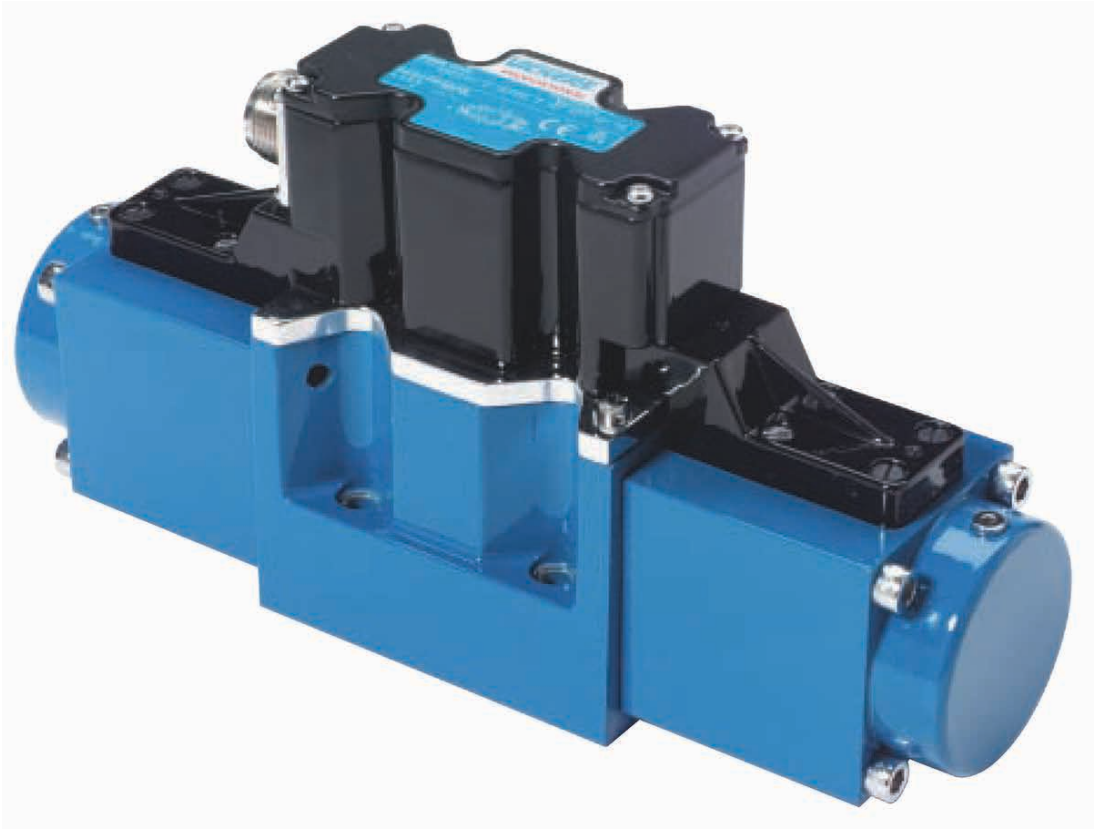
Proportional direction valves without feedback

KBD/TG4V-5, 1" Series
Pressures to 315 bar (4500 psi)



Powering Business Worldwide

Contents

CE

This product has been designed and tested to meet specific standards outlined in the European Electromagnetic Compatibility Directive (EMC) 2014/30/EU which repealed Directive 2004/108/EC. For Restriction of Hazardous Substances, complies to (RoHS) Directive 2011/65/EU. For instructions on installation requirements to achieve effective protection levels, see the Installation Wiring Practices for Eaton's Electronic Products. Wiring practices relevant to this Directive are indicated by ⚠ Electromagnetic Compatibility (EMC).

Introduction

General description

Vickers™ KB*G4V-5 proportional valves are designed to provide controlled oil flow in proportion to an electrical command signal. They are available in two versions. Firstly a double solenoid version that will provide reversible flow and return to an actuator. Secondly a single solenoid version that provides a single direction of flow.

The KB valve incorporates an integral control amplifier. Factory set adjustments for gain, spool deadband compensation and dither ensure excellent reproducibility valve-to-valve.

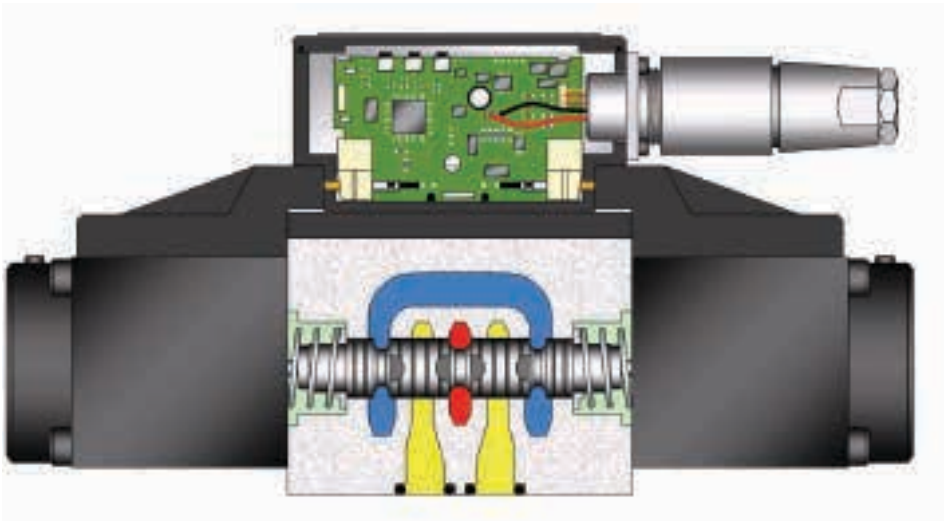
Electrical connection is via a standard 7-pin plug and requires a power supply and command signal which can be either voltage or current (model code option).

