# Directional control valves, direct operated, with electrical position feedback and integrated electronics (OBE)

## Type HD-4WRPEH6


- Size 6
- Component series 3X
- Maximum operating pressure 350 bar
- Rated flow 4 ... 40 l/min
- Digital interface, IO link for I4.0

### Features

- Reliable - proven and robust design
- Safe - fail-safe position of the control spool in switched-off condition
- Energy-efficient - no pilot oil demand
- High quality - control spool and sleeve in servo quality
- Flexible - suitable for position, velocity and pressure control
- Precise - high response sensitivity and little hysteresis
- IO-Link interface, optional. Use of the valve with IO-Link as a shut-off element up to category 3, PL d according to EN 13849-1.

### Contents

## Ordering code

| 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HD** | **–** | **4** | **WRP** | **E** | **H** | **6** | | **B** | | | **–** | **3X** | **/** | | **/** | | **24** | | | ***** |

| | | |
|---|---|---|
| 01 | Huade hydraulic | **HD** |
| 02 | 4 main ports | **4** |
| 03 | Directional control valve, direct operated | **WRP** |
| 04 | With integrated electronics | **E** |
| 05 | Control spool/sleeve | **H** |
| 06 | Size 6 | **6** |
| 07 | Symbols; possible version see page 3 | |
| 08 | Installation side of the inductive position transducer | **B** |

**Nominal flow** (***Δp*** = 35 bar per control edge)

| 09 | | Flow characteristic | | |
|---|---|---|---|---|
| | | **"L"** | **"P"** | |
| | 4 l/min | ✓ | ✓ (Inflection at 20%) | **04** |
| | 12 l/min | ✓ | – | **12** |
| | 15 l/min | – | ✓ (Inflection at 60%) | **15** |
| | 24 l/min | ✓ | – | **24** |
| | 25 l/min | – | ✓ (Inflection at 60%) | **25** |
| | 40 l/min | ✓ ◊ | ✓ (Inflection at 40%) | **40** |

**Flow characteristic**

| | | |
|---|---|---|
| 10 | Linear | **L ◊** |
| | Inflected characteristic curve, linear | **P** |
| 11 | Component series 30 ... 39 (30 ... 39: unchanged installation and connection dimensions) | **3X** |

**Seal material** (observe compatibility of seals with hydraulic fluid used, see page 7)

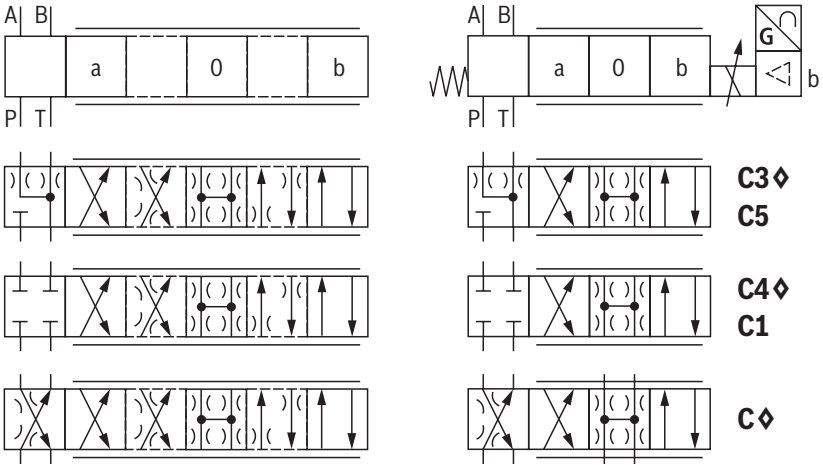
| | | |
|---|---|---|
| 12 | NBR seals | **M ◊** |
| | FKM seals | **V** |
| 13 | **Without** damping plate | **no code** |
| | **With** damping plate | **D** |
| 14 | Supply voltage of the integrated electronics 24 VDC | **24** |

**Interfaces of the control electronics**

| | | |
|---|---|---|
| 15 | Command value input ±10 V | **A1 ◊** |
| | Command value input 4 ... 20 mA | **F1 ◊** |
| | IO-Link interface | **L1 ◊** |
| | Command value ±10 mA, actual value 4 ... 20 mA, release (connector 6+PE) | **C6** |
| 16 | **Without** electronics protection membrane | **no code ◊** |
| | **With** electronics protection membrane | **-967** |
| 17 | Further details in the plain text | |

☞ **Notice:** ◊ = Preferred type

## Symbols



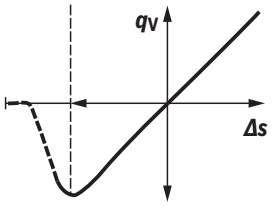
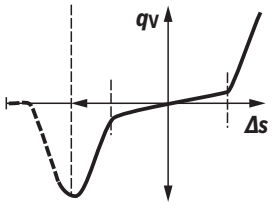
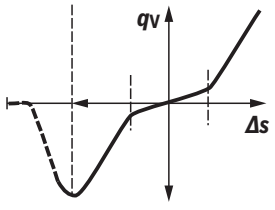
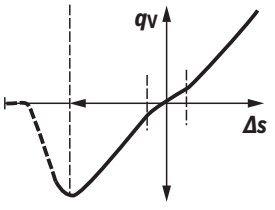
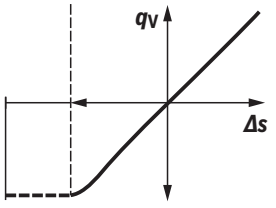
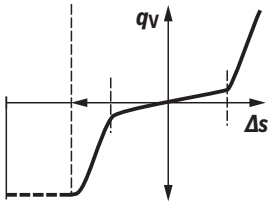
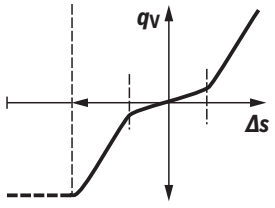
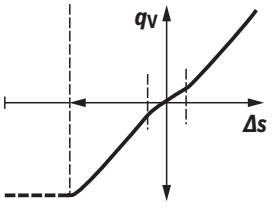

**With symbols C5 and C1:** [1)]
P → A: $q_{V\,nom}$ B → T: $q_{V\,nom}/2$
P → B: $q_{V\,nom}/2$ A → T: $q_{V\,nom}$

☞ **Notice:**
Representation according to DIN ISO 1219-1.
Hydraulic interim positions are shown by dashes.

☞ **Notice:** ◊ = Preferred type

[1)] $q_{V\,nom}$ 2:1 in connection with flow characteristic "P" only for rated flow 40 l/min (version "40")

### Flow characteristic

| Symbol | **Linear characteristic curve** (version "L") | **Inflected characteristic curve** (version "P") | | |
|---|---|---|---|---|
| | | Inflection 60% ($q_{V\,nom}$ = 15.25 l/min) | Inflection 40% | Inflection 20% |
| **C3, C5**<br>**C4, C1** |  |  |  |  |
| **C** |  |  |  |  |

## Function, section

Valves of type HD-4WRPEH are direct operated directional control valves with electrical position feedback and integrated electronics (OBE).

**Set-up**

The HD-4WRPEH high-response valve mainly consists of:

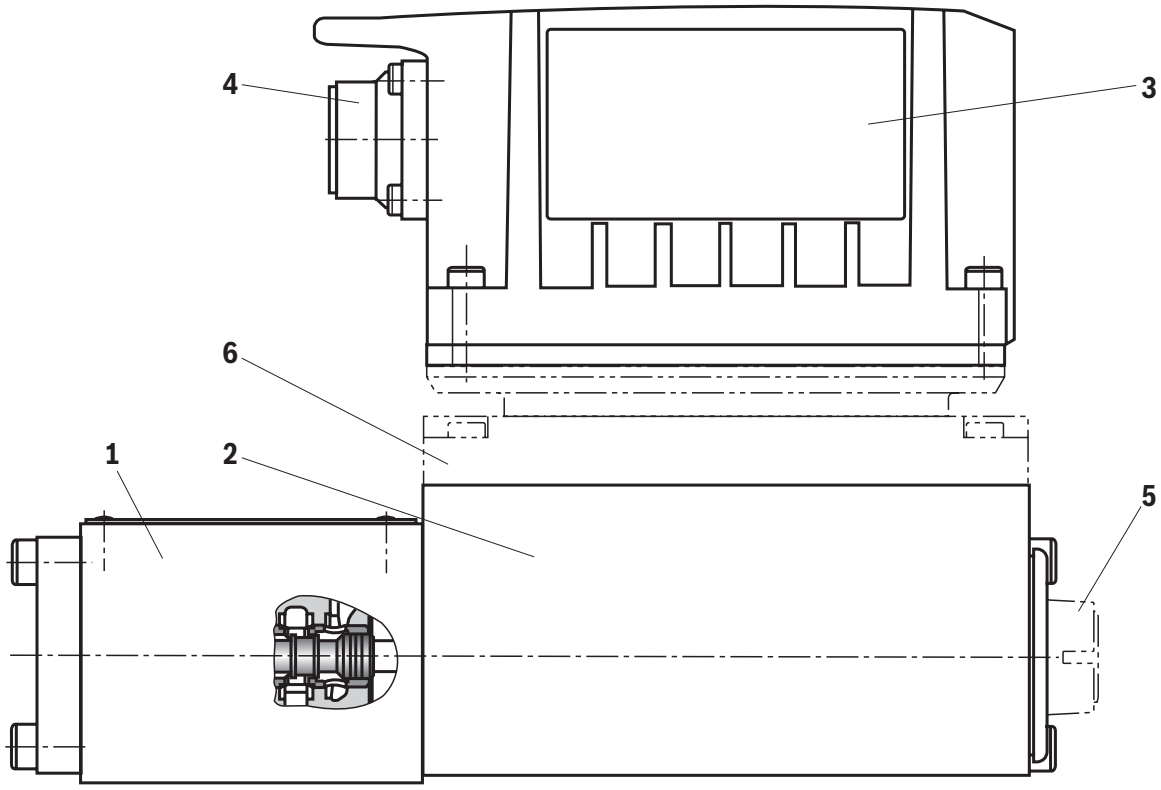
- Valve housing with control spool and sleeve in servo quality (1)
- Control solenoid with position transducer (2) (optionally with electronics protection membrane (5))
- On-board electronics (OBE) (3) with analog or IO-Link interface (4) (optionally with damping plate (6))

