



*Powering Business Worldwide*

# Solenoid Operated Directional Valve

DG4V-3-60 Design (Soft Shift Design)

## General Description

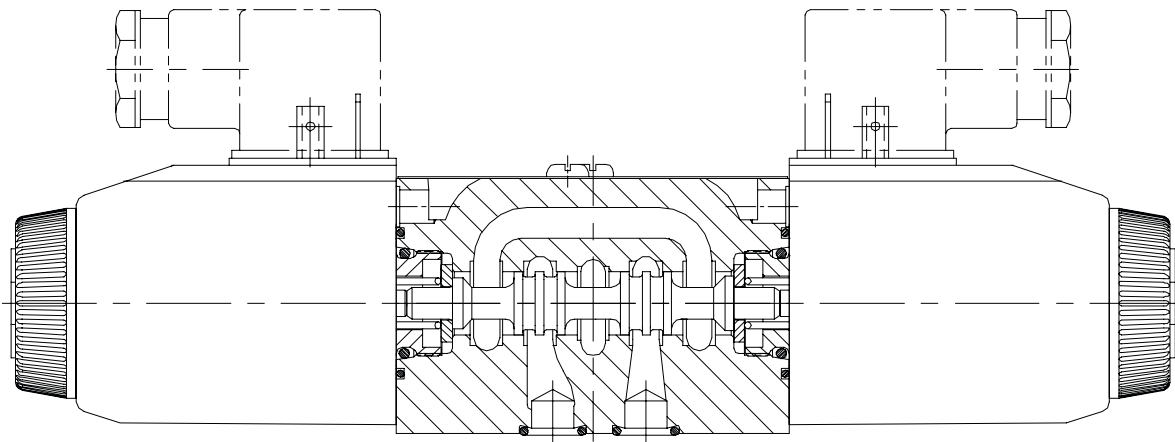
These solenoid operated directional control valves are for directing and stopping flow at any point in a hydraulic system. The soft shift feature is designed to provide smoother control of actuator acceleration and deceleration than is possible with conventional solenoid valves. The result is minimum hydraulic shock, more reliable systems with longer component life and less downtime.

There are 2 options for the soft shift feature:

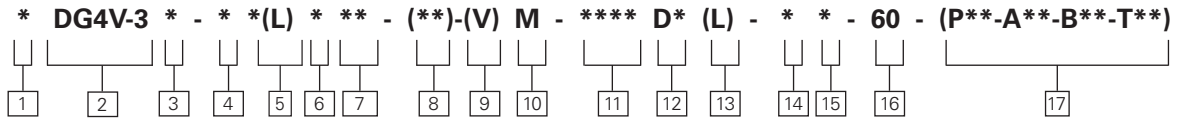
1. Variable orifice design where you can use an optimized damping orifice tuned to suit your application.
2. A fixed orifice design, which is non-serviceable and cannot be tuned.

## Features & Benefits

- Milled metering notches on the spool enable precise control of flow rate change as the spool is shifted.
- A "P12L"- model offers a junction box with rectifier, lights and plug-in coils for quick and easy solenoid changing without removing the valve from the machine.



# DG4V-3 Soft Shift Model Series



## 1 Seal Type

**Blank** – Viton

**F6** – Buna Nitrile/High CAN

## 2 Valve Type

**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

## 4 Spool Type

Please refer functional symbols on Page 4 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 Detent

## 6 Orifice Type

**2** – Variable type  
**3** – Optimized Fixed type▲  
 ▲High performance only

## 7 Soft Shift Orifice Size

**00** – No Orifice  
**05** – 0.5 mm dia  
**06** – 0.6 mm dia  
**07** – 0.7 mm dia  
**08** – 0.8 mm dia

**09** – 0.9 mm dia  
**10** – 1.00 mm dia  
**11** – 1.10 mm dia  
**20** – 2.0 mm dia  
**23** – 2.30 mm dia

\*Minimum Orifice Size recommended for high performance type “8C” spool

## 8 Manual Override

**Blank** – Override in solenoid end only  
**H** – Water-resistant override(s) on solenoid end(s)  
 No override in non-solenoid end of single solenoid valves

## 9 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.

## 10 Flag Symbol

**M** – Electrical options and features

## 11 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 n

**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

**X4** – Atex approved coil, ‘me’ type

**X5** – Atex approved coil, ‘d’ type  
 • Also CSA and UL approved P12L

## 12 Surge Suppressor/ Damper

**Blank** – No diode  
**D1** – diode positive bias  
**D2** – negative bias

See Page13 for circuit details

## 13 Solenoid Indicator Lights

**Blank** – No Solenoid indicator lights  
**L** – Solenoid indicator lights▲  
 ▲Flying lead coil type only

## 14 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

## 15 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.

• X5 coil type only

## 16 Design Number

**60** – Basic design

## 17 Orifice Plug

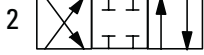
**00** – No orifice required  
**03** – 0.3 mm dia.  
**06** – 0.6 mm dia.  
**08** – 0.8 mm dia.  
**09** – 0.9 mm dia.  
**10** – 1.0 mm dia.  
**13** – 1.3 mm dia.  
**15** – 1.5 mm dia.  
**20** – 2.0 mm dia.  
**23** – 2.3 mm dia.

