Servoproportional directional valves sleeve execution

direct, with LVDT transducer and zero spool overlap with fail safe

DLHZO-T-060

① Valve body
② Spool
③ Sleeve
④ Proportional solenoid
⑤ LVDT transducer
⑥ Solenoid connector
⑦ Transducer connector
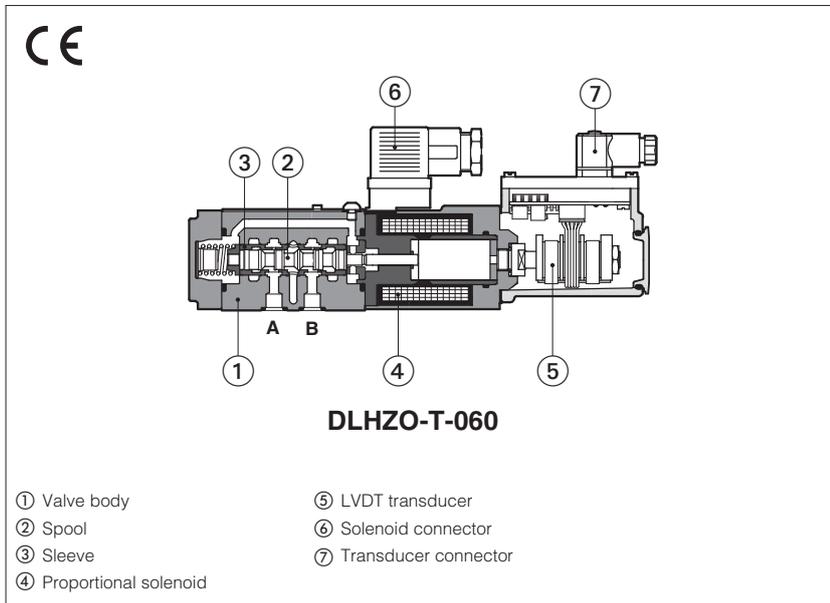
DLHZO-T, DLKZOR-T

Servoproportional directional valves, direct, with LVDT position transducer and zero spool overlap for best performances in any position closed loop.

The valves operate in association with digital off-board divers or axis card, see section ☐2.

The LVDT transducer and the sleeve execution grant very high regulation accuracy and response sensitivity.

The fail safe position permits to intercept the actuator movement in case of power supply interruption.

Spools regulation characteristics:
L = linear
V = progressive
T = non linear for fine low flow control
D and DT = differential, for control of actuators with area ratio 1:2

DLHZO:
Size: **06** - ISO 4401
Max flow: **70 l/min**
Max pressure: **350 bar**

DLKZOR:
Size: **10** - ISO 4401
Max flow: **160 l/min**
Max pressure: **315 bar**

☐1 MODEL CODE

| DLHZO | -T | -0 | 40 | -L | 7 | 3 | / | * | * | / | * |

DLHZO = size 06
DLKZOR = size 10

T = with LVDT transducer

Valve size ISO 4401:
0 = 06   **1** = 10

Configuration:

Standard   Option **/B**
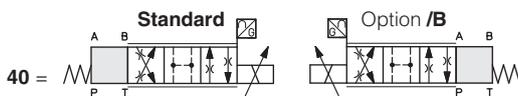
40 = with fail safe configuration 1 or 3
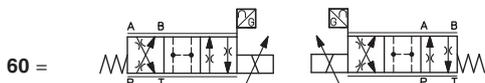
60 = without fail safe

Spool type, regulating characteristics:

L = linear   **V** = progressive   **T** = not linear **(1)**

D = differential-linear **(1)**   **DT** = differential-not linear **(1)**

P-A = Q,   B-T = Q/2
P-B = Q/2, A-T = Q

P-A = Q,   B-T = Q/2
P-B = Q/2, A-T = Q

(1) Not available for configuration **60**
(2) Possible combined options: /BY

Seals material,
see section ☐6 :
- = NBR
PE = FKM
BT = HNBR

Series number

Hydraulic options (2):
B = solenoid and LVDT transducer at side of port A
Y = external drain

Fail safe configuration, see section ☐8 :

1 =   **3** =

Note: select **1** for configuration **60** even without fail safe

Spool size:	0(L)	1(L)	1(V)	3(L)	3(T)	3(V)	5(L,T)	7(L,T,V,D,DT)
DLHZO =	4	7	8	14	-	20	28	40
DLKZOR =	-	-	-	60	60	-	-	100

Nominal flow (l/min) at Δp 70bar P-T

OFF-BOARD ELECTRONIC DRIVERS

Please include in the driver order also the complete code of the connected proportional valve.