In addition to improving machine performance and life, the KB proportional valves substantially simplify system design by combining direction and flow capabilities in one single package that mounts onto a standard ISO 4401 interface.

Standard features and benefits

- State of the art digital electronic technology
- Rugged and robust diecast housing
- Optional voltage (+/-10 volt) or current (4-20 mA) demand input
- Adjustable ramp (2 sec)
- Wide range of supply voltage
- Optional external enable feature
- IP67 environmental protection
- Full CE electromagnetic capability to EN 50081-2 and EN 50082-2
- Vibration and shock tested
- Factory adjusted to ensure excellent valve-to valve reproducibility
- Installation wiring reduced and simplified
- Wide range of spool and flow rate options
- Simple valve removal and replacement for service i.e. plug and play
- Standard 7-pin connector
- 315 bar (4500 psi) pressure rating
- Supported by auxiliary function electronic modules

Typical section



KBDG4V-5-PE, 1* Series

Model codes

KB	*	G	4	V	5	**	*	**	*	**	Z	*	P*7	H	7	11
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

1 Valve type

KB	Proportional valve with integral amplifier, B series

2 Control type

D	Directional valve
T	Throttle valve

3 Mounting

G	Subplate mounted

4 Operation

4	Solenoid operated

5 Pressure rating

V	315 bar (4500 psi), ports P, A & B

6 Interface

5	ISO 4401, size 05-02-0-94, ANSI B93.7M-D05

7 Spool type

2	Closed center
33	P port closed, A & B to tank

8 Spool/spring arrangement

(See next page for Spool Configurations)

C	Spring centered, dual solenoid
B	Spring centered, single solenoid

9 Spool flow rating - at 5 bar (75 psi) per meter ing flow path

30	30 L/min (7.9 USgpm)
50	50 L/min (13.2 USgpm)
60	60 L/min (15.9 USgpm)
65	65 L/min (17.2 USgpm)
70	70 L/min (18.5 USgpm)

10 Spool metering type

S	Meter-out only (65 spool only)
N	Meter-in and meter-out

11 Flow rating for asymmetric flow spools

(Omit for symmetrical spools)

25	25 L/min (6.6 USgpm) (2C50N25 only)
35	35 L/min (9.24 USgpm)

12 Manual overrides

Z	No overrides

13 Electrical command option

M1	+/- 10V control signal
M2	4-20 mA control signal

14 Electrical connection

PC7	7 pin connector without plug supplied
PE7	7 pin connector with plug supplied
PH7	As PE7 but with pin "C" used for enable signal
PR7	As PC7 but with pin "C" used for enable signal

15 Coil rating

H	24V DC amplifier supply

16 T port pressure

6	160 bar (2270 psi) (65S spool only)
7	210 bar (3000 psi) (not available with 65S spool)

17 Design number, 1* series

11	Subject to change. Installation dimensions unaltered for design numbers 10 to 19 respectively

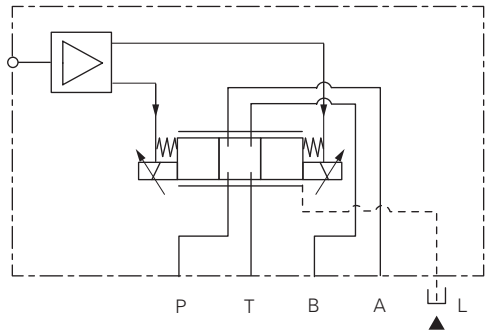
⚠ WARNING

Valves with integral amplifiers are supplied with or without the metal 7-pin plug. The Vickers plug, part no. 934939, must be correctly fitted to ensure that the EMC rating and IP67 rating are achieved. The plug retaining nut must be tightened with a torque of 2- 2,5 Nm (1.5-2.0 lbf ft) to effect a proper seal.

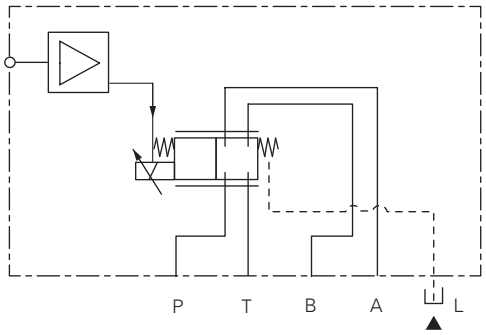
Spool data

Functional symbols

Model type KBDG4V-5
Proportional directional valve (with integrated electronics)



Model type KBTG4V-5
Proportional throttle valve (with integrated electronics)



▲ If port T pressure will not exceed 160 bar (2320 psi), port L need not to be connected to tank.