# Functional Symbols

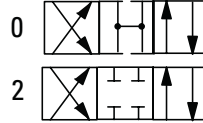
## Spool Options

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

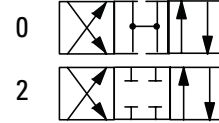
DG4V-3(S)-\*N(V)



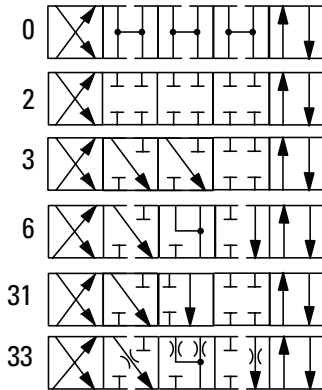
DG4V-3(S)-\*A(V)



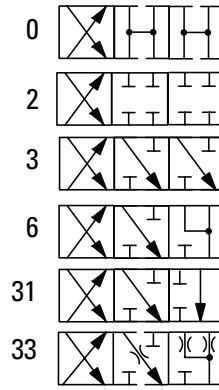
DG4V-3(S)-\*AL(V)



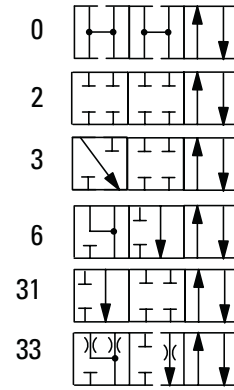
DG4V-3(S)-\*C(V)



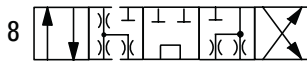
DG4V-3(S)-\*B



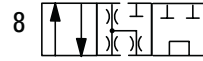
DG4V-3(S)-\*BL



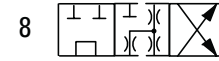
DG4V-3(S)-8CV



DG4V-3(S)-8BLV



DG4V-3(S)-8BV

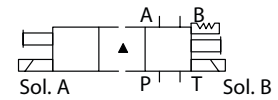
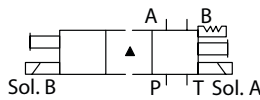


## Solenoid Identified to US and European Standards

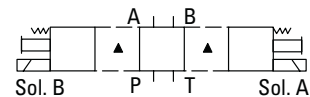
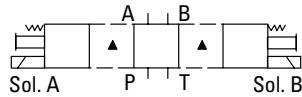
### U.S. Solenoid Standard

### European Solenoid Standard (specify "V" in the model code)

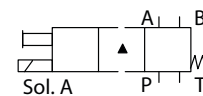
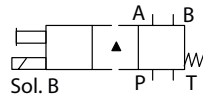
Double solenoid valves, two position, detented



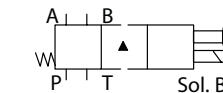
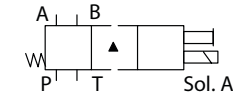
Double solenoid valves, spring centered



Single solenoid valves, solenoid at port A end



Single solenoid valves, solenoid at port B end



▲ Transient condition only

# Operating Data

## Response Time

Response times are increased over that of a standard solenoid. These times are influenced by flow, pressure, applied solenoid voltage, oil viscosity and ambient temperatures.

Response times can be fine tuned to the application by orifices that are interchangeable via the manual actuator in the solenoid end. See model code for available orifices.

Response times shown are for a type "2C" spool at a system pressure of 210 bar (3000 psi), flow at 19 L/min (5 USgpm), solenoid voltage at 100% of rating and 38°C (100° F) oil temperature. Times are determined from the instant of power on/off to the point of maximum cylinder velocity (shift) or the end of cylinder movement (spring return). All times are without arc suppression diodes. Spring return times can be expected to increase with diodes in place.

Response times greater than 700 msec are not recommended.

**NOTE:** For the high performance type "8C" model, core tube orifice sizes smaller than 2.0 mm diameter are not recommended.

### For Variable Orifice(2)

Orifice Diameter mm	Response Times		Color Code
	Shift (ms)	Spring Return (ms)	
0,7	625	550	Green
0,8	400	375	Blue
0,9	250	250	Purple

Response times for spools other than the 2C spool are similar and are system dependent.

### For Fixed Orifice(3)

Response Times	
Shift (ms)	Shift Return (ms)
400	175

Response times for spools other than the 2C spool are similar and are system dependent.

## Orifice Changing Procedure

### WARNING

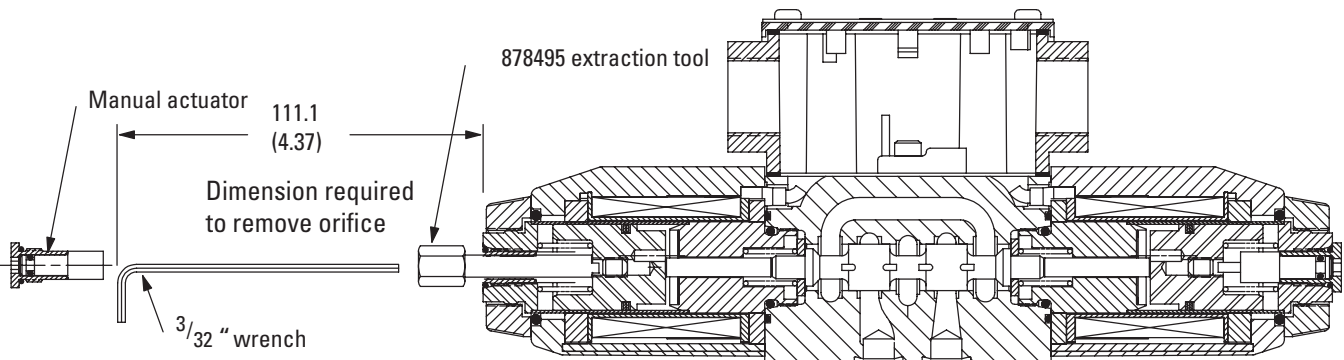
1. Before breaking a circuit connection make certain that power is off and system pressure has been released. Lower all vertical cylinders, discharge accumulators and block any load whose movement could generate pressure. Plug all removed units and cap all lines to prevent entry of dirt into the system.