Drivers model	E-BM-TEB	E-BM-TID	E-BM-TES	Z-BM-TEZ
Type	Digital	Digital	Digital	Digital
Format	DIN-rail panel	DIN-rail panel	DIN-rail panel	DIN-rail panel
Tech table	GS230	GS235	GS240	GS330

3 **GENERAL CHARACTERISTICS**

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index: Ra ≤ 0,8, recommended Ra 0,4 – Flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	150 years, see technical table P007
Ambient temperature range	**Standard** = -20°C ÷ +60°C **/PE** option = -20°C ÷ +60°C **/BT** option = -40°C ÷ +60°C
Storage temperature range	**Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Surface protection	Zinc coating with black passivation
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE according to EMC directive 2014/30/EU (Immunity: EN 61000-6-2; Emission: EN 61000-6-3) RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

4 **HYDRAULIC CHARACTERISTICS** - based on mineral oil ISO VG 46 at 50 °C

Valve model							DLHZO									DLKZOR				
Pressure limits [bar]	ports **P**, **A**, **B** = 350; **T** = 210 (250 with external drain /Y) **Y** = 10												ports **P**, **A**, **B** = 315; **T** = 210 (250 with external drain /Y) **Y** = 10							
Spool type	L0	L1	V1	L3	V3	L5	T5	L7	T7	V7	D7	DT7	L3	T3	L7	T7	V7	D7	DT7
Nominal flow Δp P-T [l/min] **(1)** Δp= 30 bar	2,5	4,5	8	9	13	18		26			26÷13		40		60			60÷33	
Δp= 70 bar	4	7	12	14	20	28		40			40÷20		60		100			100÷50	
Max permissible flow	8	14	16	30	40	50		70			70÷40		90		160			160÷80	
Leakage **(2)** [cm³/min]	<100	<200	<100	<300	<150	<500	<200	<900	<200	<200	<700	<200	<1000	<400	<1500	<400	<400	<1200	<400
Response time **(3)** [ms]	≤ 10												≤ 15						
Hysteresis	≤ 0,1 [% of max regulation]																		
Repeatibility	± 0,1 [% of max regulation]																		
Thermal drift	zero point displacement < 1% at ΔT = 40°C																		

(1) For different Δp, the max flow is in accordance to the diagrams in section 7.2
(2) Referred to spool in neutral position and 50°C oil temperature
**(3)** 0-100% step signal

5 **ELECTRICAL CHARACTERISTICS**

| Max power consumption	30 W
Max. solenoid current	**DLHZO** = 2,6 A **DLKZOR** = 3 A
Coil resistance R at 20°C	**DLHZO** = 3 ÷ 3,3 Ω **DLKZOR** = 2,2 ÷ 2,4 Ω
Insulation class	H (180°) Due to the occuring surface temperatures of the solenoid coils, the European standards ISO 13732-1 and EN982 must be taken into account
Protection degree to DIN EN60529	IP65 with mating connectors
Duty factor	Continuous rating (ED=100%)

6 **SEALS AND HYDRAULIC FLUIDS** - for other fluids not included in below table, consult our technical office

| Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	20÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s		
Max fluid contamination level	normal operation ISO4406 class 18/16/13 NAS1638 class 7		see also filter section at www.atos.com or KTF catalog
	longer life ISO4406 class 16/14/11 NAS1638 class 5		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

7.1   Regulation diagrams

1 = Linear spools L
2 = Differential - linear spool D7

3 = Differential non linear spool DT7
4 = Non linear spool T5 (only for DLHZO)

