Proportional directional valves high performance
direct, with LVDT transducer and positive spool overlap

DHZO-T, DKZOR-T
Proportional directional valves, direct, with LVDT position transducer and positive spool overlap for best dynamics in directional controls and not compensated flow regulations.
The valves operate in association with digital off-board divers, see section 7.
The LVDT transducer grants very high regulation accuracy and response sensitivity.
With de-energized proportional solenoids, mechanical central position of the spool is performed by centering springs.
Spools regulation characteristics:
L = linear
S = progressive, for fine low flow control
D = differential-progressive, for control of actuators with area ratio 1:2
Q5 and Q6 = for P/Q control

DHZO
DKZOR:
Size: 06 - ISO 4401 Size: 10 - ISO 4401
Max flow: 80 l/min Max flow: 180 l/min
Max pressure: 350 bar Max pressure: 315 bar

Table F165-4/E

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Spool type, regulating characteristics (3):</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L = linear</td>
</tr>
<tr>
<td></td>
<td>S = progressive</td>
</tr>
<tr>
<td></td>
<td>D = differential-progressive</td>
</tr>
<tr>
<td></td>
<td>P-A = Q, B-T = Q/2, P-B = Q/2, A-T = Q</td>
</tr>
</tbody>
</table>

Seals material, see section 7:
- NBR
PE FKM
BT HNBR

Valve body
Spool
Proportional solenoid
LVDT transducer
Solenoid connector
Transducer connector

(1) Only for DKZOR-SS the spool overlapping type 2 provides the same characteristic of type 1, but in central position the internal leakages from P to A and B are drained to tank, avoiding the drift of cylinders with differential areas
(2) Possible combined options: /BY
(3) Spools for P/Q control, see section 5

1 MODEL CODE OF STANDARD SPOOLS

DHZO - T - 071 - L

T = with LVDT transducer
Valve size ISO 4401:
0 = 06 1 = 10

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Spool size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14 (L) 1 (L) 2 (S) 3 (L,S,D) 5 (L,S,D)</td>
</tr>
<tr>
<td></td>
<td>1 4,5 8 17 28</td>
</tr>
<tr>
<td></td>
<td>45 75</td>
</tr>
</tbody>
</table>

Nominal flow (l/min) at Δp 10bar P-T

(1) Only for DKZOR-SS the spool overlapping type 2 provides the same characteristic of type 1, but in central position the internal leakages from P to A and B are drained to tank, avoiding the drift of cylinders with differential areas
(2) Possible combined options: /BY
(3) Spools for P/Q control, see section 5
2 MODEL CODE OF SPOOLS FOR ALTERNATED P/Q CONTROL - for valve model code and options, see section 1

<table>
<thead>
<tr>
<th>Configuration and spool:</th>
<th>73-Q5</th>
<th>73-Q5/B</th>
<th>73-V9</th>
<th>73-V9/B</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHZO</td>
<td>T</td>
<td>0</td>
<td>V9</td>
<td></td>
</tr>
<tr>
<td>DKZOR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Spool size: Q5 V9
DHZO = 30 30
DKZOR = 75 75
Nominal flow (l/min) at Δp 10 bar P-T

3 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>Type</th>
<th>Format</th>
<th>Tech table</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-BM-TID</td>
<td>digital</td>
<td>DIN-rail panel</td>
<td>GS235</td>
</tr>
<tr>
<td>E-BM-TEB</td>
<td>digital</td>
<td>DIN-rail panel</td>
<td>GS230</td>
</tr>
<tr>
<td>E-BM-TES</td>
<td>digital</td>
<td>DIN-rail panel</td>
<td>GS240</td>
</tr>
</tbody>
</table>

4 GENERAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Assembly position</th>
<th>Any position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subplate surface finishing to ISO 4401</td>
<td>Acceptable roughness index: Ra ≤ 0.8, recommended Ra 0.4 – Flatness ratio 0.01/100</td>
</tr>
<tr>
<td>MTTFd valves according to EN ISO 13849</td>
<td>150 years, see technical table P007</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>Standard = -20°C ÷ +60°C /PE option = -20°C ÷ +60°C /BT option = -40°C ÷ +60°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>Standard = -20°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C</td>
</tr>
<tr>
<td>Surface protection</td>
<td>Zinc coating with black passivation</td>
</tr>
<tr>
<td>Corrosion resistance</td>
<td>Salt spray test (EN ISO 9227) &gt; 200 h</td>
</tr>
<tr>
<td>Compliance</td>
<td>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</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Valve model</th>
<th>DHZO</th>
<th>DKZOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure limits [bar]</td>
<td>T = 210 (250 with external drain /Y) Y = 10</td>
<td>T = 210 (250 with external drain /Y) Y = 10</td>
</tr>
<tr>
<td>Configuration</td>
<td>51, 53, 71, 73</td>
<td>73</td>
</tr>
<tr>
<td>73</td>
<td>51, 53, 71, 73</td>
<td>72</td>
</tr>
<tr>
<td>Spool type</td>
<td>standard</td>
<td>L14</td>
</tr>
<tr>
<td>Δp= 10 bar</td>
<td>1</td>
<td>4.5</td>
</tr>
<tr>
<td>Δp= 30 bar</td>
<td>1.7</td>
<td>8</td>
</tr>
<tr>
<td>Δp= 70 bar</td>
<td>2.6</td>
<td>12</td>
</tr>
<tr>
<td>Max permissible flow (2)</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>Leakage [cm³/min]</td>
<td>&lt;30 (at p = 100 bar), &lt;135 (at p = 350 bar)</td>
<td>&lt;80 (at p = 100 bar), &lt;600 (at p = 315 bar)</td>
</tr>
<tr>
<td>Response time (3) [ms]</td>
<td>≤ 15</td>
<td>≤ 20</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>≤ 0.2 [% of max regulation]</td>
<td></td>
</tr>
<tr>
<td>Repeatability</td>
<td>≤ 0.1 [% of max regulation]</td>
<td></td>
</tr>
<tr>
<td>Thermal drift</td>
<td>zero point displacement &lt; 1% at ΔT = 40°C</td>
<td></td>
</tr>
</tbody>
</table>

