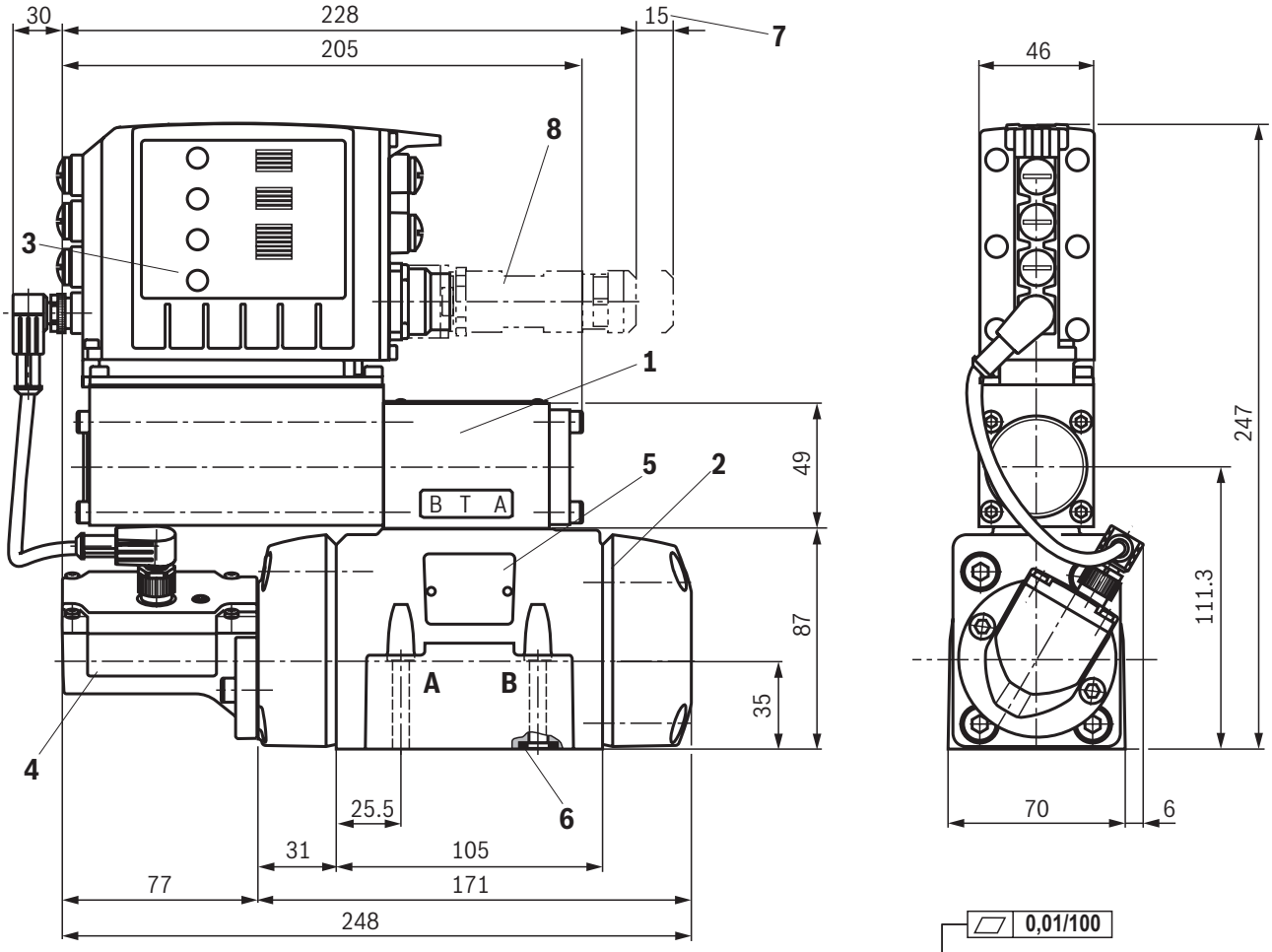
Flow/load function (with maximum valve opening; tolerance ±10%)

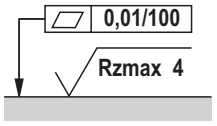


1 Maximum flow

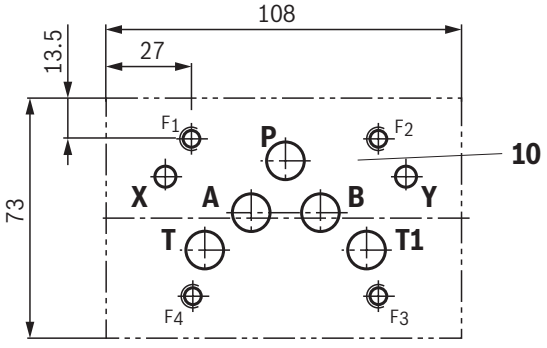
2 Recommended flow
(flow velocity 30 m/s)

