Proportional Directional Control Valve with Digital Control Electronics and Feedback

Technical Features

› Direct acting, proportional control valve with integrated on-board digital electronic unit, spool position feedback and process feedback
› Control valve with subplate mounting surface acc. to ISO 4401, DIN 24340 (CETOP 02) standards
› The valve opening and resulting flow rate can be modulated continuously in proportion to the reference signal
› Digital converter card allows fine control of the valve spool position, reducing hysteresis and response time and optimizing the performance of the valve
› Various models with or without onboard digital converter card or position sensor feedback available
› Used for directional and speed control of hydraulic actuators
› Wide range of interchangeable spools available
› For versions without integrated digital electronic unit wide range of solenoid electrical terminal versions available
› The driver directly manages digital settings. It’s possible to customize the settings for special applications using the optional kit
› In the standard version, the valve housing is phosphated and steel parts zinc-coated for 240 h protection acc. to ISO 9227
› Enhanced surface protection for mobile sector available (ISO 9227, 520 h salt spray)

Functional Description

The proportional directional valve PRM7 consists of a cast iron housing, a special control spool, two centering springs with supporting washers, one or two proportional solenoids, a position sensor or, if desired, of a control box with digital electronics. The measurement system of the position sensor consists of a differential transformer with sensor core and its electronic evaluation unit.

Models without integrated electronic unit

The electrical connection of the solenoids is realized by a variety of connectors. The position sensor output is connected by the G4W1F connector plug. Both connectors are supplied.

In this case the proportional valve can be used as follows:

S01, S02  with the internal feedback from the spool position sensor.

Models with the integrated electronic unit

The model comprises an electronic control box that is mounted together with the position sensor on either of the solenoids. The connection of the position sensor to the control box is provided by a cable. For models with two solenoids, the solenoid mounted opposite the control box is connected to the control box by a EN 175301-803 connector.

The connection of the supply voltage, control signal, program input and external output of the position sensor is implemented in a 7-pin connector (M23). The connection of the external feedback is provided by a 5-pin connector, which also has three supply voltages +24 V, +10 V and -5 V for an external sensor available.

The solenoid coils, including the control box, can be turned in the range of ± 90°. The digital control unit enables the proportional valve to be controlled on the basis of data required from two feedback circuits. In this case the proportional valve can be used as follows:

E01  Proportional directional valve
E02*S01  Only with the internal feedback from the spool position sensor.
E03  Only with the external feedback (pressure sensor, position sensor, etc.).
E04*S01  With internal and external feedback.

The digital control unit utilizes pulse-with-modulation (PWM) and supplies the solenoids with current proportional to the control signal.

The supply current is additionally modulated with a dither frequency. Individual functional parameters are adjusted through software by a special programmer, or by computer through the RS 232 interface. The cable kit must be ordered separately, as detailed on page 4. The correct function of the digital control unit is signaled by a green LED. The incorrect function (failure) is indicated by a red LED. As a standard, the proportional valve is delivered with factory setting.

For a model including an external feedback contact the manufacturer.
Technical Data

ISO 4401-02-01-0-05

| Valve Size | 04 (D02) |
| Max. operating pressure at ports P, A, B | bar (PSI) | 320 (4600) |
| Max. operating pressure at port T | bar (PSI) | 210 (3050) |
| Fluid temperature range (NBR) | °C (°F) | -30 ... +80 (-22 ... +176) |
| Fluid temperature range (FPM) | °C (°F) | -20 ... +80 (-4 ... +176) |
| Ambient temperature max. | °C (°F) | -30 ... +50 (-22 ... +122) |
| Nominal flow at Δp = 10 bar (145 PSI) | l/min (GPM) | 4 (1.1) | 8 (2.1) | 12 (3.2) |
| Hysteresis | % | < 6 |
| Hysteresis - closed position loop | % | < 0.5 |
| Protection degree EN 60529 | | IP65 |
| Weight - valve with 1 solenoid | kg (lbs) | 1.5 (3.3) |
| Weight - valve with 2 solenoids | kg (lbs) | 1.8 (3.96) |
| Data Sheet | Type |  |
| General information | GL 0060 | Products and operating conditions |
| Coil types / Connectors | C_8007 / K_8008 | C198* / K* |
| Mounting interface | SMT_0019 | Size 04 |
| Spare parts | SP_8010 |
| Subplates | DP_0002 | DP*-04 |