- Using a  $5/32$ " hex key, remove manual actuator plug and spring from the end of solenoid (Tightening torque 6.2–7.3 N.m 55–65 lbf.in.)
- Insert extraction tool (878495) into solenoid via the manual actuator opening. Rotate tool until aligned and push pin into slot in armature.
- Using  $1/2$ " wrench and tool to prevent the armature from rotating, insert  $3/32$ " hex key down the center of tool and remove orifice plug.

5. Replace by the same method, tightening orifice snug to ensure bottoming of threads. Smaller orifices increase response times, larger orifices decrease response time.

### Orifice & Tool Kit 02-140211

For fine tuning shift performance, orifices must be ordered separately. The kit includes (2) each of .7, .8 & .9 mm dia. orifices, (1) installation tool, (1)  $5/32$ " hex key and (1)  $3/32$ " hex key.



# Operating Data

## Solenoid Identified to US and European Standards

Feature	DG4V-3	DG4V-3S
<b>Pressure Limits</b>		
P, A and B ports	350 bar (5075 psi)	350 bar (5075 psi) ■
T port:	210 bar (3045 psi)	100 bar (1450 psi)
Flow rating	See performance data	See performance data
Relative duty factor	Continuous; ED = 100%	Continuous; ED = 100%
Type of protection: ISO 4400 coils with plug fitted correctly	IEC 144 class IP65	IEC 144 class IP65
Coil winding	Class H	Class H
Lead wires (coils type F***)	Class H	Class H
Coil encapsulation	Class F	Class F
<b>Permissible voltage fluctuation:</b>		
Maximum	Refer to temperature limits.	Refer to temperature limits.
Minimum	90% rated	90% rated
<b>Typical response times at 100% rated volts measured from application/removal of voltage to full spool displacement of "2C" spool at:</b>		
Flow rate P-A, B-T	40 l/min (10.6 USgpm)	20 l/min (5.3 USgpm)
Pressure	175 bar (2537 psi)	175 bar (2537 psi)
DC (=) energizing	45 ms	60 ms
DC (=) de-energizing	28 ms	40 ms
<b>Power consumption, DC solenoids at rated voltage and 20 C (68 F).</b>		
<b>Full power coils:</b>		
12V, model type "G"	30W	30W
24V, model type "H"	30W	30W

■ 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.

