General Description

Series D*1FP pilot operated servo proportional valves transfer the advantages of the Parker patented Voice Coil Drive (VCD®) to larger frame sizes for high flow rates. The high dynamic / high precision drive of the pilot valve allows the optimum control of the main spool and results in servo performance of the complete valve.

Series D*1FP is available in 5 sizes:
D31FP NG10 (CETOP 5)
D41FP NG16 (CETOP 7)
D91FP NG25 (CETOP 8)
for port diameter up to 32 mm (1.26 in.)
D111FP NG32 (CETOP 10)

The power down mode works with a safe 4th position of the D1FP pilot valve. This ensures that the main stage is hydraulically balanced at power down and allows the main spool spring to center (for overlapped spools), or approximately 10% spring offset to spool position A or B (for zerolap spools).

The innovative integrated regenerative function into the A-line (optional) allows new energy saving circuits for differential cylinders. The hybrid version can be switched between regenerative mode and standard mode at any time.

Features

- High dynamics.
- High flow.
- Defined spool positioning at power-down – optional P-A/B-T or P-B/A-T or center position (for overlapped spools).
- Onboard electronics.
- Closed loop position – controlled pilot valve and main stage.
- NEW: Switchable hybrid version.

D41FPE52 (Standard)
D*1FPR and D*1FPZ

Regenerative Valve D*1FPR

Hybrid Valve D*1FPZ

D*1FPR (Regenerative Valve)
Cylinder extending

D*1FPZ (Hybrid Valve)
Cylinder extending regenerative mode (high speed)

Cylinder extending standard mode (high force)

Flow Rate in % of Nominal Flow

<table>
<thead>
<tr>
<th>Size</th>
<th>Spool</th>
<th>A-T</th>
<th>P-A</th>
<th>P-B</th>
<th>B-A (R-Valve)</th>
<th>B-A (Hybrid)</th>
<th>B-T (Hybrid)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D41FPR/Z</td>
<td>31/32/61</td>
<td>100%</td>
<td>50%</td>
<td>100%</td>
<td>50%</td>
<td>40%</td>
<td>20%</td>
</tr>
<tr>
<td>D91FPR/Z</td>
<td>31/32/61</td>
<td>100%</td>
<td>50%</td>
<td>100%</td>
<td>50%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>D111FPR/Z</td>
<td>31/32/61</td>
<td>100%</td>
<td>50%</td>
<td>100%</td>
<td>50%</td>
<td>50%</td>
<td>25%</td>
</tr>
</tbody>
</table>

on request
Proportional Directional Control Valves
Series D*1FP

Ordering Information

Directional Control Valve
Size
NG6
Proportional Control
High Response
Spool Flow
Type
Spool Position on Power Down
Pilot Connections
Seal
Input Signal
Options
Hybrid Options
Design Series

NOTE: Not required when ordering.

Code Description
3 NG10 / CETOP 5
4 NG16 / CETOP 7
9 1) NG25 / CETOP 8
11 NG32 / CETOP 10

1) For enlarged connections Ø 32 mm

Standard
Code Spool Type
Overlap 10%

E01
Zerolap
E52
B61

NEW: Regenerative Function 4)
Code Spool Type
Overlap 10%

B31
R31
Qb = Qa/2

NEW: Hybrid Function 5)
Code Spool Type
Overlap 10%

B32
Z31
Qb = Qa/2

For regenerative and hybrid function at D31FP (NG10) please refer to solutions with sandwich and adapter plates:
A10-1664 / A10-1665L / H10-1662 / H10-1666L.

Hybrid Options

4) Not available with D91FP.
D31FP spool style: R31

5) Not available in valve D31FP.

Flow LPM (GPM)
at Δp = 5 Bar (72.5 PSI)
per metering edge

Code D31 D41 D91 D111
D 90 (23.8)
E 120 (32)
F — 200 (53)
H — — 450 (119)
L — — — 1000 (265)

Bolt Kit: D31FP BK98
D41FP BK160
D91FP BK228
D111FP BK150

Weight:
D31FP 11.3 kg (24.9 lbs.)
D41FP 14.2 kg (31.3 lbs.)
D91FP 23.5 kg (51.8 lbs.)
D111FP 64.5 kg (142.2 lbs.)

