Proportional Directional Control Valve Controlled by Digital Electronics

Technical Features

- Proportional control valve controlled by integrated digital electronics with the external feedback or proportional control valve controlled by external digital electronics with a spool position sensor
- Control valve with subplate mounting surface acc. to ISO 4401, DIN 24340 (CETOP 05) 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 PRM7-10 proportional directional control valve is designed for the smooth control of the volumetric flow rate, i.e. the movement speed of the piston rod of a hydraulic cylinder or the speed of the output shaft of a rotary hydraulic motor. A valve with two control solenoids also controls the direction of the flow of the working fluid and thus the direction of the output member of the consumer.

The hydraulic part of the valve consists of a cast iron body with subplate mounting in accordance to ISO 4401 on the bottom surface, a spool with shaped control edges and spool centering springs. Spool movement is assured by control solenoids, proportionally controlled via a signal from integrated or external digital electronic control unit (ECU). The valve can operate in an open control loop (without feedback signal) or a closed control loop via an internal or external feedback signal. Internal feedback is assured by a spool position sensor, which operates on the principle of a Linear Variable Differential Transformer (LVDT), the core of which is mechanically connected to the valve spool. Externally feedback is provided by a sensor connected to the hydraulic circuit which reads the actual value of the controlled parameter.

Design without integrated electronic control unit (ECU)

In this design, the valve is offered with a LVDT spool position sensor with a voltage (type S01) or a current (type S02) output. The valve is controlled by external ECU. It is possible to select the connector types (E1, E2) for electrical connection of control solenoids.

The sensor is connected using a G4W1F connector. Connector plugs are included.

Design with integrated electronic control unit (ECU)

This valve is designed to be operated in an open loop without feedback (type E01) or in a closed loop using a feedback signal from an external sensor (type E02).

The plastic housing with the ECU is mounted on one of the control solenoids, the other solenoid is connected to the ECU by a cable ending with an EN 175301-803 connector plug. Communication with the external sensor is achieved via a five-pin connector which also enables supply voltages of +24 V, +10 V or -5 V. The solenoid coils including the integrated ECU can be rotated by ±90°.

Integrated electronic control unit (ECU)

The ECU utilizes pulse width modulation (PWM) of the control signal to the solenoid coils, reducing loss and heating the coil as well as increasing control precision. The resulting current entering the coils is proportional to that of the control signal. Additionally, the coil input current can be modulated by a dither signal. This signal causes permanent vibration of the armature and spool, thus greatly reducing the effects of adhesive forces and reducing valve hysteresis. Basic valve parameters are set through software and by means of a special programmer, or by computer via a RS 232 interface. The PC connection set must be ordered separately as described on page 4. Correct function of the ECU is indicated by a green LED, Incorrect function is indicated by a red LED.

In the basic version, the valve is supplied with factory settings. Consult the manufacturer for external feedback.

Note:

The PRM9-10 proportional directional control valve, equipped with integrated electronic control unit and spool position sensor (LVDT), enables closed loop control using a combination of internal and external feedback. The valve can also be connected to the CAN-Bus. (see catalogue HC 5129).
### Technical Data

**ISO 4401-05-04-0-05**

| Valve size | 10 (D05) |
| Max. operating pressure at ports P, A, B | bar (PSI) | 350 (5100) |
| Max. operating pressure at port T | bar (PSI) | 210 (3046) |
| Fluid temperature range (NBR) | °C (°F) | -30 ... +80 (-22 ... +176) |
| Fluid temperature range (FPM) | °C (°F) | -20 ... +60 (-4 ... +140) |
| Ambient temperature max. | °C (°F) | -30 ... +50 (-22 ... +122) |
| Nominal flow rate Q0 at Δp=10 bar (145 PSI) | l/min (GPM) | 30 (7.9) / 60 (15.9) / 80 (21.1) |
| Hysteresis | % | < 6 |
| Protection degree EN 60529 | | IP 65 |
| Weight | kg (lbs) | 4.4 (9.70) / 5.9 (13.01) |
| Data Sheet | Type | General information GI_0060 Products and operating conditions |

**Ordering Code**

**PRM7-10**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Valve size</td>
</tr>
<tr>
<td>2</td>
<td>Spool symbols</td>
</tr>
<tr>
<td>K1</td>
<td>Hysteresis - closed position loop</td>
</tr>
<tr>
<td>4</td>
<td>Protection degree</td>
</tr>
<tr>
<td>5</td>
<td>Weight</td>
</tr>
</tbody>
</table>