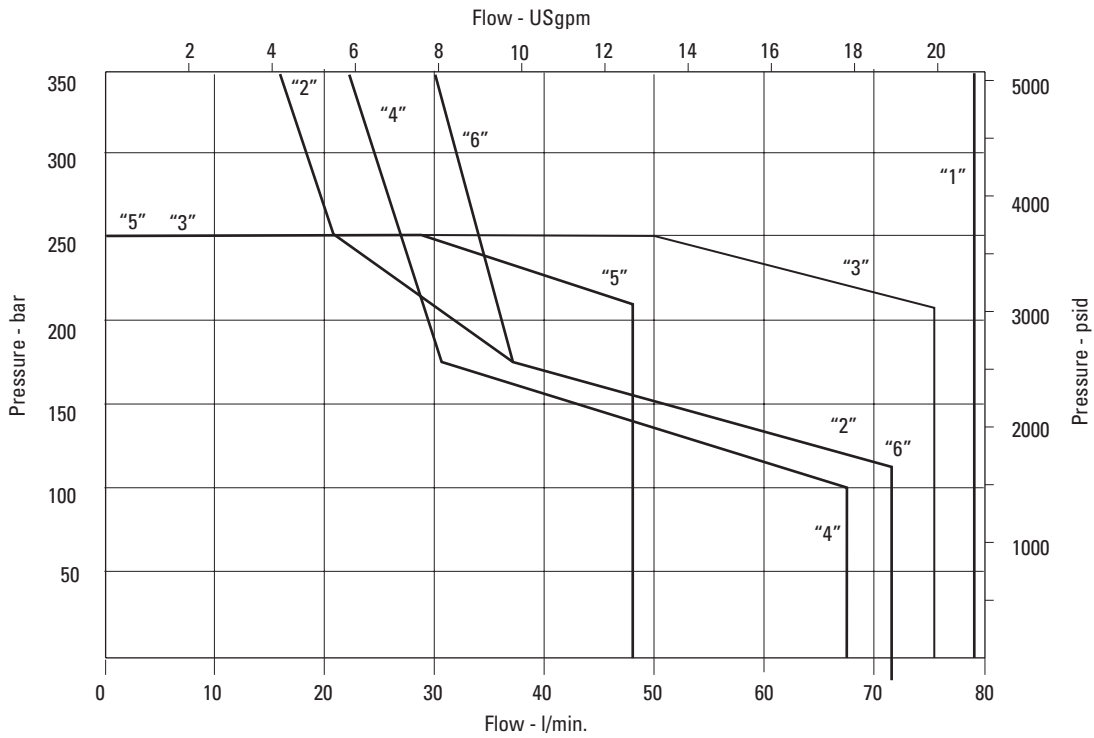
# Performance Data

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

## Maximum flow rates

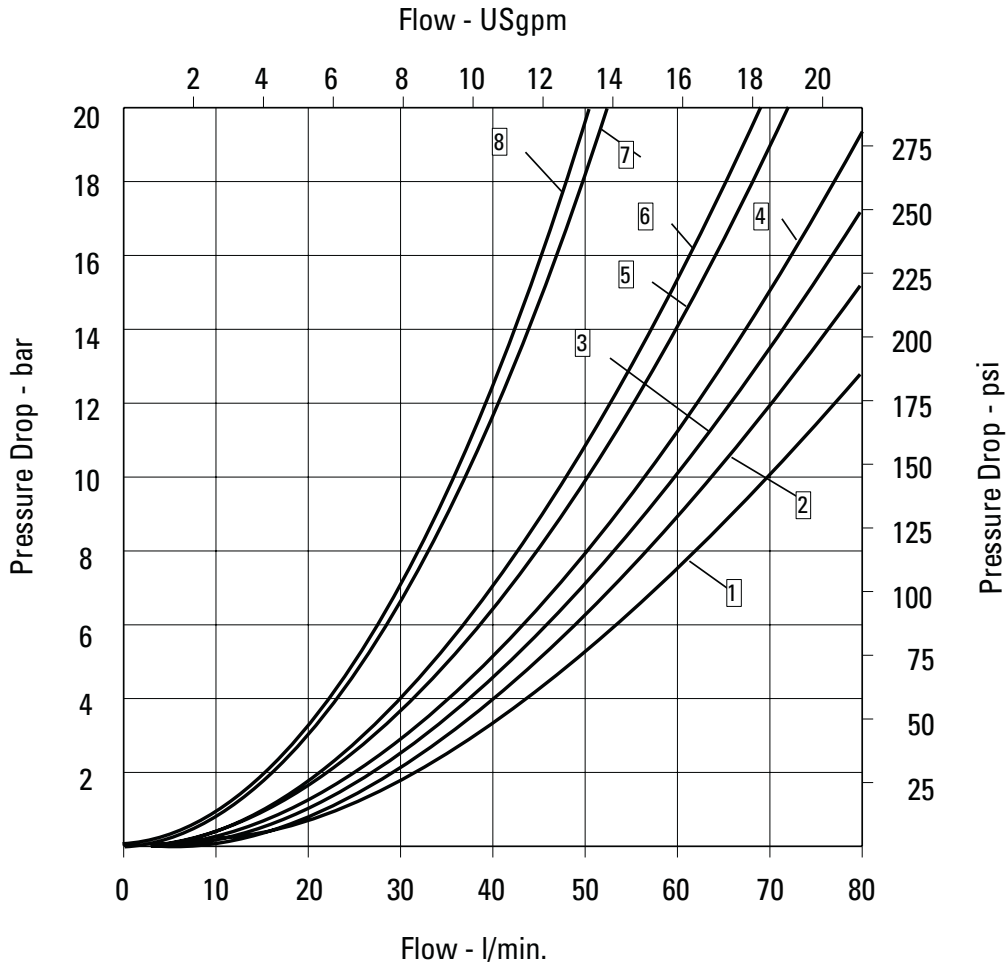
Performance based on full power solenoid coils warm and operating at 90% rated voltage.

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



Spool Type	Curve Number
"0C"	1
"2C"	1
"6C"	2
"3C"	6
"8C"	5
"31C"	2
"33C"	3
"2A"	4

## Pressure Drop Curves



Spool Type	Pressure Drop Curve Reference Chart			
Spring Centered	P-A	B-T	P-B	A-T
"0C" +	5	1	5	1
"2C"	5	4	5	4
"6C"	6	1	6	1
"8C" +	5	3	5	3
"3C"	5	4	5	1
"31C" *	5	1	5	4
"33C" *	6	2	6	3

Spring Offset	P-A	B-T	P-B	A-T
"2A"	7	5	8	5

For any other viscosity the pressure drop ( $\Delta P$ ) will change as follows:

Viscosity(s)	cSt	14	32	43	54	65	76	87
	(SUS)	(75)	(150)	(200)	(250)	(300)	(350)	(400)
% of $\Delta P$ (Approximate)		93	111	119	126	132	137	141