Spool type and flow ratings

Symmetric spools

Base line starting at p = 5 bar (72 psi) per metering flow path, e.g. B to T. For actual maximum flow refer to power capacity envelope curves.

Spool code	Spool symbol	Flow rating
For KBDG4V-5 valves:		
2C30N	2C	30 L/min (7.9 USgpm)
2C50N	2C	50 L/min (13.2 USgpm)
2C60N	2C	60 L/min (15.9 USgpm)
2C70N	2C	70 L/min (18.5 USgpm)
2C65S	2C	65 L/min (17.2 USgpm)
33C30N	33C	30 L/min (7.9 USgpm)
33C50N	33C	50 L/min (13.2 USgpm)
For KBTG4V-5 valves:		
2B30N	2B	30 L/min (7.9 USgpm)
2B50N	2B	50 L/min (13.2 USgpm)
2B70N	2B	70 L/min (18.5 USgpm)

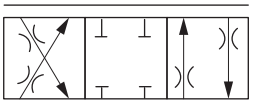
Asymmetric spools

Figure preceding metering type designator, "N" (e.g. 2C***N) is flow rating P-A, or A-T ("A" port flow); figure after "N" (N***) is flow rating P-B, or B-T ("B" port flow).

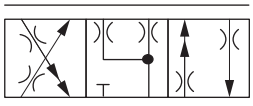
Spool code	Spool symbol	Flow rating
For KBDG4V-5 valves:		
2C50N25	2C	50 L/min (13.2 USgpm) "A" port flow
		25 L/min (6.6 USgpm) "B" port flow
2C60N35	2C	60 L/min (15.8 USgpm) "A" port flow
		35 L/min (9.24 USgpm) "B" port flow
33C50N25	33C	50 L/min (13.2 USgpm) "A" port flow
		25 L/min (6.6 USgpm) "B" port flow

Available spools for KBDG4V-5

Spool symbols

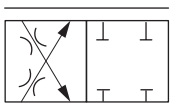


Spool type 2C

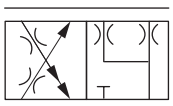


Spool type 33C

Available spools for KBTG4V-5



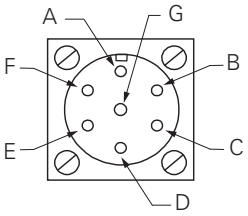
Spool type 2B
meter-in/meter-out



Spool type 33B
meter-in/meter-out

Operating data

Proportional Directional Valves without Feedback

KBD/TG4V-5	
Data is typical with fluid at 36 cSt (168 SUS) and 50 C (122 F).	
Power supply	24V DC (21V to 34V including 10% peak-to-peak ripple) max current 1.2A
Command signal	
Voltage mode	0 to 10V DC, or 0 to –10V DC, or –10V to + 10V DC
• Input impedance	47 kΩ
• Common mode voltage to pin D	18V (max)
• Max differential voltage to pin E to pin B	10V
Current mode	4-20 mA
The content of row input impedance	100 ohms
Command signal (Current)	4 to 20 mA
Input impedance	100Ω
Valve enable signal	
Enable	>9.0V (34V max)
Disable	<2.0V
Input impedance	36 kΩ
7-pin plug connector	Pin Description
 View of pins of fixed half	A Power supply positive (+) B Power 0V C Valve enable (PH7 & PR7) D Command signal (+V or current in) E Command signal (–V or current return) F Output monitor G Protective ground
Electromagnetic compatibility (EMC)	IEC 61326-2-1 (Electrical equipment for measurement, control and laboratory use)
	Conducted Emissions CISPR11 -2015-06 Ed 6.0/EN55011 - Class A, 150kHz to 30MHz
	Radiated Emissions CISPR11 -2015-06 Ed 6.0 /EN55011 - Class A, 30MHz – 1GHz
	RF Continuous Conducted disturbances IEC 61000-4-6, 3Vrms Class A 150 KHz to 80 MHz
	RF Electromagnetic Field, 80MHz to 1GHZ, 10V/m; 1.4GHz to 2.7GHz, 3V/m; Meets Criterion A
	Surge: IEC 61000-4-5
	• DC Power Port : ±1kV • Signal/Control Port : ±1kV
	Electrical Fast Transients IEC 61000-4-4, Class B
	• DC Power Port : ±1kV • Signal/Control Port : ±0.5kV
	Electrostatic discharges (ESD) IEC 61000-4-2, Class B
	• Air ±8kV • Contact ±4kV
ROHS Compliance:	Complies with: Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU
Monitor signal (pin F) KDB values	2V for 1.2 solinoid current
Output impedance	10kΩ
Power stage PWM frequency	1.2 kHz nominal
Step input response, with flow through P–A–B–T, Δp=5 bar (72 psi) per metering path, e.g. P–A	
Required flow step for 24V version:	Time to reach 90% of required step:
0 to 100%	115 ms
100% to 0	105 ms
Reproducibility, valve-to-valve (at factory settings):	
Flow at 100% command signal	<5%
Protection:	
Electrical	Reverse polarity protected
Environmental	IEC 529, Class IP67
Ambient air temperature range for full performance	0° C to 70° C (32° F to 158° F)
Oil temperature range for full performance	0° C to 70° C (32° F to 158° F)