**Function**

The integrated electronics (OBE) compares the specified command value to the position actual value. In case of control deviations, the stroke solenoid will be activated. Due to the changed solenoid force, the control spool is adjusted against the spring. Stroke/control spool cross-section is controlled proportionally to the command value. In case of a command value presetting of 0, the electronics adjusts the control spool against the spring to central position. In deactivated condition, the spring is untensioned to a maximum and the valve is in fail-safe position.

**Safety function (IO-Link shut-off)**

By shutting off the supply voltage at the IO-Link master (Class B-Port), pins 2 and 5, the IO-Link valve can be safely switched off. After shut-off of the supply voltage, the control spool of the valve is set to fail-safe position. In order to also guarantee the hydraulic prerequisite for the safety shut-down, the overlap of control spool/sleeve must also be considered.
Sufficient overlap is guaranteed by the symbols C3, C5, C4 and C1.
The safe shut-off is not part of the IO-Link valve and must be taken into account for the safe design of the machinery.



## Function, section

**Control solenoid shut-off**
In case of the following errors, the control solenoids are de-energized by the integrated electronics (OBE) and the control spool is set to fail-safe position:

- Falling below the minimum supply voltage
- Only at interface "F1":
  - Falling below the minimum current command value of 2 mA (includes cable break of the command value line (current loop))
- Only at interface "L1":
  - Enable inactive, communication interruption (watchdog)
  - In case of internal IO-Link error
- Only at interface "C6":
  - Additionally, release inactive

**Damping plate "D"**
The damping plate reduces the acceleration amplitudes on the on-board electronics (frequencies >300 Hz).

☞ **Notice:**
Use of the damping plate is not recommended for applications with mainly low-frequency excitation <300 Hz

**Electronics protection membrane "-967"**
To prevent condensate formation in the housing of the integrated electronics (OBE), an electronics protection membrane (5) can be used.
Recommended for use outside industry-standard conditions with high ambient air humidity and significant cyclic temperature changes (e.g. outdoors).

☞ **Notice:**

- 4/4 directional control valves do not have a leakage-free basic locking when deactivated. Leakage must be considered when designing the drive. While the electrical supply voltage is being switched off, the drive may be accelerated for a short time in functional direction P→B.
- When using the valve with IO-Link interface in compliance with category 3 according to EN 13849-1, adequate cyclic diagnosis or monitoring of the valve function outside of the valve by the control system must be implemented by the machine integrator. Without suitable diagnostic measures, only cat. B or 1 according to EN 13849-1.

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

| **General** | | |
|---|---|---|
| Type of connection | | Subplate mounting |
| Porting pattern | | ISO 4401-03-02-0-05 |
| Weight | kg | 2.9 |
| Installation position | | Any |
| Ambient temperature range | °C | –20 ... +60 |
| Transport temperature | °C | –30 ... +80 |
| Maximum storage time | Years | 1 |
| Maximum relative humidity (no condensation) | % | 95 |
| Protection class according to EN 60529 | | IP65 (if suitable and correctly mounted mating connectors are used) |
| Maximum surface temperature | °C | 150 |
| $MTTF_D$ value according to EN ISO 13849 | Years | 150 (for further details see data sheet 08012) |
| Sine test according to DIN EN 60068-2-6 | ▶ Without damping plate | 10 ... 2000 Hz / maximum of 10 g / 10 cycles / 3 axes |
| | ▶ With damping plate [1] | 10 ... 2000 Hz / maximum of 10 g / 10 cycles / 3 axes |
| Noise test according to DIN EN 60068-2-64 | ▶ Without damping plate | 20 ... 2000 Hz / 10 $g_{RMS}$ / 30 g peak / 30 min. / 3 axes |
| | ▶ With damping plate [1] | 20 ... 2000 Hz / 10 $g_{RMS}$ / 30 g peak / 24 h / 3 axes |
| Transport shock according to DIN EN 60068-2-27 | ▶ Without damping plate | 15 g / 11 ms / 3 shocks / 3 axes |
| | ▶ With damping plate [1] | 15 g / 11 ms / 3 shocks / 3 axes |
| Shock according to DIN EN 60068-2-27 | ▶ With damping plate [1] | 35 g / 6 ms / 1000 shocks / 3 axes |
| Conformity | ▶ CE according to EMC directive 2014/30/EU, tested according to | EN 61000-6-2 and EN 61000-6-3 |
| | ▶ RoHS directive | 2011/65/EU [2] |

| **Hydraulic** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Maximum operating pressure | ▶ Ports A, B, P | bar | 350 | | | | |
| | ▶ Port T | bar | 250 | | | | |
| Hydraulic fluid | | | See table on page 7 | | | | |
| Viscosity range | ▶ Recommended | $mm^2/s$ | 20 ... 100 | | | | |
| | ▶ Maximum admissible | $mm^2/s$ | 10 ... 800 | | | | |
| 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] | | | | |
| Rated flow (***Δp*** = 35 bar per control edge) [4] | | l/min | 4 | 12 | 15 | 24/25 | 40 |
| Limitation of use (***Δp***) with regard to the transition to failsafe (values apply to summated edge) | ▶ Symbols C3, C5, C | bar | 350 | 350 | 350 | 350 | 160 |
| | ▶ Symbols C1, C4 | bar | 350 | 350 | 280 | 250 | 100 |

[1] Not recommended for applications with mainly low-frequency excitation <300 Hz

[2] The product fulfills the substance requirements of the RoHS directive 2011/65/EU.

[3] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components.

[4] Flow for deviating ***Δp*** (per control edge):

$$q_x = q_{Vnom} \cdot \sqrt{\frac{\Delta p_x}{35}}$$

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

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

☞ **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 ambient 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 | | |
|---|---|---|
| Hysteresis | % | <0.1 |
| Range of inversion | % | <0.05 |
| Response sensitivity | % | <0.05 |
| Manufacturing tolerance $q_{Vmax}$ | % | <10 |
| Temperature drift (temperature range 20 °C ... 80 °C) | | Zero shift <0.25% with $\Delta\vartheta$ = 10 K |
| Pressure drift | %/100 bar | Zero shift <0.15 |
| Zero point calibration | % | ±1 (ex works) |

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

| **Electrical, integrated electronics (OBE) – Interface "A1"** | | | |
|---|---|---|---|
| Supply voltage | ▶ Nominal value | VDC | 24 |
| | ▶ Minimum | VDC | 19 |
| | ▶ Maximum | VDC | 36 |
| | ▶ Maximum residual ripple | Vpp | 2.5 |
| | ▶ Maximum power consumption | VA | 40 |
| | ▶ Fuse protection, external | $A_T$ | 2.5 (time-lag) |
| Relative duty cycle time according to VDE 0580 | | % | S1 (continuous operation) |
| Functional ground and screening | | | See pin assignment on page 11 (CE-compliant installation) |
| Maximum voltage of the differential inputs against 0 V | | | D → B; E → B (max. 18 V) |
| Command value (differential amplifier) | ▶ Measurement range | V | ±10 |
| | ▶ Input resistance | kΩ | >100 |
| Actual value (test signal) | ▶ Output range | V | ±10 |
| | ▶ Minimum load impedance | kΩ | >1 |

| **Electrical, integrated electronics (OBE) – Interface "F1"** | | | |
|---|---|---|---|
| Supply voltage | ▶ Nominal value | VDC | 24 |
| | ▶ Minimum | VDC | 19 |
| | ▶ Maximum | VDC | 36 |
| | ▶ Maximum residual ripple | Vpp | 2.5 |
| | ▶ Maximum power consumption | VA | 40 |
| | ▶ Fuse protection, external | $A_T$ | 2.5 (time-lag) |
| Relative duty cycle time according to VDE 0580 | | % | S1 (continuous operation) |
| Functional ground and screening | | | See pin assignment on page 11 (CE-compliant installation) |
| Maximum voltage of the differential inputs against 0 V | | | D → B; E → B (max. 18 V) |
| Command value | ▶ Input current range | mA | 4 ... 20 |
| | ▶ Input resistance | kΩ | 200 |
| Actual value (test signal) | ▶ Output range | mA | 4 ... 20 |
| | ▶ Maximum load | Ω | 500 |