(1) For different Δp, the max flow is in accordance to the diagrams in section 8.2
(2) See detailed diagrams in section 8.3
(3) 0-100% step signal
6 ELECTRICAL CHARACTERISTICS

Max power consumption 30 W
Max. solenoid current DHZO = 2.6 A  DKZOR = 3 A
Coil resistance R at 20°C DHZO = 3 + 3.3 Ω  DKZOR = 3.8 + 4.1 Ω
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%)

7 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

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 | |

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

8 DIAGRAMS - based on mineral oil ISO VG 46 at 50°C

8.1 Regulation diagrams - values measure at Δp 30 bar P-T

DHZO
1 = L14  2 = L1

DHZO
4 = L3  5 = S3
6A = D3 (P → A, A → T)
6B = D3 (P → B, B → T)

DKZOR
10 = L3  11 = S3
12A = D3 (P → A, A → T)
12B = D3 (P → B, B → T)
Note:
Hydraulic configuration vs. reference signal for configurations 71, 72 and 73 (standard and option /B)
Reference signal $0 \div +10 \text{ V}$
$12 \div 20 \text{ mA}$ $\rightarrow$ P $\rightarrow$ A / B $\rightarrow$ T
Reference signal $0 \div -10 \text{ V}$
$12 \div 4 \text{ mA}$ $\rightarrow$ P $\rightarrow$ B / A $\rightarrow$ T

16 = linear spool Q5
Q5 spool type is specific for alternate P/Q controls in combination with S* option of digital integral drivers (see tech table FS500).
It allows to control the pressure in A port or B port and it provides a safety central position (A-T/B-T) to depressurize the actuator chambers.
The strong meter-in characteristic makes the spool suitable for both pressure control and motion regulations in several applications.

17 = differential - progressive spool V9
V9 spool type is specific for alternate P/Q controls in combination with S* option of digital integral drivers (see tech table FS500).
This spool is specially designed to manage the whole injection cycle in plastic machinery, thanks to the following specific features:
- strong meter-in characteristic to allow the pressure control in A port during the holding pressure (P-A) and the plasticizing (A-T) phases
- safety central position (A-T/B-T) to depressurize the actuator chambers
- large A-T and B-T flow capability, required during the plasticizing phase, to discharge big volumes from high differential injection cylinders with low pressure drops and permitting the contemporary oil suction from tank

8.2 Flow/Δp diagrams
stated at 100% of valve stroke

DHZO
1 = spool L14
2 = spool L1
3 = spool S2
4 = spool L3, S3, D3
5 = spool L5, S5, D5, V9

DKZOR
6 = spool S3, L3, D3
7 = spool S5, L5, D5, V9

8.3 Operating limits

DHZO
1 = spool L14
2 = spool L1
3 = spool S2
4 = spool L3, S3, D3
5 = spool L5, S5, D5, V9

DKZOR
6 = spool S3, L3, D3
7 = spool S5, L5, D5, V9
8.4 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.

8.5 Bode diagrams

1. amplitude ratio [dB]
2. frequency [Hz]
3. phase [degrees]

DHZO
DKZOR

8.6 Operation as throttle valve
Single solenoid valves configuration 51 and 53 can be used as simple throttle valves:

Max flow $\Delta p = 15 \text{bar} \quad \text{[l/min]}

<table>
<thead>
<tr>
<th>Spool stroke [%]</th>
<th>DHZO</th>
<th>DKZOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8.4 HYDRAULIC OPTIONS

B = Solenoid and position transducer at side of port A of the main stage. For hydraulic configuration vs reference signal, see 8.1

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

9 ELECTRICAL CONNECTION

10.1 Solenoid connector - supplied with the valve

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>TECHNICAL SPECIFICATION</th>
<th>Connector code 666</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COIL</td>
<td>Power supply</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>COIL</td>
<td>Power supply</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>

10.2 LVDT transducer connector - supplied with the valve

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>TECHNICAL SPECIFICATION</th>
<th>Connector code 345</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TR</td>
<td>Output signal</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>VT-</td>
<td>Power supply -15Vcc</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>VT+</td>
<td>Power supply +15Vcc</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>
11 FASTENING BOLTS AND SEALS

**DHZO**
- Fastening bolts: 4 socket head screws M5x50 class 12.9
- Tightening torque = 8 Nm

**DKZOR**
- 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)

12 INSTALLATION DIMENSIONS [mm]

**DHZO-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]**
- DHZO-T-05: 1.9
- DHZO-T-07: 2.6

**DKZOR-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]**
- DKZOR-T-15: 3.8
- DKZOR-T-17: 4.5

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

13 RELATED DOCUMENTATION

<table>
<thead>
<tr>
<th>FS001</th>
<th>Basics for digital electrohydraulics</th>
</tr>
</thead>
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<tr>
<td>FS900</td>
<td>Operating and maintenance information for proportional valves</td>
</tr>
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<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>
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<td>GS500</td>
<td>Programming tools</td>
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<td>K800</td>
<td>Electric and electronic connectors</td>
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<tr>
<td>P005</td>
<td>Mounting surfaces for electrohydraulic valves</td>
</tr>
</tbody>
</table>