Operating data

Minimum temperature at which valves will work at reduced performance	–20° C (–4° F)
Storage temperature range	–25° C to +85° C (–13° F to +185° F)
Supporting products:	
Auxiliary electronic modules (DIN -rail mounting):	
EHA-CON-201-A2* signal converter	See catalog GB 2410A
EHD-DSG-201-A-1* command signal generator	See catalog GB 2470
EHA-RMP-201-A-2* Ramp generator	See catalog GB 2410A
EHA-PSU-201-A-10 Power supply	See catalog GB 2410A
EHA-PID-201-A-20 PID controller	See catalog GB 2427
Ramp time	0-2 sec for full step input (0-100%)
Relative duty factor	Continuous rating (ED = 100%)
Hysteresis with flow through P-A-B-T	<8% of rated flow
Mass:	
KBDG4V-5	7.2 kg (15.9 lb) approx.
KBTG4V-5	5.7 kg (12.6 lb) approx.

Maximum pressures, bar (psi)

Model	Port L Condition ▲	Ports P, A & B	T	L ▲
KBDG4V-5-**C**N-Z-M*-P*7-H7-10	Externally drained	315 (4500)	210 (3000)	10 (142)
All KBDG4V-5 models	Blocked by mating surface	315 (4500)	160 (2300)	160 (2300)
KBTG4V-5	Externally drained	315 (4500)	210 (3000)	10 (142)
	Blocked by mating surface	315 (4500)	160 (2300)	160 (2300)

▲ If port T pressure will not exceed 160 bar (2320 psi), port L need not be connected to tank.

Minimum recommended flow rates

Valve size/spool code	L/min	In³/min
KBDG4V-5-**C30N	1,5	91
KBDG4V-5-**C50N	2,5	152
KBDG4V-5-**C70N	3,0	182
KBDG4V-5-**C65S	3,0	182

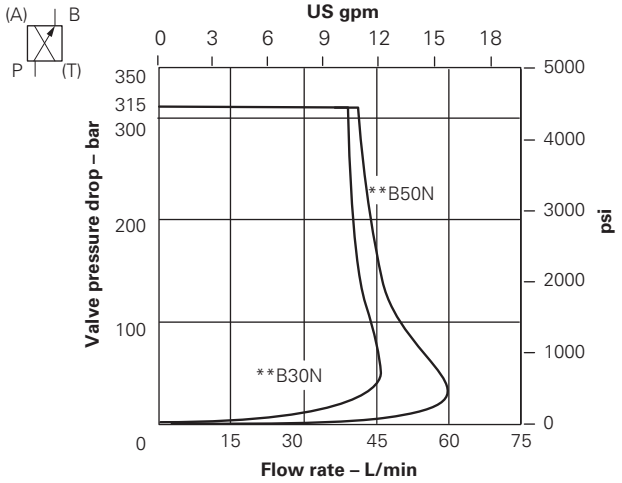
For spool types 2C and 33C
Δp = 10 bar (142 psi)
for looped flow P–A–B–T
(or P–B–A–T)

Performance curves

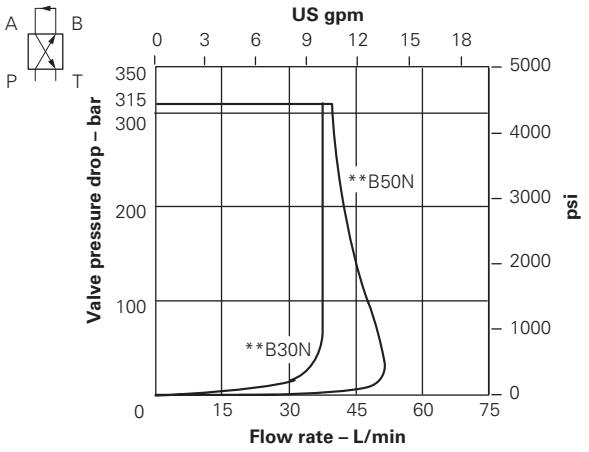
KBTG4V-5 Power capacity envelopes

Single solenoid models

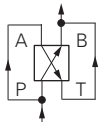
Single flow path P to B



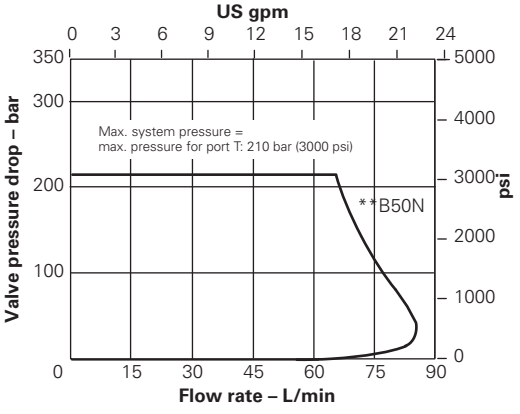
Looped flow path P to B plus A to T



Parallel flow path P to B and A to T using parallel flow path module:



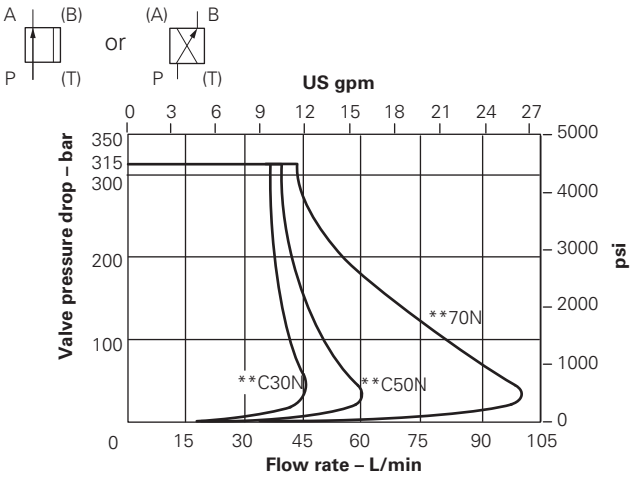
KDGMA-5-616877-10R■ or
KDGMA-5-02-139150-10S■



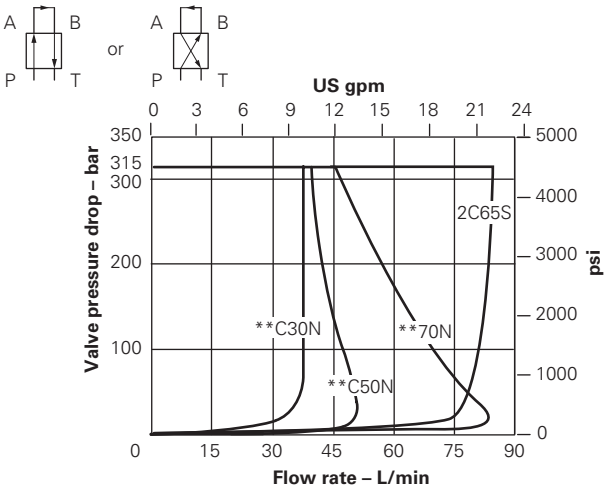
KBDG4V-5 Power capacity envelopes

Double solenoid models

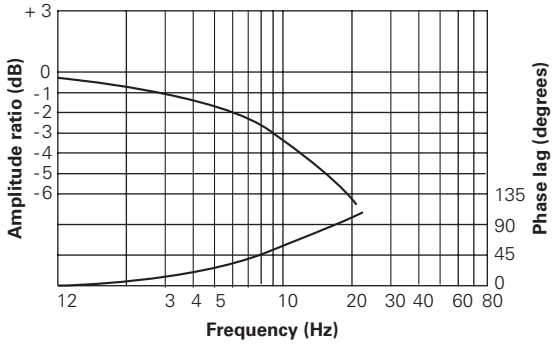
Single flow path P to A, or P to B



Looped flow path P to A (or B) plus B (or A) to T

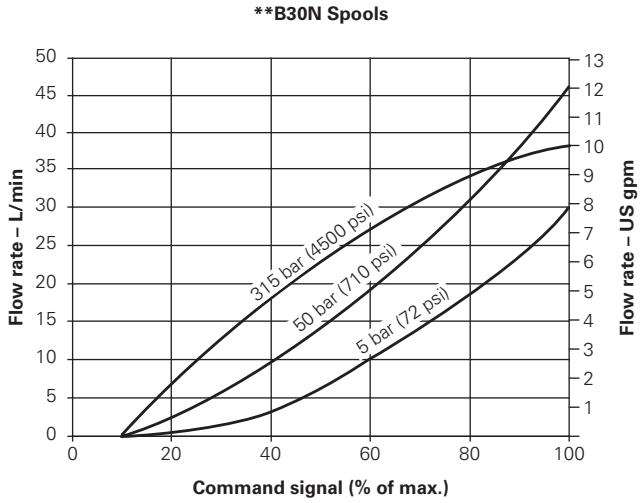


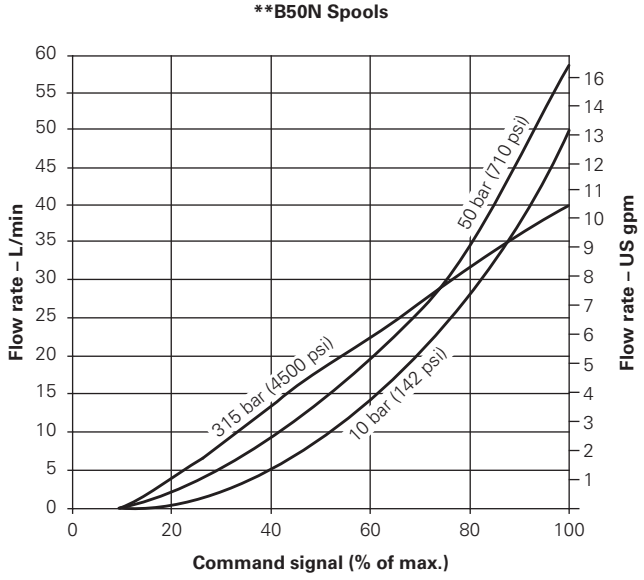
Frequency response

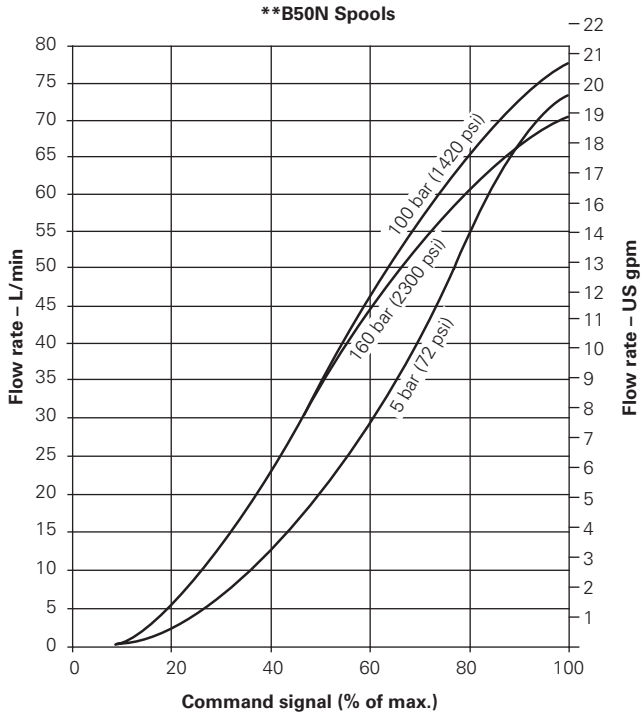


■ See catalog 2336, "Subplates and Auxiliary Connection Plates, Size 05".

Performance curves







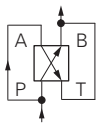
KBTG4V-5

Single solenoid models

Flow gain

Single flow path P to B

Parallel flow paths P to B and A to T using parallel flow path module:



KDGMA-5-616877-10R■ or
KDGMA-5-02-139150-10S■

Maximum system pressures for this configuration:

With "L" port externally drained - 210 bar (3000 psi)

With "L" port blocked - 160 bar (2320 psi)

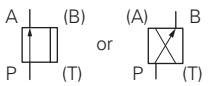
■ See catalog 2336, "Subplates and Auxiliary Connection Plates, Size 05".