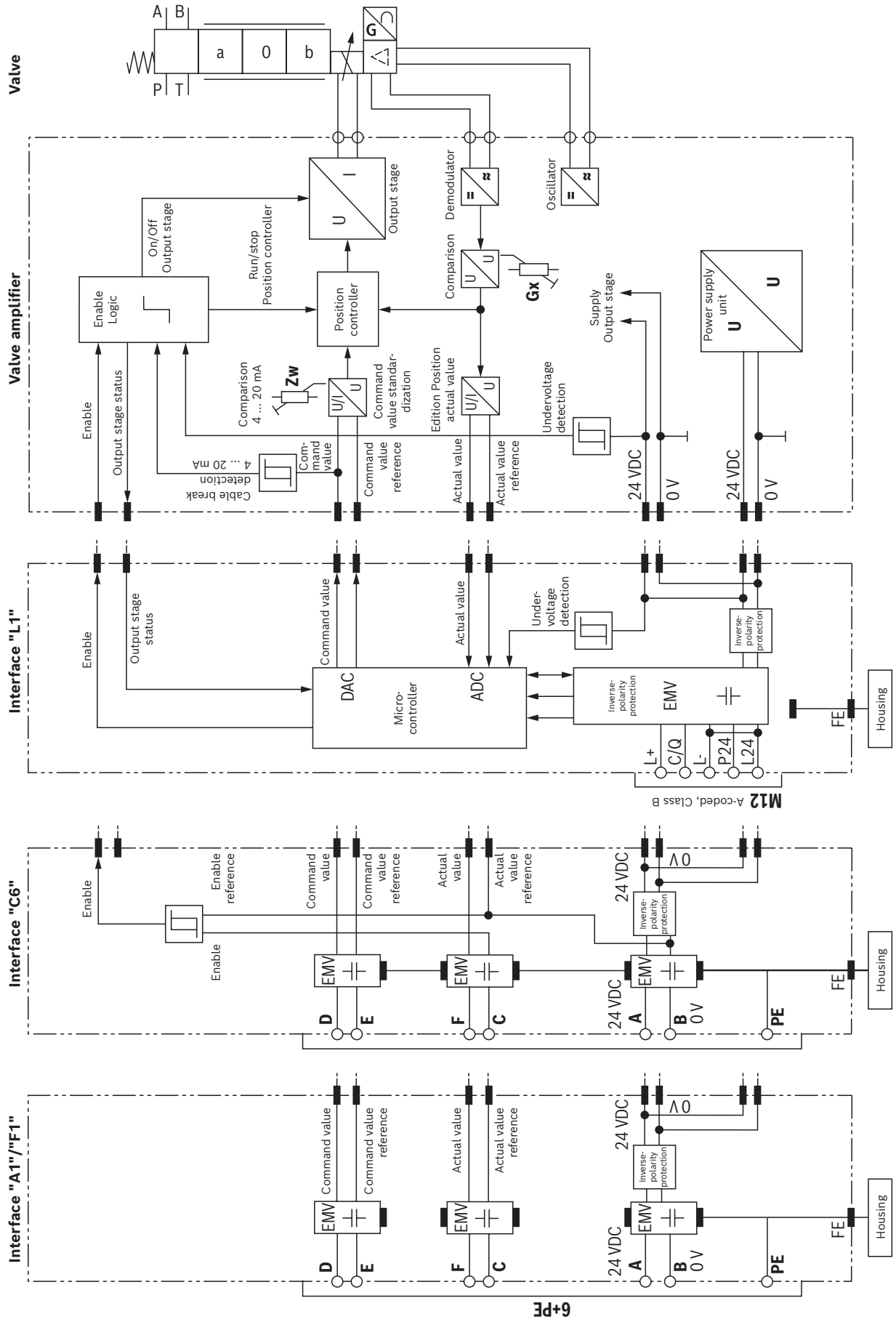
| **Electrical, integrated electronics (OBE) – Interface "C6"** | | | |
|---|---|---|---|
| Supply voltage | ▶ Nominal value | VDC | 24 |
| | ▶ Minimum | VDC | 19 |
| | ▶ Maximum | VDC | 36 |
| | ▶ Maximum residual ripple | Vpp | 2.5 |
| | ▶ Maximum power consumption | VA | 40 |
| | ▶ Fuse protection, external | $A_T$ | 2.5 (time-lag) |
| Relative duty cycle time according to VDE 0580 | | % | S1 (continuous operation) |
| Functional ground and screening | | | See page 11 (EMC-compliant installation) |
| Command value | ▶ Input current range | mA | ±10 |
| | ▶ Input resistance | Ω | 200 |
| Actual value (test signal) | ▶ Output range | mA | 4 ... 20 |
| | ▶ Maximum load | Ω | 500 |
| Enable | ▶ Low level range | V | –3 ... 5 |
| | ▶ High level range | V | 11 ... $\boldsymbol{U}_B$ |
| | ▶ Maximum current consumption at high level | mA | 7.25 ($\boldsymbol{U}_B$ = 24 V); 11 ($\boldsymbol{U}_{B\,max}$) |

## Technical data

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

| **Electrical, integrated electronics (OBE) – Interface "L1"** | | | |
|---|---|---|---|
| Supply voltage | ▶ Valve amplifiers | | |
| | – Nominal value | VDC | 24 |
| | – Minimum | VDC | 18 |
| | – Maximum | VDC | 30 |
| | – Maximum residual ripple | Vpp | 1.3 |
| | – Maximum power consumption | VA | 40 |
| | ▶ IO-Link interface | | |
| | – Nominal value | VDC | 24 |
| | – Minimum | VDC | 18 |
| | – Maximum | VDC | 30 |
| | – Maximum residual ripple | Vpp | 1.3 |
| | – Maximum power consumption | VA | 1.2 |
| Relative duty cycle time according to VDE 0580 | | % | S1 (continuous operation) |
| Functional ground and screening | | | Provide via valve block |
| Bit rate COM3 | | kBaud (kbit/s) | 230.4 |
| Required master port class | | | Class B |
| Directive | | | IO-Link Interface and System Specification Version 1.1.2 |

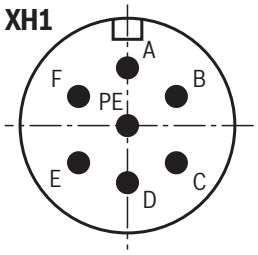
## Block diagram/controller function block



## Electrical connections and assignment

| Contact | Interface assignment | | |
|---|---|---|---|
| | **"A1"** (6 + PE) | **"F1"** (6 + PE) | **"C6"** (6 + PE) |
| **A** | Supply voltage | Supply voltage | Supply voltage |
| **B** | GND | GND | GND, reference potential actual value/enable (Current loop $I_{F-B}$ feedback) |
| **C** | Reference potential actual value | Reference potential actual value (Current loop $I_{F-C}$ feedback) | Enable input |
| **D** | Command value | Command value | Command value |
| **E** | Reference potential command value | Reference potential command value (Current loop $I_{D-E}$ feedback) | Reference potential command value (Current loop $I_{D-E}$ feedback) |
| **F** | Actual value | Actual value | Actual value |
| **FE** | Functional ground (directly connected to the valve housing) | | |

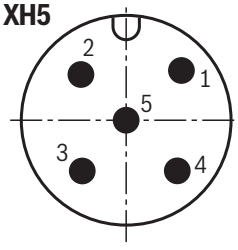
**XH1**

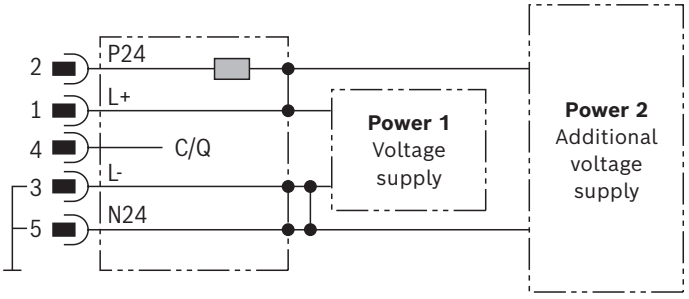



| | |
|---|---|
| **Command value** | ▶ Positive command value (0 ... 10 V or 12 ... 20 mA) at D and reference potential at E cause flow from P → A and B → T. |
| | ▶ Negative command value (0 ... –10 V or 12 ... 4 mA) at D and reference potential at E cause flow from P → B and A → T. |
| **Connection cable** | ▶ Up to 20 m cable length type LiYCY 7 x 0.75 mm² |
| | ▶ Up to 40 m cable length type LiYCY 7 x 1.0 mm² |
| | ▶ EMC-compliant installation:<br>– Apply screening to both line ends<br>– Use metal mating connector<br>▶ Alternatively up to 30 m cable length admissible<br>– Apply screening on supply side<br>– Plastic mating connector can be used |

**Connector pin assignment "L1"** (M12-5, A-coded, class B)

**XH5**




☞ **Notice:**
▶ M12 sensor/actuator connection line, 5-pole; M12 connector/bush, A-coded, without shield, maximum cable length 20 m (observe the voltage drop over the cable; wire cross-section at least 0.34 mm² for a cable length of up to 5 m).

