Proportional Directional Control Valve with Position Sensor

PRMF2-04

Size 04 (D02)  •  Q_{\text{max}} 20 l/min (5 GPM)  •  p_{\text{max}} 320 bar (4600 PSI)

### Technical Features

- Proportional directional control spool valve with subplate mounting surface acc. to ISO 4401 (size 04) and DIN 24340 (CETOP 02)
- The valve is designed for control of movement direction of actuator and continuous speed regulation in the given range
- The volumetric flow through the valve is proportional to the electrical input commend signal
- Manual override
- Spool position sensor with 520h corrosion protection
- Wide range of electrical connectors
- Adjustable position of coil connector suitable for mounting
- In the standard version, the valve housing is phosphated for basic surface corrosion protection and as preparation for painting. Steel parts are zinc-coated for 240 h salt spray protection acc. to ISO 9227
- Enhanced surface protection for mobile sector available for the valve housing and steel parts (ISO 9227, 520 h salt spray)

### Functional Description

The proportional directional control valve is designed to control direction of the movement, speed and position of the piston rod of hydraulic cylinder or shaft of hydraulic motor. The speed of movement is proportional to the volumetric flow through the valve, which is continuously regulated by throttling at the control edges of spool, proportionally to the input command signal. An electronic control unit (ECU) EL7 is used for the valve control. The ECU converts the input command signal into an output current control PWM signal for solenoid coils. The ECU EL7 is available as external for connection to the DIN rail (EL7-E, see datasheet HA 9152) or integrated on the valve in the form of connector plug (EL7-I, see datasheet HA 9151).

The valve is equipped with a spool position sensor. However, its output signal is intended for the machine control system and cannot be connected to the valve control loop via ECU EL7.

### Technical Data

#### ISO 4401-02-01-0-05

- Ports P, A and B - max. ∅4.5 mm (0.18 in)

<table>
<thead>
<tr>
<th>Valve size</th>
<th>04 (D02)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. operating pressure at port P, A, B</td>
<td>bar (PSI)</td>
</tr>
<tr>
<td>Max. operating pressure at port T</td>
<td>bar (PSI)</td>
</tr>
<tr>
<td>Fluid temperature range (NBR)</td>
<td>°C (°F)</td>
</tr>
<tr>
<td>Fluid temperature range (FPM)</td>
<td>°C (°F)</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>°C (°F)</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>%</td>
</tr>
<tr>
<td>Nominal flow rate Q at ∆p=10 bar (145 PSI)</td>
<td>l/min (GPM)</td>
</tr>
<tr>
<td>Min. protection degree acc. to EN 60529</td>
<td>IP65</td>
</tr>
<tr>
<td>Weight - valve with 1 solenoid</td>
<td>kg (lbs)</td>
</tr>
<tr>
<td>Weight - valve with 2 solenoids</td>
<td></td>
</tr>
</tbody>
</table>

#### Technical data of proportional solenoid

- Nominal supply voltage | V | 24 DC |
- Limit current | A | 0.8 |
- Mean resistance value at 20 °C (68 °F) | Ω | 21 |

#### Technical data of electronic control unit EL-7

- Operating supply voltage Ucc | V DC | 9 ... 32 |
- Reference voltage Uref | V DC | 5 |
- Max. current at Uref | mA | 20 |
- Types of input command signal, when EL7 is used | see datasheet EL7* |
- Max. output current / 1 coil | A | 3 |
- PWM frequency | Hz | 80 ... 1 000 |
- Resolution of A/D converters | bit | 12 |
- Ramp function | s | 0 ... 45 |
- Dither – amplitude* | % from Imax | 0 ... 30 % from Imax |
- Dither – frequency* | Hz | 60 ... 300 |
- * When the dither is activated, the PWM frequency is automatically set to 15 kHz |

#### General information

- Datasheet Type | GI_0060 | products and operating conditions |
- Coil types / Connectors | C_8007 / K_8008 | C19B* / K* |
- Mounting interface | SMT_0019 | Size 04 |
- Spare parts | SP_8010 |
- Subplates | DP_0002 | DP*-04 |

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*When the dither is activated, the PWM frequency is automatically set to 15 kHz.*
### Ordering Code