# Installation Dimensions

## Models for use with ISO 4400 (DIN 43650) connectors



Double solenoid models ▲

DG4V-3(S)-\*C-\*\*-(-V)M-U-\*\*-60

DG4V-3(S)-\*N-\*\*-(-V)M-U-\*\*-60

Single solenoid models ▲

DG4V-3(S)-\*A-\*\*-■

DG4V-3(S)-\*B-\*\*-■

DG4V-3(S)-8BL-\*\*-■

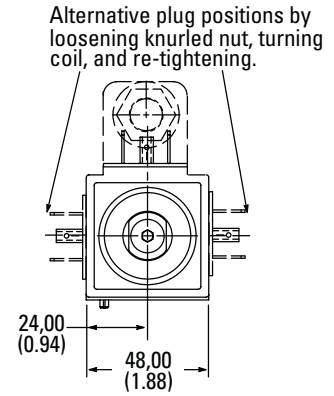
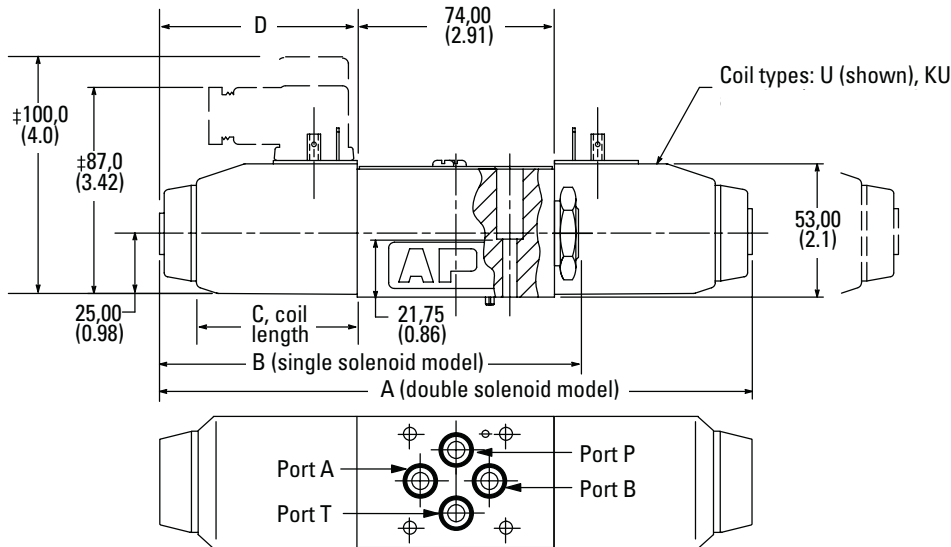
As shown

DG4V-3(S)-\*AL-\*\*-■

DG4V-3(S)-\*BL-\*\*-■

DG4V-3(S)-8B-\*\*-■

Solenoid and end cap interchanged



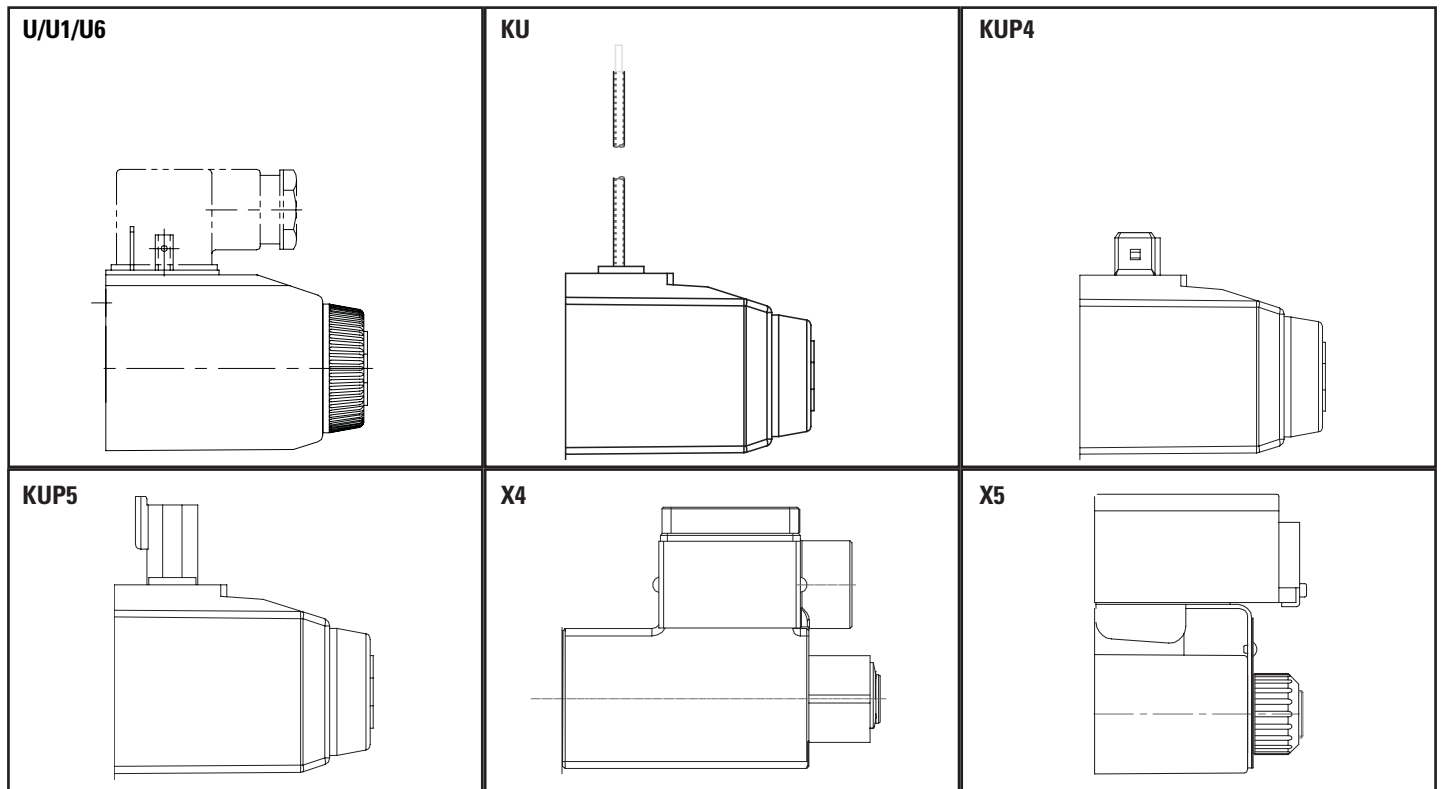
■ Not applicable to type "8" spool.

‡ Can vary dependent on source of plug.

Dimensions in mm(in).