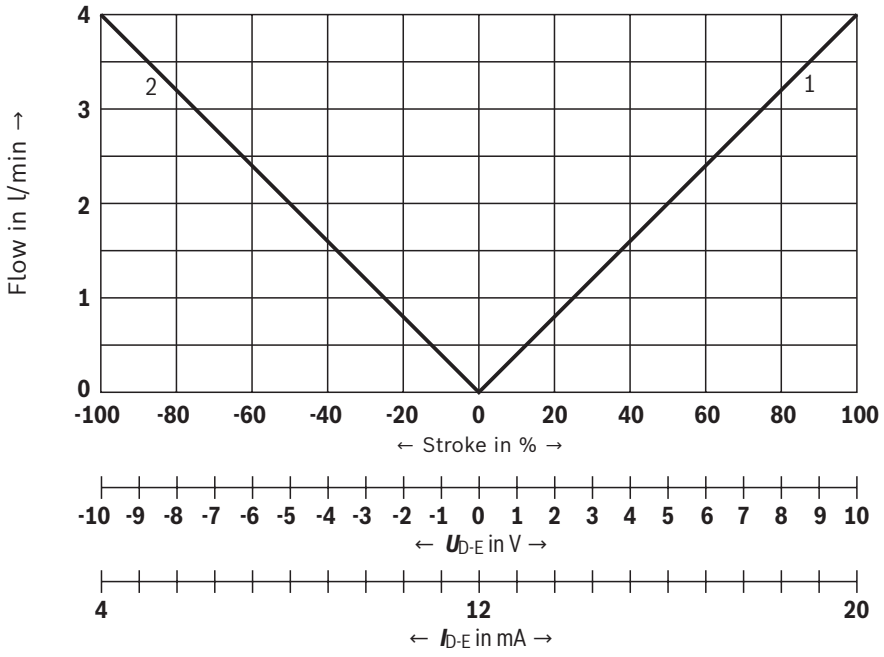
| Pin | Signal | Allocation interface "L1" |
|---|---|---|
| 1 | L+ | Voltage supply IO-Link |
| 2 | P24 | Voltage supply valve electronics and power part (current consumption 2 A) |
| 3 | L- | Reference potential pin 1 [1)] |
| 4 | C/Q | Data line IO-Link (SDCI) |
| 5 | N24 | Reference potential pin 2 [1)] |

[1)] Pin 3 and 5 are linked with each other in the valve electronics. The reference potentials L- and N24 of the two supply voltages must also be linked with each other on the power supply unit side.

**Characteristic curves:** Flow characteristic "L"
(measured with HLP46, $\vartheta_{oil}$ = 40 ±5 °C; $\Delta p$ = 35 bar/control edge)

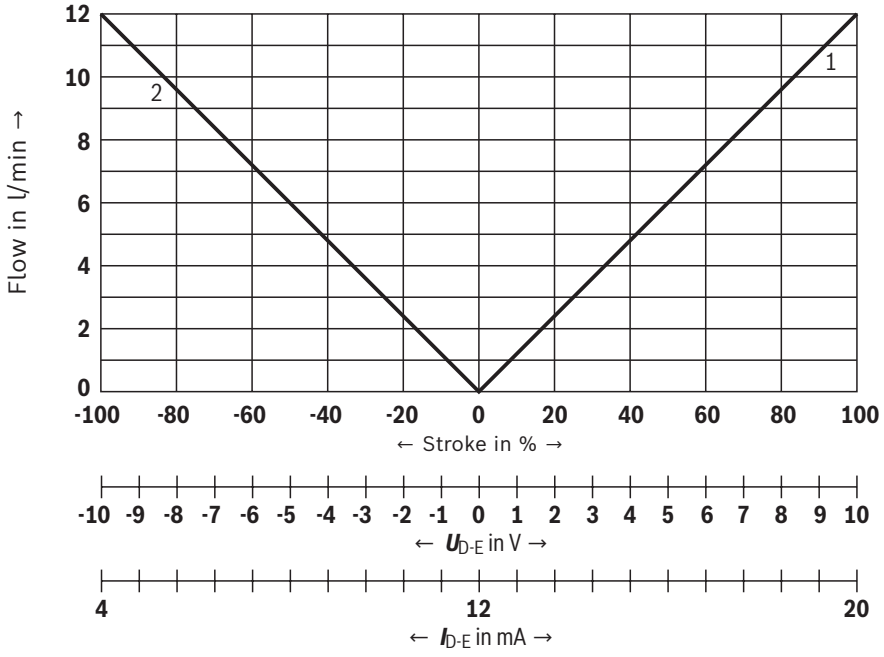
**Flow/signal function**

**Symbol C, C3 and C4 – Version "04"**




**1** P–A; B–T
**2** P–B; A–T

**Symbol C, C3 and C4 – Version "12"**

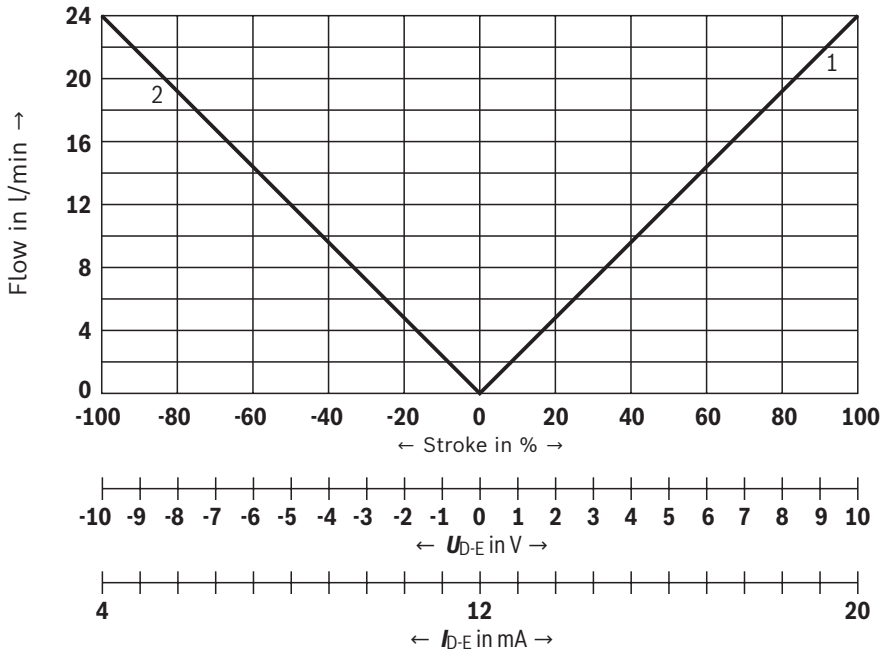



**1** P–A; B–T
**2** P–B; A–T

**Characteristic curves:** Flow characteristic "L"
(measured with HLP46, $\vartheta_{oil}$ = 40 ±5 °C; $\Delta p$ = 35 bar/control edge)

