Servopropotional directional valves sleeve execution
direct, with LVDT transducer and zero spool overlap with fail safe

DLHZO-T, DLKZOR-T
Servopropotional 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 7
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

Table F180-18/E

Spool size
- 0 = 06
- 1 = 10

Configuration:
- 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)

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

Note: select 1 for configuration 60 even without fail safe

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

Seals material, see section [T]
- = NBR
PE = FKM
BT = HNBR

Series number

Nominal flow (l/min) at Δp 70bar P-T

DLHZO = 4 7 8 14 - - 40
DLKZOR = - - - 60 60 - - 100

F180
2 OFF-BOARD ELECTRONIC DRIVERS

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

<table>
<thead>
<tr>
<th>Drivers model</th>
<th>E-BM-TEB</th>
<th>E-BM-TID</th>
<th>E-BM-TEZ</th>
<th>Z-BM-TEZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Digital</td>
<td>Digital</td>
<td>Digital</td>
<td>Digital</td>
</tr>
<tr>
<td>Format</td>
<td>DIN-rail panel</td>
<td>DIN-rail panel</td>
<td>DIN-rail panel</td>
<td>DIN-rail panel</td>
</tr>
<tr>
<td>Tech table</td>
<td>GS230</td>
<td>GS235</td>
<td>GS240</td>
<td>GS330</td>
</tr>
</tbody>
</table>

3 GENERAL CHARACTERISTICS

- **Assembly position**: Any position
- **Subplate surface finishing** to ISO 4401. Acceptable roughness index: $Ra \leq 0.8$, 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 $= -20°C \div +60°C$ /PE option $= -20°C \div +60°C$ /BT option $= -40°C \div +60°C$
- **Storage temperature range**: Standard $= -20°C \div +70°C$ /PE option $= -20°C \div +70°C$ /BT option $= -40°C \div +70°C$
- **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**

**Valve model**

**Pressure limits** [bar]

<table>
<thead>
<tr>
<th><strong>Spool type</strong></th>
<th>L0</th>
<th>L1</th>
<th>V1</th>
<th>L3</th>
<th>V3</th>
<th>L5</th>
<th>T5</th>
<th>T7</th>
<th>V7</th>
<th>D7</th>
<th>DT7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal flow $\Delta p-T$ [l/min]</td>
<td>2.5</td>
<td>4.5</td>
<td>8</td>
<td>9</td>
<td>13</td>
<td>18</td>
<td>26</td>
<td>26+13</td>
<td>40</td>
<td>60</td>
<td>60+33</td>
</tr>
<tr>
<td>$\Delta p= 30$ bar</td>
<td>4</td>
<td>7</td>
<td>12</td>
<td>14</td>
<td>20</td>
<td>28</td>
<td>40</td>
<td>40+20</td>
<td>60</td>
<td>100</td>
<td>100+50</td>
</tr>
<tr>
<td>Max permissible flow</td>
<td>8</td>
<td>14</td>
<td>16</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>70</td>
<td>70+40</td>
<td>90</td>
<td>160</td>
<td>160+80</td>
</tr>
</tbody>
</table>

**Leakage** [cm³/min]

<table>
<thead>
<tr>
<th></th>
<th>&lt;100</th>
<th>&lt;200</th>
<th>&lt;300</th>
<th>&lt;500</th>
<th>&lt;500</th>
<th>&lt;200</th>
<th>&lt;200</th>
<th>&lt;200</th>
<th>&lt;200</th>
<th>&lt;100</th>
<th>&lt;400</th>
<th>&lt;400</th>
<th>&lt;1200</th>
<th>&lt;400</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>500</td>
<td>500</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>100</td>
<td>400</td>
<td>400</td>
<td>1200</td>
<td>400</td>
</tr>
</tbody>
</table>

**Response time** [ms]

<table>
<thead>
<tr>
<th></th>
<th>≤ 10</th>
<th>≤ 15</th>
</tr>
</thead>
</table>

