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

Type 4WRLD

RE 29289
Edition: 2017-09
Replaces:
2016-05
and 29288



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 little 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

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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**

Symbols

05	Possible versions 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

10	NBR seals	**M**
	FKM seals	**V**
	Observe compatibility of seals with hydraulic fluid used! (other seals on request)	

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**

[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**		*****

12	Supply voltage 24 V	**24**

Ethernet interface

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

Electrical interface

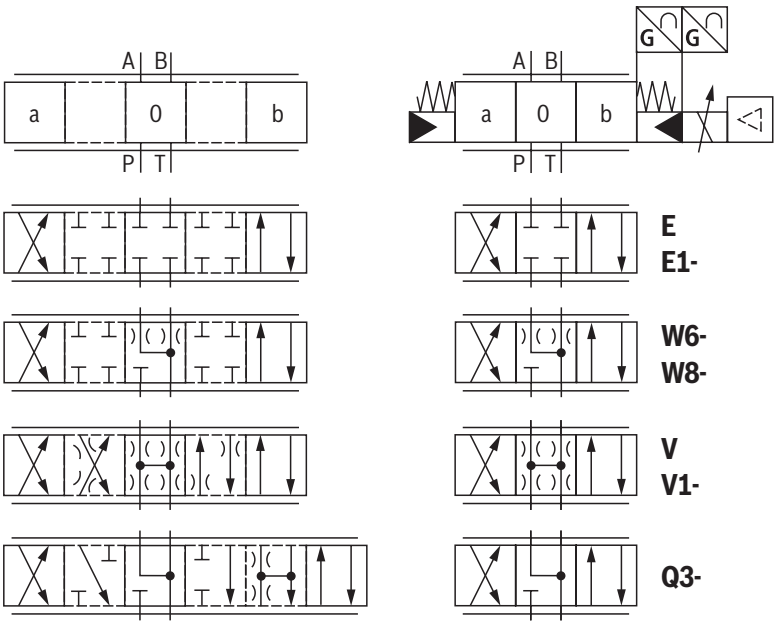
14	±10 VDC or 4 ... 20 mA	**D6**

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/1Vss	**U**

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

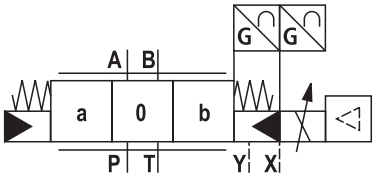
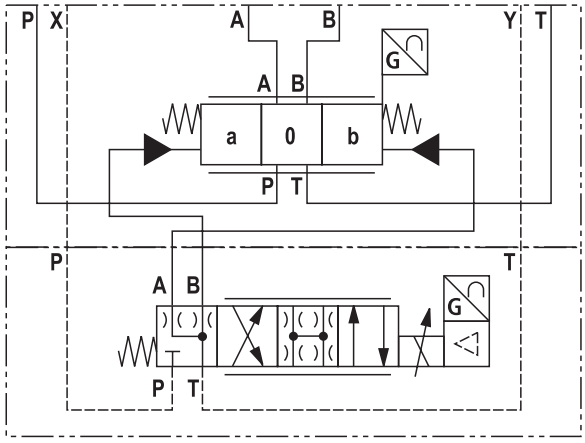
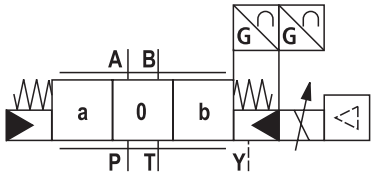
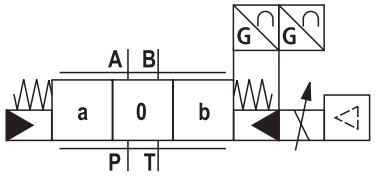
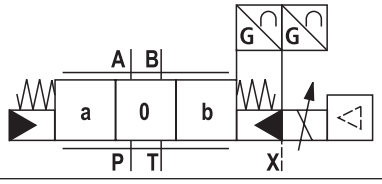
Symbols



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:

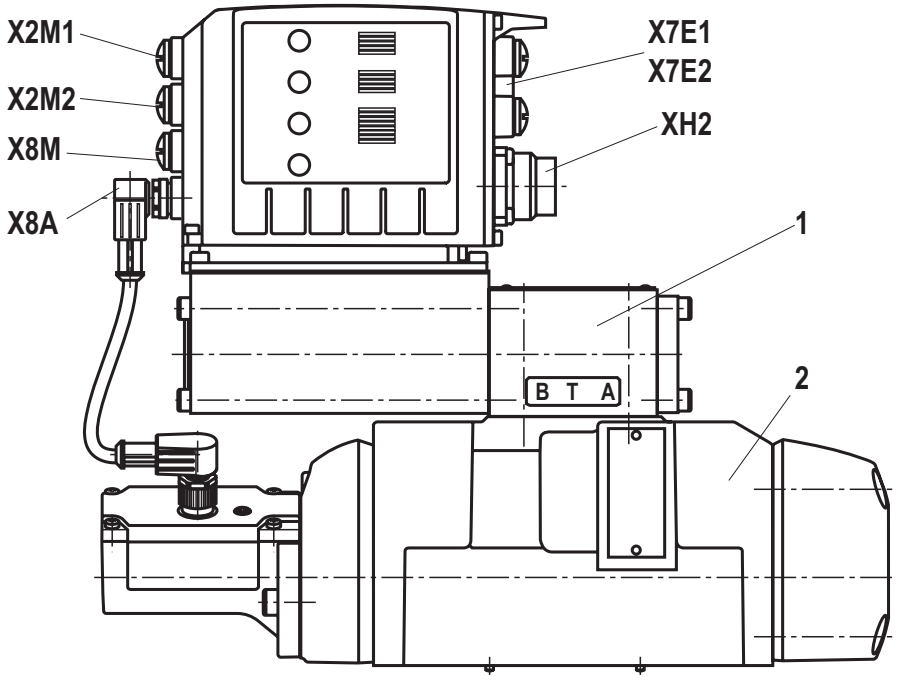
- Valve direct control
- Drive-controlled position control
- Drive-controlled positioning
- Positioning block operation

- 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.

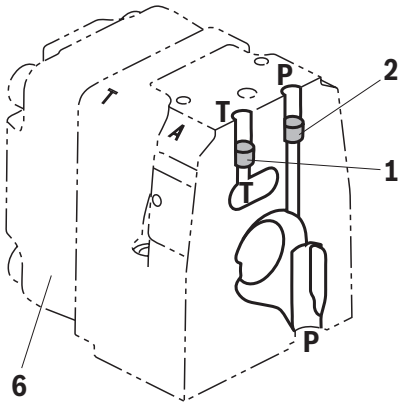
Monitoring
The digital control electronics enable comprehensive monitoring functions/error detection including:
- Undervoltage
- Communication error
- Cable break for analog sensor inputs and digital position measurement system
- Short-circuit monitoring for analog/digital outputs
- Monitoring of the 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 management of all data on a PC
- PC operating systems: Windows XP (SP3), Windows 7-10

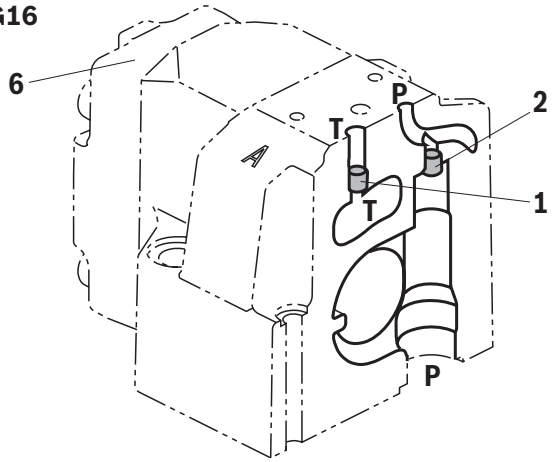
☞ **Notes:**
- Symbol V and V1-:
  Pilot-operated 4/3 directional control valves are only functional in the active control loop and do not have a locking basic position when deactivated. Thus, "external isolator valves" are necessary in many applications and have to be considered in the switch-on/switch-off 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 deactivated condition 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)

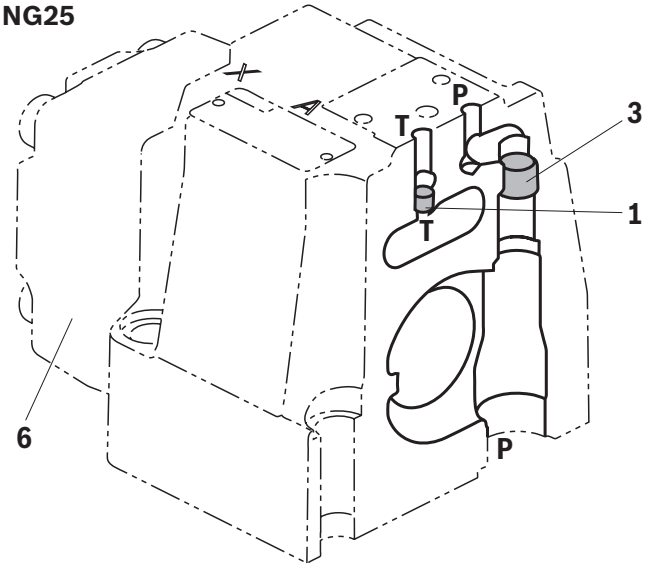
NG10



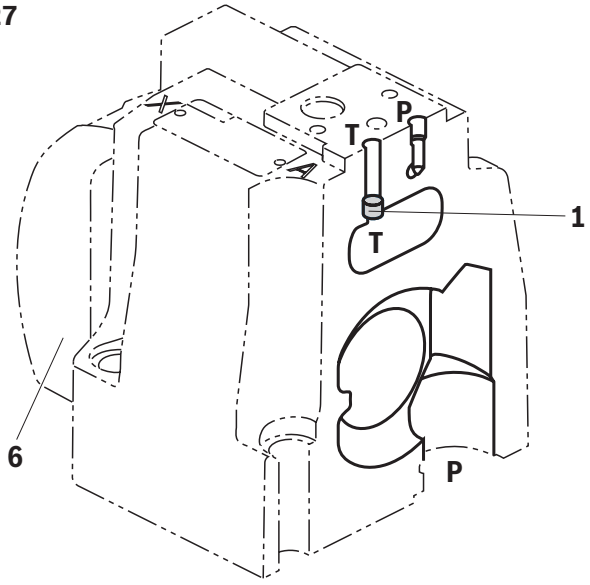
NG16



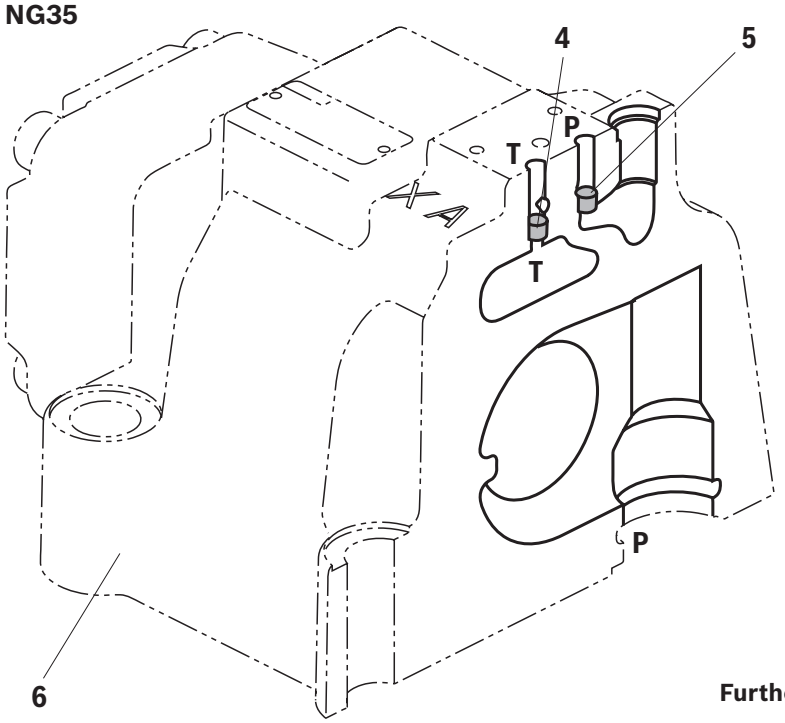
NG25



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 DIN 906, wrench size 6 – pilot oil supply

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

5 Plug screw 1/16-27 NPTF, wrench size 4 – 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 (internally).
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 (internally).
The pilot oil is directly returned to channel T of the main valve (internally).
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 (internally).
In the subplate, port Y is to be closed.