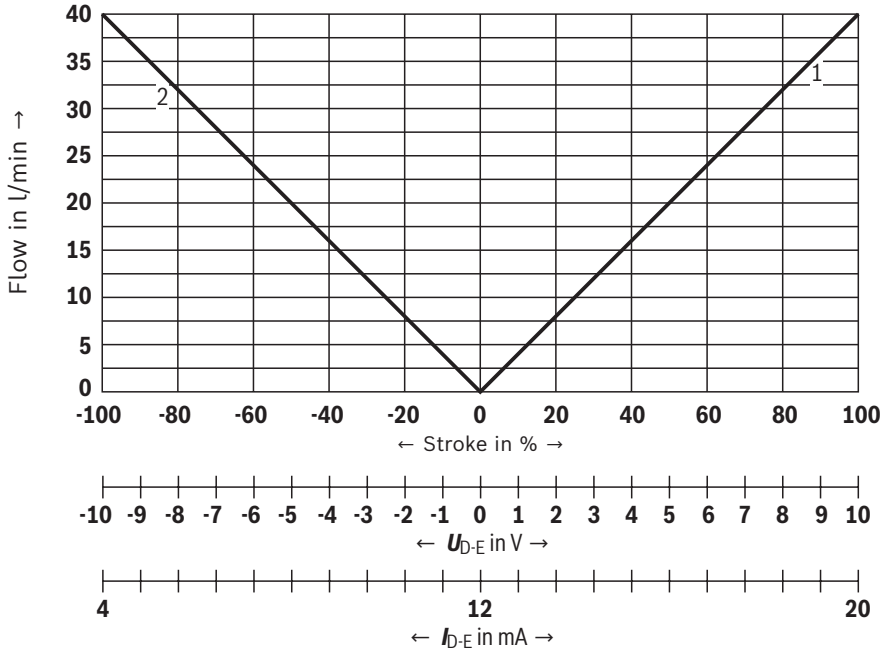
**Flow/signal function**

**Symbol C, C3 and C4 – Version "24"**




**1** P–A; B–T
**2** P–B; A–T

**Symbol C, C3 and C4 – Version "40"**

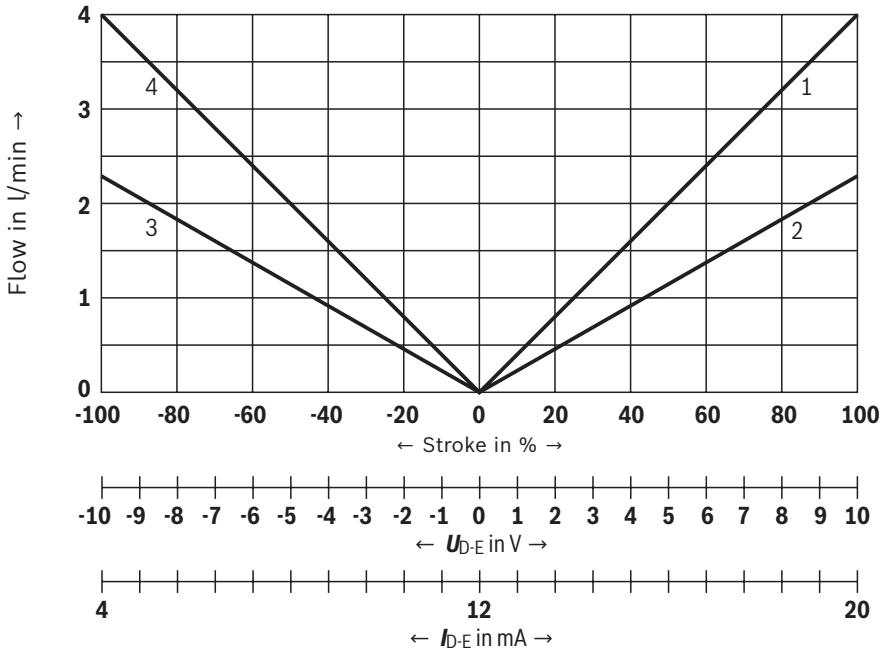



**1** P–A; B–T
**2** P–B; A–T

**Characteristic curves:** Flow characteristic "L"
(measured with HLP46, $\vartheta_{oil}$ = 40 ±5 °C; $\Delta p$ = 35 bar/control edge)

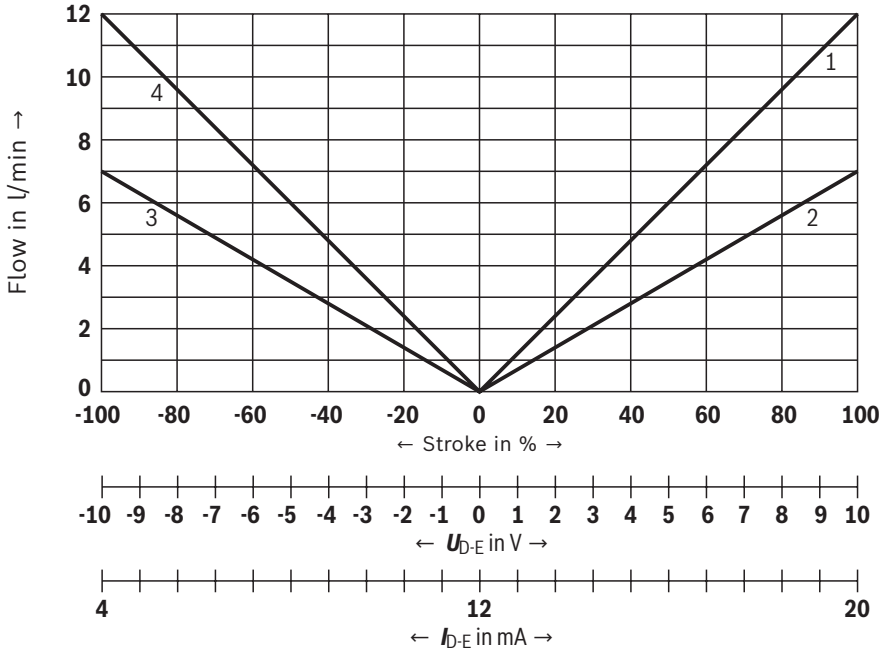
**Flow/signal function**

**Symbol C1 and C5 – Version "04"**




**1** P–A
**2** B–T
**3** P–B
**4** A–T

**Symbol C1 and C5 – Version "12"**

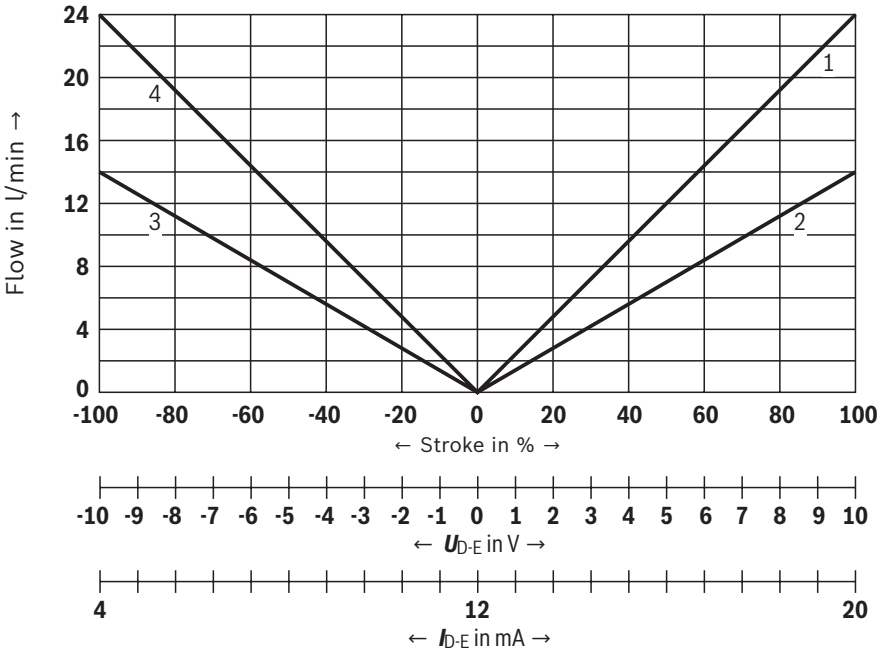



**1** P–A
**2** B–T
**3** P–B
**4** A–T

**Characteristic curves:** Flow characteristic "L"
(measured with HLP46, $\vartheta_{oil}$ = 40 ±5 °C; $\Delta p$ = 35 bar/control edge)

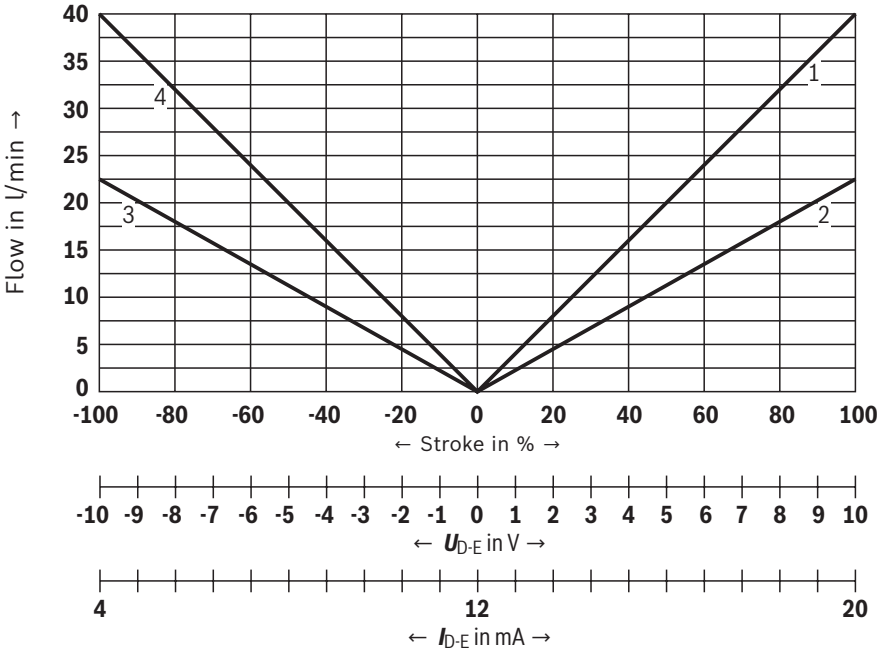
**Flow/signal function**

**Symbol C1 and C5 – Version "24"**




**1** P–A
**2** B–T
**3** P–B
**4** A–T

**Symbol C1 and C5 – Version "40"**

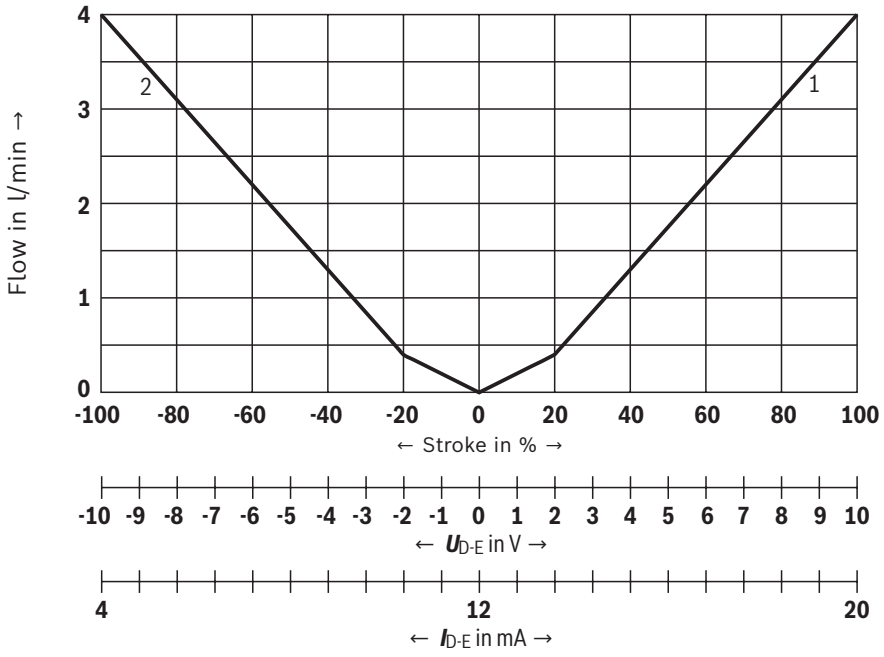



**1** P–A
**2** B–T
**3** P–B
**4** A–T

**Characteristic curves:** Flow characteristic "P"
(measured with HLP46, $\vartheta_{oil}$ = 40 ±5 °C; $\Delta p$ = 35 bar/control edge)