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

## Coil Connectors

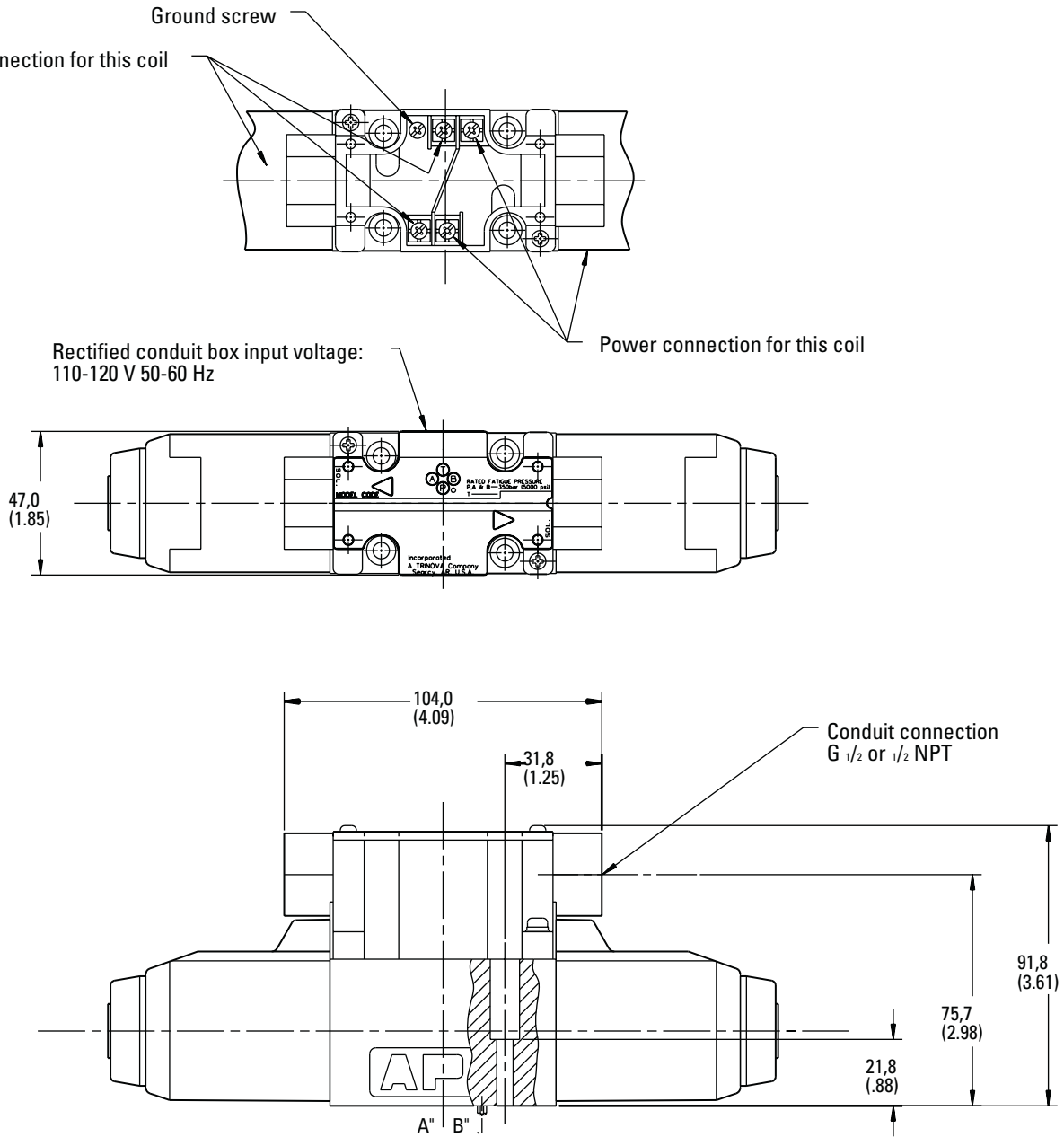


# Installation Dimensions

## DG4V-3 - \*\*\*\*\*-M-P12L-DJH5-60 Plug-in Coil

Millimeters (inches)

C



# Installation Dimensions

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

Double solenoid models ▲

DG4V-3(S)-\*C-\*\*-(-V)M-E-\*\*-60

DG4V-3(S)-\*N-\*\*-(-V)M-E-\*\*-60

Single solenoid models ▲

DG4V-3(S)-\*A(-\*\*)●

DG4V-3(S)-\*B(-\*\*)●

DG4V-3(S)-8BL(-\*\*) ]

