



# Solenoid Operated Directional Valve

DG4V-3-60 Design

### **General Description**

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Solenoid operated directional control valves are for directing and stopping flow at any point in a hydraulic system.

• Efficient control of greater hydraulic powers without increasing solenoid power consumption.

• Installed cost and space savings from higher power/weight-and-size ratios.

• Installation flexibility resulting from choice of numerous combinations of solenoid connectors and locations. • Viton seals as standard for multi-fluid capability. Nitrile seals available as a model code option.

- Higher sustained machine productivity and higher uptime because of proven fatigue life and endurance, tested over 20 million cycles.
- Solenoid coils can be changed quickly and easily without leakage from hydraulic system.
- Compact, cost effective system design when used with Eaton<sup>®</sup> SystemStak<sup>™</sup> valves and subplates.

### DG4V3-S/R- High Performance and Standard Performance Valves

• Minimum pressure drop 2.5 bar at 30 l/min.

• Range of coil connectors including DIN, Deutsch, AMP and terminal box.

• Range of coil voltages and power options.

• Up to 80 l/min (21 USgpm) and up to 40 l/min (10.5 USgpm) respectively at 350 bar (5000 psi).

• Offers designers the opportunity to select the optimum value package for each application.

• International standard interface. The valve mounting face conforms to ISO 4401, size 03 and is compatible with related international standards.



### 

### 1 Seal Type

Blank – Viton F6 – Buna Nitrile/High CAN

### 2 Model series

4 – Solenoid operated
V – Pressure rating 350 bar
(5000 psi) on P, A & B ports
3 – ISO4401 Size 03

### **3** Performance

Blank – High performance S – Standard performance R – Standard performance with 8 Watt coil

### 4 Spool Type

Please refer functional symbols on Page 5 for spool types.

# **5** Spool Spring Arrangement

A – Spring offset, end-to-end
AL – Same as "A" but left
hand build
B – Spring offset, end to
center
BL – Same as "B" but left
hand build
C – Spring centered
N – No-spring detented

### 6 Manual Override Option

Blank – Plain override(s) in solenoid end(s) only ▲ H – Water-resistant override(s) on solenoid end(s) ▲ Z – No overrides at either end

**W** – Twist and lock override in solenoid ends•

No override in non-solenoid end of single solenoid valves
DC high performance only

# **7** Solenoid Energization Identity

### Blank - None

V – Solenoid "A" is at port "A" end and/ or solenoid "B" is at port "B" end, independent of spool type **NOTE:** Used to select the identification of the solenoid. Refer to table on page 4.

### 8 Flag Symbol

**M** – Electrical options and features

### **9** Spool Indicator Switch

**S7** – Spool position monitoring switch. Single solenoid valves only. NOTE: Refer Page B-6 and B-10 for further details

### 10 Coil Type

U - ISO4400, DIN43650 connector U1 - ISO4400 fitted with PG11 plug U6 - ISO4400 with fitted DIN plug with lights KU - Top exit flying lead (150mm) KUP4 – Junior timer (Amp) connector KUP5 - Integral Deutsch connector KUPM4L- Integral M12, 4-Pin connector FW – Flying lead with 1/2" NPT thread wiring housing FTW - Fly. lead wired terminal block & 1/2" NPT thread wiring housing FPA3W - Fly. lead, 3 Pin connector & 1/2" NPT thread wiring housing FPA5W - Fly. lead, 5 pin connector & 1/2" NPT thread wiring housing X5 – Atex approved coil, 'd' type▲ Also CSA and UL approved

# Image Suppressor/ Damper

- D1 Diode positive biasD2 Negative bias
- D7 Transorb type
- See Page12 for circuit details

### 12 Solenoid Indicator Lights

Blank – None L – Solenoid indicator lights▲

▲ Flying lead coil type only

### 13 Coil Rating

**B** – 110V AC 50Hz/120V AC 60 Hz **BL** – 110V 50 Hz/120V 60 Hz **D** – 220V AC 50 Hz/240V AC 60 Hz **DS** – 28V DC 30 watt **ER** – 120V AC 60 Hz ▲ **ES** – 240V AC 60 Hz ▲ **G** – 12V DC **GL** – 12V DC **H** – 24V DC **HL** – 24V DC **HM** – 24V DC 8 watt

### ▲X5 coil type only

### 14 Tank Pressure Rating

Refer to "Operating Data" for port T pressure ratings. **4** – 70 bar (1000 psi) ▲ **5** – 100 bar (1500 psi) for standard performance models, DG4V-3S, with AC or DC solenoids. **6** – 207 bar (3000 psi) for AC high performance models, DG4V-3, including spool position indicator type S6.