5 = Non linear spool T3 (only for DLKZOR) and T7
**6** = Progressive spool V
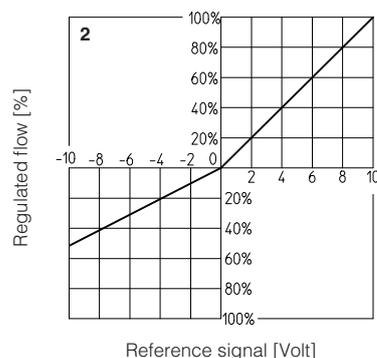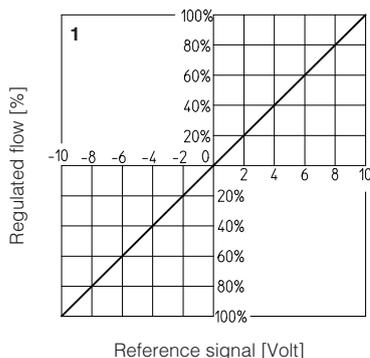
T3, T5 and T7 spool types are specific for fine low flow control in the range from 0 to 60% (T5) and 0 to 40% (T3, T7) of max spool stroke.
The non linear characteristics of the spool is compensated by the electronic driver, so the final valve regulation is resulting linear respect the reference signal (dotted line).

DT7 has the same characteristic of T7 but it is specific for applications with cylinders with area ratio 1:2
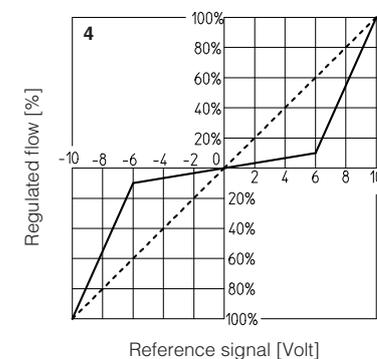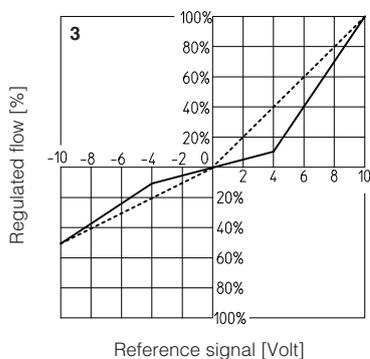
Note:
Hydraulic configuration vs. reference signal:

Standard:
Reference signal $\left.\begin{matrix} 0 \div +10 \text{ V} \\ 12 \div 20 \text{ mA} \end{matrix}\right\}$ P → A / B → T

Reference signal $\left.\begin{matrix} 0 \div -10 \text{ V} \\ 12 \div 4 \text{ mA} \end{matrix}\right\}$ P → B / A → T

option /B:
Reference signal $\left.\begin{matrix} 0 \div +10 \text{ V} \\ 12 \div 20 \text{ mA} \end{matrix}\right\}$ P → B / A → T

Reference signal $\left.\begin{matrix} 0 \div -10 \text{ V} \\ 12 \div 4 \text{ mA} \end{matrix}\right\}$ P → A / B → T
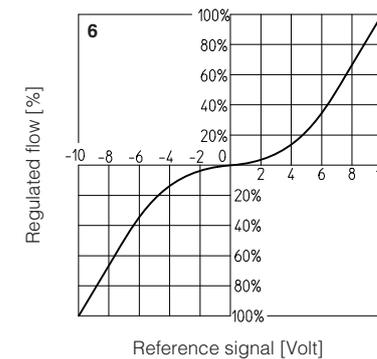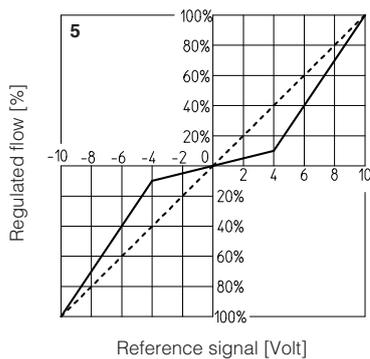
7.2 Flow /Δp diagrams
Stated at 100% of spool stroke

DLHZO:
1 = spool L7, T7, V7, D7, DT7
2 = spool L5, T5
3 = spool V3
4 = spool L3
5 = spool L1, V1
6 = spool L0

DLKZOR:
7 = spool L7, T7, V7, D7, DT7
8 = spool L3

Flow rate [l/min] vs Valve pressure drop Δp [bar]