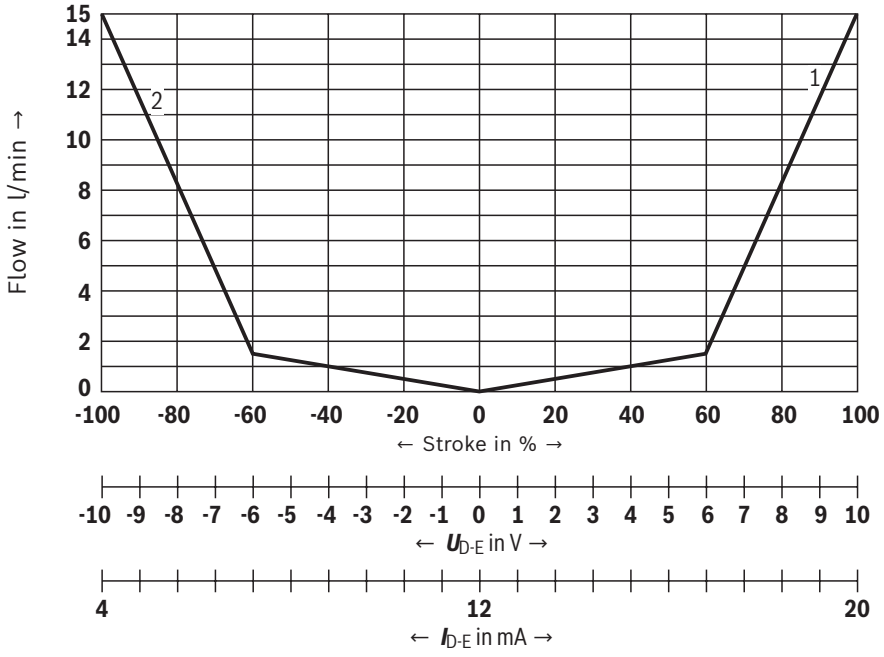
**Flow/signal function**

**Symbol C, C3 and C4 – Version "04"**




**1** P–A; B–T
**2** P–B; A–T

**Symbol C, C3 and C4 – Version "15"**

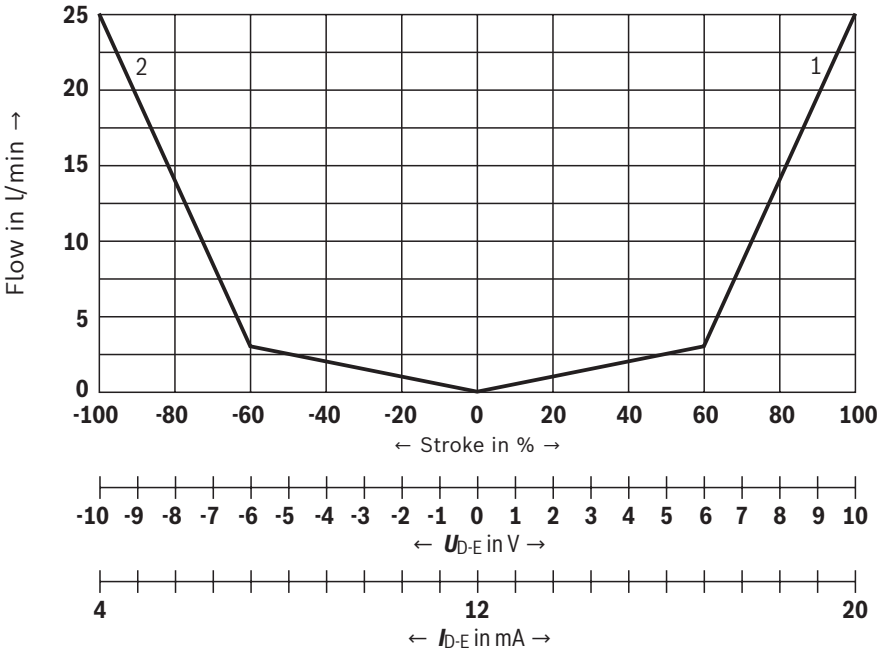



**1** P–A; B–T
**2** P–B; A–T

**Characteristic curves:** Flow characteristic "P"
(measured with HLP46, $\vartheta_{oil}$ = 40 ±5 °C; $\Delta p$ = 35 bar/control edge)

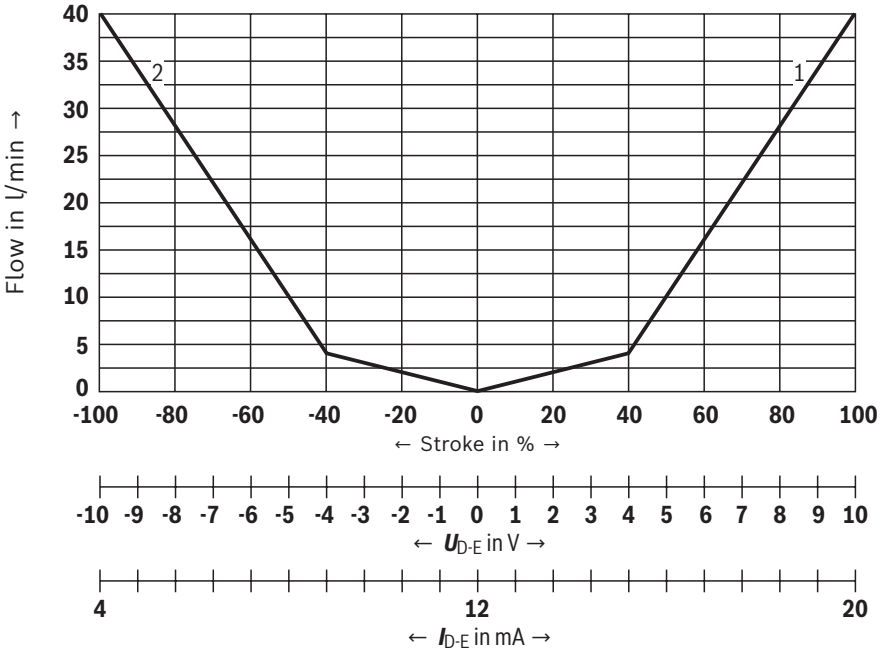
**Flow/signal function**

**Symbol C, C3 and C4 – Version "25"**




**1** P–A; B–T
**2** P–B; A–T

**Symbol C, C3 and C4 – Version "40"**

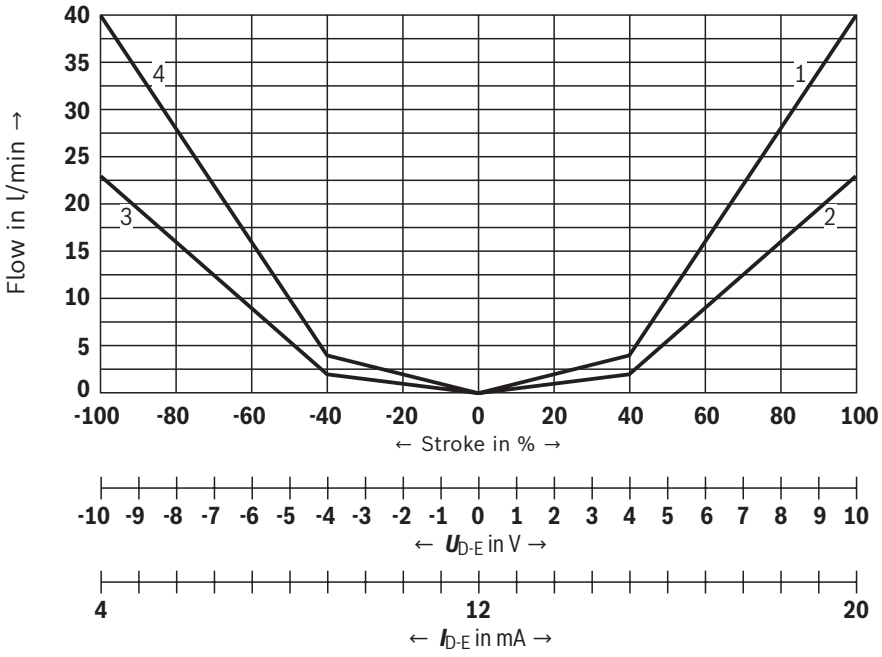



**1** P–A; B–T
**2** P–B; A–T

## **Characteristic curves:** Flow characteristic "P"
(measured with HLP46, $\vartheta_{oil}$ = 40 ±5 °C; $\Delta p$ = 35 bar/control edge)