<table>
<thead>
<tr>
<th>Ordering Code</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRMF2-04</td>
<td></td>
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</tbody>
</table>

#### Proportional directional control valve with position sensor

#### Valve size

#### Spool symbols

- See table „Spool Symbols“

#### Nominal flow rate at Δp=10 bar (145 PSI)

<table>
<thead>
<tr>
<th>Flow Rate</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 l/min</td>
<td>(1.05 GPM)</td>
</tr>
<tr>
<td>8 l/min</td>
<td>(2.1 GPM)</td>
</tr>
<tr>
<td>12 l/min</td>
<td>(3.2 GPM)</td>
</tr>
</tbody>
</table>

#### Rated supply voltage of solenoid (at the coil terminal)

- 24 V DC

### Integrated electronic control unit

- Standardly on the solenoid „a“

#### Electronic control unit EL7-IA with an analogue input command signal

#### Electronic control unit EL7-IC for connection to the CAN bus

#### Integrated electronic control unit

- Standardly on the solenoid „a“

- Electronic control unit EL7-IA with an analogue input command signal
- Electronic control unit EL7-IC for connection to the CAN bus

### Spool Symbols

#### Type

<table>
<thead>
<tr>
<th>Type</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>2Z51</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>2Z11</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>2Y51</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>2Y11</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
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</table>

#### Symbol

<table>
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<tr>
<th>Type</th>
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<tbody>
<tr>
<td>3Z11</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>3Z12</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>3Y11</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>3Y12</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
</tbody>
</table>

#### Spool position sensor

- Always on the solenoid „a“
- Sensor with analogue output: 0 - 5 V DC
- Sensor with analogue output: 4 - 20 mA
- Sensor with analogue output: 12 - 3 V DC
- Sensor with analogue output: 0 - 10 V DC

#### Rated supply voltage of solenoid (at the coil terminal)

- 24 V DC

#### Manual override

- Standard (operated by pin)
- Rubber boot protected

#### Connector plug acc. to EN 175301-803-A

- Valve with integrated electronic control unit
- Connector plug EN 175301-803-A without rectifier for the valve without integrated ECU and with coils E1 or E2

#### Connector

- (only for valves without EL7-I)
- EN 175301-803-A
- E1 with quenching diode
- E2 with quenching diode
- AMP Junior Timer - radial direction (2 pins; male)
- AMP Junior Timer - axial direction (2 pins; male)
- E3A with quenching diode
- E3A with quenching diode
- E3A with quenching diode
- Deutsch DT04-2P - axial direction (2 pins; male)
- E12A with quenching diode
- E12A with quenching diode

#### Spool position sensor

- Without connector plug
- Connector plug M12x1 (4 pins)

#### Seals

- NBR
- FPM (Viton)

#### Surface treatment

- Standard zinc-coated (ZnNi), ISO 9227 (520 h)

#### No designation

- B
- V
- KN

- For proportional valves with two solenoids, single solenoid must be de-energized before the other solenoid can be charged.
- Mounting bolts M5 x 35 DIN 912-10.9 or studs must be ordered separately. Tightening torque is 5+1 Nm (3.7+0.7 lbf.ft).
- Besides the shown, commonly used valve versions other special models are available.
- Contact our technical support for their identification, feasibility and operating limits.

* Model for cylinders with asymmetric piston area ratio 1:2
**Operating limits:** Flow direction P → A / B → T or P → B / A → T

Nominal flow 4 l/min (1.1 GPM)

Nominal flow 8 l/min (2.1 GPM)

Nominal flow 12 l/min (3.2 GPM)

Solenoid current:

- 1 = 50 %
- 2 = 60 %
- 3 = 70 %
- 4 = 80 %
- 5 = 90 %
- 6 = 100 %

Regulated flow related to control signal \( \Delta p = 10 \) bar (145 PSI)

The coil current which initializes the flow through the proportional directional valve can differ due to the production tolerances about in a range of ± 6% of the limit current.

**Transient Characteristic** measured at \( v = 32 \) mm/s (156 SUS), \( \Delta p = 10 \) bar (145 PSI)

The values in table have only an informative character.

The times of the transient characteristics at pressure or flow control will be in a particular hydraulic circuit always longer.