7 - 207 bar (3000 psi) for DC high performance models, DG4V-3, including spool position indicator type S6.
8 - 160 bar (2300 psi) for AC high performance models with lower tank port rating.

▲ X5 coil type only

### **Design Number**

- 60 Basic design
- 61 Type 8 spool

### <sup>16</sup> Special Features

"EN\*\*\*" code number assigned as required. **EN21** – CSA approved models with 1/2" NPT entry conduit box, type FW and solenoid coil letter B,D,G, or H. **EN38** - Low leakage version. Typical leakage 5ml/min/land at 100 bar.

**NOTE:** EN38 valve spools have additional overlap and resulting 2X pressure drop compared to standard valve spools.

### **17** Orifice Plug

- **00** No orifice required **03** 0.3 mm dia.
- **06** 0.6 mm dia.
- **08** 0.8 mm dia.
- **09** 0.9 mm dia.
- **10** 1.0 mm dia.
- **13** 1.3 mm dia.
- **15** 1.5 mm dia.
- **20** 2.0 mm dia.
- **23** 2.3 mm dia.

# **Functional Symbols**

Spool Options

### The valve function schematics apply to both U.S. and European valves













DG4V-3(S)-\*ALV



DG4V-3(S)-\*CV







DG4V-3(S)-\*BLV



ТТ

т

52





### Solenoid Identified to US and European Standards

	U.S. Solenoid Standard	European Solenoid Standard (specify "V" in the model code at position 7 on page 3)
Double solenoid valves, two position, detented	A B Sol. B P <sup>1</sup> T Sol. A	
Double solenoid valves, spring centered	A B Sol. A P T Sol. B	A B Sol. B P T Sol. A
Single solenoid valves, solenoid at port A end		
Single solenoid valves, solenoid at port B end		

▲ Transient condition only

# **Operating Data**

Feature	DG4V-3		DG4V-3S		DG4V-3R	
Pressure Limits						
P, A and B ports	350 bar (5075	5 psi)	350 bar (5075	5 psi) 🔳	350 bar (5075 psi)	l
T port	210 bar (3045	5 psi)	100 bar (1450	) psi)	210 bar (3045 psi)	l
Flow rating	See performa	ince data	See performa	ance data	See performance	data
Relative duty factor	Continuous; E	ED = 100%	Continuous; E	ED = 100%	Continuous; ED =	100%
Type of protection: ISO 4400 coils with plug fitted correctly	IEC 144 class	IP65	IEC 144 class	IP65	IEC 144 class IP6	5
Coil winding	Class H		Class H		Class H	
Lead wires (coils type F***)	Class H		Class H		Class H	
Coil encapsulation	Class F		Class F		Class F	
Maximum	Permissable Refer to temp	voltage fluctuat perature limits.	t <b>ion:</b> Refer to temp	perature limits.	. Refer to temperat	ure limits.
Minimum	90% rated		90% rated		90% rated	
Typical response times at 10	0% rated volt	s measured from	n application/	removal of vo	oltage to full spoo	I displacement of "2C" spool at:
Flow rate P-A, B-T	40 l/min (10.6	USgpm)	20 l/min (5.3	USgpm)	20 l/min (5.3 Usgp	om)
Pressure	175 bar (2537	′ psi)	175 bar (2537	7 psi)	175 bar (2527 PSI	)
AC (~) energizing	15 ms		18 ms		18 ms	
AC (~) de-energizing	23 ms		32 ms		32 ms	
DC (=) energizing	45 ms		60 ms		60 ms	
DC (=) de-energizing	28 ms		40 ms		40 ms	
Power consumption, AC	Initial	Holding	Initial	Holding	Initial	Holding
solenoids (for coils listed in model code).	VA (RMS) ▲	VA (RMS)	VA (RMS) ▲	VA (RMS)	VA (RMS)	VA (RMS)
<b>Full power coils:</b> Dual frequency coils at 50 Hz	280	61	280	61	N/A	
Dual frequency coils at 60 HZ	300	58	300	58	N/A	
Low power coils, "BL" and "DL": (Not available with "N" – No-spring detented models)	Low power c not usable wi DG4V-3S valv	oils th res.	170	37	N/A	
Dual frequency coils at 50 Hz	_	_	190	37	N/A	
Dual frequency coils at 60 Hz	-	-	-	-	N/A	
Power consumption, DC sole Full power coils:	enoids at rated	d voltage and 20	30W/	_	Ν/Δ	
24\/ model type "H"	2014/		20/0/			
	3000		3000		N/A	
12V, model type "GL"	Low power contraction has not usable with DG4V-35	oils S valves.	-	18W	N/A	
24V, model type "HL"			18W	_	N/A	
24V, HM Coil	·		8W	-	N/A	