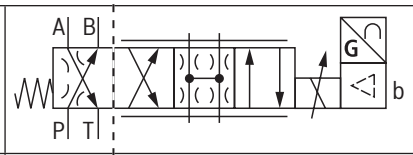
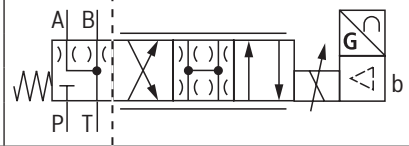
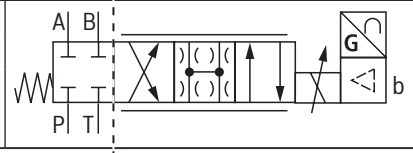
**Flow/signal function**

**Symbol C1 and C5 – Version "40"**




**1** P–A
**2** B–T
**3** P–B
**4** A–T

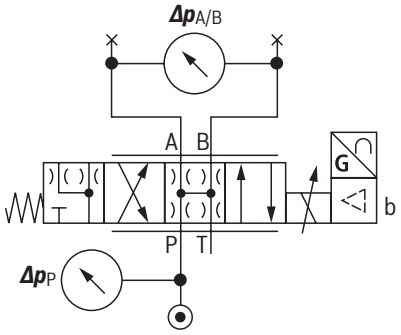
**Fail-safe position:** Flow/leakage flow

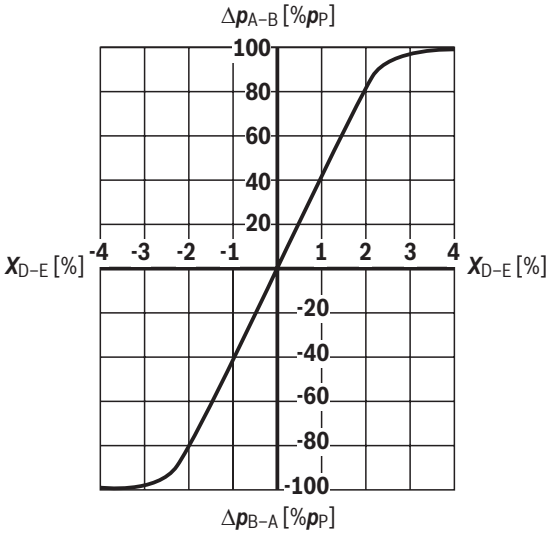
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Fail-safe position | Rated flow at $\Delta p$ = 35 bar/control edge | | l/min | 4 | 12 | 15 | 24/25 | 40 |
| **C** |  | Flow at $\Delta p$ = 35 bar/control edge | | l/min | 4 | 10 | 13 | 18 | 20 |
| **C3, C5** |  | Leakage flow at 100 bar | P→A | cm³/min | 50 | | | | |
| | | | P→B | cm³/min | 70 | | | | |
| | | Flow at $\Delta p$ = 35 bar | A→T | l/min | 10 ... 20 | | | | |
| | | | B→T | l/min | 7 ... 20 | | | | |
| **C4, C1** |  | Leakage flow at 100 bar | P→A | cm³/min | 50 | | | | |
| | | | P→B | cm³/min | 70 | | | | |
| | | | A→T | cm³/min | 70 | | | | |
| | | | B→T | cm³/min | 50 | | | | |

| | | |
|---|---|---|
| **Fail-safe** | $p$ = 0 bar ⇒ 7 ms | Internal shut-off in case of the following errors:<br>▶ Drop of supply voltage $U_B$ ≤15 V and restarting at $U_B$ ≥17.5 V.<br>▶ Only at interface "F1":<br>– Falling below the minimum current command value of 2 mA (includes cable break of the command value line (current loop))<br>▶ Only at interface "L1":<br>– Enable inactive, communication interruption (watchdog)<br>– In case of internal IO-Link error |
| | $p$ = 100 bar ⇒ 10 ms | |

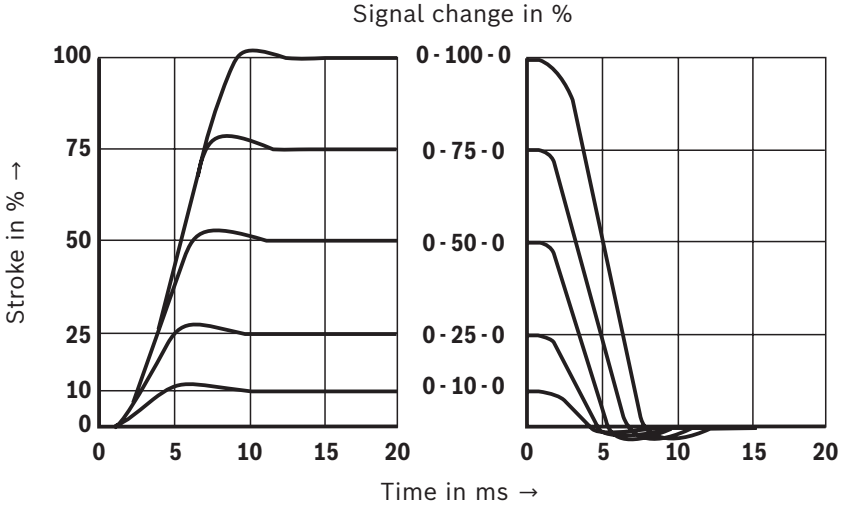
## Characteristic curves
(measured with HLP46, $\vartheta_{oil}$ = 40 ±5 °C)