7.3 Pressure gain

Δp A→B

Δp A→B [%P] vs Spool stroke [%]
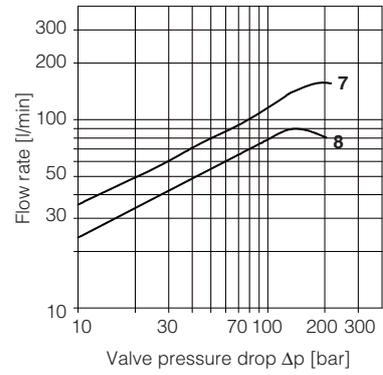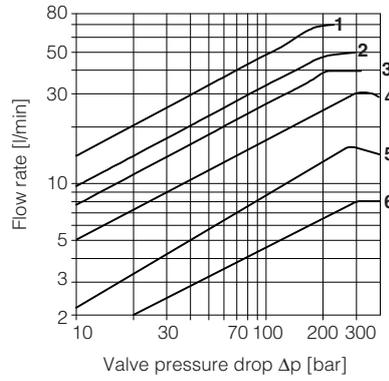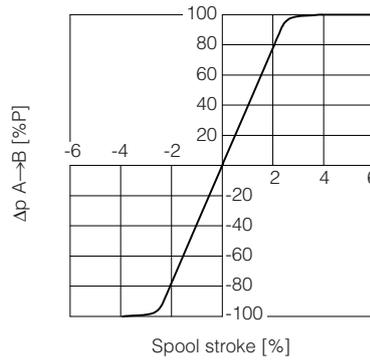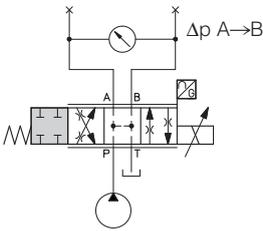
7.4 Response time
The response times in below diagrams are measured at different steps of the reference input signal. They have to be considered as average values.
For the valves with digital electronics the dynamics performances can be optimized by setting the internal software parameters.

DLHZO
Step signal [%]
Spool stroke [%] vs Time [ms]
0 -100
0 -75
0 -50
0 -25

DLKZOR
Step signal [%]
Spool stroke [%] vs Time [ms]
0 -100
0 -75
0 -50
0 -25
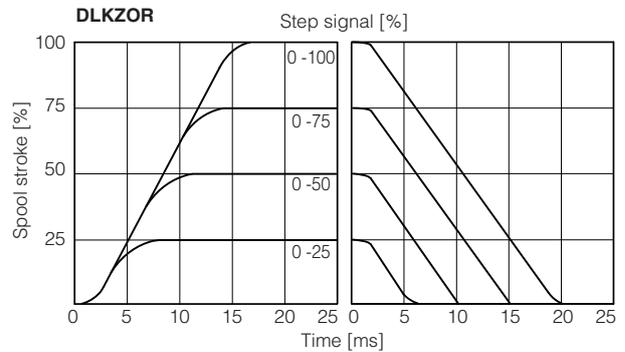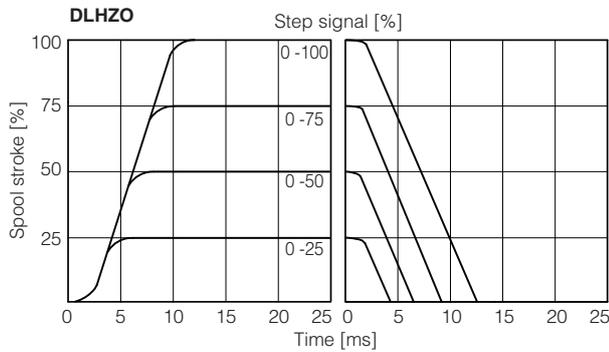
7.5 Bode diagrams
Stated at nominal hydraulic conditions

DLHZO:
1 = ± 100% nominal stroke
2 = ±   5% nominal stroke

DLKZOR:
3 = ± 100% nominal stroke
4 = ±   5% nominal stroke

Amplitude ratio [dB] / Phase [degree] vs Frequency [Hz]