Please order plugs separately. See Accessories.
### Specifications

**Proportional Directional Control Valves**  
*Series D*1FP*  

## General

<table>
<thead>
<tr>
<th>Size</th>
<th>NG10 (CETOP 5)</th>
<th>NG16 (CETOP 7)</th>
<th>NG25 (CETOP 8)</th>
<th>NG32 (CETOP 10)</th>
</tr>
</thead>
</table>

### Mounting Position
- DIN 24340 / ISO 4401 / CETOP RP121 / NFPA
- Unrestricted

### Ambient Temperature Range
- -20°C to +50°C (-4°F to +122°F)

### Hydraulic

#### Maximum Operating Pressure
- Internal Pilot Drain P, A, B, X: 350 Bar (5075 PSI); T, Y: 35 Bar (508 PSI)
- External Pilot Drain P, A, B, T, X: 350 Bar (5075 PSI); Y: 35 Bar (508 PSI)

#### Fluid Temperature
- -20°C to +60°C (-4°F to +140°F)

#### Fluid Viscosity
- Permitted: 20 to 380 cSt / mm²/s (93 to 1761 SSU)
- Recommended: 30 to 80 cSt / mm²/s (139 to 371 SSU)

#### Filtration
- ISO Class 4406 (1999) 18/16/13 (acc. NAS 1638: 7)

### Nominal Flow

<table>
<thead>
<tr>
<th>Flow Rate at ∆p=5 Bar (72.5 PSI) per control edge</th>
<th>LPM (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Flow rate for different ∆p per control edge: Q = Q_{nom} · √(∆p/∆p_{nom})</td>
<td></td>
</tr>
</tbody>
</table>

### Max. Recommended Flow Std Regenerative B-A / B-T

<table>
<thead>
<tr>
<th>Flow Rate</th>
<th>LPM (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Bar (1450 PSI)</td>
<td></td>
</tr>
<tr>
<td>Overlap Spool</td>
<td>0.2 (0.05)</td>
</tr>
<tr>
<td>Zero overlap Spool</td>
<td>0.9 (0.24)</td>
</tr>
<tr>
<td>Pilot</td>
<td>0.6 (0.16)</td>
</tr>
</tbody>
</table>

### Leakage at 100 Bar (1450 PSI)

<table>
<thead>
<tr>
<th>Flow Rate</th>
<th>LPM (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 LPM (0.26 GPM)</td>
<td></td>
</tr>
</tbody>
</table>

### Pilot Flow, Step Response at 210 Bar (3045 PSI)

<table>
<thead>
<tr>
<th>Flow Rate</th>
<th>LPM (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 Bar (290 PSI) to 350 Bar (5075 PSI)</td>
<td></td>
</tr>
<tr>
<td>10 (2.6)</td>
<td></td>
</tr>
<tr>
<td>12 (3.2)</td>
<td></td>
</tr>
<tr>
<td>24 (6.3)</td>
<td></td>
</tr>
<tr>
<td>40 (10.6)</td>
<td></td>
</tr>
</tbody>
</table>

### Static / Dynamic

#### Step Response at 100% Stroke
- 10 ms
- 13 ms
- 19 ms
- 45 ms

#### Frequency Response

<table>
<thead>
<tr>
<th>Amplitude</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 Hz</td>
<td>118 Hz</td>
</tr>
<tr>
<td>95 Hz</td>
<td>95 Hz</td>
</tr>
<tr>
<td>90 Hz</td>
<td>75 Hz</td>
</tr>
<tr>
<td>40 Hz</td>
<td>95 Hz</td>
</tr>
<tr>
<td>75 Hz</td>
<td>90 Hz</td>
</tr>
</tbody>
</table>