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

general							
Size		NG	10	16	25	27	35
Installation position			any				
Ambient temperature range		°C	–20 ... +60				
Maximum storage time		Years	1 (if the storage conditions are observed; refer to the operating instructions 07600-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				
Weight		kg	9	12	19	21	80
Maximum relative humidity (no condensation)		%	95				
Maximum solenoid surface temperature		°C	120 (individual operation)				
$MTTF_d$ 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)				

Technical data

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

hydraulic											
Size		NG	10		16		25		27		35
Maximum operating pressure	▶ Port 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
Minimum pilot pressure (pilot control valve)		bar	10								
Maximum flow		l/min	300		800		1250		1850		4700
Rated flow (***Δp*** = 5 bar/control edge) [1]		l/min	60/100		200/250		350/400		430/600		1000/1200/1500
Pilot oil 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 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
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
Hydraulic fluid			see table page 10									
Viscosity range	▶ recommended	mm^2/s	30 ... 45									
	▶ maximum admissible	mm^2/s	20 ... 380									
Hydraulic fluid temperature range (flown-through)		°C	–20 ... +70									
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [3]									

[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 parameters, 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	NBR, 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		
	▶ Containing water	HFC (Fuchs Hydrotherm 46M, Petrofer Ultra Safe 620)	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 40 K higher than the maximum solenoid surface temperature.
- ▶ **Flame-resistant – containing water**:
  - – Maximum operating pressure 210 bar, otherwise increased cavitation erosion
  - – Life cycle as compared to operation with mineral oil HL, HLP 30 ... 100%
  - – Maximum hydraulic fluid temperature 60 °C
- ▶ **Bio-degradable and flame-resistant:** When using hydraulic fluids that are simultaneously zinc-solving, zinc may accumulate (700 mg zinc per pole tube).

static / dynamic							
Size		NG	10	16	25	27	35
Hysteresis		%	< 0.1				
Response sensitivity		%	< 0.05				
Range of inversion		%	< 0.08				
Manufacturing tolerance q_{Vmax}		%	≤ 10				
Actuating time for 0 ... 100% at X = 100 bar	▶ Symbol E, E1-, W6-, W8-	ms	40	60	60	60	90
Switch-off behavior (after electrical shut-off)	▶ Symbol 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)				
Temperature drift (temperature range 20 °C ... 80 °C)		%/10 °C	Zero shift < 0.25				
Zero compensation			Ex plant ±1%				

electrical, integrated electronics (OBE)			
Relative duty cycle		%	100 (continuous operation)
Protection class according to EN 60529			IP 65 with mounted and locked plug-in connectors
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 value)
Current consumption	▶ Maximum [6]	A	2.5
	▶ Impulse current	A	4

[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] The maximum current consumption will increase when using the sensor inputs or the switching output according to the external load

Technical data

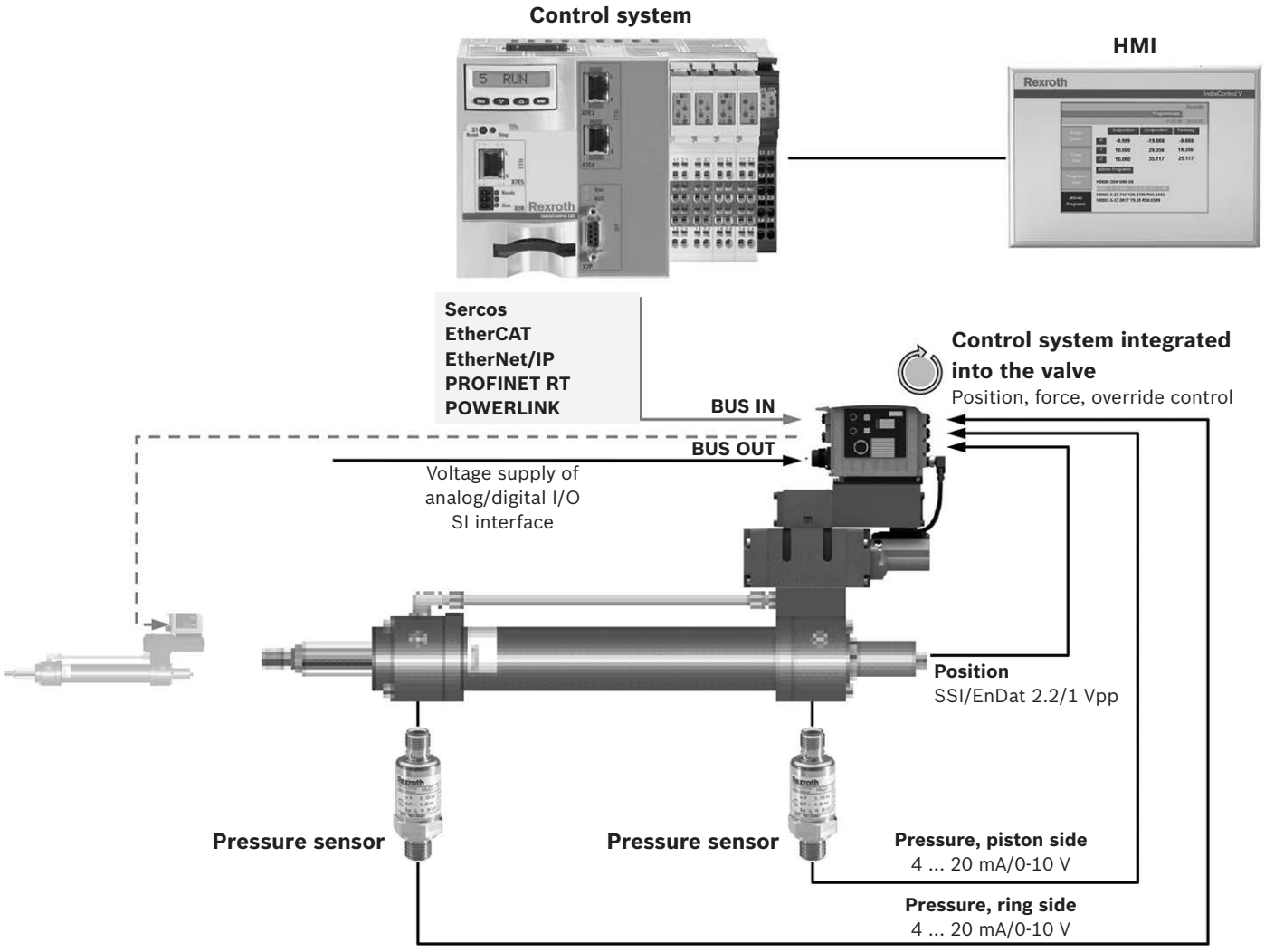
(For applications outside these parameters, please consult us!)

electrical, integrated electronics (OBE)			
Maximum power consumption		W	40
AD/DA resolution	▶ Analog inputs		12 bit
	▶ Analog output		12 bit
Protective grounding conductor and screening			see connector pin assignment (CE-compliant installation) page 15 and 16
Required fuse protection, external		A	4, time-lag
Adjustment			calibrated in the plant, see characteristic curves page 18 ... 30
Conformity			CE according to EMC Directive 2014/30/EU tested according to EN 61000-6-2 and EN 61000-6-3
Parameterization interface			Ethernet
Scan time pressure and force controller (minimum)		msec	0.5
Scan time position controller (minimum)		msec	1
Booting time		sec	< 15
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	msec	< 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
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

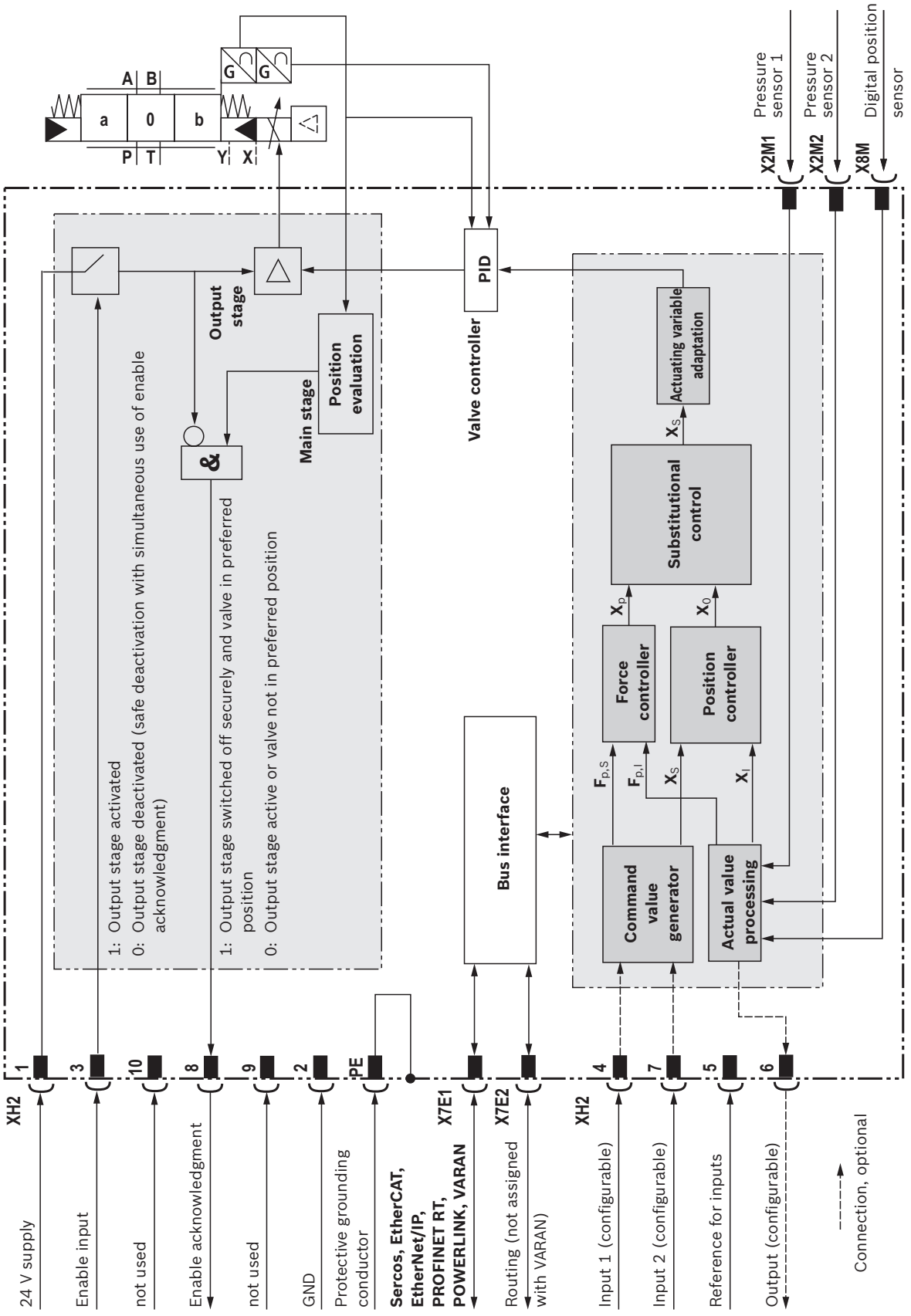
Technical data
(For applications outside these parameters, please consult us!)

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.

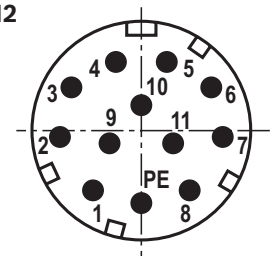
Electrical connections, assignment

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 value 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

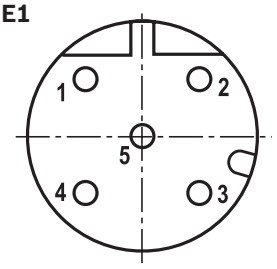
XH2



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

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

X7E1

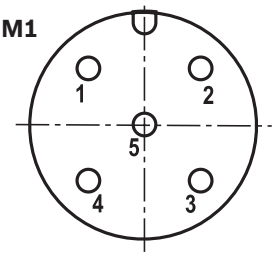


Analog configurable sensor interfaces, connections "X2M1", "X2M2" (coding A), M12, 5-pole, socket

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

X2M1

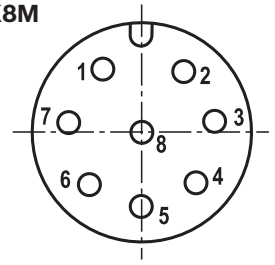


Electrical connections, assignment

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 –

X8M



1) Pins 2, 8 and 1, 5 have the same assignment each

2) Supported resolution ≥ 10 nm

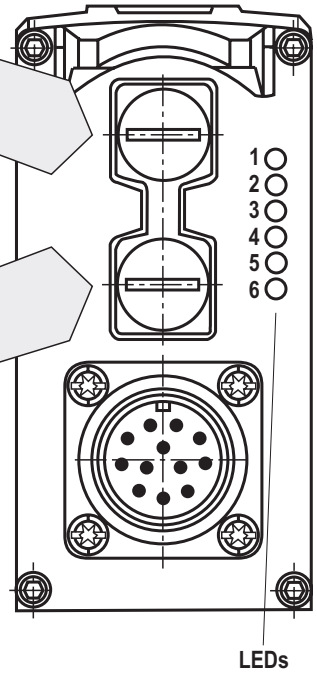
3) A load increases the current consumption of the valve (pin 1 on the connector XH2)

☞ **Notes:**

- 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
Off	No voltage supply
Green-red, flashing	Initialization
Green, flashing	Drive ready for operation
Green	Drive active
Orange, flashing	Warning
Red, flashing	Error

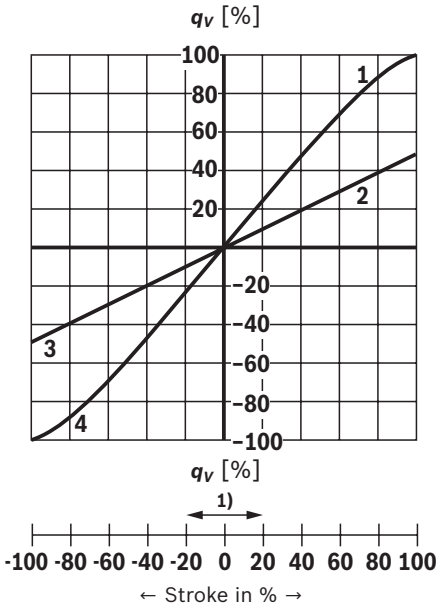
Network status LED (LED 3)	Display status
Off	No voltage supply
Green	Operation

☞ **Notes:**
- ▶ 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.