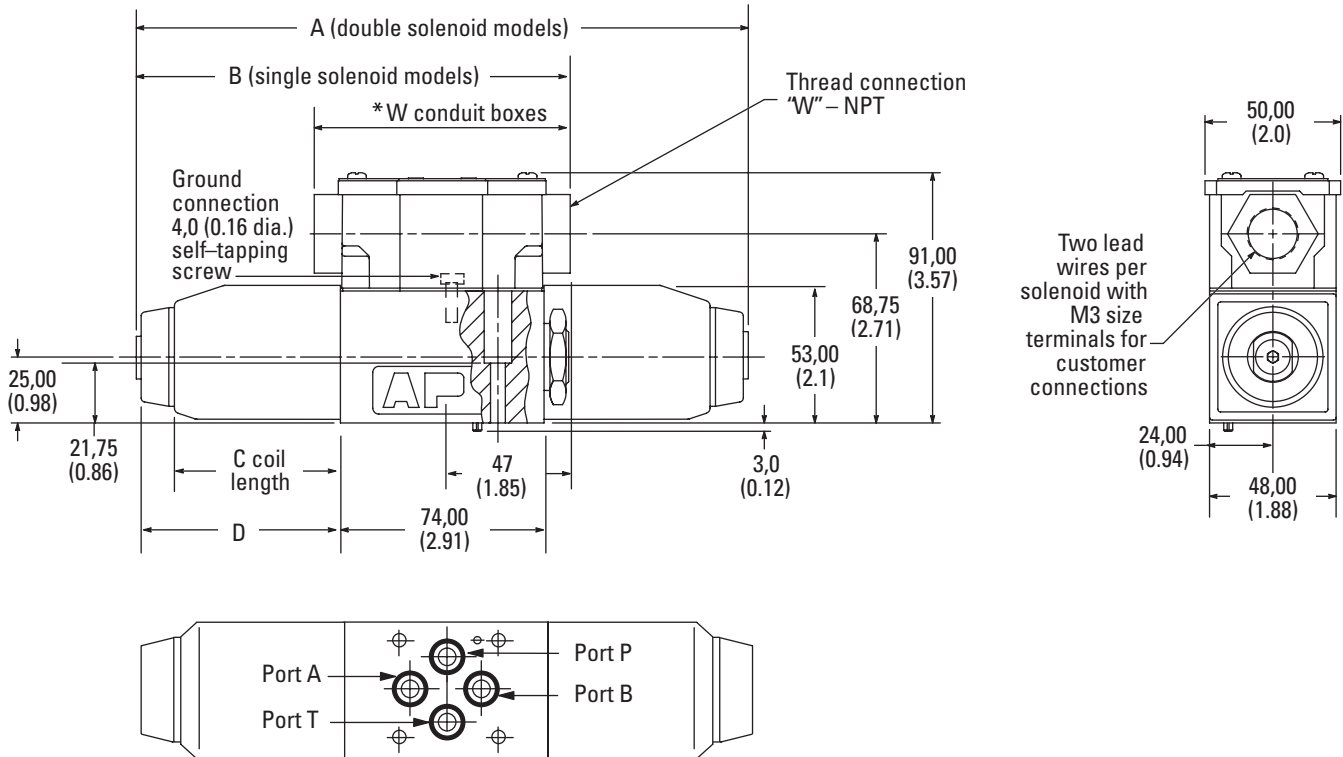
As shown

DG4V-3(S)-\*AL(-\*\*)●

DG4V-3(S)-\*BL(-\*\*)●

DG4V-3(S)-8B(-\*\*) ]

Solenoid and end cap interchangeable



\* 89 (3.5) for FPB – J & W conduit boxes  
104 (4.0) All plug-in conduit boxes

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)

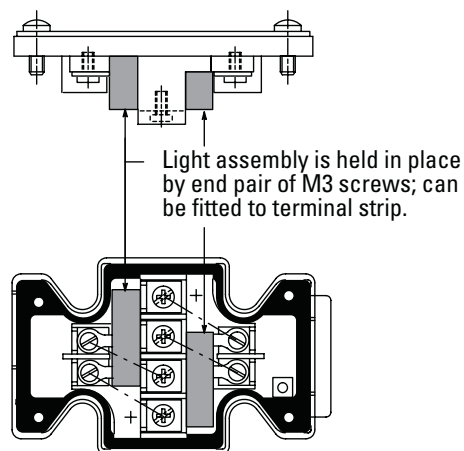
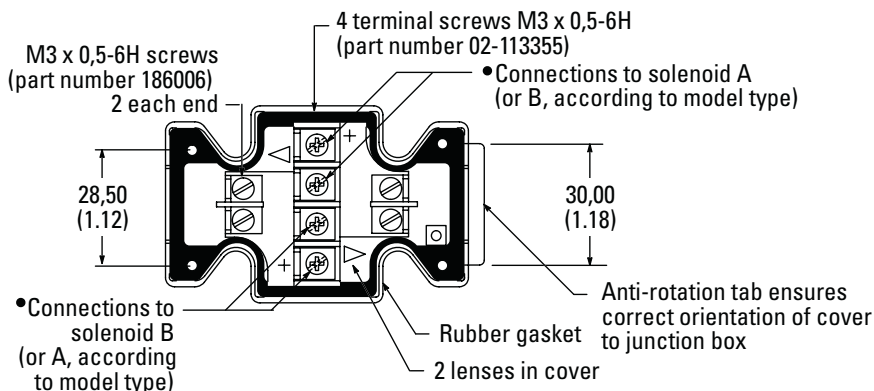
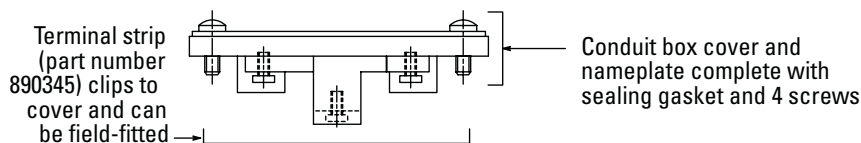
Codes "FW" : 2 lead wires for each solenoid, approximately 150,00 (6.00) long. M3 (#6) terminals provided for customer connection.

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

# Electrical Plugs and Connectors

## Terminal strip and lights

For valves with type "F" coils.



1. For DC coils the +ve lead(s) must be connected to the terminal(s) marked +. When using 3-wire incoming leads to double

solenoid valves (i.e. common neutral) the inner pair of terminals must be interconnected.