#### Hysteresis
- < 0.1%

#### Sensitivity
- < 0.05%

#### Temperature Drift
- < 0.025%

## Electrical

#### Duty Ratio
- 100% ED; CAUTION: Coil temperature up to 150°C (302°F) possible

#### Protection Class
- IP65 in accordance with EN 60529 (plugged and mounted)

#### Supply Voltage / Ripple
- 22...30V, ripple < 0.5% eff., surge free

#### Current Consumption
- 3.5 A maximum

#### Input Signal

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>+10...0...-10V, ripple &lt; 0.01% eff., surge free, 0...+10V P→A</td>
<td>100k Ohm</td>
</tr>
<tr>
<td>4...12...20 mA, ripple &lt; 0.01% eff., surge free, 12...20 mA P→A</td>
<td></td>
</tr>
<tr>
<td>&lt; 3.6 mA = enable off, &gt; 3.8 mA = enable on acc. NAMUR NE43</td>
<td></td>
</tr>
</tbody>
</table>

#### Differential Input Maximum

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30V for terminal D and E against PE (terminal G)</td>
</tr>
<tr>
<td>5</td>
<td>30V for terminal 4 and 5 against 0V (terminal 2)</td>
</tr>
<tr>
<td>7</td>
<td>30V for terminal D and E against PE (terminal G)</td>
</tr>
</tbody>
</table>

#### Enable Signal
- Code 5 / 7
- 5...30V, Ri = 9 kOhm

#### Diagnostic Signal
- +10...0...-10V / +Ub, rated maximum 5 mA

#### Pre-fusing
- 4.0 A medium lag

#### EMC
- EN 61000-6-2, EN 61000-6-4

#### Electrical Connection

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6 + PE acc. EN 175201-804</td>
</tr>
<tr>
<td>5</td>
<td>11 + PE acc. EN 175201-804</td>
</tr>
</tbody>
</table>

#### Wiring Min.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7 x 1.0 (AWG16) overall braid shield</td>
</tr>
<tr>
<td>5</td>
<td>11 x 1.0 (AWG20) overall braid shield</td>
</tr>
</tbody>
</table>

#### Wiring Length
- 50m (164 ft.) maximum

---

1) Flow rate for different ∆p per control edge: \( Q = Q_{nom} \cdot \sqrt{\frac{\Delta p}{\Delta p_{nom}}} \)  

2) Measured with load 210 Bar (3045 PSI) pressure drop; two control edges
Catalog HY14-2550/US
Performance Curves
Proportional Directional Control Valves
Series D*1FP

Frequency Response

D31FP Frequency Response
±5% / ±25% / ±90% Command Signal
Dynamics at 210 Bar (3045 PSI) Pilot Supply Pressure

D41FP Frequency Response
±5% / ±25% / ±90% Command Signal
Dynamics at 210 Bar (3045 PSI) Pilot Supply Pressure

D91FP Frequency Response
±5% / ±25% / ±90% Command Signal
Dynamics at 210 Bar (3045 PSI) Pilot Supply Pressure

D111FP Frequency Response
±5% / ±25% / ±90% Command Signal
Dynamics at 210 Bar (3045 PSI) Pilot Supply Pressure

D*1FPB/E Flow

D31FP Flow Characteristics
at Δp = 5 Bar (72.5 PSI) / metering edge

D41FP Flow Characteristics
at Δp = 5 Bar (72.5 PSI) / metering edge
**Proportional Directional Control Valves**

**Series D*1FP**

---

**D*1FPB/E Flow**

**D91FP Flow Characteristics**

\[ \Delta p = 5 \text{ Bar (72.5 PSI)} / \text{metering edge} \]

- Spool Type E01/02/52
- Spool Type B31/32/61

**D*1FPR/Z Flow**

**D31FPR Flow Characteristics**

\[ \Delta p = 5 \text{ Bar (72.5 PSI)} / \text{metering edge} \]

- Spool Type R31/32/61

**D91FPR/Z Flow Characteristics**

\[ \Delta p = 5 \text{ Bar (72.5 PSI)} / \text{metering edge} \]

