Wet Armature Solenoid Operated Directional Control Valves

DG4V4-01, 1* Design; Flows to 115 L/min (30 USgpm), 315 bar (4570 psi)
Introduction

This wet armature solenoid operated directional control valve is for directing and stopping flow at any point in a hydraulic system. Its primary function is to determine the direction of the fluid flow in a work cylinder or determine the direction of rotation of a fluid motor. These valves are designed to meet the requirements of high performance, precision industrial hydraulic systems operating at pressures up to 315 bar (4570 psi) and flows to 115 L/min (30 USgpm). They mount on the ISO size 05 mounting surface.

The performance of the most conventional solenoid operated directional valves is limited by the flow forces acting on the spool in opposition to the solenoids and return springs. Special attention is given to compensating for, or minimizing, these undesirable forces in the design of the series 5 valve.

Features and Benefits

High Performance

High pressure and flow capability with performance comparable to competitors, due to 315 bar (4570 psi) and 115 L/min (30 USgpm) ratings.

Reliability

A high margin of shifting force is available to overcome spool friction due to dirt and other contaminants. Also, a balance spool with cushioned shift means less wear and long life.

- Wet armature solenoids for quieter operation and long life with no dynamic seal leakage.
- Molded coil construction is impervious to moisture and dirt.
- Larger diameter spool combined with constant area and tangential flow passages result in low pressure drop.

- Stainless steel solenoid pin is processed hardened for long life.
- Patented detent mechanism for greater reliability and long life.

Serviceability

Plug-in coils and electrical connections simplify maintenance.

- Cartridge style manual actuators; easily replaced or exchanged for an SAE plug.
- Plug-in solenoid coil for ease of servicing can be replaced without disturbing the hydraulic system or wiring cavity.
- Two solenoid sizes to choose from for optimum performance and cost selection.
- Optional pin-type or top-side plug-in electrical connectors for easy valve replacement. Reversible to fit any installation need.
- Dual frequency (50/60 Hz) 2-wire coils for lower inventory at the OEM (optional).
**Optimum Performance Features**

- **Spool Cushioning Passage** - Equalizes hydraulic force on ends of the spool and cushions spool shift.

  When spool is shifted, the fluid displaced from one end of the spool is transferred to the other end through this passage which is designed to provide a cushioning effect and balance the spool.

- **Spool Land Sequencing** - Accurate sequencing of land opening and closing provides maximum axial stability.

  In the example above, it is important that the flow path A to T is opened before the path P to B to prevent pressure intensification which could upset axial balance and limit valve function.

- **Spool Force-Balancing Contour** - The hydraulic unbalancing effects of fluid momentum between the cylinder and tank ports is minimized.

  Flow forces that are developed at the conventional square land orifice (P to B) are partially compensated for by the force balancing contour on the outer spool lands (A to T).

- **Isolated Solenoid Chambers** - Transient pressure peaks in the solenoid to prevent solenoid tube failure are minimized.

**Typical 2-Land Spool**

Pressure surges can occur within the armature tube of 2-land wet armature valves due to cylinder port decompression. These surges can easily exceed tube pressure rating and result in premature tube failure.

**4-Land Spool**

The armature tube area is isolated from the tank port area by the outboard lands on the 4-land spool. Tank port pressure surges do not reach the armature tube to cause failure.
Model Code

**Model Series**

DG4V4-01 - Subplate mounting; solenoid operated. Pressure rating 315 bar (4570 psi) for ports P, A & B.

**Spool Type**

0 - Open center (all ports)
1 - Open center (P to A & T) B blocked
2 - Closed center (all ports)
3 - Open center (P & B blocked) A to T
6 - Closed center (P blocked) A & B to T
7 - Open center (P to A & B) T blocked
8 - Tandem center (P to T) open crossover
11 - Open center (P to B & T) A blocked
22 - Closed center (two way)
31 - Closed center (P & A blocked) B to T
33 - Closed center, bleed A & B to T

**Left Hand Build**

Omit if not required.

**Manual Override Options**

Omit if serviceable.
Z - No manual override

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**Special Seals**

Omit if not required.
F3 - Seals for fire retardant fluids
F6 - Seals for water glycol

**Solenoid Energization Identity**

V - Solenoid “A” is at port “A” end/or solenoid “B” is at port “B” end, independent of spool type.