8 FAIL SAFE POSITION

CONFIGURATION	LINEAR	NOT LINEAR
fail safe **1**	**t** = 7-10 ms (DLHZO) **t** = 15-20 ms (DLKZOR)	**t** = 7-10 ms (DLHZO) **t** = 15-20 ms (DLKZOR)
fail safe **3**		
without fail safe		

t = time required by the valve to switch from central to fail safe position at the power switch-off, with pressure 0 to 100 bar
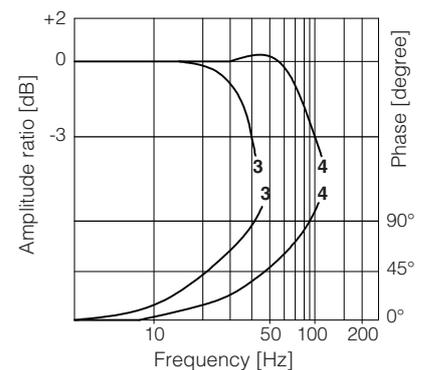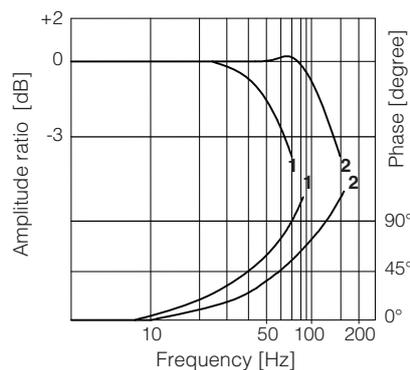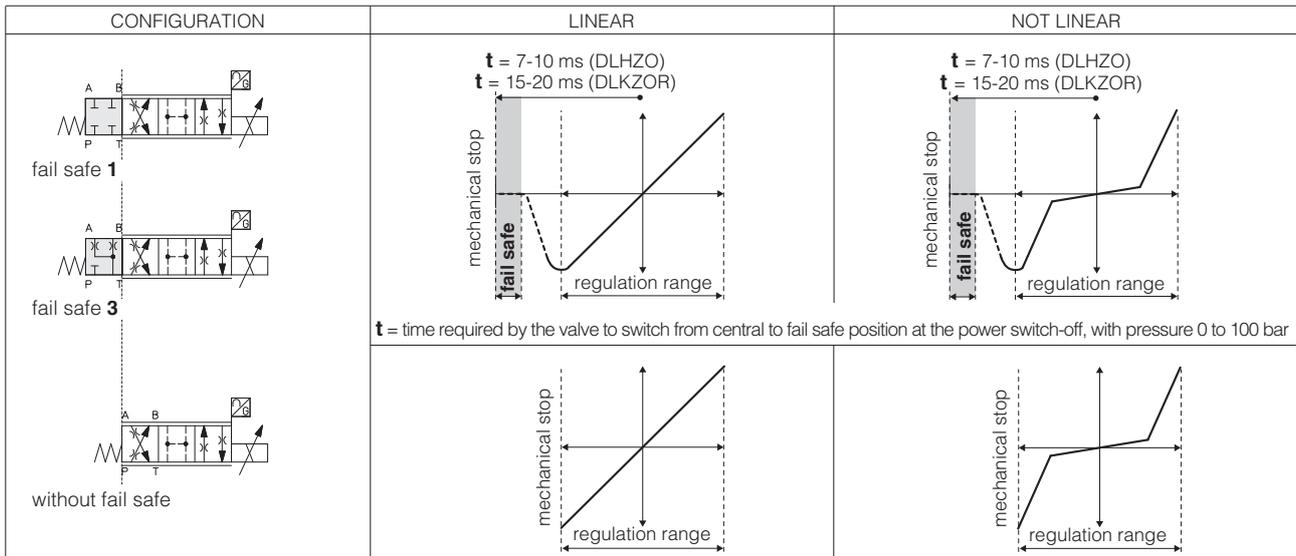
Fail safe connections		**P → A**	**P → B**	**A → T**	**B → T**
Leakage [cm³/min] at P = 100 bar **(1)**	Fail safe 1	50	70	70	50
	Fail safe 3	50	70	-	-
Flow [l/min] **(2)** DLHZO / DLKZOR	Fail safe 3	-	-	15÷30	10÷20
		-	-	40÷60	25÷40

(1) Referred to spool in fail safe position and 50°C oil temperature   **(2)** Referred to spool in fail safe position at Δp = 35 bar per edge

9 HYDRAULIC OPTIONS

B = Solenoid and position transducer at side of port A of the main stage. For hydraulic configuration vs reference signal, see 7.1

Y = This option is mandatory if the pressure in port T exceeds 210 bar.