Dimensions: Size 10
(dimensions in mm)





Required surface quality of the valve contact surface

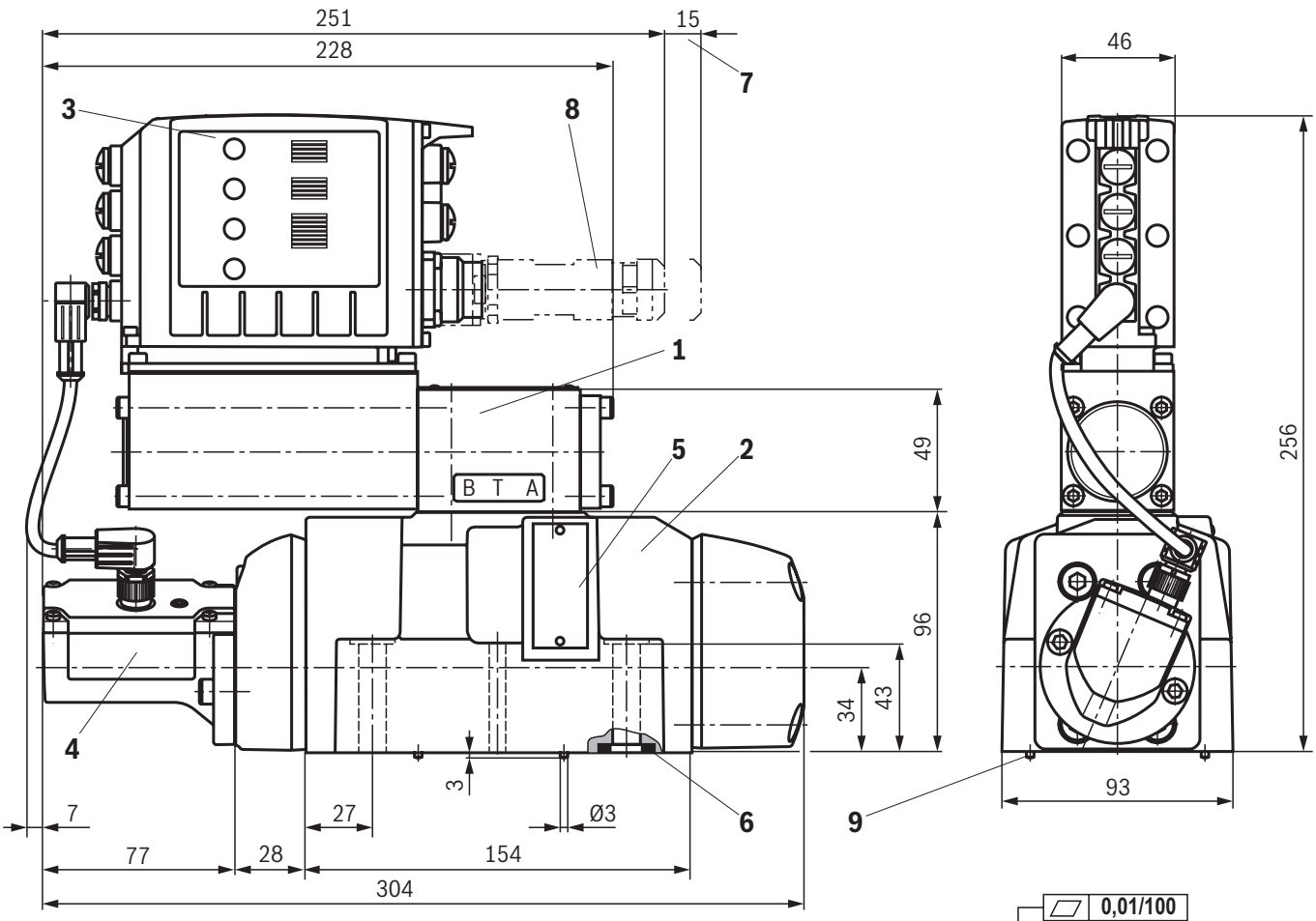


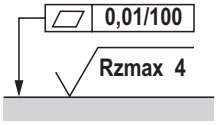
Valve mounting screws and **subplates,** see page 36.