### Spool Symbols

#### Type

<table>
<thead>
<tr>
<th>Type</th>
<th>Symbol</th>
<th>Type</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>2Z51</td>
<td><img src="2Z51.png" alt="Spool Symbol" /></td>
<td>3Z11</td>
<td><img src="3Z11.png" alt="Spool Symbol" /></td>
</tr>
<tr>
<td>2Z11</td>
<td><img src="2Z11.png" alt="Spool Symbol" /></td>
<td>3Z12</td>
<td><img src="3Z12.png" alt="Spool Symbol" /></td>
</tr>
<tr>
<td>2Y51</td>
<td><img src="2Y51.png" alt="Spool Symbol" /></td>
<td>3Y11</td>
<td><img src="3Y11.png" alt="Spool Symbol" /></td>
</tr>
<tr>
<td>2Y11</td>
<td><img src="2Y11.png" alt="Spool Symbol" /></td>
<td>3Y12</td>
<td><img src="3Y12.png" alt="Spool Symbol" /></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Operating pressure</th>
<th>bar (PSI)</th>
<th>to 350 (5080), static</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical connection for S01 model</td>
<td></td>
<td>electrical connector G4W1F Hirschmann</td>
</tr>
</tbody>
</table>
| 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 |  | 2.5 |
| 1 solenoid - stroke 1.8 mm (0.07 in) | V | 0.125 ... 2.5 |
| 2 solenoids - stroke ±1.8 mm (0.07 in) |  | 0.125 ... 4.875 |
| Max. load current | mA | 2 |
| Noise voltage - at load current 0 | mV<sub>p-p</sub> | < 20 |
| - at load current of 2 mA |  | < 15 |
| Additional output signal error at:  |  | typical 0.2% / 10K |
| - temperature change between 0 ... 80° C (32... 176 °F) |  | max. 0.5 % / 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 3dB fall in amplitude | Hz | > 600 |
| Frequency 90° |  | > 600 |

### Technical Data of Position Sensor - Current Outlet

<table>
<thead>
<tr>
<th>Operating pressure</th>
<th>bar (PSI)</th>
<th>to 350 (5076), static</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical connection for S02 model</td>
<td></td>
<td>electrical connector G4W1F Hirschmann</td>
</tr>
</tbody>
</table>
| Contact assignment |  | 1 - Power supply  
2 - Command signal  
3 - GND  
4 - not used |
| Enclosure protection type according to EN 60529 |  | IP 65 |
| Operating voltage | V | 20 ... 30 DC |
| Current | mA | < 35 |
| Output signal range | mA | 4 ... 20 |
| Output signal range used: 0 position | mA | 12 |
| 1 solenoid - stroke 1.8 mm (0.07 in) |  | 4.4 ... 12 |
| 2 solenoids - stroke ±1.8 mm (0.07 in) |  | 4.4 ... 19.6 |
| Additional output signal error:  |  | 0.2% / 10K |
| - at temperature change from +10... 55° C (50... 131° F) |  | ≤ 0.1% |
| - at impedance change beyond 50% |  | ≤ 0.05% |
| - at input voltage change in the operating voltage range |  |  |
| 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  
24 DC |
| Limiting current | A | 1.9  
1.1 |
| Resistance at 20° C (68 °F) | Ω | 4.7  
13.9 |

### 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>

## Operating limits:

**Flow direction:** P → A / B → T or P → B / A → T

### Operating limits (E01 model only)

#### Nominal flow 30 l/min (7.9 GPM)

![Graph showing flow characteristics for nominal flow 30 l/min (7.9 GPM)]

#### Nominal flow 60 l/min (15.9 GPM)

![Graph showing flow characteristics for nominal flow 60 l/min (15.9 GPM)]

#### Nominal flow 80 l/min (21.1 GPM)

![Graph showing flow characteristics for nominal flow 80 l/min (21.1 GPM)]

### Solenoid current:

- 1 = 40%
- 2 = 60%
- 3 = 80%
- 4 = 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)

## Factory Settings

<table>
<thead>
<tr>
<th>Item / Model</th>
<th>E01</th>
<th>E03</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Magnet</td>
<td>2 Magnets</td>
</tr>
<tr>
<td>Control signal</td>
<td>0 ... 10 V</td>
<td>± 10 V</td>
</tr>
<tr>
<td>Signal external feedback</td>
<td>-</td>
<td>0 ... 10 V</td>
</tr>
<tr>
<td>Output position sensor spool</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Connectors

<table>
<thead>
<tr>
<th>Connector</th>
<th>PIN</th>
<th>Technical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>KN1 - type M23 (male)</td>
<td>1</td>
<td>Power supply input</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Ground (power supply)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Control signal</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Ground (signal)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Power reference signal</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Control signal of position sensor spool</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Protective earth lead (PE)</td>
</tr>
<tr>
<td>KN2 - type M12x1 (male)</td>
<td>1</td>
<td>TxD</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>RxD</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Ground (signal)</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Not used</td>
</tr>
<tr>
<td>KN3 - type M12x1 (female)</td>
<td>1</td>
<td>Power supply output</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Signal of external feedback</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Ground</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Not used</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Not used</td>
</tr>
<tr>
<td>KN4 - type G4A5M (male)</td>
<td>1</td>
<td>Power supply input</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Power supply output</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Ground</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Not used</td>
</tr>
</tbody>
</table>

*Recommended min. lead cross section 0.75 mm²

**KN1** - Main input connector M23 (7 PIN)
Cable diameter 8 ... 12 mm (0.31 ... 0.47 in)

**KN2** - Connection RS232 M12x1 (4 PIN)
to program the electronics

**KN3** - Connector M12x1 (5 PIN)
Signal of external feedback (for configurations E03)

**KN4** - Connector G4A5M (4 PIN)
Internal feedback - spool position signal for valve without ECU
Dimensions in millimeters (inches)

PRM7-102, 103 ... E01 - without connector plug for spool position feedback
PRM7-102, 103 ... E03

1 Solenoid a
2 Solenoid b
3 Manual override
4 Name plate
5 5 mounting holes
6 Solenoid fixing nut
7 Connector M12x1 for connection of external feedback
8 Main supply connector M23
9 Square ring 12.42x1.68 (5 pcs.), supplied in delivery packet
10 Cover of connector M12x1 for programming
11 Plastic box with integrated electronics
12 Position sensor