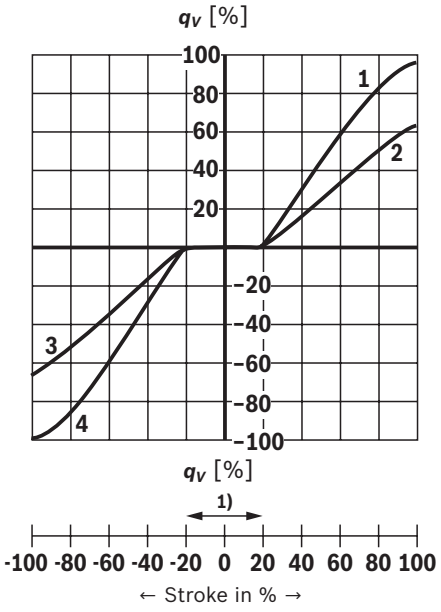
Characteristic curves: Flow characteristic "L" and "P"
(measured with HLP46, ϑ_{Oil} = 40 ±5 °C)

Flow/signal function – Version "L"

Symbol V, V1-

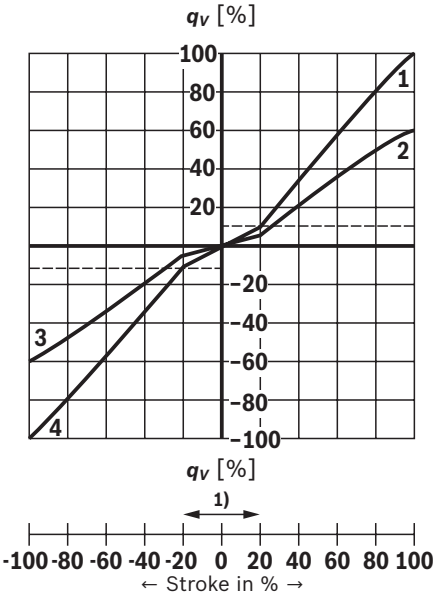


Symbol E, E1-, W6-, W8-

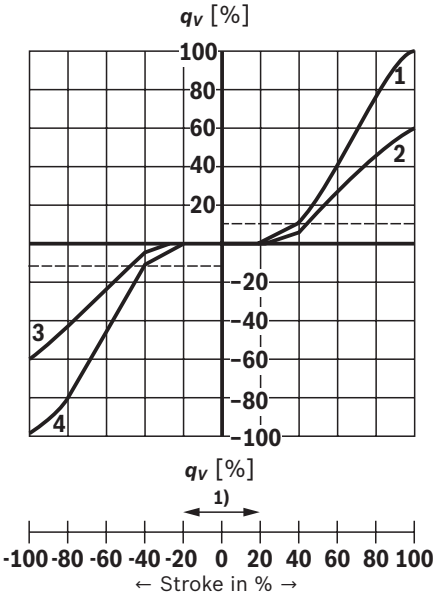


Flow/signal function – Version "P"

Symbol V, V1-



Symbol E, E1-, W6-, W8-

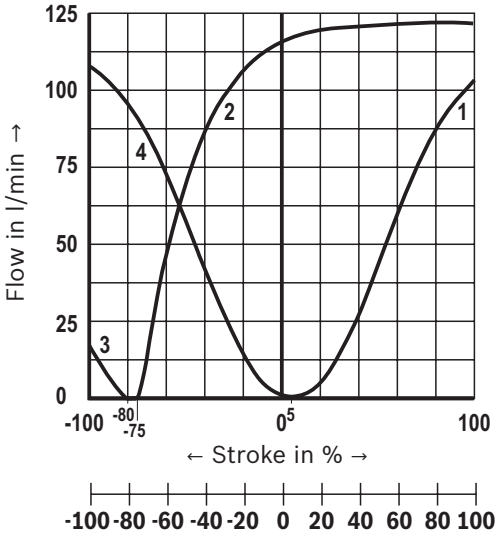


1 P–A; B–T (1:1)
2 B–T (2:1)
3 P–B (2:1)
4 P–B; A–T (1:1)
––– 10 % q_V

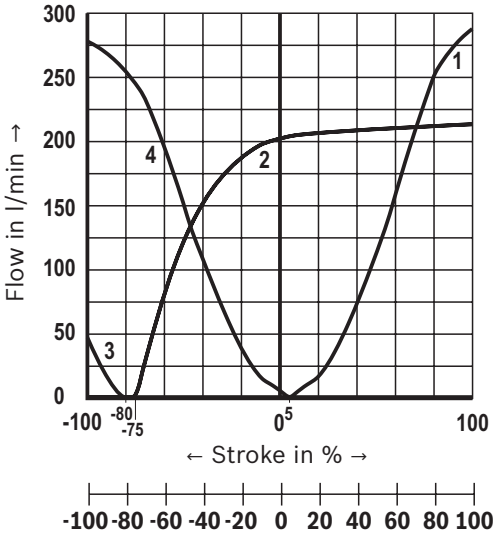
1) Step compensation (opening at 5%)

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

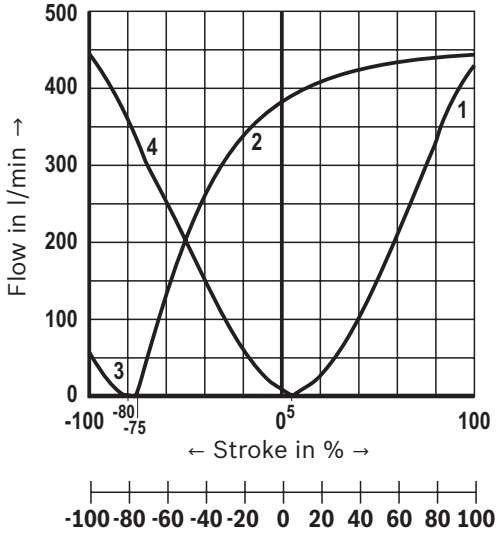
Symbol Q3, version "100"



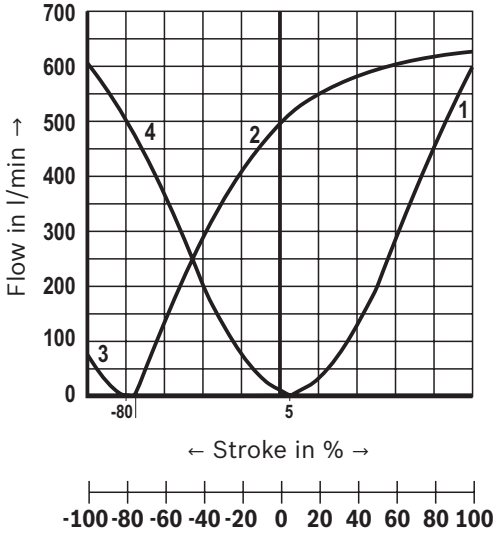
Symbol Q3, version "250"



Symbol Q3, version "400"



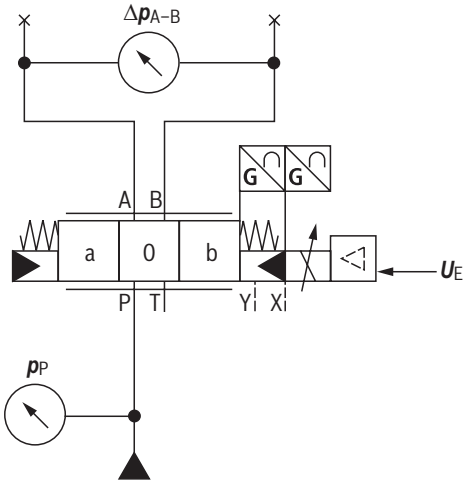
Symbol Q3, version "600"

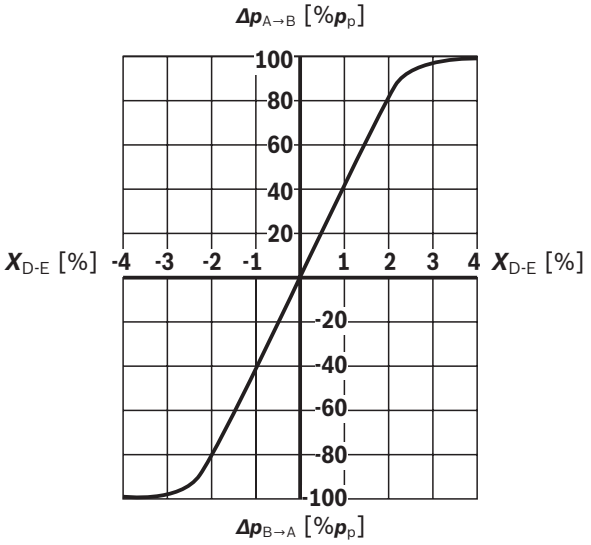


1 P–A
2 B–T
3 P–B
4 A–T

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

Pressure amplification

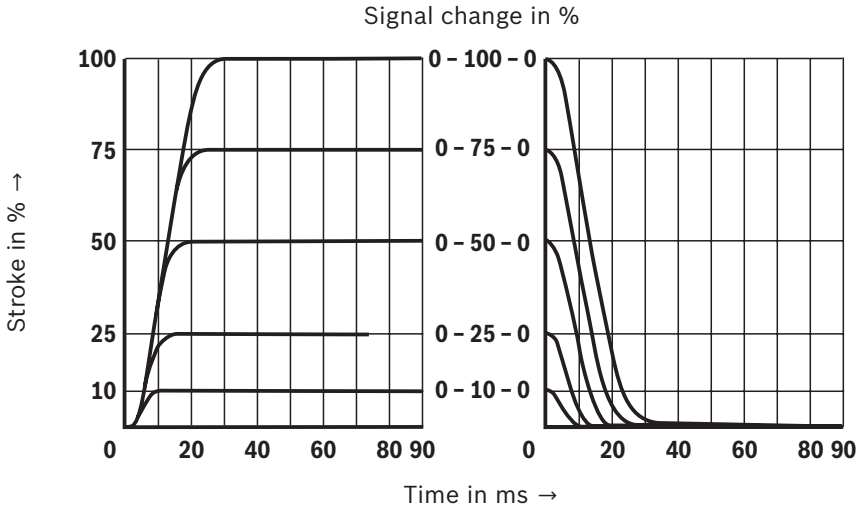




Characteristic curves: Size 10
(measured with HLP46, ϑ_{Oil} = 40 ±5 °C)