1 Pilot control valve
2 Main valve
3 Integrated electronics (OBE)
4 Inductive position transducer (main valve)
5 Name plate
6 Identical seal rings for ports P, A, B, T
Identical seal rings for ports X, Y
7 Space required for removing the mating connector
8 Mating connectors, separate order, see page 37 and data sheet 08006.
9 Locking pin
10 Machined valve contact surface,
Porting pattern according to ISO 4401-05-05-0-05

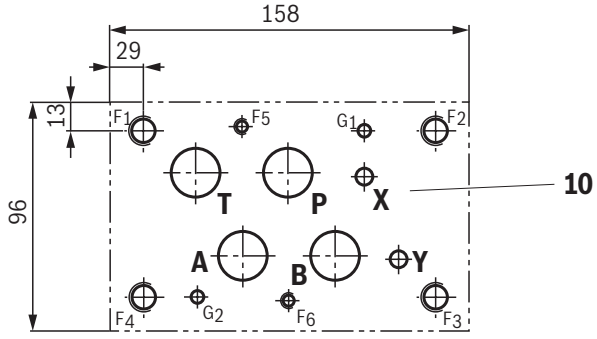
☞ **Notice:**
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions: Size 16
(dimensions in mm)





Required surface quality of the valve contact surface

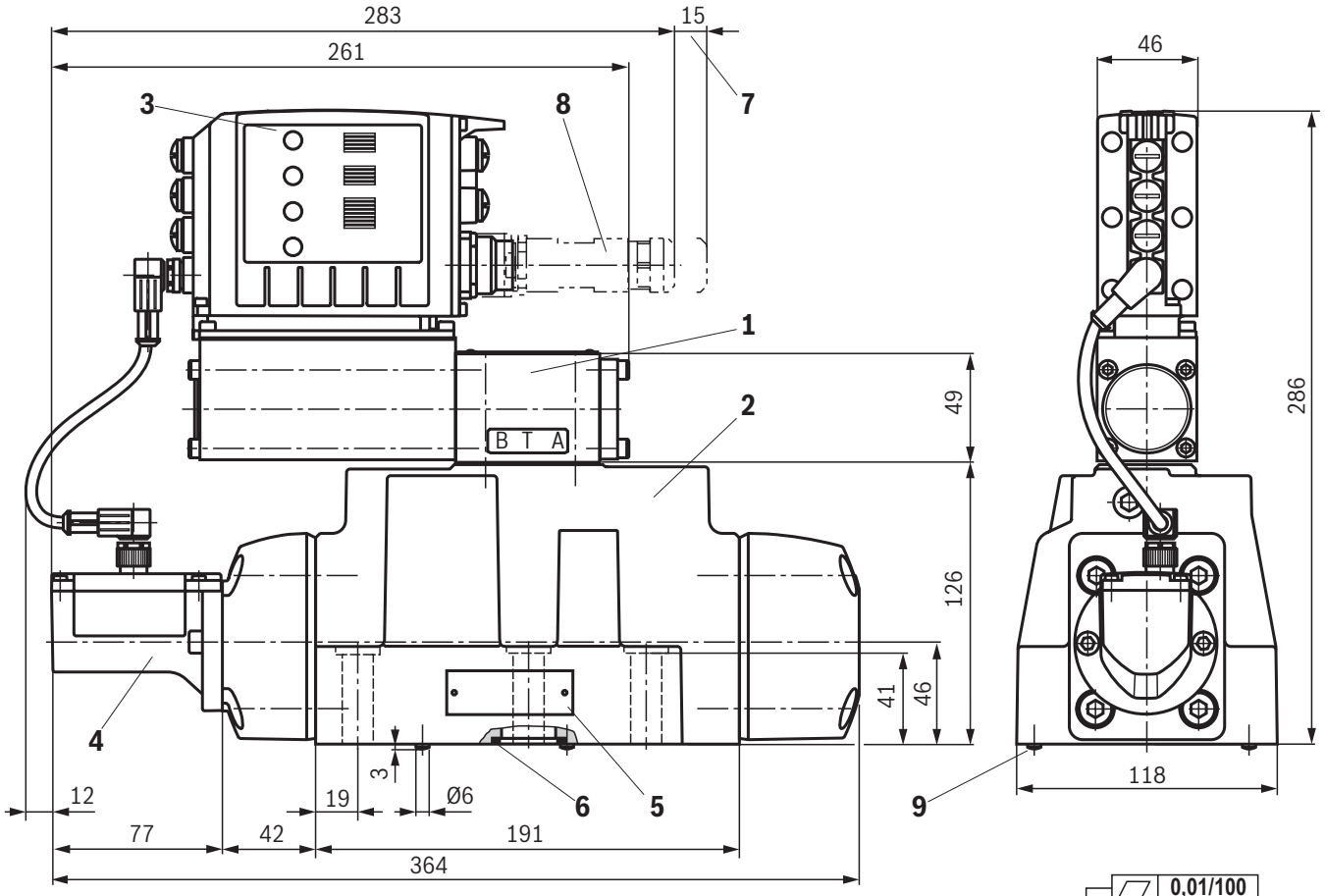


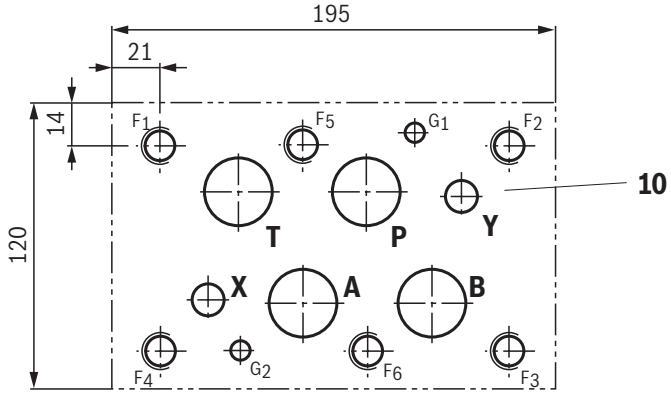
Valve mounting screws and **subplates,** see page 36.