**Flag Symbol**

M - Electrical options and features

**Spool Indicator Switch**

S3 - Switch, wired normally open
S4 - Switch, wired normally closed

**Spool/Spring Arrangement**

A - Spring offset, end-to-end
B - Spring offset, end to center
C - Spring centered
N - No spring detented

**Left Hand Build**

Omit if not required.

**Solenoid Indicator Lights**

Omit if not required.
L - Lights fitted

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**Electrical Connector**

PA - Insta-plug male receptacle only
PB - Insta-plug male & female receptacle
PA5 - Five pin connector
PM4 - Mini connector

**Housing**

G - G1/2 BSP thread wiring housing
J - 20 mm thread wiring housing
W - 1/2” NPT thread wiring housing

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**Coil Rating (Standard Power)**

Omit for low power.
A - 110V AC 50 Hz
B - 110V AC 50 Hz/120V AC 60 Hz
C - 220V AC 50 Hz
D - 220V AC 50 Hz/240V AC 60 Hz
DP - 125V DC
ED - 240V AC 50 Hz
G - 12V DC
H - 24V DC
NN - 24V AC 50 Hz
OJ - 48V DC
X - 250V DC

**Coil Rating (Low Power)**

Omit for standard power.
AL - 110V AC 50 Hz
BL - 110V AC 50 Hz/120V AC 60 Hz
CL - 220V AC 50 Hz
DL - 220V AC 50 Hz/240V AC 60 Hz
DML - 80V DC
EDL - 240V AC 50 Hz
NNL - 24V AC 50 Hz
NVL - 24V AC 60 Hz
PL - 110V DC
XL - 250V DC

**Port T Code**

4 - 70 bar (1000 psi) (Low power)
5 - 120 bar (1750 psi) (Standard power)

**Design Number**

Subject to change, installation dimensions remain as shown for design numbers 10 through 19.

**Special Features**

S - Special suffix
Performance Characteristics

Maximum Pressure

| Ports A & B | 315 bar (4570 psi)* |
| Port T     | 120 bar (1750 psi) |

*(See Model Code)

* 70 bar (1000 psi) with high water base fluids (95% maximum water content) or low watt coils.

Response times were measured from the point of energization/de-energization to the point of first indication of inlet pressure change.

**Solenoid Energizing**

Spring centered and spring offset valves will be spring positioned unless the solenoid is energized continuously. No-spring detented valves may be energized momentarily, approximately 0.15 second; when the solenoid is de-energized the spool will remain in the last position attained, provided there is no shock, vibration or unusual pressure transients.

<table>
<thead>
<tr>
<th>Series</th>
<th>Valve type</th>
<th>AC Solenoid</th>
<th>DC Solenoid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Solenoid</td>
<td>Spring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Energized</td>
<td>Return</td>
</tr>
<tr>
<td>Standard</td>
<td>Spring centered</td>
<td>20 ms</td>
<td>50 ms</td>
</tr>
<tr>
<td>Low Power</td>
<td></td>
<td>20 ms</td>
<td>35 ms</td>
</tr>
<tr>
<td>Standard</td>
<td>Spring offset</td>
<td>18 ms</td>
<td>25 ms</td>
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<tr>
<td>Low Power</td>
<td></td>
<td>15 ms</td>
<td>35 ms</td>
</tr>
<tr>
<td>Standard</td>
<td>Detented</td>
<td>22 ms</td>
<td>—</td>
</tr>
<tr>
<td>Low Power</td>
<td></td>
<td>15 ms</td>
<td>—</td>
</tr>
</tbody>
</table>

**Response Time**

The following response times were measured from the point of energization/de-energization to the point of first indication of inlet pressure change. Response up to full system pressure is dependent on the system's compressed volume and can vary with each application.