**Frequency Response**

The control signal course of the integrated electronics

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Electronic control unit EL7

The ECU EL7 allows direct independent control of the valve with an analogue input command signal or connection of the valve to the CANBus control system of machine.

Proportional valve with external electronic control unit EL7-E

The valve can be controlled by external ECU EL7-E designed for connection to a DIN rail. The user electrically connects the ECU to the valve with a cable. The ECU EL7-E can be used for control of single solenoid or two solenoid valves.

Selection and setting of ECU parameters is described in datasheet HA 9152

Valve with single solenoid and integrated ECU EL7-I*-1

The ECU in the form of connector plug is simply mounted on the socket of connector EN 175301-803-A of solenoid coil and fastened with a fixing screw.

Valve with two solenoids and integrated ECU EL7-I*-2-105

The ECU in the form of connector plug is simply mounted on the socket of connector EN 175301-803-A of solenoid coil and fastened with a fixing screw. The second solenoid is connected to the ECU with a cable. If the integrated ECU EL7-I is ordered separately, the length of cable must be specified. The length of cable is defined as a distance between fastening screws of ECU and connector plug.

Selection and setting of ECU parameters is described in datasheet HA 9151

Spool position sensor

The spool position sensor is designed to monitoring of actual spool position by control system of machine. The proportional valve can thus operate in a closed control loop with feedback. The sensor works on the principle of differential transformer (LVDT). The sensor core is firmly mechanically connected with a rod to the solenoid armature, which is pressed by spring force to the face of spool inside the valve body. The ECU EL7 does not have any port for connection of sensor as a feedback and allows the valve control only in the open loop. A circular 4-pin M12x1 connector is used for an electrical connection. The surface of sensor is blue chromated.

Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. fluid pressure</td>
<td>350 (5080) bar (PSI)</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>24 (±10 %) V DC</td>
</tr>
<tr>
<td>Power current consumption</td>
<td>&gt; 20 (no load) mA</td>
</tr>
<tr>
<td>Linearity</td>
<td>&lt; ±1 % from the measuring range</td>
</tr>
<tr>
<td>Repeatability</td>
<td>0.1 % from the measuring range</td>
</tr>
<tr>
<td>Temperature drift</td>
<td>&lt; ± 0.05 % from the measuring range / °C</td>
</tr>
<tr>
<td>Current output signal</td>
<td>4 … 20 mA</td>
</tr>
<tr>
<td>Voltage output signal</td>
<td>0 ... 5 / 0 ... 10 / 12 ... 3 V DC</td>
</tr>
<tr>
<td>Load resistance – current output</td>
<td>&lt; 500 Ω</td>
</tr>
<tr>
<td>Load resistance – voltage output</td>
<td>&gt; 10 kΩ</td>
</tr>
<tr>
<td>Limit frequency</td>
<td>1 kHz</td>
</tr>
<tr>
<td>Stroke range of sensor core</td>
<td>± 4 (0.158) mm (in)</td>
</tr>
<tr>
<td>Weight with connector plug</td>
<td>0.240 (0.53) kg (lbs)</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>-40 … +85 (-40 … +185) °C (°F)</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>-40 … +85 (-40 … +185) °C (°F)</td>
</tr>
<tr>
<td>Electrical enclosure protection</td>
<td>IP65*</td>
</tr>
<tr>
<td>Resistance to mechanical shocks</td>
<td>200 g, 2 ms</td>
</tr>
<tr>
<td>Resistance to vibrations</td>
<td>10 g / 2 Hz … 2 kHz</td>
</tr>
</tbody>
</table>

*under the condition of correctly mounted connector plug
In case of solenoid malfunction or power failure, the spool of the valve can be shifted by manual override as long as the pressure in port T does not exceed 25 bar (363 PSI). For alternative manual overrides contact our technical support.

The indicated IP protection level is only achieved if the connector is properly mounted.
Valve with two solenoids and position sensor
Example with electrical terminal
EN 175301-803-A (E1, E2)

Valve with single solenoid “a” and position sensor
Spool type 2Z51, 2Y51

Valve with single solenoid “b” and position sensor
Spool type 2Z11, 2Y11

Valve with single solenoid “a”, integrated electronic control unit EL-I*-1 and position sensor

Valve with two solenoids, integrated electronic control unit EL-I*-2-105 and position sensor