Transition function with stepped electric input signals

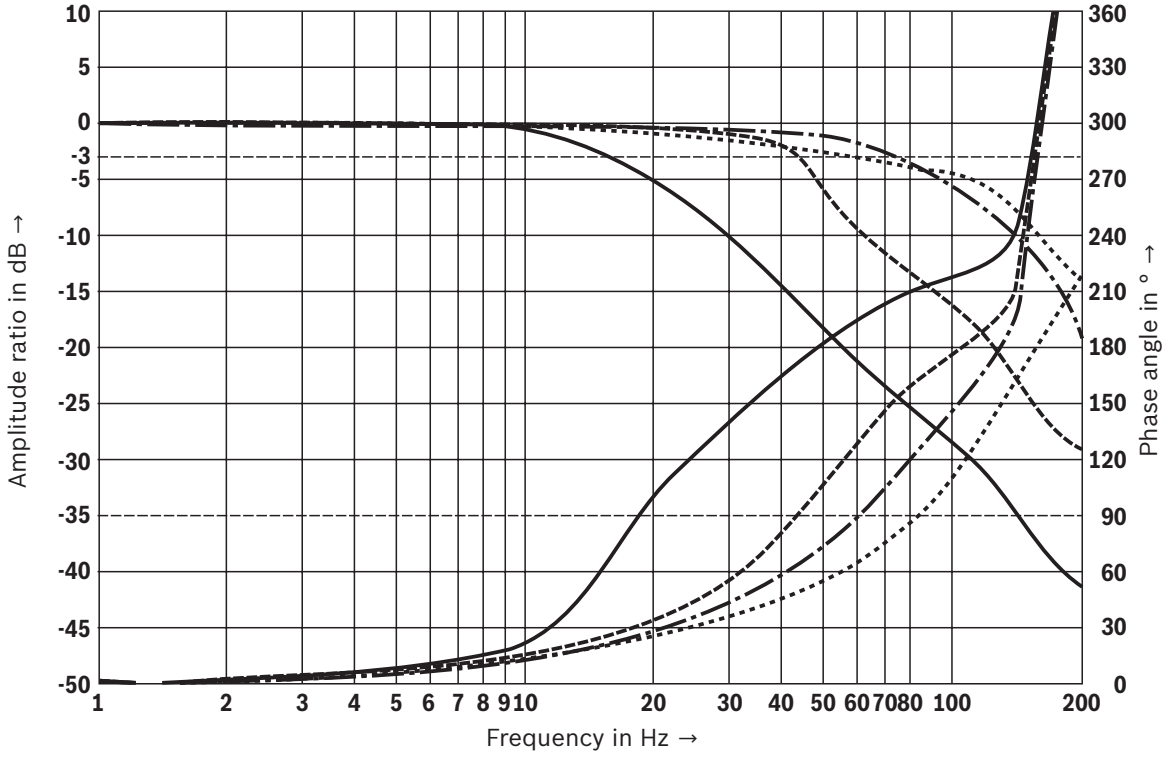
Symbols V and Q3-



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

Frequency response characteristic curves

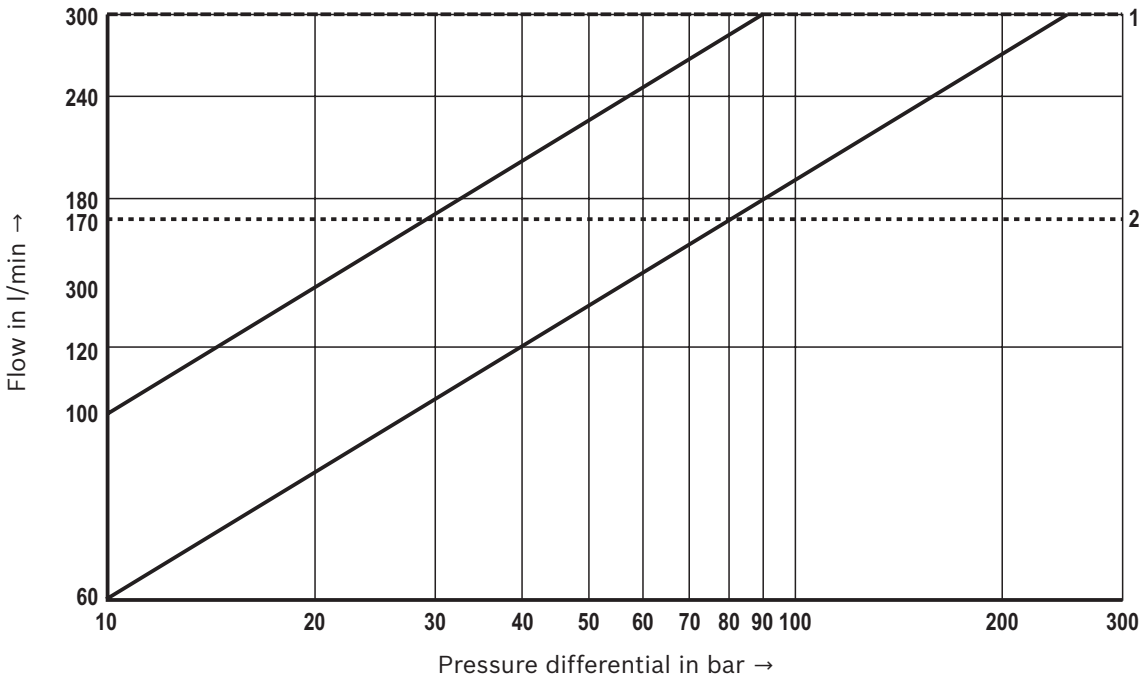
Symbols V and Q3-



- 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 (with maximum valve opening; tolerance ± 10%)

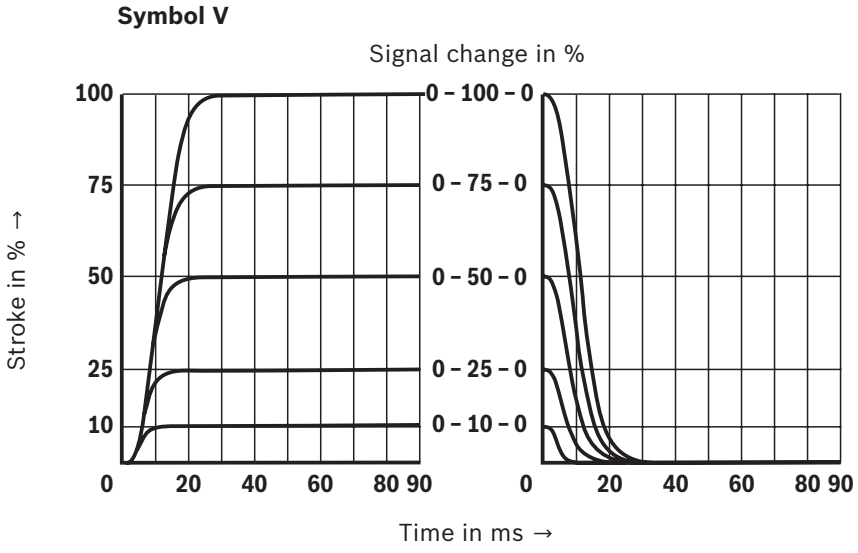


1 Maximum admissible flow

2 Recommended flow
(flow velocity 30 m/s)

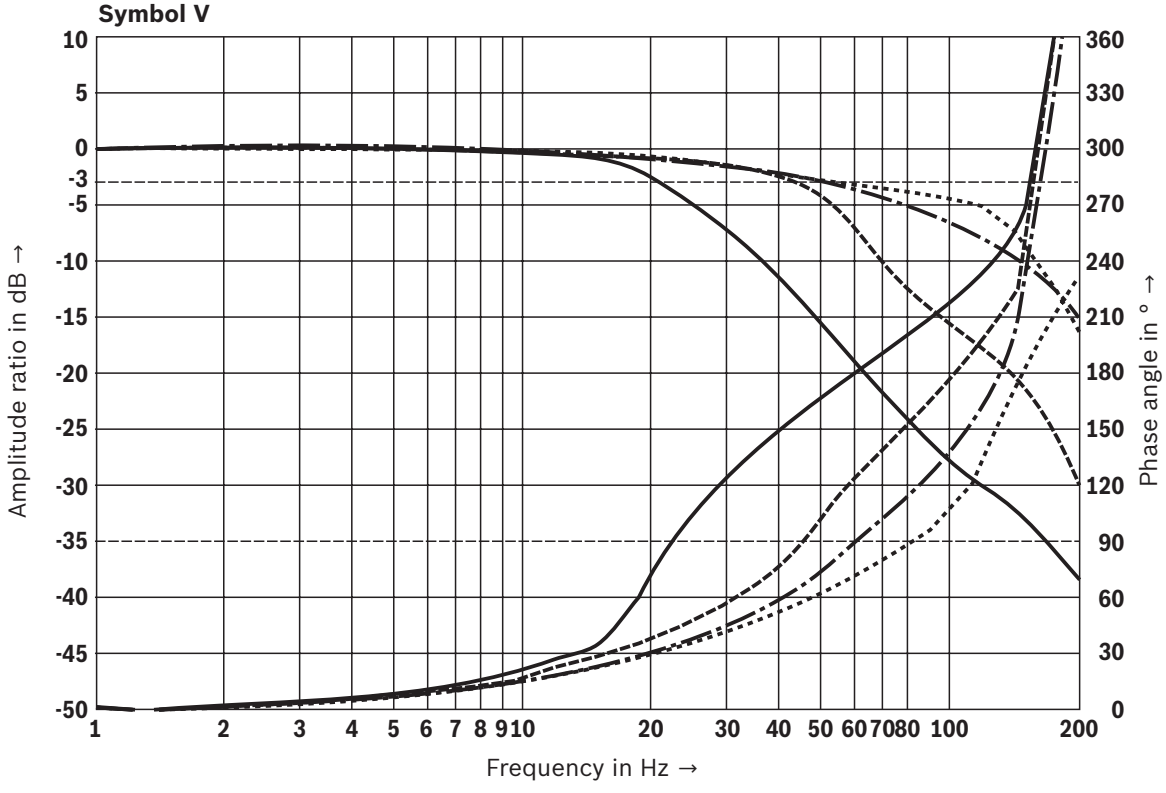
Characteristic curves: Size 16
(measured with HLP46, ϑ_{Oil} = 40 ±5 °C)

Transition function with stepped electric input signals



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

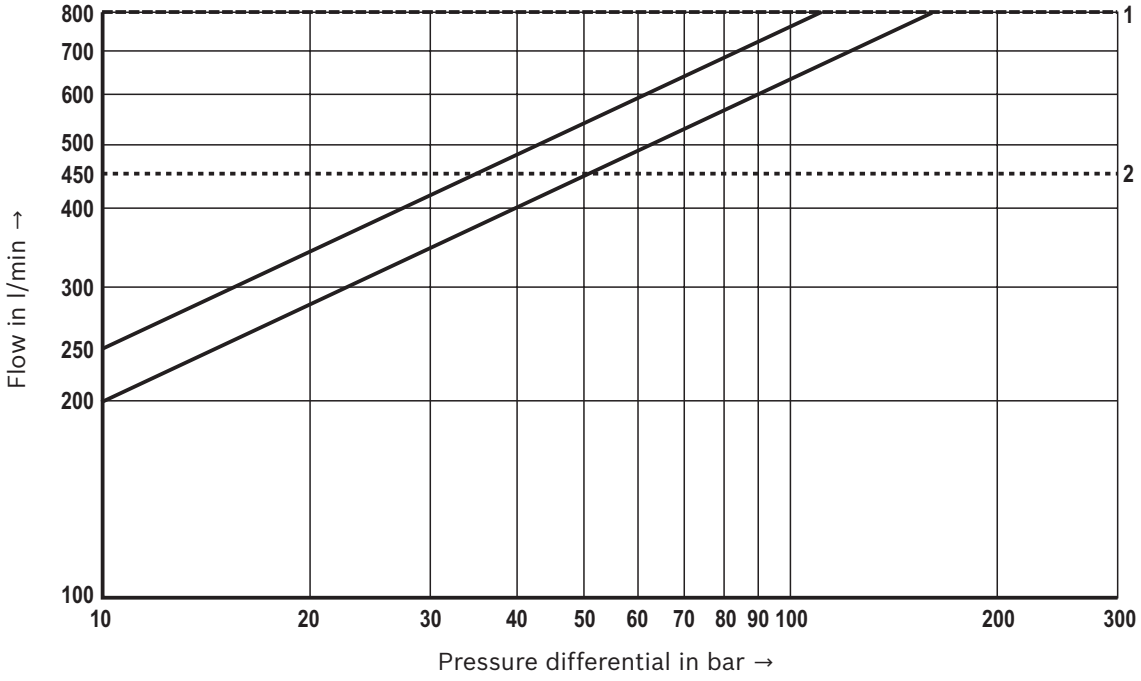
Frequency response characteristic curves



- 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 (with maximum valve opening; tolerance ± 10%)