Ordering Code

PRM7-04

Proportional Directional Control Valve with Digital Control Electronics and Feedback

Valve size

| Nominal flow rate at Δp = 10 bar (145 PSI) |  |
| flow 4 l/min (1.1 GPM) | 04 |
| flow 8 l/min (2.1 GPM) | 08 |
| flow 12 l/min (3.2 GPM) | 12 |

Nominal solenoid supply voltage

| 12 V DC | 12 |
| 24 V DC | 24 |

Model

- proportional directional valve without feedback E01
- proportional directional valve with external feedback E03
- proportional directional valve with position feedback E02S01
- proportional directional valve with position and external feedback E04S01

Surface treatment

- standard
- zinc-coated (ZnCr-3), ISO 9227 (240 h)
- zinc-coated (ZnNi), ISO 9227 (520 h)

Installations side of electronic unit and position transducer

- No designation
- for port A

Connector according to EN 175301-803-A

- No designation
- K1
- position sensor with voltage outlet
- position sensor with current outlet

Connector for models without integrated electronics

- E1
- EN 175301-803-A
- E1 with quenching diode

- Valves without integrated control electronics with E1, E2 coils (with connector according to EN 175301-803, form A) are delivered in the standard version with connector sockets.
- For proportional valves with two solenoids, one 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 Nm (3.7 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.

Spool Symbols

<table>
<thead>
<tr>
<th>Type</th>
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<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>2Z51</td>
<td><img src="2Z51.png" alt="Symbol" /></td>
<td>3Z11</td>
<td><img src="3Z11.png" alt="Symbol" /></td>
</tr>
<tr>
<td>2Z11</td>
<td><img src="2Z11.png" alt="Symbol" /></td>
<td>3Z12</td>
<td><img src="3Z12.png" alt="Symbol" /></td>
</tr>
<tr>
<td>2Y51</td>
<td><img src="2Y51.png" alt="Symbol" /></td>
<td>3Y11</td>
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</tr>
</tbody>
</table>

*Model for cylinders with asymmetric piston area ratio 1:2
Technical Data of Position Sensor - Voltage Outlet

- Operating pressure: bar (PSI) to 320 (4640), static
- Electrical connection: * only for S01 model, electrical connector G4W1F Hirschmann*
- Contact assignment:
  1 - Power supply
  2 - Command signal
  3 - GND
  4 - not used
- Enclosure protection type according to EN 60529: IP65
- Measured distance: mm (in) 8 (0.315)
- Operating voltage: V 9.6 ... 30 DC
- Linearity error: % < 1
- Current consumption at load current of 2 mA: mA < 15
- Output voltage: V 0 ... 5
- Output signal range used:
  0 position
  1 solenoid - stroke 1.8 mm (0.07 in)
  2 solenoids - stroke ±1.8 mm (0.07 in)
- Max. load current: mA 2
- Noise voltage:
  - at load current 0: mV < 20
  - at load current of 2 mA: mV < 15
- Additional output signal error at:
  - temperature change between 0 ... 80°C (32... 176 °F): typical 0.2% / 10K
  - between 0... -25 °C (32 ... -13 °F): max. 0.5 % / 10K
  - Load change from 0 to 2 mA: 0.1 %
- Input voltage change:
  - from 9.6 V to 14.4 V: % < 0.1
  - from 14.4 V to 30 V: % < 0.25
- Long-term drift (30 days): % < 0.25
- Cut-off frequency
  - 1dB fall in amplitude: Hz > 600
  - 2dB fall in amplitude: Hz > 600