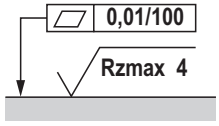
1 Pilot control valve
2 Main valve
3 Integrated electronics (OBE)
4 Inductive position transducer (main valve)
5 Name plate
6 Identical seal rings for ports P, A, B, T
Identical seal rings for ports X, Y
7 Space required for removing the mating connector
8 Mating connectors, separate order, see page 37 and data sheet 08006.
9 Locking pin
10 Machined valve contact surface,
porting pattern according to ISO 4401-07-07-0-05
Deviating from the standard: Ports P, A, B, T – Ø20 mm
Minimum screw-in depth:
- Ferrous metal: 1.5 x Ø
- Non-ferrous metal: 2.0 x Ø

☞ **Notice:**
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions: Size 25
(dimensions in mm)







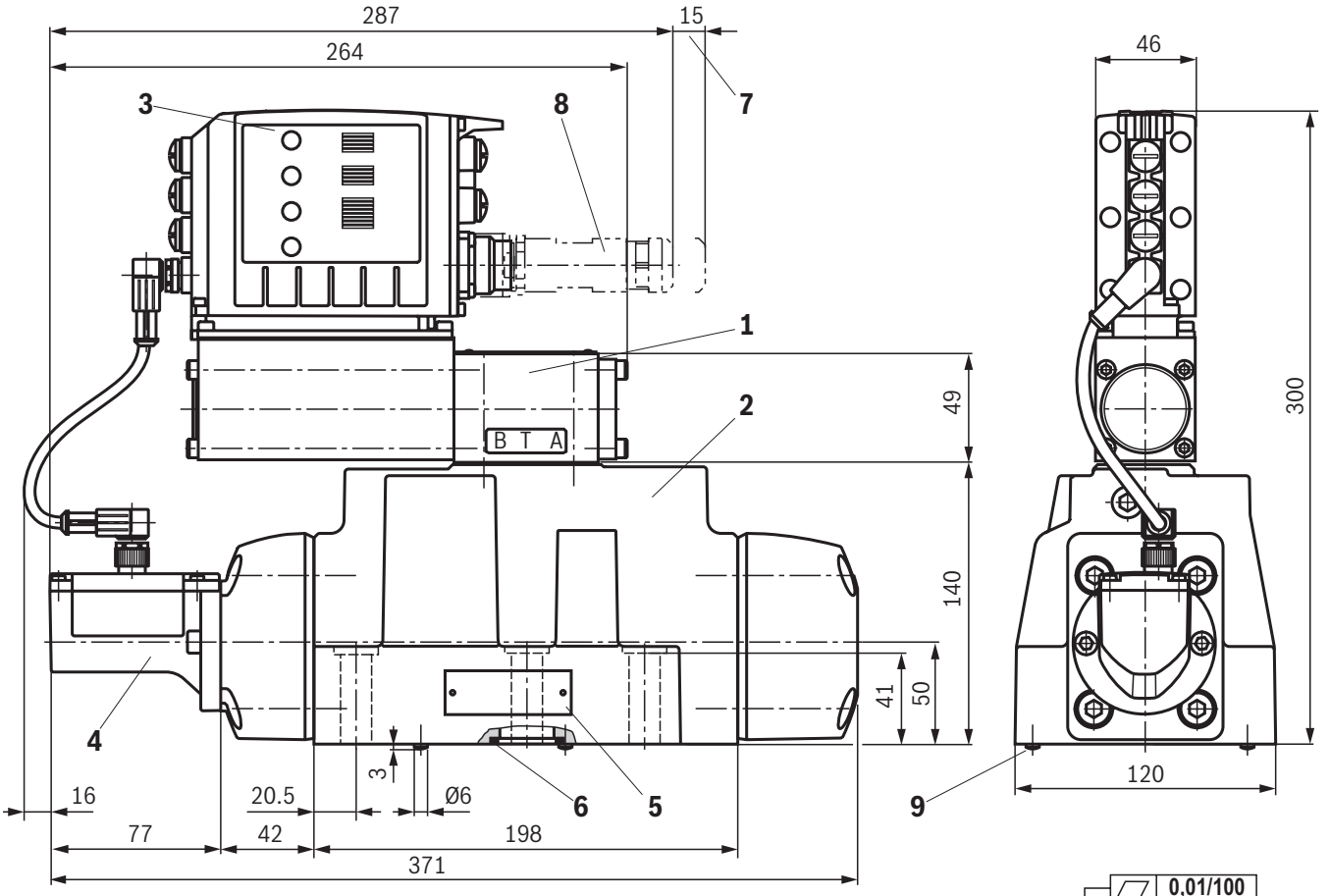
Required surface quality of the valve contact surface