Performance curves

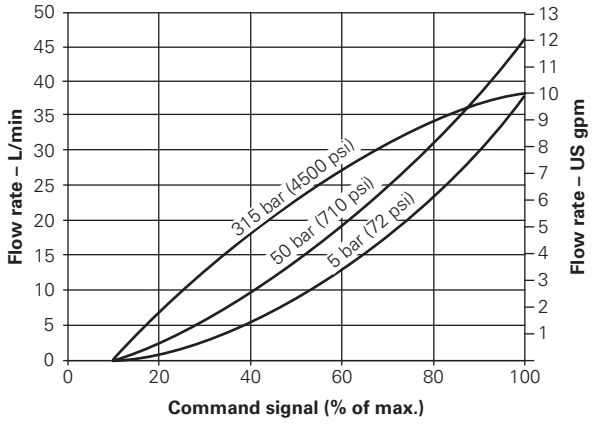
KBDG4V-5 Double solenoid models

Flow gain

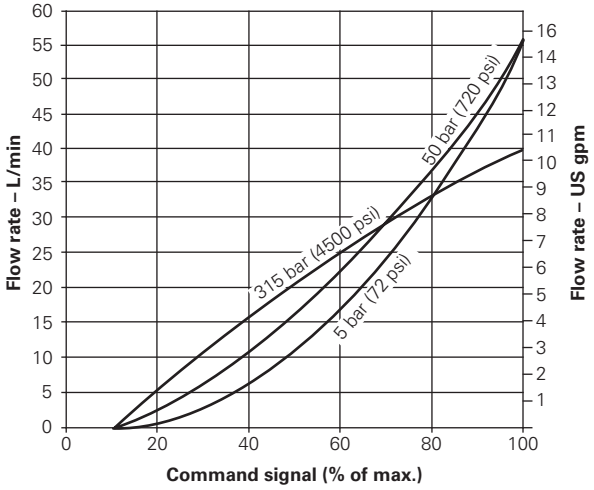
Single flow path P to A or P to B



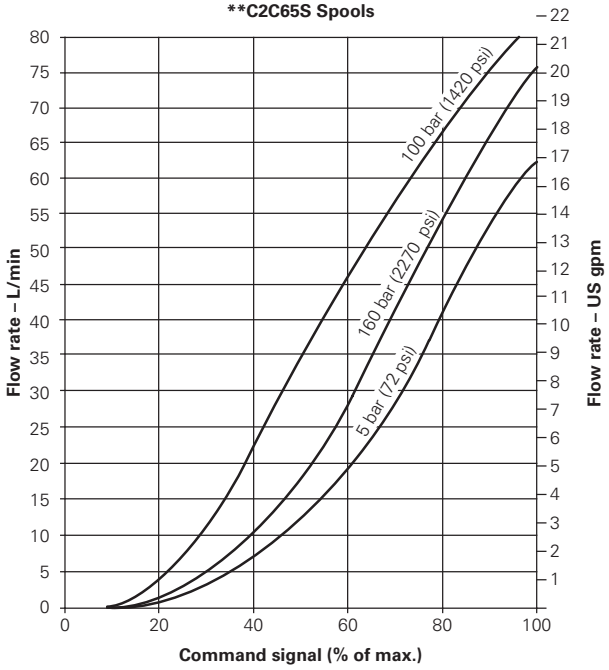
****C30N Spools**



****C50N Spools**



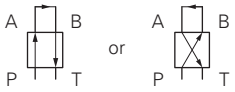
****C2C65S Spools**



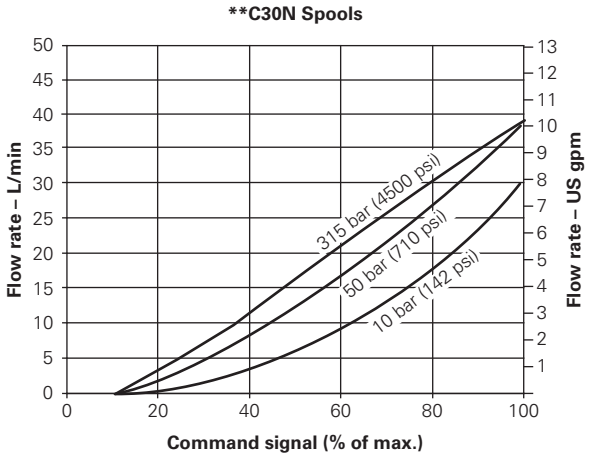
KBDT4V-5 Double solenoid models

Flow gain

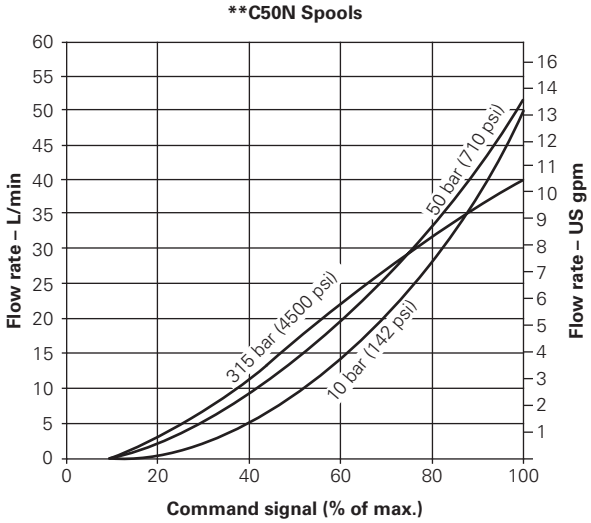
Looped flow paths P to A, (or B), plus B (or A) to T