2. For correct light indication of energized solenoid ensure that solenoid leads are correctly connected: light terminals are

common with each outer pair of solenoid terminals according to the side with + mark.

## Insta-Plug

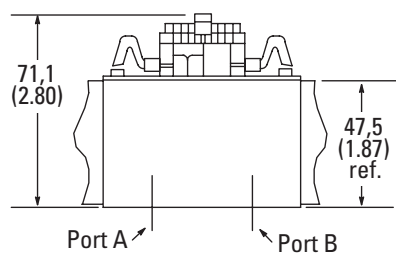
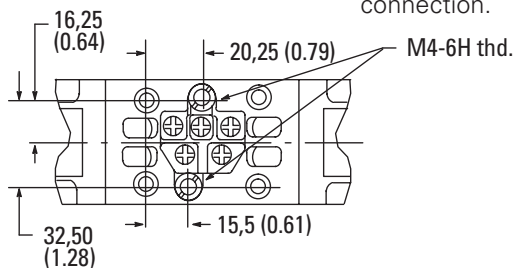
DG4V-3(S)—FPA—60  
DG4V-3(S)—FPBW—60

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

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

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.

## PA configuration



Dimensions in mm(in).

## DIN 43650 Connector

Cable diameter range:

Ø6-10 mm (0.24-0.40)

Wire section range:

Ø,5-1,5 mm<sup>2</sup> (0.0008-0.0023 in<sup>2</sup>)

Terminals:

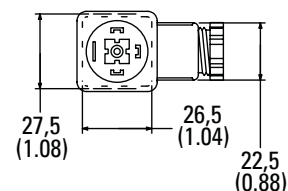
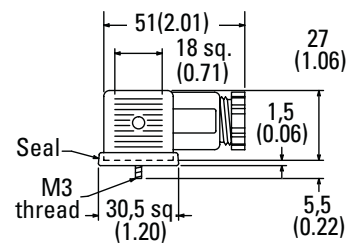
Screw type

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° intervals on valve by re-assembling contact holder inside connector housing.

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



# Electrical Plugs and Connectors

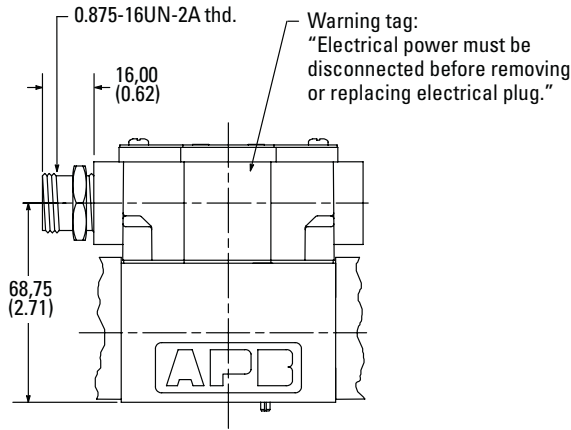
## NFPA Connector T3.5.29-1980

DG4V-3(S)-FPA3W(L)-\*\* -60  
 DG4V-3(S)-FPA5W(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

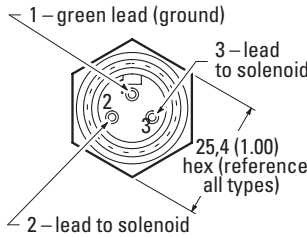


## 3 pin connector

Use with single solenoid valve

Key model code designations:

DG4V-3(S)-\*A(L)(-\*\*-)(V)M-FPA3W(L)  
 DG4V-3(S)-\*B(L)(-\*\*-)(V)M-FPA3W(L)



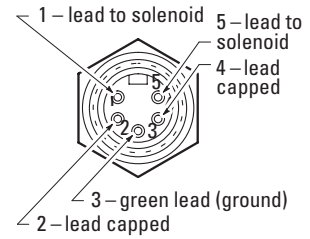
5 pin connector

## 5 pin connector

Use with single solenoid valve

Key model code designations:

DG4V-3(S)-\*A(L)(-\*\*-)(V)M-FPA5W(L)  
 DG4V-3(S)-\*B(L)(-\*\*-)(V)M-FPA5W(L)



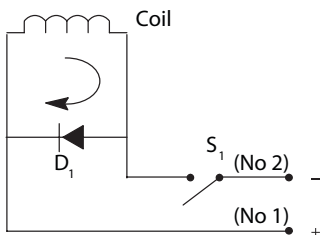
5 pin connector

## 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

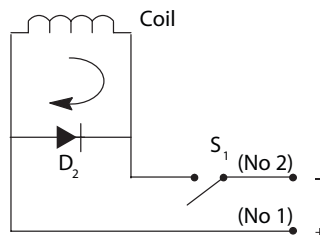


## Surge Suppression Devices (For DC Valves)

### 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



**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

Eaton  
Hydraulics Business USA  
14615 Lone Oak Road  
Eden Prairie, MN 55344  
USA  
Tel: 952-937-9800  
Fax: 952-294-7722  
[www.eaton.com/hydraulics](http://www.eaton.com/hydraulics)

Eaton  
Hydraulics Business Europe  
Route de la Longeraie 7  
1110 Morges  
Switzerland  
Tel: +41 (0) 21 811 4600  
Fax: +41 (0) 21 811 4601

Eaton  
Hydraulics Group Asia Pacific  
Eaton Building  
4<sup>th</sup> Floor, No. 3 Lane 280 Linhong Rd.  
Changning District  
Shanghai 200335  
China  
Tel: (+86 21) 5200 0099  
Fax: (+86 21) 5200 0400