<table>
<thead>
<tr>
<th>Series</th>
<th>Valve type</th>
<th>Inrush (rms)</th>
<th>Holding (rms)</th>
<th>Holding Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Spring centered</td>
<td>2.40</td>
<td>0.69</td>
<td>27.5</td>
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<tr>
<td>Low Power</td>
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<td>2.40</td>
<td>0.78</td>
<td>28.5</td>
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<tr>
<td>Standard</td>
<td>Spring offset</td>
<td>2.40</td>
<td>0.35</td>
<td>28.5</td>
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<tr>
<td>Low Power</td>
<td></td>
<td>1.00</td>
<td>0.24</td>
<td>23</td>
</tr>
<tr>
<td>Standard</td>
<td>Detented</td>
<td>1.20</td>
<td>0.26</td>
<td>23</td>
</tr>
<tr>
<td>Low Power</td>
<td></td>
<td>2.33</td>
<td>2.33</td>
<td>33</td>
</tr>
</tbody>
</table>

**CAUTION**

Any sliding spool valve, if held shifted under pressure for long periods, may stick and not return, due to silting. Therefore, it is recommended that the valve be cycled periodically to prevent this from occurring.
## Specifications

### Maximum Flow Data

Maximum recommended flow data is for AC or DC solenoids at 90% nominal voltage in a 4-way circuit with cylinder ports either looped or blocked and containing 2.5 liter (0.66 USgpm) compressed volume. Reduced performance may result when certain spools are used in 3-way circuits.

### Fluids & Seals

Buna N seals are standard and are compatible with water-in-oil emulsions, high water base fluids and petroleum oils. For phosphate ester fire resistant fluids, Viton® seals must be specified. Seals for water glycol have an F6 designation. Maximum operating pressure for high water base fluids is 1000 psi.

### Application Recommendations

Filtration: ISO 4406 Code 20/18/15
Operating Temperature: 20° to 50°C (70° to 120°F)
Fluid Viscosity: 16 - 51 cSt (75 - 250 SUS)

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**Valve function, symbol and recommended maximum flow (See page 7 for maximum flow curves).**

<table>
<thead>
<tr>
<th>Spool Type</th>
<th>3 Position Spring Centered (C)</th>
<th>Max. Flow Curve</th>
<th>Spool Type</th>
<th>2 Position Detented (N)</th>
<th>Max. Flow Curve</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Standard</td>
<td>Low Power</td>
<td>Standard</td>
<td>Low Power</td>
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<td></td>
<td>AC  DC</td>
<td>AC  DC</td>
<td>AC  DC</td>
<td>AC  DC</td>
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<tr>
<td>0</td>
<td></td>
<td>1   10</td>
<td>17  21</td>
<td>0</td>
<td>1   11</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>6   13</td>
<td>18  N/A</td>
<td>2</td>
<td>1   11</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1   10</td>
<td>17  21</td>
<td>2 Position</td>
<td></td>
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<td></td>
<td>2 Position</td>
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<td></td>
<td></td>
<td></td>
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<td>Spring Offset to</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Port A (A)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>4   11</td>
<td>18  21</td>
<td>0</td>
<td>7   14</td>
</tr>
<tr>
<td>6</td>
<td></td>
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<td>9   16</td>
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<td></td>
<td>5   12</td>
<td>20  21</td>
<td>2 Position</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Spring Offset to</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Port B (B)</td>
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<td>13</td>
<td></td>
<td>1   10</td>
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<td>7   14</td>
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<td></td>
<td>2   11</td>
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<td>2</td>
<td>8   15</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Flow Curves

Maximum Flow Curves

- **Standard AC A/B**
- **Standard DC A/B**
- **Standard AC C/N**
- **Standard DC C/N**
- **Low Power AC & DC A/B/C/N**

[Graphs showing flow rates and pressures for different configurations]
Pressure Drop

Pressure drops in offset positions except where otherwise indicated.

<table>
<thead>
<tr>
<th>Spool code</th>
<th>P to A</th>
<th>P to B</th>
<th>A to T</th>
<th>B to T</th>
<th>P to T</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
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<td>1</td>
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<td>4</td>
<td>1</td>
<td>6</td>
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<td>2</td>
<td>4</td>
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</tr>
<tr>
<td>3</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>–</td>
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<tr>
<td>6</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>6</td>
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<tr>
<td>8</td>
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<td>7</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>22</td>
<td>4</td>
<td>4</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<tr>
<td>31</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>33</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>–</td>
</tr>
</tbody>
</table>

For other viscosities, pressure drops approximate to:

**Viscosity cSt (SUS)**

| 14 | 20 | 43 | 54 | 65 | 76 | 85 |
| 17.5 | 97.8 | 200 | 251 | 302 | 352 | 399 |

| % of ΔP |
| 81 | 88 | 104 | 111 | 116 | 120 | 124 |

A change to another specific gravity will yield an approximately proportional change in pressure drop.