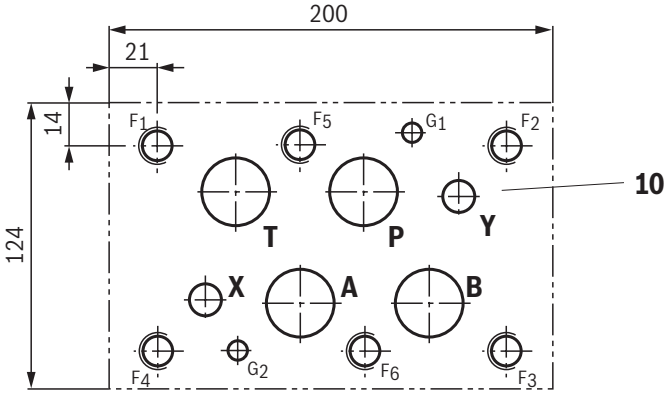
Valve mounting screws and **subplates,** see page 36.

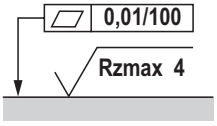
1 Pilot control valve
2 Main valve
3 Integrated electronics (OBE)
4 Inductive position transducer (main valve)
5 Name plate
6 Identical seal rings for ports P, A, B, T
Identical seal rings for ports X, Y
7 Space required for removing the mating connector
8 Mating connectors, separate order, see page 37 and data sheet 08006.
9 Locking pin
10 Machined valve contact surface,
Porting pattern according to ISO 4401-08-08-0-05
Deviating from the standard:
▶ Ports X, Y – Ø14 mm
Minimum screw-in depth:
▶ Ferrous metal: 1.5 x Ø
▶ Non-ferrous metal: 2.0 x Ø

☞ **Notice:**
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions: Size 27
(dimensions in mm)







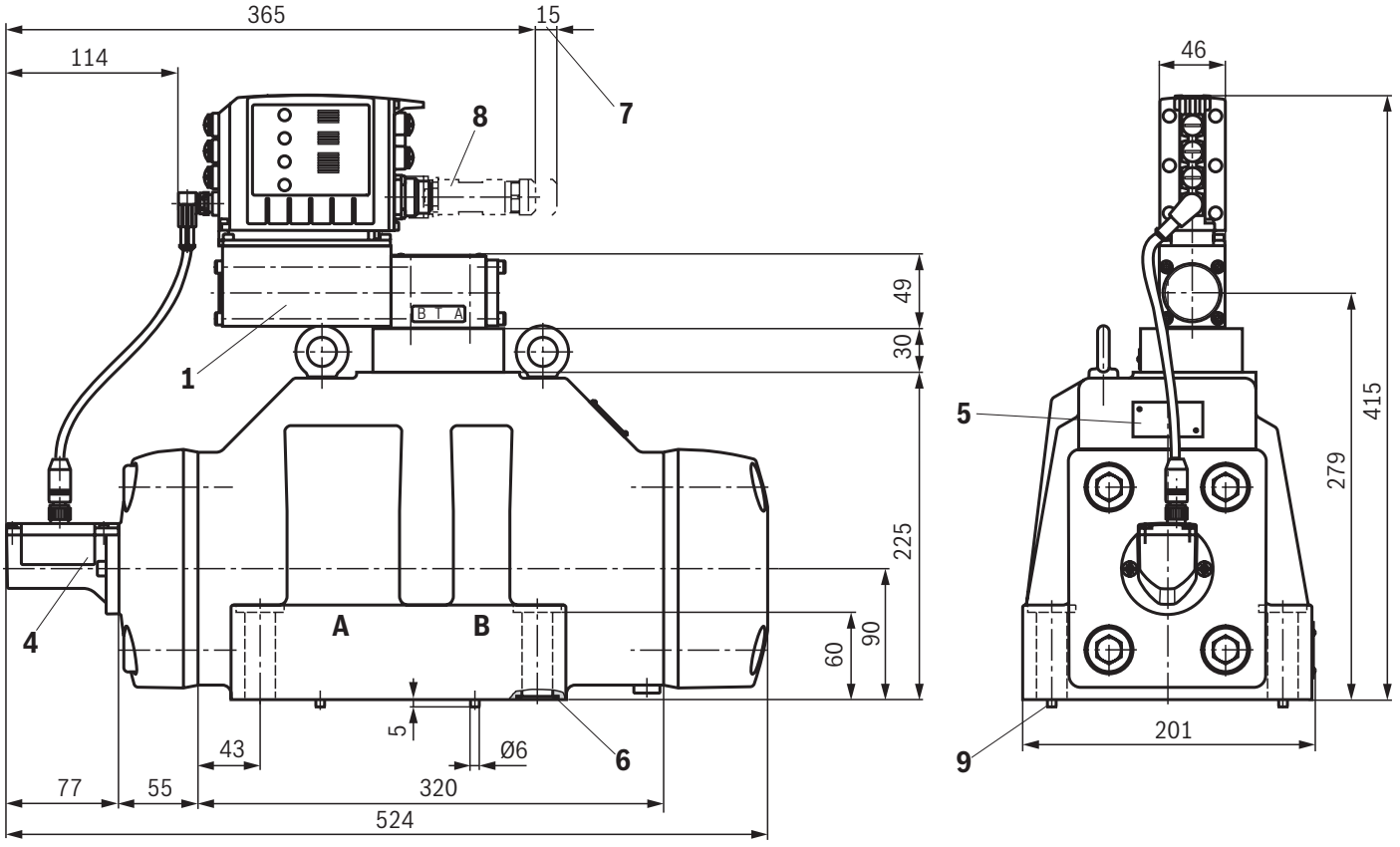
Required surface quality of the valve contact surface