For applications where valves are to remain pressurized (either energized or de-energized) at pressures over 210 bar (3045 psi) without frequent switching, it is recommended to use the high performance model, DG4V-3.
 1<sup>st</sup> half cycle; armature fully retracted.

B-5

# **Operating Data**

### **Spool Position Indicator Models**

Spool/spring arrangement types 0A, 0B, 2A, 2B, 22A, 23A, 35A, 52B, 3B, 6B

### DC model type "S7"



Input:

B

•	
Supply Voltage	20-32 VDC
Reverse Pol. Protection	Yes
	outputs with alternating function - PNP
Output:	
Max output load	<=400mA ; Duty Ratio 100%
Short Circuit Protection	Yes
Hysteresis	<=0.05mm
Electrical connector	M12x1 4-Pole
Thermal shift	<=±0.1mm
Plug connections:	
Pin 1	+ Supply
Pin 2	Normal Closed
Pin 3	0V
Pin 4	Normal Open
EMC	Protection DIN EN 61000-6-1/2/3/4, Aug 2002
Humidity	0-95% rel. (nach DIN 40040)
Protection Class	IP65 DIN 40050
Vibration 0-500Hz	Max. 20g
Shock	Max. 50g

• Factory setting ensures this condition under all combinations of manufacturing tolerance and of temperature drift (see "Temperature Limits").

### Wiring Connections





### WARNING: Electromagnetic Compatibility (EMC)

It is necessary to ensure that the unit is wired up in accordance with the connection arrangements shown above. For effective protection the user's electrical cabinet, the valve subplate or manifold and the cable screens should be connected to efficient ground points. In all cases both valve and cable should be kept as far away as possible from any sources of electromagnetic radiation such as cables carrying heavy current, relays and certain kinds of portable radio transmitters, etc. Difficult environments could mean that extra screening may be necessary to avoid the interference.

Warning

# Performance Data

### DG4V-3 models (high performance)

### Graph 1

AC solenoid valves operating at 50 Hz



### Graph 3

DC solenoid valves



### Graph 2

AC solenoid valves operating at 60 Hz



Spool / spring code	Graph 1 curve	Graph 2 curve	Graph 3 curve
0A(L)	2	2	3
0B(L) & 0C	1	1	2
2A(L)	2	2	3
2B(L) & 2C	1	1	1
2N	1	1	2
6B(L) & 6C	6	5	6
8B(L) & 8C	5 🔺	4 🔺	5 🔺
22A(L)	8	7	8
22B(L) & 22C	7	6	7
33B(L) & 33C	4	3	4
52BL, 52C	6	5	6
521B	6	5	6

▲ Consult Eaton regarding each application that will jointly have flow rates approaching this curve and a pressurized volume exceeding 2000 cm3 (122 cu.in.)