**Hysteresis** ≤ 0,1 [% of max regulation]

**Repeatability** ± 0,1 [% of max regulation]

**Thermal drift** zero point displacement < 1% at $\Delta T = 40°C$

(1) For different $\Delta p$, 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 $= 3 \div 3.3 \Omega$, DLKZOR $= 2.2 \div 2.4 \Omega$
- **Insulation class**: H (180°C). Due to the occurring 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) $= -20°C \div +80°C$, with HFC hydraulic fluids $= -20°C \div +50°C$
|-------------------------------------| FKM seals (PE option) $= -20°C \div +80°C$
| HNBR seals (BT option) $= -40°C \div +60°C$, with HFC hydraulic fluids $= -40°C \div +50°C$
| **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
| **Longer life** ISO4406 class 16/14/11 NAS1638 class 5
| see also filter section at www.atos.com or KTF catalog
<table>
<thead>
<tr>
<th><strong>Hydraulic fluid</strong></th>
<th><strong>Suitable seals type</strong></th>
<th><strong>Classification</strong></th>
<th><strong>Ref. Standard</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral oils</td>
<td>NBR, FKM, HNBR</td>
<td>HIL, HLP, HLPD, HLVPL, HVLPD</td>
<td>DIN 51524</td>
</tr>
<tr>
<td>Flame resistant without water</td>
<td>FKM</td>
<td>HFDU, HDFR</td>
<td>ISO 12922</td>
</tr>
<tr>
<td>Flame resistant with water</td>
<td>NBR, HNBR</td>
<td>HFC</td>
<td>ISO 12922</td>
</tr>
</tbody>
</table>
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 $0 \div +10 \text{ V}$ $\rightarrow P \rightarrow A / B \rightarrow T$
Reference signal $0 \div -10 \text{ V}$ $\rightarrow 12 \div 4 \text{ mA}$ $P \rightarrow B / A \rightarrow T$

Option /B:
Reference signal $0 \div +10 \text{ V}$ $\rightarrow 12 \div 20 \text{ mA}$ $P \rightarrow B / A \rightarrow T$
Reference signal $0 \div -10 \text{ V}$ $\rightarrow 12 \div 4 \text{ mA}$ $P \rightarrow A / B \rightarrow T$
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 V5
4 = spool L3
5 = spool L1, V1
6 = spool L0

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

7.3 Pressure gain

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.

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
8 FAIL SAFE POSITION

<table>
<thead>
<tr>
<th>CONFIGURATION</th>
<th>LINEAR</th>
<th>NOT LINEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
<td><img src="image3" alt="Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fail safe connections</th>
<th>P → A</th>
<th>P → B</th>
<th>A → T</th>
<th>B → T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage [cm³/min] at P = 100 bar (1)</td>
<td>50</td>
<td>70</td>
<td>70</td>
<td>50</td>
</tr>
<tr>
<td>Flow [l/min] (2) DLHZO DLKZOR</td>
<td>-</td>
<td>-</td>
<td>15±30</td>
<td>10±20</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>40±60</td>
<td>25±40</td>
</tr>
</tbody>
</table>

(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

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>TECHNICAL SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COIL</td>
<td>Power supply</td>
</tr>
<tr>
<td>2</td>
<td>COIL</td>
<td>Power supply</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Connector code 666

10.2 LVDT transducer connector - supplied with the valve

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>TECHNICAL SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TR</td>
<td>Output signal</td>
</tr>
<tr>
<td>2</td>
<td>VT-</td>
<td>Power supply -15Vdc</td>
</tr>
<tr>
<td>3</td>
<td>VT+</td>
<td>Power supply +15Vdc</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Connector code 345

11 FASTENING BOLTS AND SEALS

<table>
<thead>
<tr>
<th>DLHZO</th>
<th>DLKZOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fastening bolts:</td>
<td>Fastening bolts:</td>
</tr>
<tr>
<td>4 socket head screws M5x50 class 12.9</td>
<td>4 socket head screws M6x40 class 12.9</td>
</tr>
<tr>
<td>Tightening torque = 8 Nm</td>
<td>Tightening torque = 15 Nm</td>
</tr>
<tr>
<td>Seals:</td>
<td>Seals:</td>
</tr>
<tr>
<td>4 OR 108; Diameter of ports A, B, P, T: Ø 7.5 mm (max)</td>
<td>5 OR 2050; Diameter of ports A, B, P, T: Ø 11.2 mm (max)</td>
</tr>
<tr>
<td>1 OR 2025; Diameter of port Y: Ø 3.2 mm (only for /Y option)</td>
<td>1 OR 108; Diameter of port Y: Ø 5 mm (only for /Y option)</td>
</tr>
</tbody>
</table>
**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)

<table>
<thead>
<tr>
<th>Mass [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLHZO</td>
</tr>
</tbody>
</table>

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

**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)

<table>
<thead>
<tr>
<th>Mass [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLKZOR</td>
</tr>
</tbody>
</table>

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

**RELATED DOCUMENTATION**

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

01/20