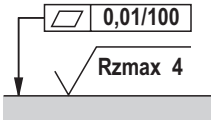
Valve mounting screws and **subplates,** see page 36.

1 Pilot control valve
2 Main valve
3 Integrated electronics (OBE)
4 Inductive position transducer (main valve)
5 Name plate
6 Identical seal rings for ports P, A, B, T
Identical seal rings for ports X, Y
7 Space required for removing the mating connector
8 Mating connectors, separate order, see page 37 and data sheet 08006.
9 Locking pin
10 Machined valve contact surface,
Porting pattern according to ISO 4401-08-08-0-05
Deviating from the standard:
▶ Ports P, A, B, T – Ø32 mm
Minimum screw-in depth:
▶ Ferrous metal: 1.5 x Ø
▶ Non-ferrous metal: 2.0 x Ø

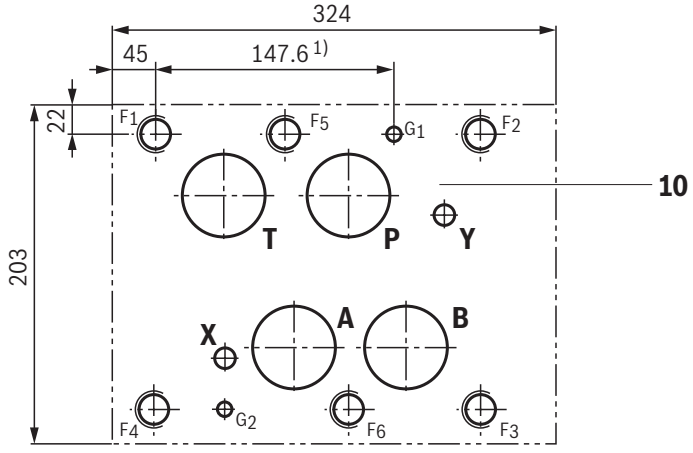
☞ **Notice:**
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions: Size 35
(dimensions in mm)





Required surface quality of the valve contact surface



Valve mounting screws and **subplates,** see page 36.

1 Pilot control valve
2 Main valve
3 Integrated electronics (OBE)
4 Inductive position transducer (main valve)
5 Name plate
6 Identical seal rings for ports P, A, B, T
Identical seal rings for ports X, Y
7 Space required for removing the mating connector
8 Mating connectors, separate order, see page 37 and data sheet 08006.
9 Locking pin
10 Machined valve contact surface,
Porting pattern according to ISO4401-10-09-0-05
Deviating from the standard:
Ports P, A, B, T – Ø50 mm
1) Position G1 according to DIN 24340 Form A

Notice:
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions

Valve mounting screws (separate order)