# Performance Data

Typical with mineral oil at 36 cSt (168.6 SUS) and a specific gravity of 0.87.

### Maximum flow rates

Performance based on full power solenoid coils warm and operating at 90% rated voltage.

See note at bottom of next page when using low power coils (DG4V-3 models only).

### В

### DG4V-3S models (standard performance)

### Graph 4

AC solenoid valves operating at 50 Hz



### Graph 5

AC solenoid valves operating at 60 Hz



Graph 6

DC solenoid valves



Spool / spring code	Graph 1 curve	Graph 2 curve	Graph 3 curve
0A(L)	1	1	3
0B(L) & 0C	1	1	1
2A(L)	5	5	3
2B(L) & 2C	2	2	3
2N	1	1	1
6B(L) & 6C	6	6	5
8B(L) & 8C	8 🔺	7 🔺	8 🔺
22A(L)	9	8	7
22B(L) & 22C	7	7	6
33B(L) & 33C	4	4	4
52BL, 52C	6	6	5
521B	6	6	5

▲ Consult Eaton regarding each application that will jointly have flow rates approaching this curve and a pressurized volume exceeding 2000 cm3 (122 cu.in.)

# Performance Data



### **Pressure drops**

▼ Curve for spool type 6: not recommended for flows in excess of 60 I/min (15.8 USgpm).

### Pressure drops in offset positions except where otherwise indicated

Spool / spring code	Spool positions covered	P to A	P to B	A to T	B to T	P to T	B to A or A to B
0A(L)	Both	5	5	2	2	-	-
0B(L) & 0C	De-energized	-	-	-	-	4 ▲ △	-
	Energized	4	4	2	2	-	-
2A(L)	Both	6	6	5	5	-	-
2B(L) & 2C	Energized	5	5	2	2	-	-
2N	Both	6	6	3	3	-	-
6B(L) & 6C	De-energized	-	-	3 🔺	3 Δ	-	-
	Energized	6	6	1	1	-	-
	Energized	4	4	3 🔺	3	-	-
8B(L) & 8C	All	9	9	5	5	3	-
22A(L), 22B(L) & 22C	All	6	6	-	-	-	-
33B(L) & 33C	De-energized	-	-	15 🔺	15 Δ	-	-
	Energized	5	5	2	2	-	-
52BL & 52C	Energized	6 ▲	6Δ	2	-	-	10 🔾
	Energized	6 🔺	6Δ	2	-	-	10 🔾
521B	All	6 🔺	6Δ	-	-	-	10 🔾
	De-energized	-	-	10 🔺	11 Δ	-	10 🔾
	Energized	6	6Δ	-	-	-	10 🔾

 $\blacktriangle$  B" plugged  $\Delta$  "A" plugged  $\bigcirc$  "P" plugged

### Viscosity cSt (SUS)

14	20	43	54	65	76	85
(71.75)	(97.8)	(200)	(251)	(302)	(352)	(399)
% of $\Delta P$ (A	Approx.)					
81	88	104	111	116	120	124

For other viscosities, pressure drops approximate to:

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.

# Installation Dimension





switch.

B-10

# Installation Dimension

### Models with "F" type coils (lead wires) and conduit box.



Dimensions in mm(in).

Model type	AC or DC	A Dim.	B Dim.	C Dim.	D Dim.
All	DC =	220 (8.66)	156,5 (6.14)	61 (2.5)	73 (2.87)
DG4V-3	AC ~	200 (7.87)	146,5 (5.75)	51 (2.1)	63 (2.48)
DG4V-3S	AC ~	200 (7.87)	146,5 (5.75)	45 (1.7)	63 (2.48)

Codes "FW": 2 lead wires for each solenoid, approximately 150,00 (6.00) long. M3 (#6) terminals provided for customer connection.

Codes "FTW": Valve supplied with lead wires connected into terminal strip suitable for M3 (#6) terminals for customer connection.