The specific gravity of a fluid may be obtained from its producer. Fire resistant fluids usually have higher specific gravities than oil.

### Drain

On 2-way valves, “T” is the drain and must be connected to the tank through a surge-free line, so there will be no back pressure at this port.

**CAUTION**

Surges of oil in a common line serving these and other valves can be of sufficient magnitude to cause inadvertent shifting of these valves. This is particularly critical in the no-spring detented type valves. Separate tank lines, or a vented manifold with a continuous downward path to tank are necessary. Consult your Vickers representative for instructions.
Installation Dimensions

Standard Conduit Box & ‘PB’ Insta-plug

Electrical Current
Signal Light (“Lights” & “PB”)
2 places Sol. A Light

4-Valve Mounting Holes
For Socket Head Cap Screws
$\frac{1}{4}$-20x1-$\frac{1}{2}$ or M6x40 Metric
SAE Grade 8 or Better, Metric Grade 10.9
Torque 12-15 N.m (110-130 lb. in.)

“G” - BSP
“J” - 20mm thread
“W”-$\frac{1}{2}$“ NPT
Connection Box
May be rotated 180°

Clearance Required for Coil Removal
(Both Ends)

Manual Operating Pin (Both Ends)
Across Flats (Both Ends)

NFPA D02 Mounting Surface
(ISO 4401-AC-05-4-A)

S3, S4 Switch

3rd angle projection


Electrical Plugs & Connectors

‘L’ Low Power Option

‘U’ DIN 43650 Connector* Option

Connector Plug with Lights (U6)

Connector Plug without Lights (U1)

*Connector Plug not included with valve

‘PA’

Connector Option, Pin Type

‘PA3’/‘PA5’ (NFPA T 3.5.29)

PM4 (SAE H1738-2)

<table>
<thead>
<tr>
<th>Number of Solenoids</th>
<th>Number of pins</th>
<th>Option Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>3</td>
<td>PA3</td>
</tr>
<tr>
<td>Single or Double</td>
<td>5</td>
<td>PA5</td>
</tr>
<tr>
<td>Single or Double</td>
<td>4</td>
<td>PM4</td>
</tr>
</tbody>
</table>

Single Solenoid Valve (PA3)

Double Solenoid Valve or Optional Single Solenoid Valve (PA5)

Double Solenoid Valve or Optional Single Solenoid Valve (PM4)
**Subplate & Mounting Surface**

Millimeters (inches)

```
\begin{figure}
\centering
\includegraphics[width=\textwidth]{subplate.png}
\end{figure}
```

*Ports on model DGSME–01–20–T8 only*

<table>
<thead>
<tr>
<th>Model</th>
<th>Dimension &quot;A&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>DGSM–01–20–T8</td>
<td>31.75 (1.25)</td>
</tr>
<tr>
<td>DGSME–01–20–T8</td>
<td>38.10 (1.50)</td>
</tr>
</tbody>
</table>

**Bolt Kits**

Bolt kits include 4 directional valve mounting bolts and are ordered separately.

**Note**

Metric grade 10.9 (SAE Grade 8) mounting bolts required.

<table>
<thead>
<tr>
<th>Model Codes</th>
<th>Sizes</th>
<th>Thread</th>
</tr>
</thead>
<tbody>
<tr>
<td>BKDG01-633</td>
<td>1/4–20–11/2</td>
<td>Inch</td>
</tr>
<tr>
<td>BK855993M</td>
<td>M6x1x40</td>
<td>Metric</td>
</tr>
</tbody>
</table>

**Fluid Cleanliness**

Essential information on the correct methods for treating hydraulic fluid is included in Vickers publication 561 "Vickers Guide to Systemic Contamination Control" available from your local Vickers distributor or by contacting Vickers, Incorporated. Recommendations on filtration and the selection of products to control fluid condition are included in 561.

Recommended cleanliness levels, using petroleum oil under common conditions, are based on the highest fluid pressure levels in the system. Fluids other than petroleum, severe service cycles, or temperature extremes are cause for adjustment of these cleanliness codes. See Vickers publication 561 for exact details.

**Filtration Requirements**

20/18/15