Size	Quantity	Hexagon socket head cap screws	Material number
10	4	**ISO 4762 - M6 x 45 - 10.9-CM-Fe-ZnNi-5-Cn-T0-H-B** Tightening torque M_A = 13.5 Nm ±10%	**R913043777**
	or		
	4	**ISO 4762 - M6 x 45 - 10.9** Tightening torque M_A = 15.5 Nm ±10%	Not included in the Rexroth delivery range
16	2	**ISO 4762 - M6 x 60 - 10.9-flZn-240h-L** Tightening torque M_A = 12.2 Nm ±10%	**R913000115**
	4	**ISO 4762 - M10 x 60 - 10.9-flZn-240h-L** Tightening torque M_A = 58 Nm ±20%	**R913000116**
	or		
	2	**ISO 4762 - M6 x 60 - 10.9** Tightening torque M_A = 15.5 Nm ±10%	Not included in the Rexroth delivery range
	4	**ISO 4762 - M10 x 60 - 10.9** Tightening torque M_A = 75 Nm ±20%	
25, 27	6	**ISO 4762 - M12 x 60 - 10.9-flZn-240h-L** Tightening torque M_A = 100 Nm ±20%	**R913000121**
	or		
	6	**ISO 4762- M12 x 60 - 10.9** Tightening torque M_A = 130 Nm ±20%	Not included in the Rexroth delivery range
35	6	**ISO 4762 - M20 x 90 - 10.9-flZn/nc/480h/C** Tightening torque M_A = 465 Nm ±20%	**R913009160**
	or		
	6	**ISO 4762 - M20 x 90 - 10.9** Tightening torque M_A = 610 Nm ±20%	Not included in the Rexroth delivery range

☞ **Notices:**

- The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure.
- **When replacing component series 3X with 4X, only the valve mounting screws listed here may be used. Prior to assembly, check the existing mounting bore on the block for sufficient screw-in depth.**

Subplates (separate order) with porting pattern according to ISO 4401, see data sheet 45100.

Accessories (separate order)

Mating connectors and cable sets

Port	Designation	Version	Short designation	Material number	Data sheet
XH2	Mating connector; for valves with round connector, 11-pole + PE	Metal, shielded	12PN11... EMC	**R901268000**	08006
		Plastic, two cable outlets	12PN11...2XD8	**R900884671**	
	Cable sets; for valves with round connector, 11-pole + PE	Metal, shielded, 5 m	12PN11REFS EMV...BG	**R901272854**	
		Metal, shielded, 20 m		**R901272852**	
		Plastic, shielded, 5 m	12PN11REFF 2X...	**R900032356**	
		Plastic, shielded, 20 m		**R900860399**	
X7E1, X7E2	Cable set; shielded, 4-pole, D coding	Straight connector M12, on straight connector M12, line cross-section 0.25 mm², CAT 5e, length freely selectable (= xx.x)	–	**R911172111** [1]	–
	Cable set; shielded, 4-pole	Straight connector M12, on straight connector RJ45, line cross-section 0.25 mm², CAT 5e, length freely selectable (= xx.x)	–	**R911172135** [2]	–
X2M1, X2M2	Cable set; shielded, 5-pole, for connecting Rexroth pressure sensors, type HM20, A coding	PUR/PVC, straight connector M12, on straight socket M12, line cross-section 0.34 mm², 0.6 m	–	**R901111709**	–
		PUR/PVC, straight connector M12, on straight socket M12, line cross-section 0.34 mm², 1.0 m	–	**R901111712**	–
		PUR/PVC, straight connector M12, on straight socket M12, line cross-section 0.34 mm², 2.0 m	–	**R901111713**	–
	Cable set; shielded, 5-pole, A coding	Straight connector M12, on free line end, line cross-section 0.34 mm², 1.5 m	–	**R901111752**	–
		Straight connector M12, on free line end, line cross-section 0.34 mm², 3.0 m	–	**R901111754**	–
		Straight connector M12, on free line end, line cross-section 0.34 mm², 5.0 m	–	**R901111756**	–
		Straight connector M12, on free line end, line cross-section 0.34 mm², 10.0 m	–	**R913005147**	–
	Plug-in connector; 5-pole, M12 x 1, pins, A-coding	Metal (cable diameter 4 ... 6 mm2)	–	**R901075542**	–
X8M	Cable set; Shielded, 8-pole, A coding (only SSI, 1Vss) [3]	Straight connector M12, on free line end, line cross-section 0.25 mm², 10 m	–	**R913002641**	–

1) Additional indication of type designation RKB0040/xx.x
2) Additional indication of type designation RKB0044/xx.x
3) **Recommendation:** If an EnDat 2.2 sensor is used, please refer to the sensor manufacturer Heidenhain with respect to a cable set.

☞ **Notices:**
- Tighten the M12 connector with a manual torque wrench by 1 Nm.
- Self-locking M12 cables must be used.
- It must be ensured that cables are secured without radial forces.
- All cables connected to XH1, X7E1 and X7E2 must be bundled in a wire harness after 20cm the latest. The wire harness must be fixed after further 20 ... 30cm. Make sure that there is no relative motion between the fixation and the valve.
- Before the fixation point, there must not be any cable loops.
- In general, the information on installation provided by the cable manufacturers must be observed.
- Respectively, the cables of X2M1, X2M2 and X8M, if used, are also fixed as described above.
- For further information, see operating instructions 29391-B