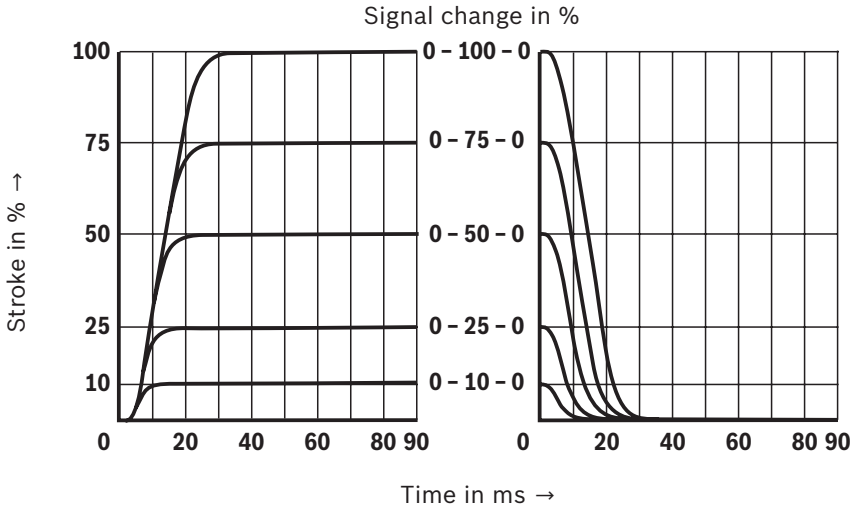
1 Maximum admissible flow

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

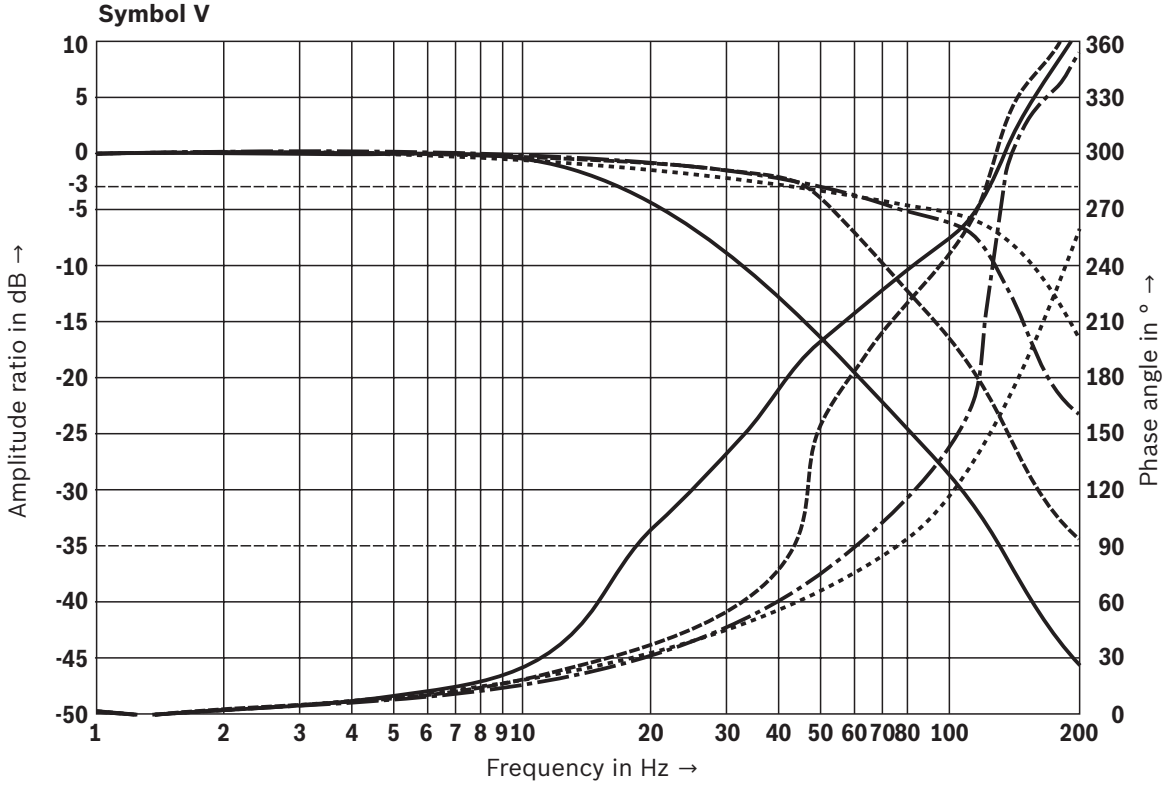
Symbol V



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

Frequency response characteristic curves

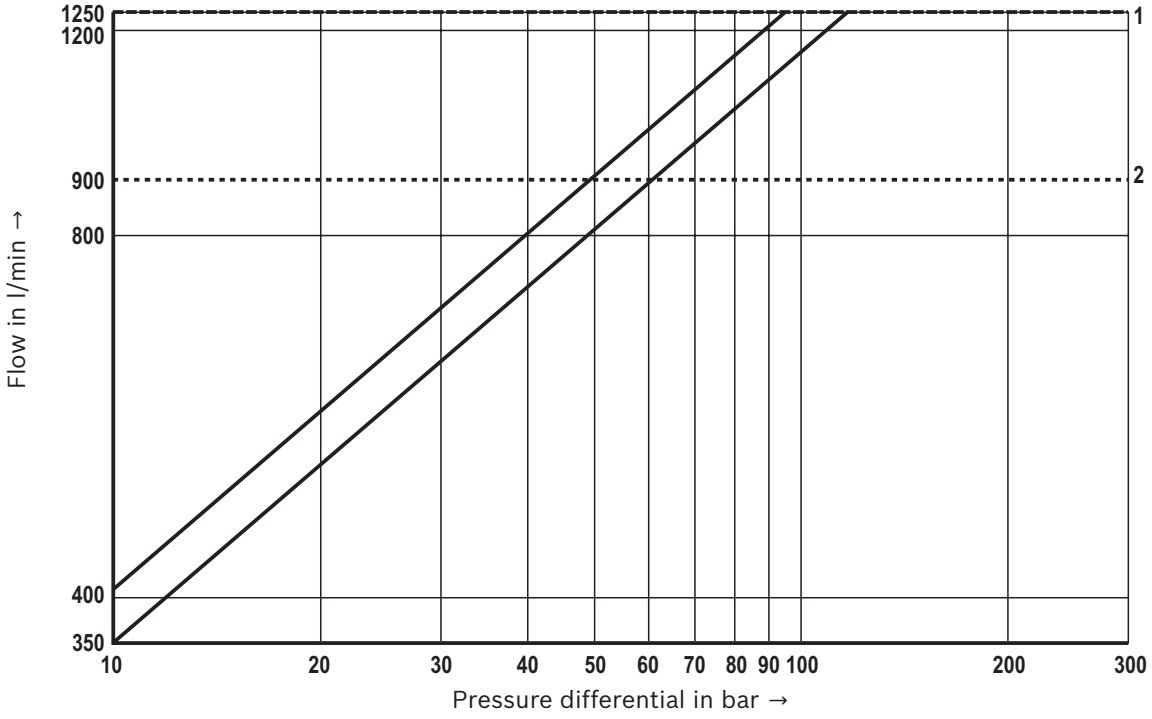
Symbol V



- 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 (with maximum valve opening; tolerance ± 10%)

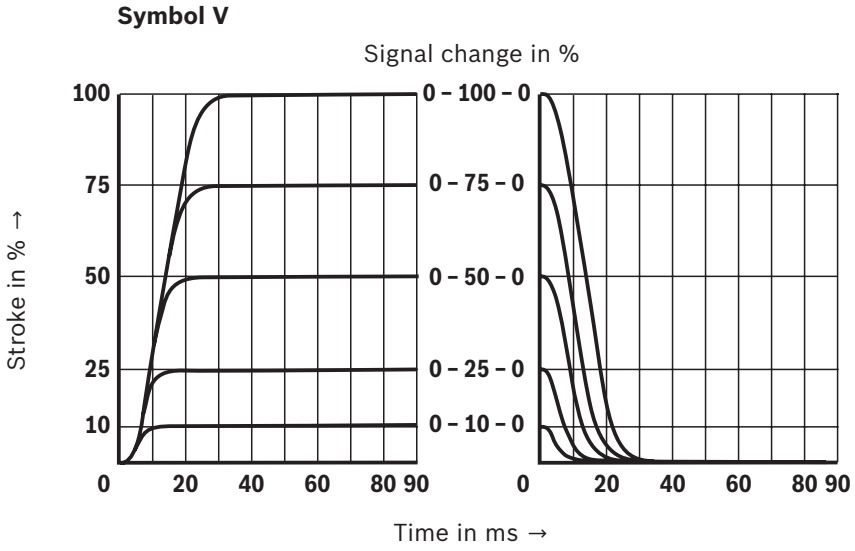


1 Maximum admissible flow

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

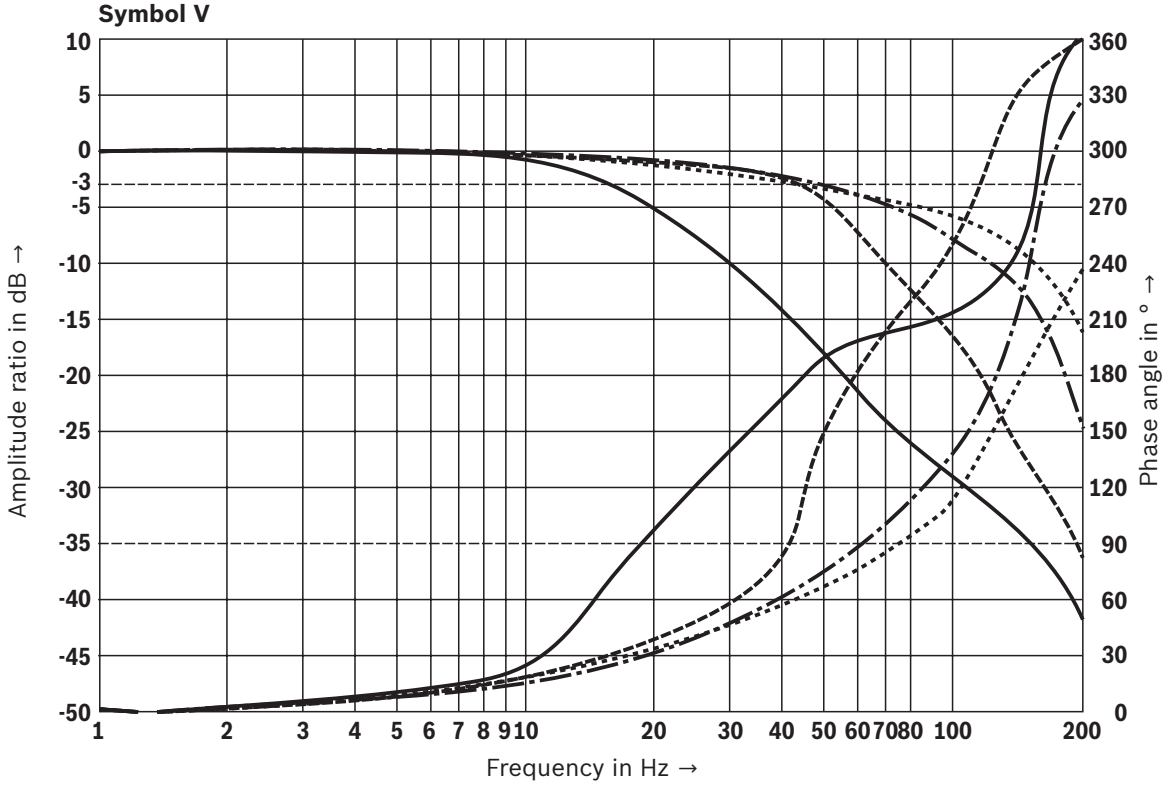
Characteristic curves: Size 27
(measured with HLP46, ϑ_{Oil} = 40 ±5 °C)

Transition function with stepped electric input signals



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

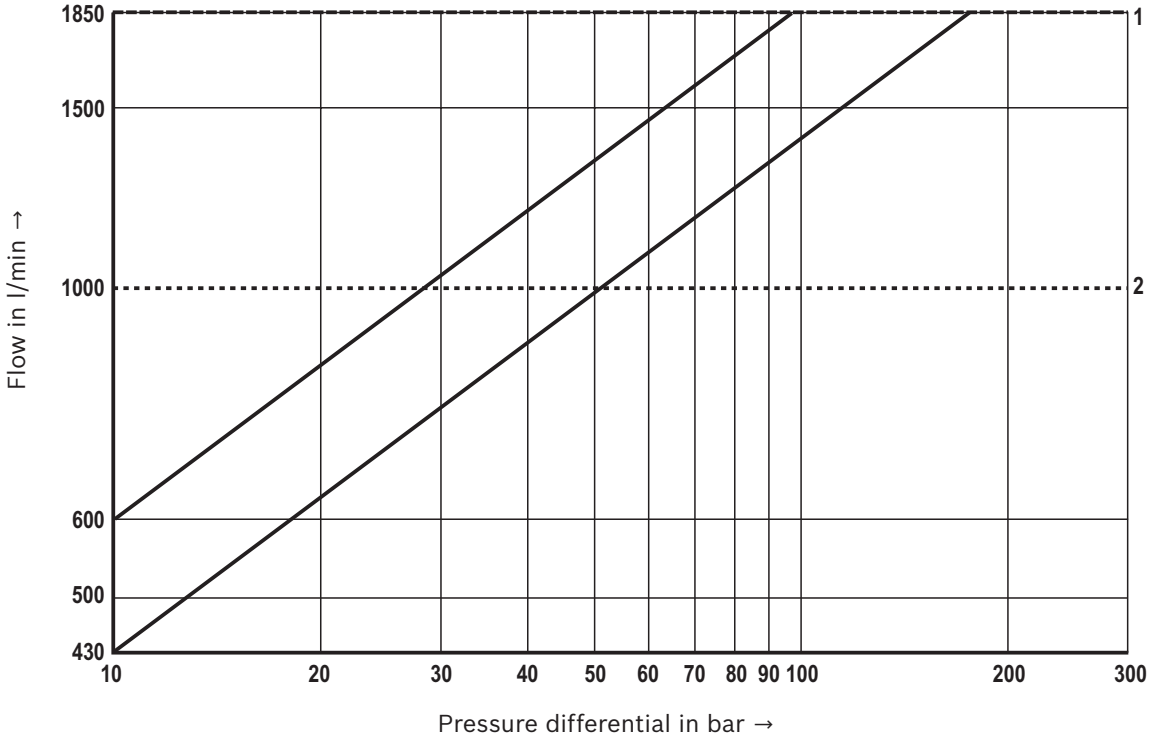
Frequency response characteristic curves