Technical Data of Position Sensor - Current Outlet

- Operating pressure: bar (PSI) to 320 (4640), static
- Electrical connection: * only for S02 model, electrical connector G4W1F Hirschmann*
- Contact assignment:
  1 - Power supply
  2 - Command signal
  3 - GND
  4 - not used
- Enclosure protection type according to EN 60529: IP 65
- Operating source: V 20 ... 30 DC
- Current: mA < 35
- Output signal range: mA 4 ... 20
- Output signal range used:
  0 position
  1 solenoid - stroke 1.8mm (0.07 in)
  2 solenoids - stroke ±1.8 mm (0.07 in)
- Impedance: Ω ≤ 500
- Additional output signal error:
  - at temperature change from +10... 55°C (50... 131°F): typical 0.2% / 10K
  - at impedance change from 50%: ≤ 0.1%
  - at input voltage change in the range of operating voltage: ≤ 0.05%
- Impedance: Ω ≤ 500
- Output signal ripple: mA R.M.S. ≤ 0.02
- Limit frequency at 3 dB amplitude decrease: Hz ≥ 800

Technical Data of Proportional Solenoid

- Type of coil:
  V 12 DC
  V 24 DC
- Limiting current: A 1.7
  A 0.8
- Resistance at 20°C (68 °F):
  Ω 4.9
  Ω 21

Electronics Data

- Supply voltage with polarity inversion protection: V 11.2 ... 28 V DC (residual ripple < 10%)
- Input: command signal / according to customer setting:
  ±10 V, 0...10 V, ±10 mA, 4...20 mA, 0...20 mA, 12 mA ±8 mA
- Input: spool position sensor signal: 0...5 V
- Input: external feedback signal: 0...10 V, 4...20 mA, 0...20 mA
- Resolution of the A/D converter: 12 bit
- Output: solenoids:
  - two PWM output stages up to max. 3.5 A
- PWM frequency: kHz 18
- Adjustment of parameters: μS 170
- EMC:
  - Interference resistance: 61000 - 6 - 2 : 2005
  - Radiation resistance: 55011 : 1998 class A
- Parameter setting:
  - Serial port RS 232 (zero modem), 19200 bauds, 8 data bits, 1 stop bit, no parity. Special software PRM7 Conf.
### Accessories

<table>
<thead>
<tr>
<th>Order number</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>23093400</td>
<td>Connecting cable to PC - length 2 m (6.56 ft), CD-ROM with program PRM7 Conf and user manual</td>
</tr>
<tr>
<td>23093500</td>
<td>Connecting cable to PC - length 5 m (16.40 ft), CD-ROM with program PRM7 Conf and user manual</td>
</tr>
<tr>
<td>24523400</td>
<td>Connecting cable to PC - length 2 m (6.56 ft)</td>
</tr>
<tr>
<td>24523500</td>
<td>Connecting cable to PC - length 5 m (16.40 ft)</td>
</tr>
</tbody>
</table>

### Frequency Response

Closed position loop, for E02S01 model

#### Characteristics

Measured at $v = 32 \text{ mm/s (156 SUS)}$

**Operating limits:** Flow direction $P \rightarrow A / B \rightarrow T$ or $P \rightarrow B / A \rightarrow T$

**Nominal flow 4 l/min (1.1 GPM)**

![Graph showing frequency response](image)

**Nominal flow 8 l/min (2.1 GPM)**

![Graph showing frequency response](image)

**Nominal flow 12 l/min (3.2 GPM)**

![Graph showing frequency response](image)

**Solenoid current:**

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

**Regulated flow related to control signal**

Flow characteristics (E01 model only) $\Delta p = 10 \text{ bar (145 PSI)}$

![Graph showing regulated flow related to control signal](image)
**Flow Characteristics** measured at \( v = 32 \text{ mm/s (156 SUS)} \)