10 ELECTRICAL CONNECTION

10.1 Solenoid connector - supplied with the valve

PIN	SIGNAL	TECHNICAL SPECIFICATION	Connector code 666
1	**COIL**	Power supply	
2	**COIL**	Power supply	
3	**GND**	Ground	
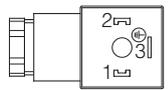
10.2 LVDT transducer connector - supplied with the valve

PIN	SIGNAL	TECHNICAL SPECIFICATION	Connector code 345
1	**TR**	Output signal	
2	**VT-**	Power supply -15VDC	
3	**VT+**	Power supply +15VDC	
4	**GND**	Ground	
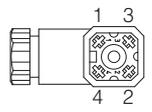
11 FASTENING BOLTS AND SEALS

|	DLHZO	DLKZOR
	Fastening bolts: 4 socket head screws M5x50 class 12.9 Tightening torque = 8 Nm	**Fastening bolts:** 4 socket head screws M6x40 class 12.9 Tightening torque = 15 Nm
	Seals: 4 OR 108; Diameter of ports A, B, P, T: Ø 7,5 mm (max) 1 OR 2025 Diameter of port Y: Ø = 3,2 mm (only for /Y option)	**Seals:** 5 OR 2050; Diameter of ports A, B, P, T: Ø 11,2 mm (max) 1 OR 108 Diameter of port Y: Ø = 5 mm (only for /Y option)

DLHZO-T

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05 (see table P005)
(for /Y surface 4401-03-03-0-05 without X port)

| Mass [kg]	
DLHZO	2,3

① = Air bleeding
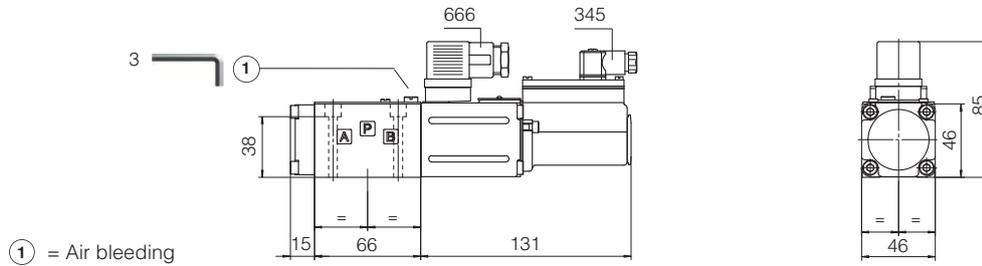
DLKZOR-T

ISO 4401: 2005
Mounting surface: 4401-05-04-0-05 (see table P005)
(for /Y surface 4401-05-05-0-05 without X port)

Mass [kg]	
DLKZOR	4,3

① = Air bleeding
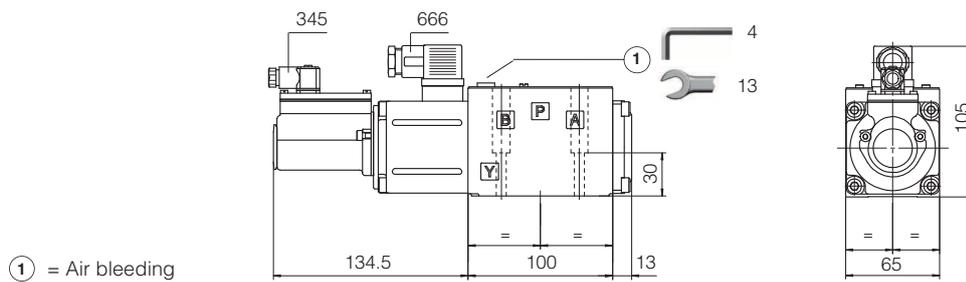
Note: for option /B the solenoid and the LVDT transducer are at side of port A

13 **RELATED DOCUMENTATION**

FS001	Basics for digital electrohydraulics	**GS330**	Z-BM-TEZ digital axis card
FS900	Operating and maintenance information for proportional valves	**GS500**	Programming tools
GS230	E-BM-TEB digital driver	**GS510**	Fieldbus
GS235	E-BM-TID digital driver	**K800**	Electric and electronic connectors
GS240	E-BM-TES digital driver	**P005**	Mounting surfaces for electrohydraulic valves