### Pressure/signal characteristic curve



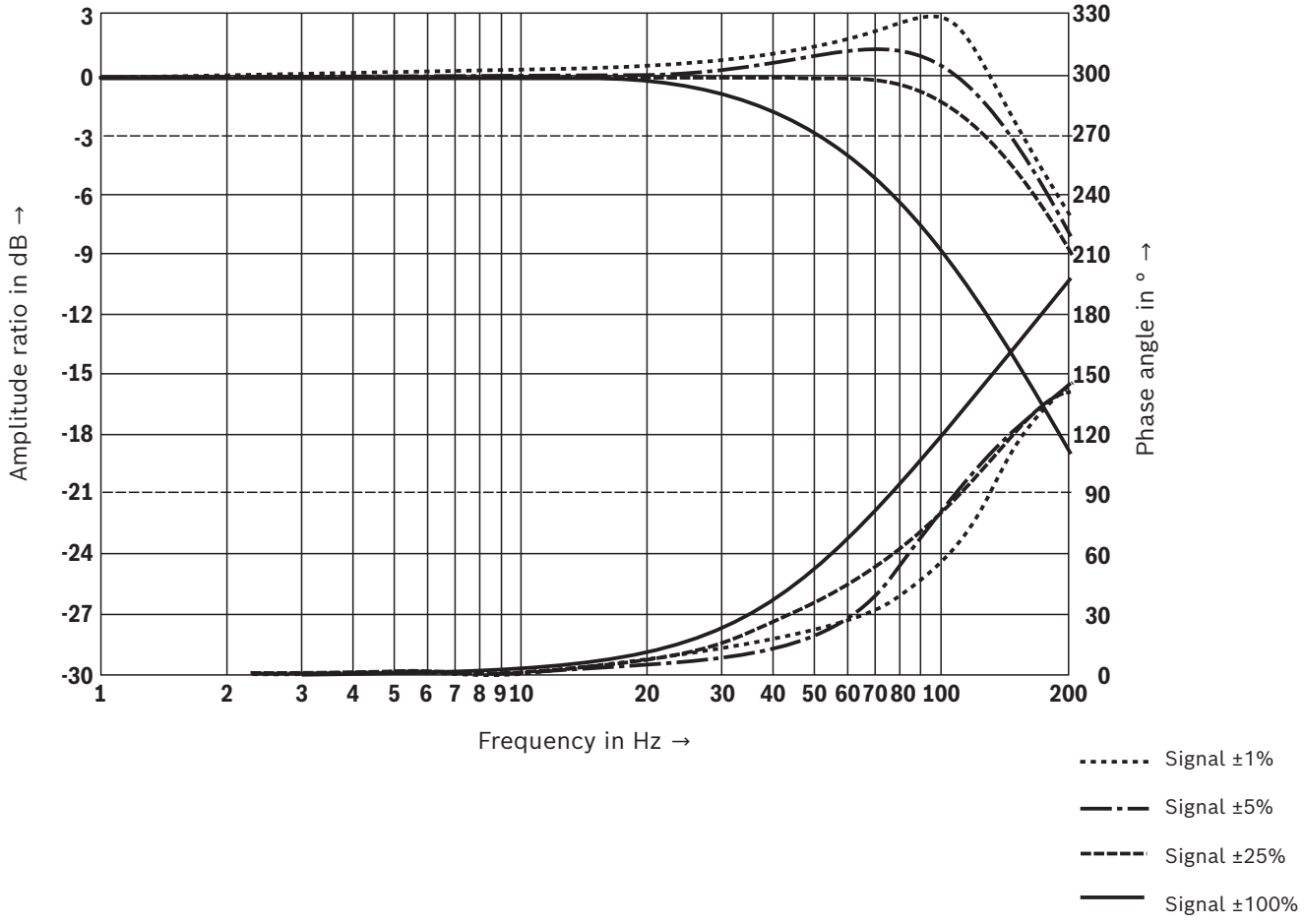

### Transition function with stepped electric input signals



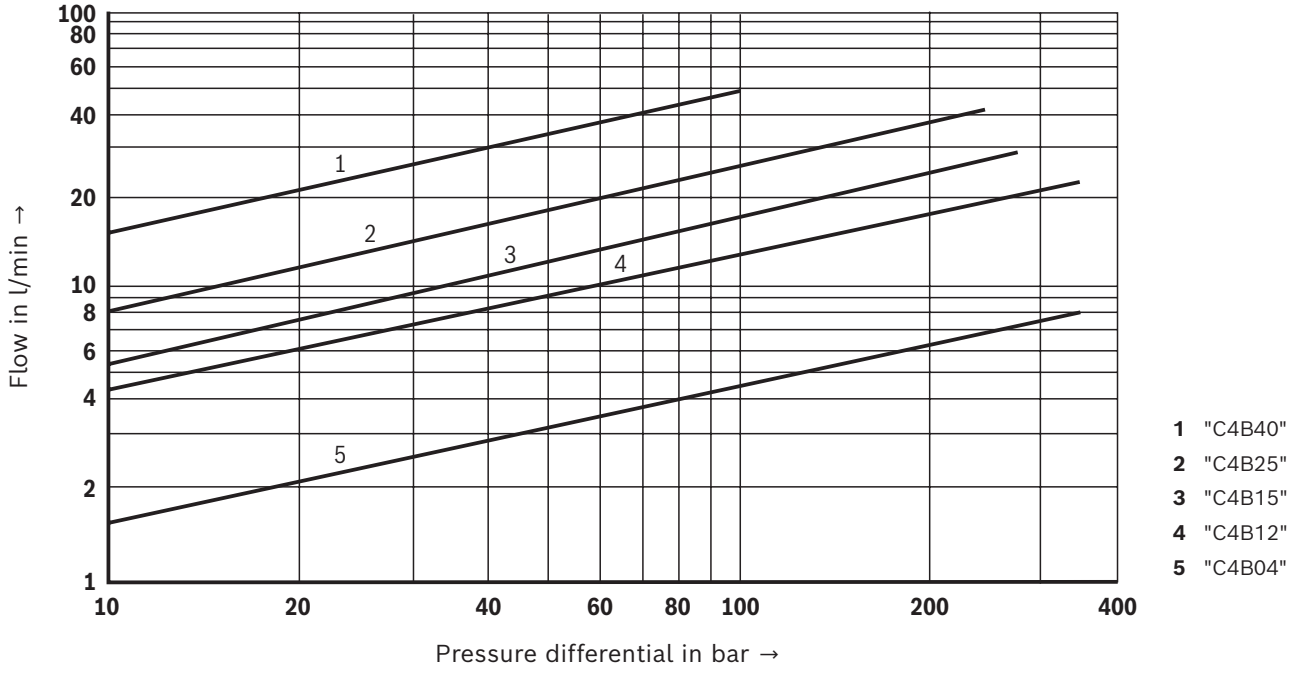
## Characteristic curves

(measured with HLP46, $\vartheta_{oil}$ = 40 ±5 °C)

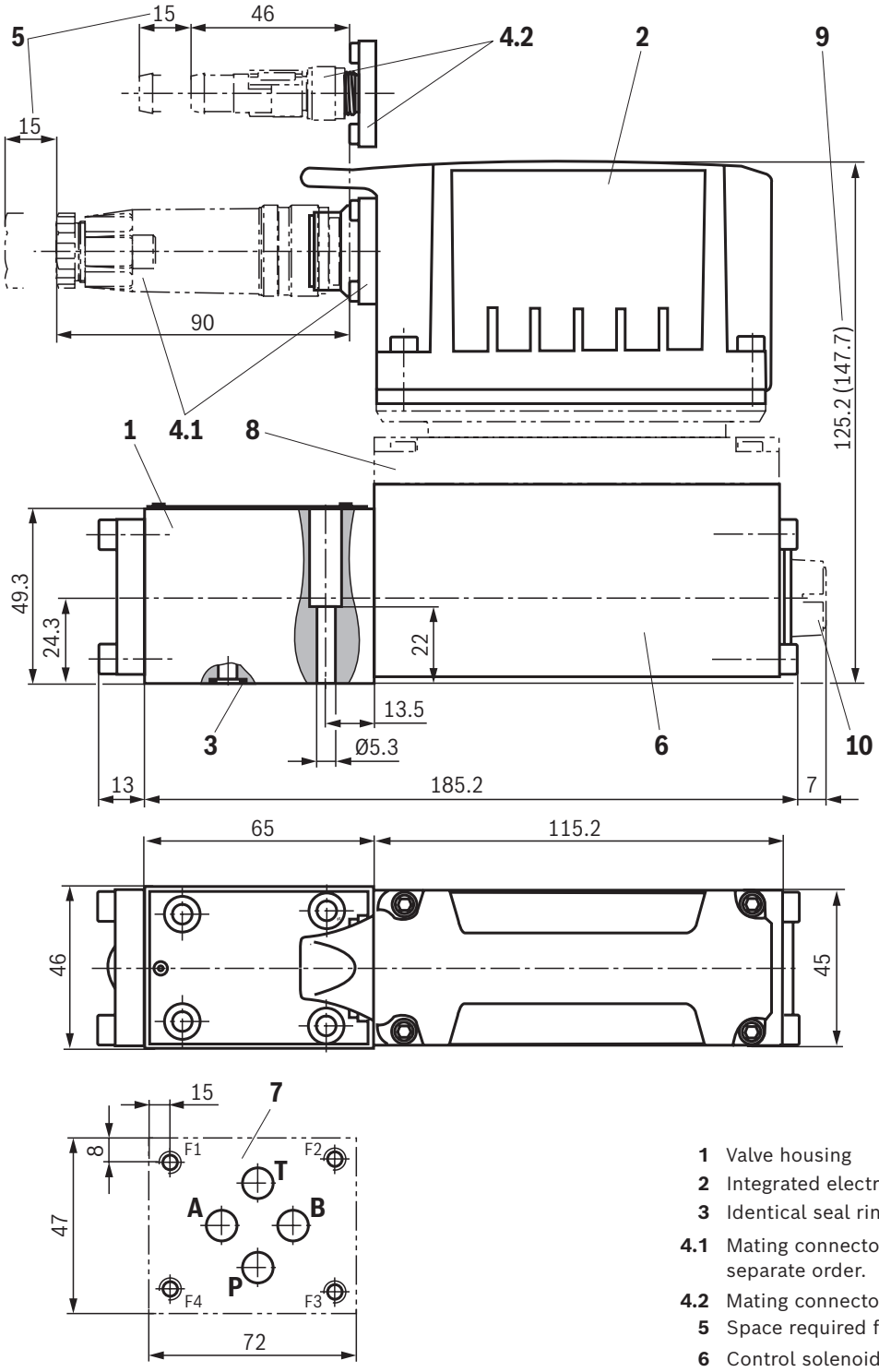
**Frequency response**

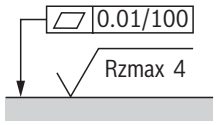



**Flow/load function with maximum valve opening**



## Dimensions
(dimensions in mm)




Required surface quality
of the valve contact surface

**1** Valve housing
**2** Integrated electronics (OBE)
**3** Identical seal rings for ports P, A, B, T
**4.1** Mating connectors with version "A1", "F1" and "C6", separate order.
**4.2** Mating connectors with version "L1", separate order.
**5** Space required for removing the mating connector
**6** Control solenoid with position transducer
**7** Machined valve contact surface, porting pattern according to ISO 4401-03-02-0-05
Deviating from the standard: Ports P, A, B, T Ø8 mm
Minimum screw-in depth:
▶ Ferrous metal 1.5 x Ø
▶ Non-ferrous 2 x Ø
**8** Damping plate "D"
**9** Dimension in () for version with damping plate "D"
**10** Electronics protection membrane "-967"

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

## Dimensions

**Valve mounting screws** (separate order)

| **4 hexagon socket head cap screws** |
|---|
| **ISO 4762 - M5 x 30 - 10.9-CM-Fe-ZnNi-5-Cn-T0-H-B**<br>Tightening torque $M_A$ = 7 Nm ±10% |
| or |
| **ISO 4762 - M5 x 30 - 10.9**<br>Tightening torque $M_A$ = 8.9 Nm ±10% |

☞ **Notice:**
The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure.

## **Accessories** (separate order)

**Valves with integrated electronics**

| **Mating connectors 6-pole + PE** | **Design** | **Version** |
|---|---|---|
| For the connection of valves with integrated electronics, round connector 6+PE, line cross-section 0.5 ... 1.5 mm² | Straight | Metal |
| | Straight | Plastic |
| | Angled | Plastic |

| **Cable sets 6-pole + PE** | **Length** in m |
|---|---|
| For the connection of valves with integrated electronics, round connector 6+PE, straight connector, shielded, potted-in mating connector, line cross-section 0.75 mm² | 3.0 |
| | 5.0 |
| | 10.0 |
| | 20.0 |

**Valves with integrated electronics and IO-Link interface**

| **Cable sets for IO-Link** | **Length** in m |
|---|---|
| For the connection of valves with IO-Link interface, M12-5, A-coded, unshielded, line cross-section 5 x 0.34 mm² | 1.5 |
| | 3.0 |
| | 5.0 |