Flow characteristics (E02S01 model only)

\[ Q_n = 4 \text{ l/min (1.1 GPM) by } \Delta p = 10 \text{ bar (145 PSI)} \]

\[ Q_n = 8 \text{ l/min (2.1 GPM) by } \Delta p = 10 \text{ bar (145 PSI)} \]

\[ \Delta p = \text{Valve pressure differential (input pressure } p_0 \text{ minus load pressure and return pressure } p_T \text{)} \]

\[ \Delta p_n = \text{Valve pressure differential for nominal flow } Q_n \]

1. \( \Delta p = 10 \text{ bar (145 PSI)} \)
2. \( p_0 = 50 \text{ bar (725 PSI)} \)
3. \( p_0 = 160 \text{ bar (2321 PSI)} \)
4. \( p_0 = 320 \text{ bar (4641 PSI)} \)

**Factory Settings**

<table>
<thead>
<tr>
<th>Item</th>
<th>E01</th>
<th>E02S01</th>
<th>E03</th>
<th>E04S01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control signal</td>
<td>0 ... 10 V</td>
<td>± 10 V</td>
<td>0 ... 10 V</td>
<td>± 10 V</td>
</tr>
<tr>
<td>Signal external feedback</td>
<td>-</td>
<td>-</td>
<td>0 ... 10 V</td>
<td>-</td>
</tr>
<tr>
<td>Output position sensor spool</td>
<td>-</td>
<td>0 ... 5 V</td>
<td>-</td>
<td>0 ... 5 V</td>
</tr>
</tbody>
</table>

**Connectors**

**K1**

Connector K1 - type M23 (male)

<table>
<thead>
<tr>
<th>PIN</th>
<th>Technical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power supply input</td>
</tr>
<tr>
<td>2</td>
<td>Ground (power supply)</td>
</tr>
<tr>
<td>3</td>
<td>Control signal</td>
</tr>
<tr>
<td>4</td>
<td>Ground (signal)</td>
</tr>
<tr>
<td>5</td>
<td>Power reference signal</td>
</tr>
<tr>
<td>6</td>
<td>Control signal of position sensor spool</td>
</tr>
</tbody>
</table>

*Recommended min. lead cross section 0.75 mm²

**K2**

Connector K2 - type M12x1 (male)

<table>
<thead>
<tr>
<th>PIN</th>
<th>Technical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TxD</td>
</tr>
<tr>
<td>2</td>
<td>RxD</td>
</tr>
<tr>
<td>3</td>
<td>Ground (signal)</td>
</tr>
<tr>
<td>4</td>
<td>Not used</td>
</tr>
</tbody>
</table>

**K3**

Connector K3 - type M12x1 (female)

<table>
<thead>
<tr>
<th>PIN</th>
<th>Technical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power supply output</td>
</tr>
<tr>
<td>2</td>
<td>Signal of external feedback</td>
</tr>
<tr>
<td>3</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>Not used</td>
</tr>
<tr>
<td>5</td>
<td>Not used</td>
</tr>
</tbody>
</table>

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Dimensions in millimeters (inches)

PRM7-043 ... S01
PRM7-043 ... S02

1 Solenoid a
2 Solenoid b
3 Manual override
4 Name plate
5 4 mounting holes
6 Solenoid fixing nut
7 Connector M12x1 for connection of external feedback
8 Main supply connector M23
9 Square ring 7.65 x 1.68 (4 pcs.), supplied in delivery packet
10 Cover of connector M12x1 for programming
11 Plastic box with integrated electronics
12 Position sensor

PRM7-043 ... E01 - without connector plug for spool position feedback
PRM7-043 ... E03

PRM7-043 ... E02S01 - without connector plug for spool position feedback
PRM7-043 ... E04S01

PRM7-043 ... E02S01 - without connector plug for spool position feedback
PRM7-043 ... E04S01

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