- 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 (with maximum valve opening; tolerance ± 10%)

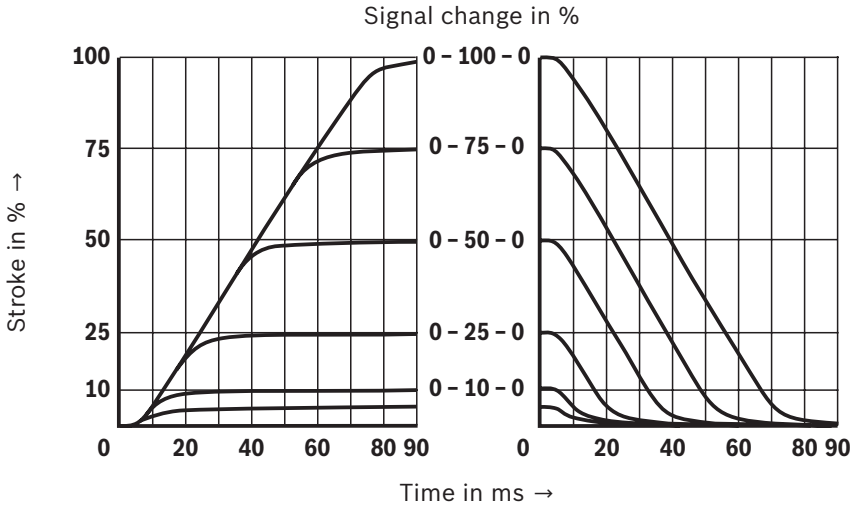


1 Maximum admissible flow
2 Recommended flow limitation (flow velocity 30 m/s)

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

Transition function with stepped electric input signals

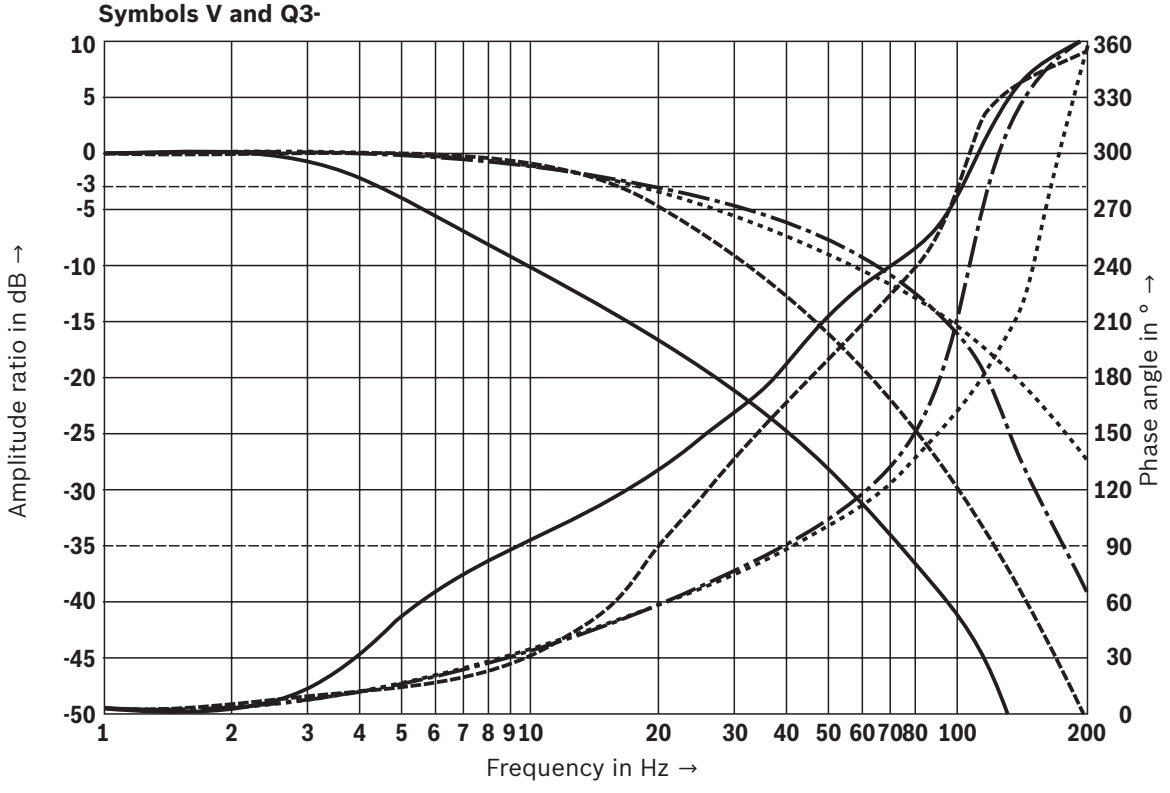
Symbols V and Q3-



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

Frequency response characteristic curves

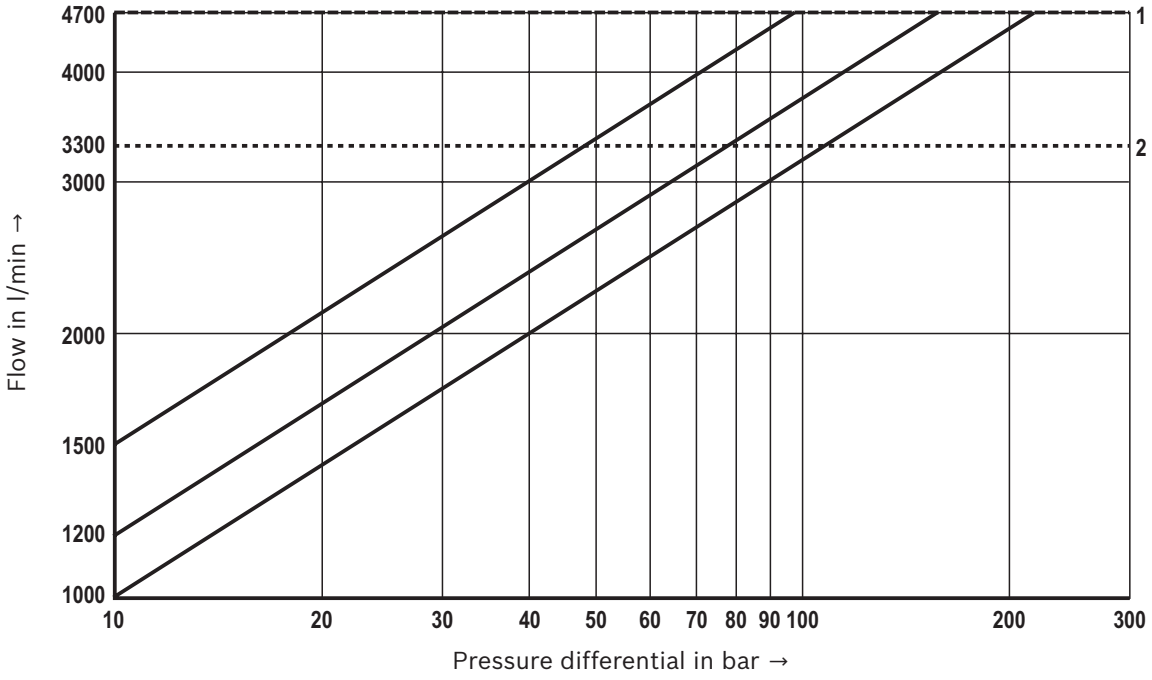
Symbols V and Q3-



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

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

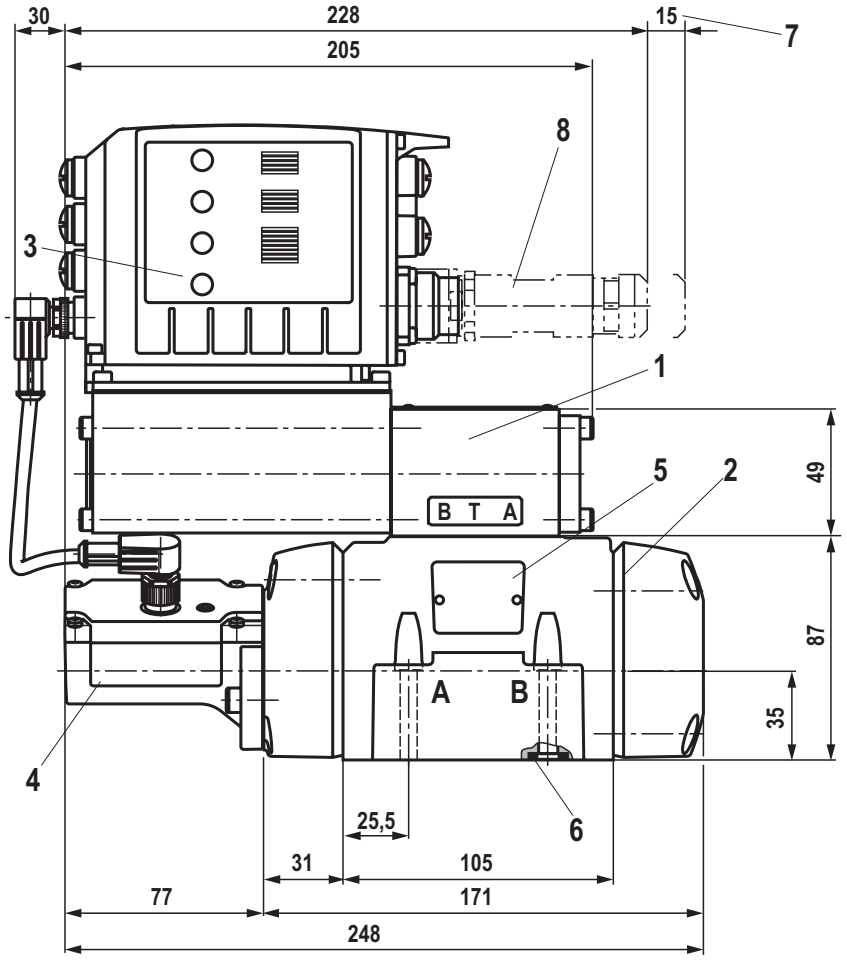
Flow/load function with maximum valve opening (with maximum valve opening; tolerance ± 10%)

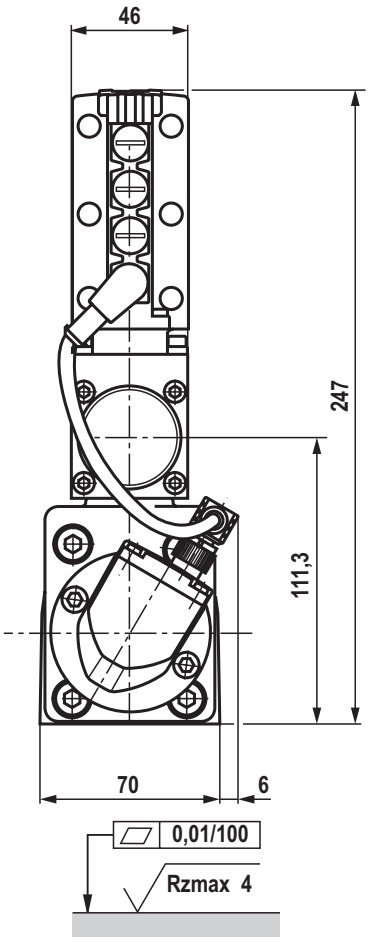


1 Maximum admissible flow

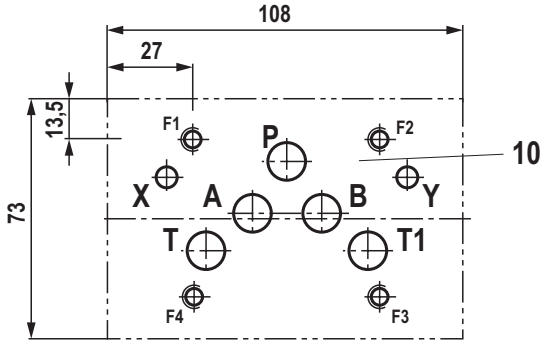
2 Recommended flow
(flow velocity 30 m/s)