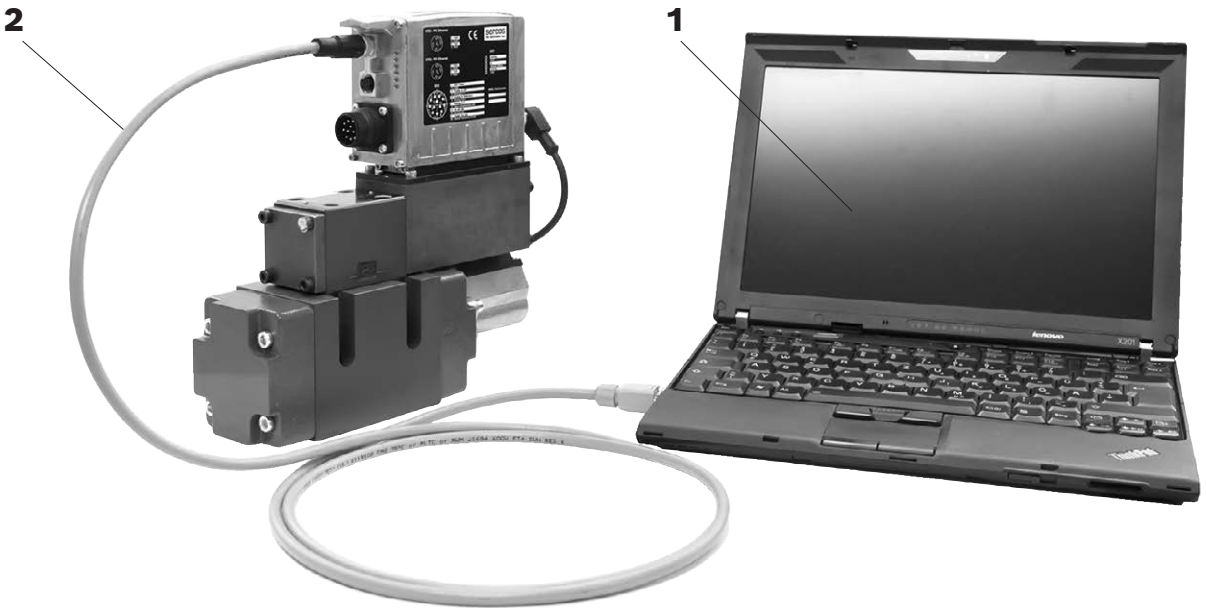
Accessories (separate order)

Protective cap

Protective cap M12	Version	Material number
		**R901075563**

Parameterization

The following is required for the parameterization with PC		Material number/download
1 Commissioning software	IndraWorks, Indraworks D, Indraworks DS	www.boschrexroth.com/IAC
2 Connection cable, 3 m	Shielded, M12 on RJ45, length can be freely selected (= xx.x)	**R911172135** (additional indication of type designation RKB0044/xx.x)



Project planning and maintenance instructions

- The supply voltage must be permanently connected; otherwise, bus communication is not possible.
- If electro-magnetic interference is to be expected, take appropriate measures to ensure the function (depending on the application, e.g. shielding, filtration).
- The devices have been tested in the plant and are supplied with default settings.
- Only complete devices can be repaired. Repaired devices are returned with default settings. User-specific settings will not be applied. The machine end-user will have to retransfer the corresponding user parameters.

Further information

▶ Directional control valve with integrated digital axis controller (IAC-Multi-Ethernet, component series 2X)	Data sheet 29391 and 29391-B
▶ CE Declaration of Conformity	Upon request
▶ Subplates	Data sheet 45100
▶ Hydraulic fluids on mineral oil basis	Data sheet 90220
▶ Environmentally compatible hydraulic fluids	Data sheet 90221
▶ Flame-resistant, water-free hydraulic fluids	Data sheet 90222
▶ Flame-resistant hydraulic fluids - containing water (HFAE, HFAS, HFB, HFC)	Data sheet 90223
▶ Hexagon socket head cap screw, metric/UNC	Data sheet 08936
▶ Hydraulic valves for industrial applications	Data sheet 07600-B
▶ General product information on hydraulic products	Data sheet 07008
▶ Installation, commissioning and maintenance of servo valves and high-response valves	Data sheet 07700
▶ Assembly, commissioning and maintenance of hydraulic systems	Data sheet 07900
▶ Operation IAC-Multi-Ethernet electronics (xx = software version): – Functional description Rexroth HydraulicDrive HDx-xx – Parameter description Rexroth HydraulicDrive HDx-xx – Description of diagnosis Rexroth HydraulicDrive HDx-xx	
▶ Commissioning software and documentation on the Internet	www.boschrexroth.com/IAC
▶ Selection of filters	www.boschrexroth.com/filter
▶ Information on available spare parts	www.boschrexroth.com/spc

Notes

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Bosch Rexroth AG, RE 29289, edition: 2021-05