# Installation Dimension

## M12 Connector type



# **Electrical Plugs and Connectors**



### **DIN 43650 Connector**

Cable diameter range: Ø6–10 mm (0.24–0.40 in)

Wire section range: Ø,5–1,5 mm2 (0.0008–0.0023 in2)

### Terminals: Screw type

**Type of protection:** IEC144 class IP65, when plugs are fitted correctly to the valves with interface seals (supplied with plugs) in place.

Connector can be positioned at  $90^\circ$  intervals on valve by reassembling contact holder into appropriate position inside connector housing.

Connectors with and without indicator lights are available (order separately).

### KUP 7

### Packard connector pins - Male









### Special packard connector pins with seals - Female



B-13

### Terminal strip and lights

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For valves with type "F" coils.



ensure that solenoid leads

are correctly connected: light

terminals according to the

side with + mark.

Insta-Plug

DG4V-3(S)----FPA----60 DG4V-3(S)----FPBW----60

to the terminal(s) marked +.

When using 3-wire incom-

Eaton 2-part "Insta-Plug" eliminates breaking electrical inputs for valve disconnect. A male half is pre-wired to the valve body. The mating

### **PA** configuration



Dimensions in mm(in).

B-14

plug is inside a wire housing with external terminals for machine wire connections.

the inner pair of terminals

must be interconnected.

Captive thumb screws, when loosened, permit the wire housing to be pulled clear of the valve for disconnect. A longer ground post provides first make/last break ground connection.

# **Electrical Plugs and Connectors**

### NFPA Connector T3.5.29-1980

DG4V-3(S)-<u>FPA3W(</u>L)-\*\*-60 DG4V-3(S)-<u>FPA5W(</u>L)-\*\*-60

The receptacle is a standard three or five pole connector with shortened leads and terminals added. The five pole plug has four leads 101,6 (4.0) long and one 177,8 (7.0) long. The three pole plug has two leads 101,6 (4.0) long and one 177,8 (7.0). All wires have underwriters recognized non-solder insulated eyelet terminals. The green wire is used for the ground (earth) connection (No. 8 screw furnished). Valves are supplied pre-wired.

Connection details and model type/model code references



### 3 pin connector

Use with single solenoid valve

Key model code designations: DG4V-3(S)-\*<u>A</u>(L)(-\*\*)-(V)M-<u>FPA3W</u>(L) DG4V-3(S)-\*<u>B</u>(L)(-\*\*)-(V)M-<u>FPA3W</u>(L)

− 1 – green lead (ground)



### 5 pin connector

Use with single solenoid valve

Key model code designations: DG4V-3(S)-\*<u>A(L)(-\*\*)-(V)M-FPA5W(L)</u>

DG4V-3(S)-\*<u>B</u>(L)(-\*\*)-(V)M-FPA5W(L)



### Surge Suppression Devices (For DC Valves) Standard diode (D1), (D2)

Diode in parallel with coil, positive bias. When switch (S1) is opened, the energy stored in the coil is trapped and dissipated by the diode (D1), (D2).

- Works only with DC voltage
- Polarity dependent
- Increase drop out time



### Surge Suppression Devices (For DC Valves) Standard diode (D2)

Diode in parallel with coil, negative bias. When switch (S1) is opened, the energy stored in the coil is trapped and dissipated by the diode (D2).

- Works only with DC voltage
- Polarity dependent
- Increase drop out time



### Transzorb (D7)

Diode and Zener diode in parallel with coil. When switch (S1) is opened, the energy stored in the coil is trapped and dissipated by the diode (D1) and Zener diode (Z1) and the coil resistance.

- The Zener makes exact limitation of inductive spikes.
- Works only with DC voltage
- Polarity dependent



NOTE: These surge suppression devices are "Polarity Dependent." Proper biasing conditions must be met when installing/connecting a coil in a system. Times represent cessation/application of voltage to coil versus velocity (start/stop) of a cylinder using a single solenoid, spring offset valve (time in milliseconds).

### Valve Shift and Dropout Times with and without Surge Suppression

Shift	Dropout		
CETOP 3			
Do Diode	23	60	
Diode Alone	23	131	
Diode/Zener	23	78	
Diode/Zener	23	/8	

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