Dimensions: Size 10
(dimensions in mm)





Required surface quality of the valve contact surface

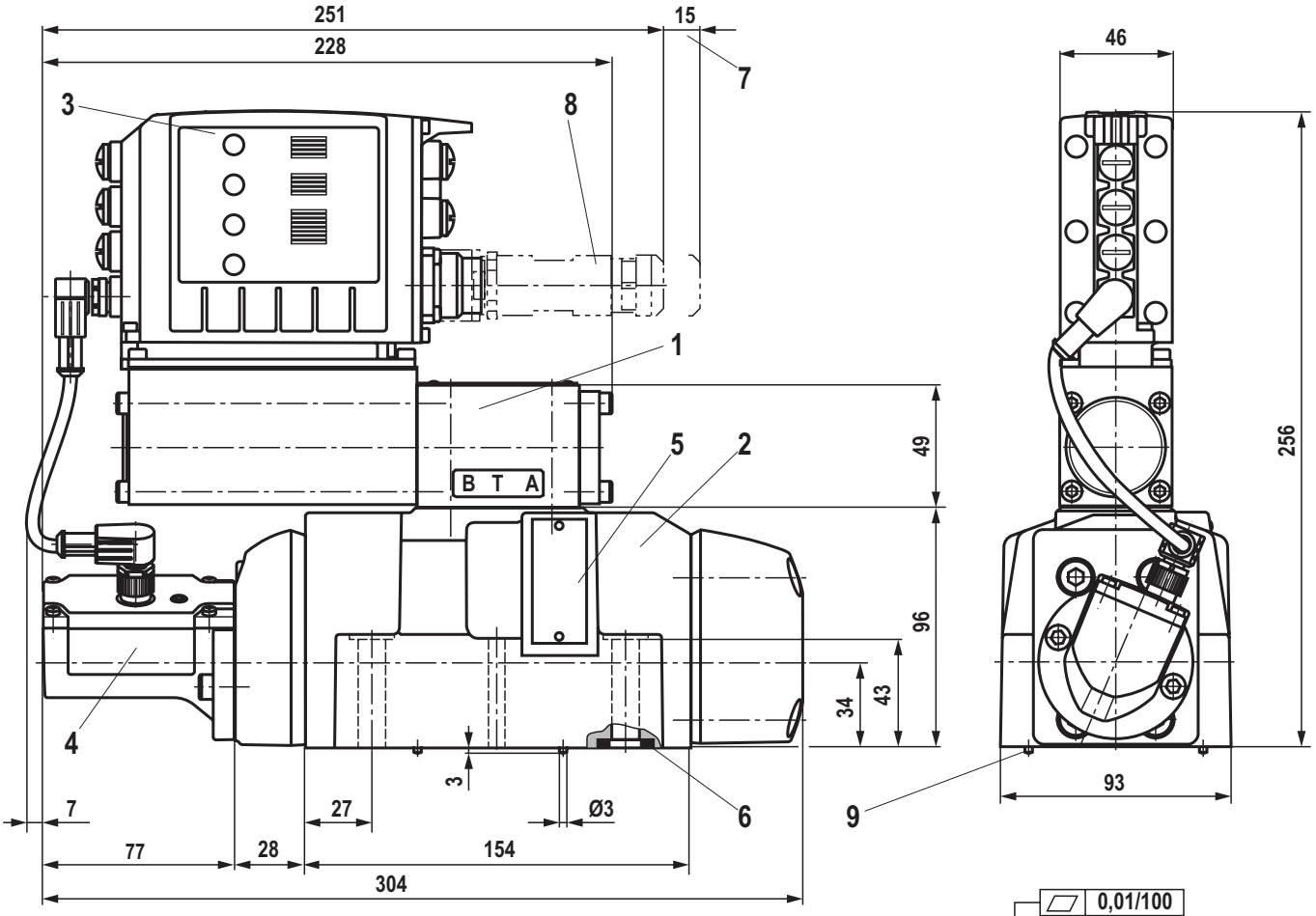


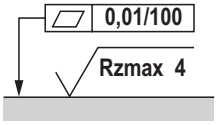
Valve mounting screws and **subplates,** see page 35.

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

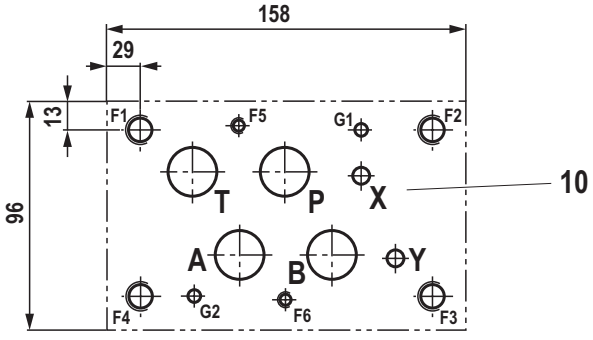
☞ **Notes:**
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions: Size 16
(dimensions in mm)





Required surface quality of the valve contact surface

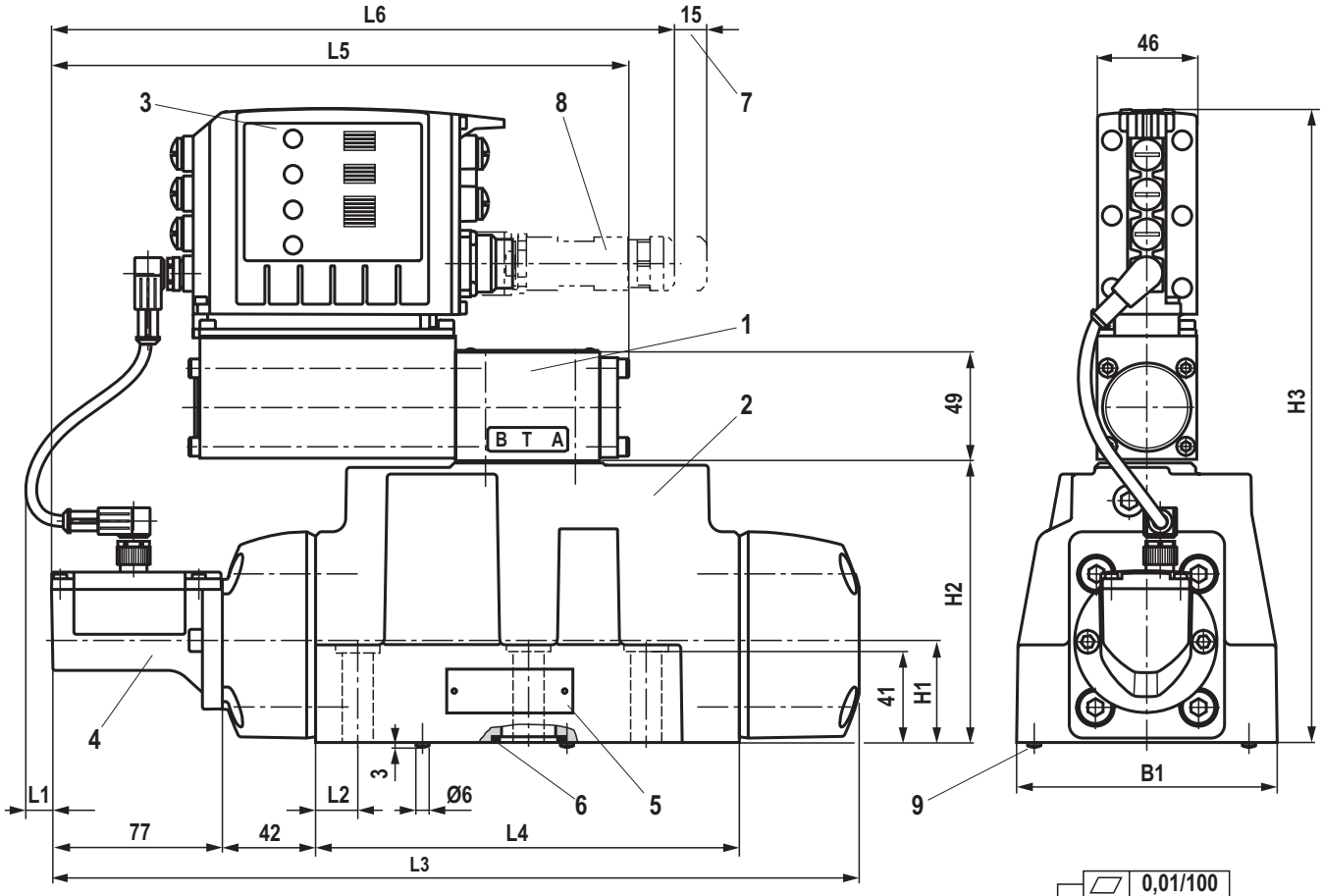


Valve mounting screws and **subplates,** see page 35.

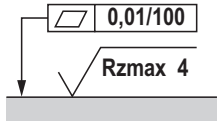
1 Pilot control valve
2 Main valve
3 Integrated electronics (OBE)
4 Inductive position transducer (main valve)
5 Name plate
6 Identical seal rings for ports P, A, B, T;
Identical seal rings for ports X, Y
7 Space required for removing the mating connector
8 Mating connectors, separate order, see page 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

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

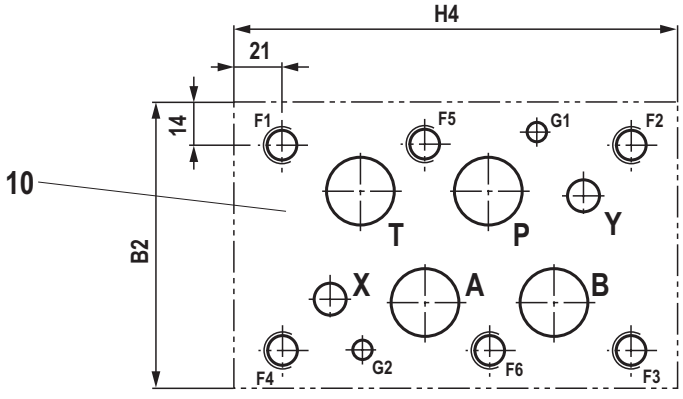
Dimensions: Size 25 and 27
(dimensions in mm)



NG	L1	L2	L3	L4	L5	L6	H1	H2	H3	H4	B1	B2
25	12	19	364	191	261	283	46	126	286	195	118	120
27	16	20.5	371	198	264	287	50	140	300	200	120	124



Required surface quality of the valve contact surface

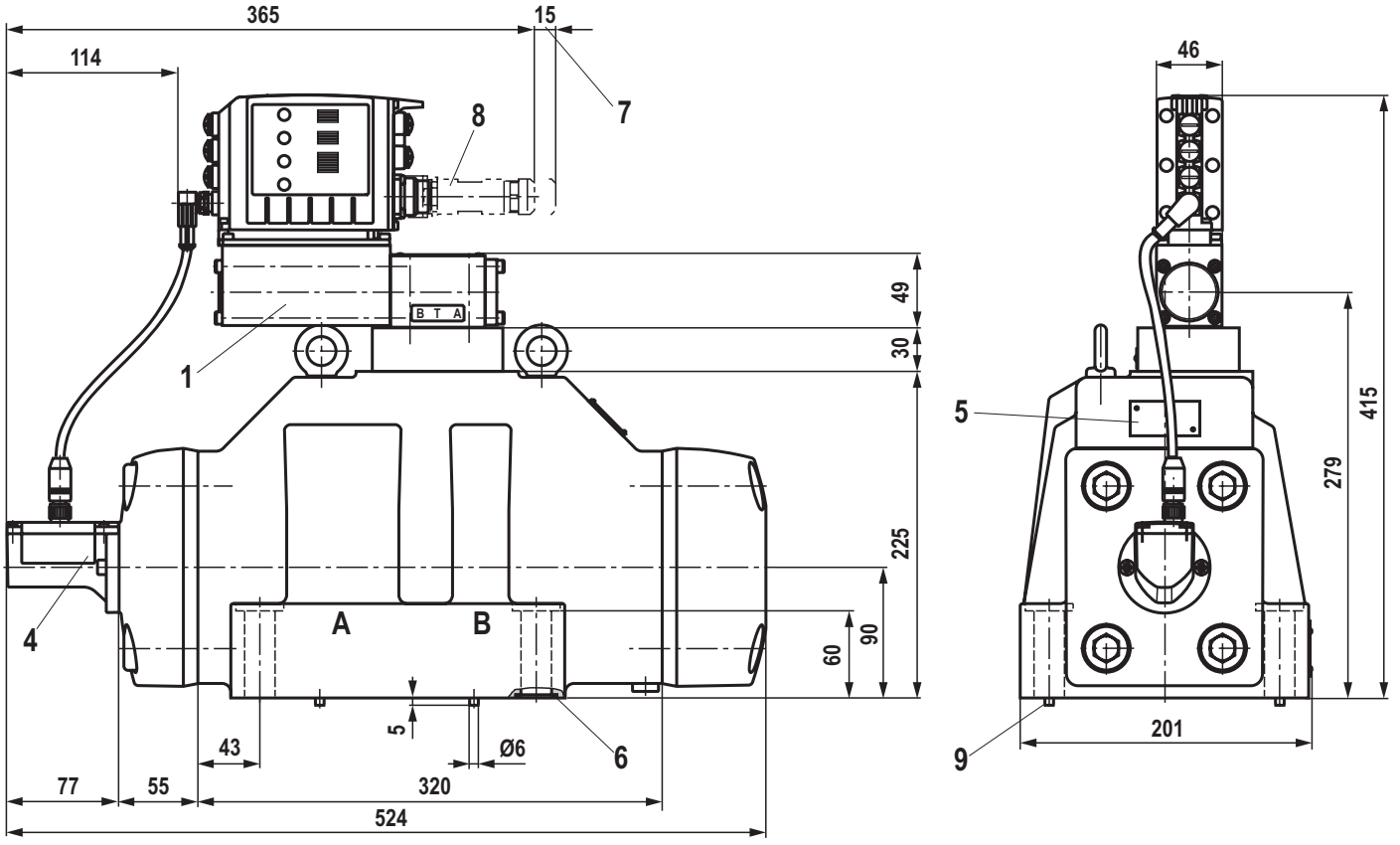


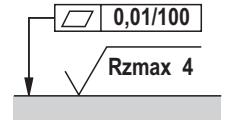
Valve mounting screws and **subplates,** see page 35.