- Spool Type R/Z 31/32/61

**D111FP Flow Characteristics**

\[ \Delta p = 5 \text{ Bar (72.5 PSI)} / \text{metering edge} \]

- Spool Type E01/02/52
- Spool Type B31/32/61

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1) with 2 tank ports

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**D111FP R/Z**

Spool Type R/Z on request

**Detail:**

Standard, Regenerative and Hybrid Flow Curves

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Overlap spools:

- E01
- E02
- B/R/Z31
- B/R/Z32

Zerolap spools:

- E52
- B/R/Z61

---

Performance Curves
### Electrical Specifications Hybrid Option

<table>
<thead>
<tr>
<th></th>
<th>100%</th>
<th>D41</th>
<th>D91</th>
<th>D111</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duty Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection Class</td>
<td>IP 65 in accordance with EN 60529 (with correctly mounted plug-in connector)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Voltage [V]</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Tolerance Supply Voltage [%]</td>
<td>±10</td>
<td>±10</td>
<td>±10</td>
<td></td>
</tr>
<tr>
<td>Current Consumption [A]</td>
<td>1.21</td>
<td>0.96</td>
<td>1.29</td>
<td></td>
</tr>
<tr>
<td>Power Consumption [W]</td>
<td>29</td>
<td>23</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Solenoid Connection</td>
<td>Connector as per EN 175301-803</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wiring Minimum [mm²]</td>
<td>3 x 1.5 recommended</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wiring Length Maximum [m]</td>
<td>50 (164 ft.) recommended</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With electrical connections the protective conductor (PE) must be connected according to the relevant regulations.

#### Code 0
**6 + PE acc. EN 175201-804**

![Power supply diagram](image1)

#### Code 5
**11 + PE acc. EN 175201-804**

![Power supply diagram](image2)

#### Code 7
**6 + PE acc. EN 175201-804 + Enable**

![Power supply diagram](image3)
Technical Information

Proportional Directional Control Valves
Series D*1FP

Pilot Flow — Pilot Oil Inlet (Supply) and Outlet (Drain)

<table>
<thead>
<tr>
<th>Pilot oil</th>
<th>Inlet</th>
<th>Drain</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>internal</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>external</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>internal</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>external</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
</tbody>
</table>

D31FPB/E

D31FPR

D41FPB/E

D41FPR

D41FPZ

D91FPB/E

D91FPR

D91FPZ

D111FPB/E

D111FPR

D111FPZ

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Parker Hannifin Corporation
Hydraulic Valve Division
Elyria, Ohio, USA
Proportional Directional Control Valves
Series D*1FP

Dimensions

Inch equivalents for millimeter dimensions are shown in (**)

D31FP

<table>
<thead>
<tr>
<th>Surface Finish</th>
<th>Kit</th>
<th>Seal</th>
<th>Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BK385</td>
<td>Nitrile:</td>
<td>SK-D31FP-V</td>
</tr>
<tr>
<td></td>
<td>BK98</td>
<td>SK-D31FP</td>
<td></td>
</tr>
</tbody>
</table>

D41FP

<table>
<thead>
<tr>
<th>Surface Finish</th>
<th>Kit</th>
<th>Seal</th>
<th>Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BK320</td>
<td>Nitrile:</td>
<td>SK-D41FP-V</td>
</tr>
<tr>
<td></td>
<td>BK160</td>
<td>SK-D41FP</td>
<td></td>
</tr>
</tbody>
</table>
Proportional Directional Control Valves

Series D*1FP

Dimensions

Inch equivalents for millimeter dimensions are shown in (**)

D91FP

D111FP

Surface Finish

Kit

BK360

BK228

Seal Kit

Nitrile: SK-D91FP

Fluorocarbon: SK-D91FP-V

Nitrile: SK-D111FP

Fluorocarbon: SK-D111FP-V

Surface Finish

Kit

BK386

BK150

Seal Kit

Nitrile: SK-D111FP

Fluorocarbon: SK-D111FP-V