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:
▶ NG25: Ports X, Y – Ø14 mm
▶ NG27: Ports P, A, B, T – Ø32 mm
Minimum screw-in depth:
▶ Ferrous metal: 1.5 x Ø
▶ Non-ferrous metal: 2.0 x Ø

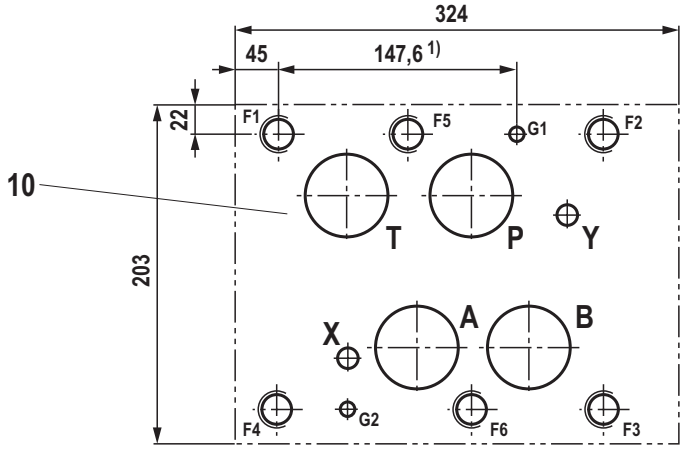
Notes:
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions: Size 35
(dimensions in mm)





Required surface quality of the valve contact surface



Valve mounting screws and **subplates,** see page 35.

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 4401-10-09-0-05
Deviating from the standard:
Ports P, A, B, T – Ø50 mm
[1] Position G1 according to DIN 24340 Form A

☞ **Notes:**
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

☞ **Notes:**

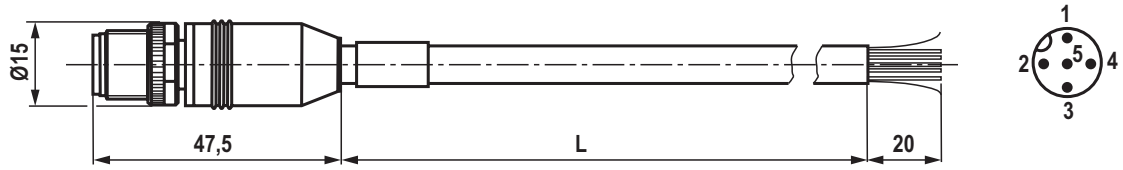
- The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure.
- **When replacing component series 3X with 4X, only the valve mounting screws listed here may be used. Prior to assembly, check the existing mounting bore on the block for sufficient screw-in depth.**

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

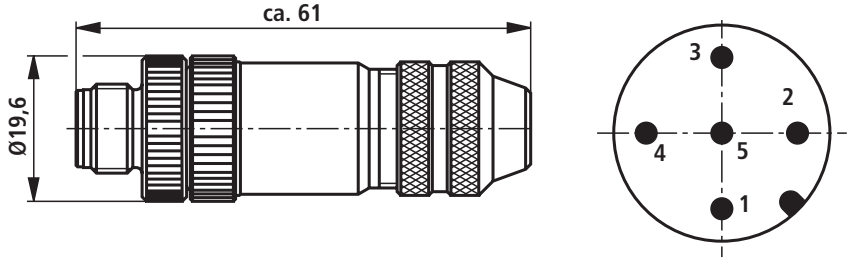
Accessories (separate order)

Sensor connections X2M1 and X2M2

Cable set (analog sensors)	**Length** in m	**Material number**
Cable set for connection of the Rexroth pressure sensors type HM20, shielded, 5-pole, A coding, PUR/PVC, straight connector M12, on straight socket M12, line cross-section 0.34 mm²	0.6	**R901111709**
	1.0	**R901111712**
	2.0	**R901111713**
Shielded, 5-pole, A coding, straight connector M12, on free line end, line cross-section 0.34 mm²	1.5	**R901111752**
	3.0	**R901111754**
	5.0	**R901111756**
	10.0	**R913005147**



Plug-in connector (analog sensors)	**View, dimensions**	**Material number**
Plug-in connector, 5-pole, M12x1, pins, A coding, metal design (cable diameter 4 ... 6 mm)	see below	**R901075542**



Sensor connection X8M

Cable set (SSI, 1Vpp only) [1]	**Length** in m	**Material number**
Shielded, 8-pole, A coding, straight connector M12, on free line end, line cross-section 0.25 mm² (due to the diameter, two plug-in connectors of this type cannot be simultaneously used at X2M1 and X2M2)	10.0	**R913002641**

[1] **Recommendation**: If an EnDat 2.2 sensor is used, please refer to the sensor manufacturer Heidenhain with respect to a cable set.

Accessories (separate order)

Ethernet connections X7E1 and X7E2

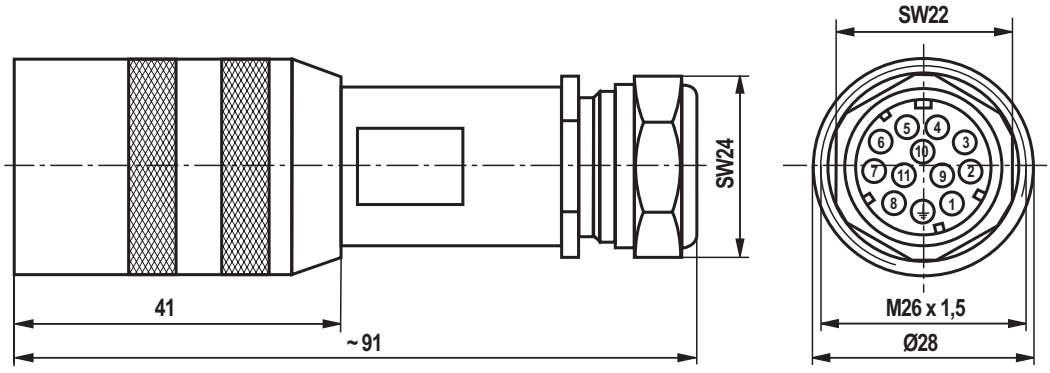
Cable set (Ethernet interface)	**Length** in m	**Material number**
Cable set, shielded, 4-pole, D coding, straight connector M12, on straight connector M12, line cross-section 0.25 mm2, CAT 5e	freely selectable (= xx.x)	**R911172111** (additionally indication of type designation RKB0040/xx.x)
Cable set, shielded, 4-pole, straight connector M12, on straight connector RJ45, line cross-section 0.25 mm², CAT 5e	freely selectable (= xx.x)	**R911172135** (additionally indication of type designation RKB0044/xx.x)

Protective cap

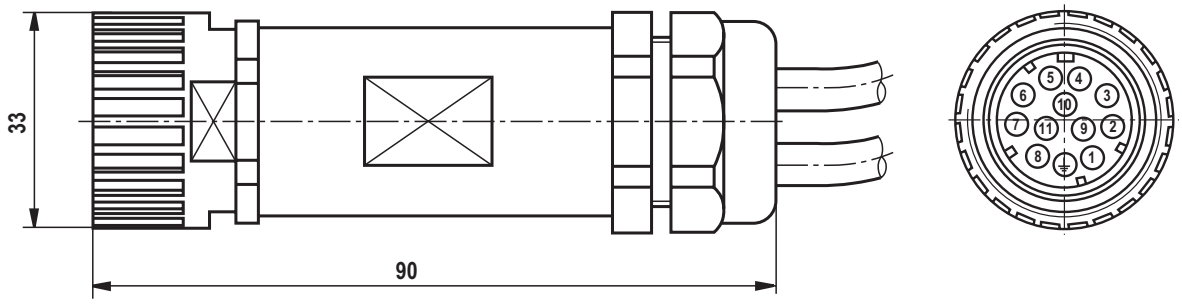
Protective cap M12	**Version**	**Material number**
		**R901075563**

Port XH2

Mating connector	**Version**	**Material number**
Mating connector according to DIN EN 175201-804 (12-pole, metal design)	Mating connector (assembly kit) for a cable diameter of 12 ... 15 mm	**R901268000**
	Mating connector with 5 m cable, 12 x 0.75 mm² with cable shield, assembled	**R901272854**
	Mating connector with 20 m cable, 12 x 0.75 mm² with cable shield, assembled	**R901272852**



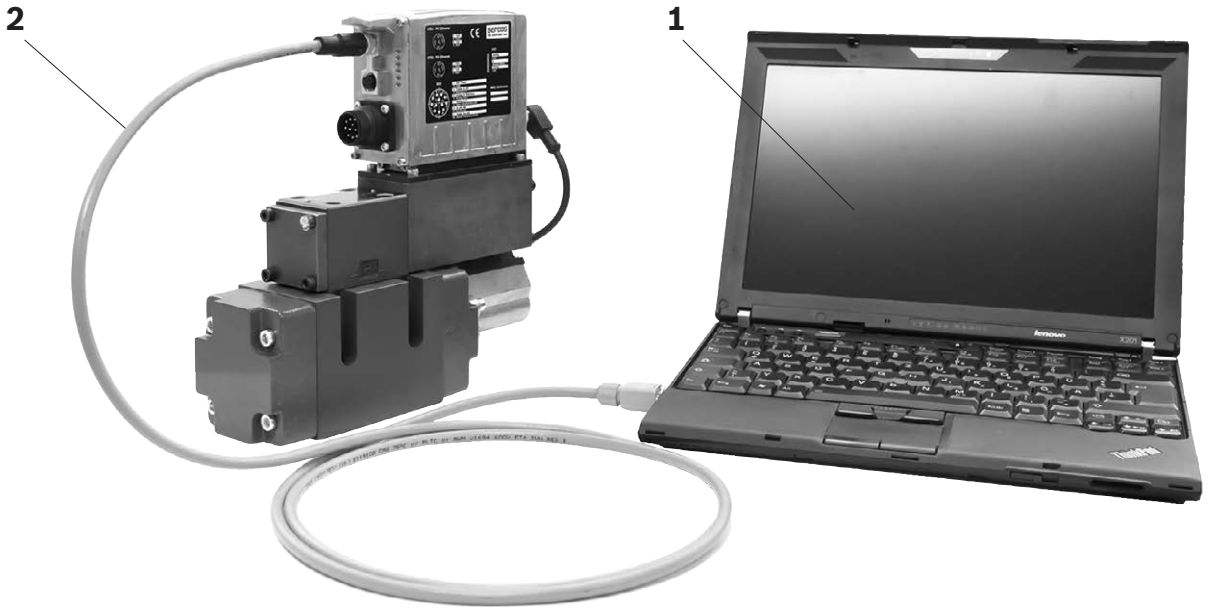
Mating connector according to DIN EN 175201-804 (12-pole, plastic variant)	Mating connector (assembly kit)	**R900884671**
	Mating connector with 2 x 5 m cable, supply line (3 x 1.0 mm²) and signal line (10 x 0.14 mm²) separated, with cable shield, assembled	**R900032356**
	Mating connector with 2 x 20 m cable, supply line (3 x 1.0 mm²) and signal line (10 x 0.14 mm²) separated, with cable shield, assembled	**R900860399**



Accessories (separate order)

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** (additionally 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 anticipated, suitable measures must be taken 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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