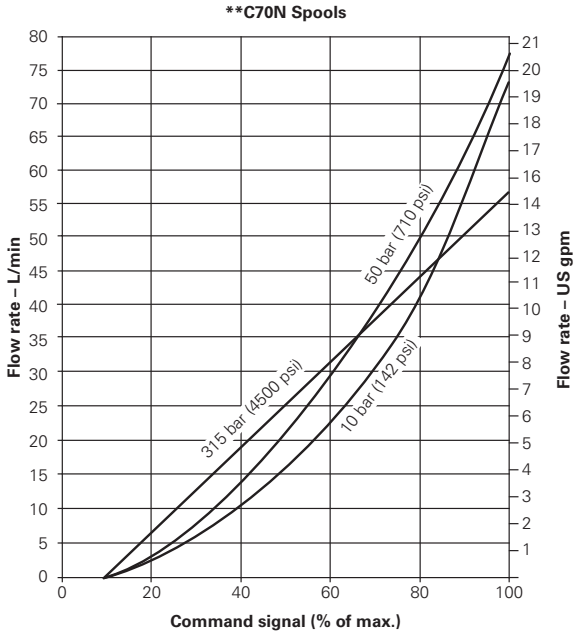
****C30N Spools**



****C50N Spools**



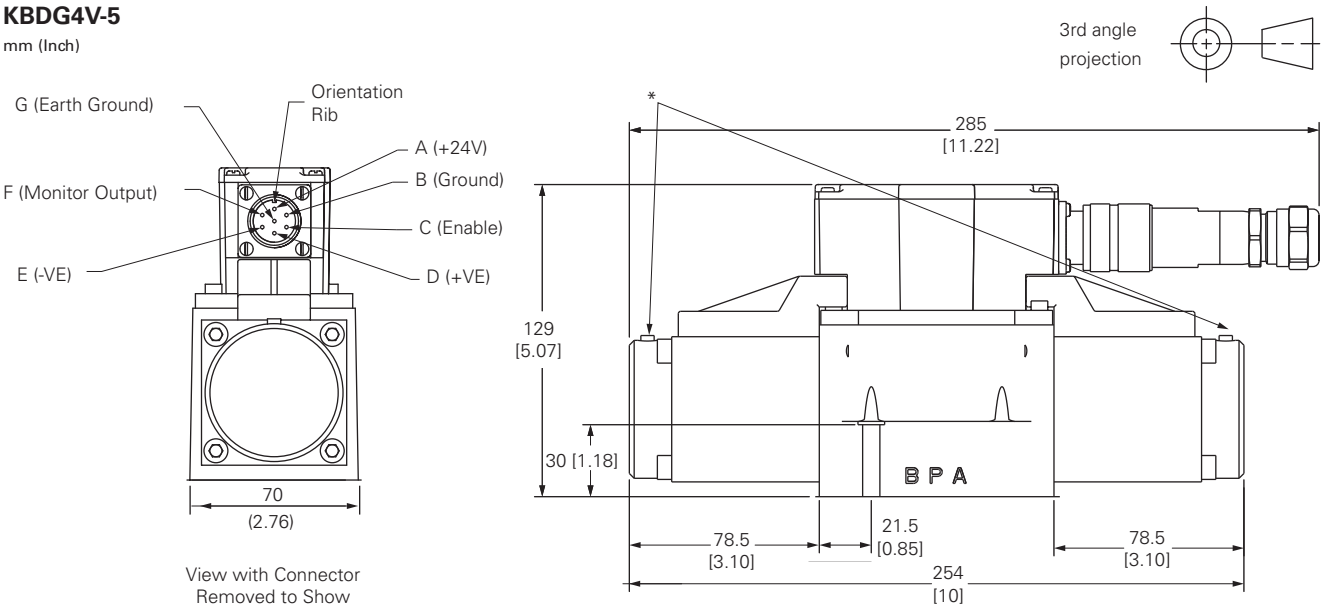
****C70N Spools**



Installation dimensions

KBDG4V-5

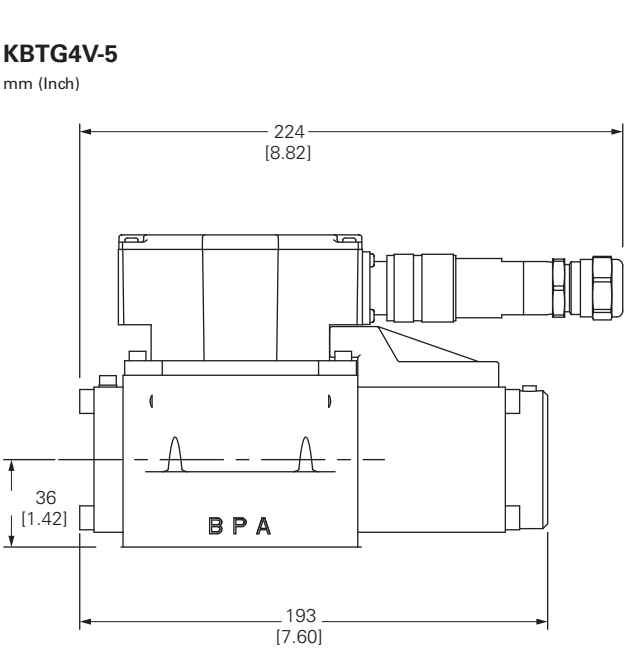
mm (Inch)



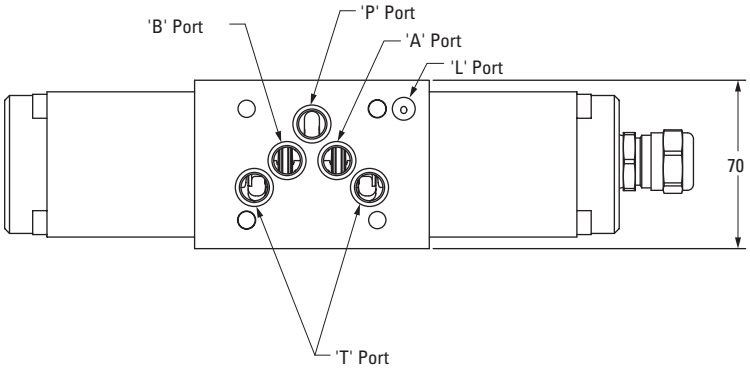
View with Connector Removed to Show Pin Designations KBD & KBT Models

KBTG4V-5

mm (Inch)



KBTG4V-5-*B***-Z-M*-P*7-H*-10
Models Shown with "PE7" Option Installed



KBDG4V-5-*C-***-Z-M*-P*7-H*-10
Models Shown with "PE7" Option Installed

▲ Mounting surface seals supplied For subplate options, see attached catalogue 2336; for mounting bolt kit options, see catalogue 2314.

* Note: Bleed screw locations. Air bleed: torque to 3,4-4,4 Nm (30-39 lbf ft).

Note: For optimum valve operation, bleed the air from the proportional solenoids at initial start-up. This may be done as follows:

- Remove the bleed screws until no bubbles appear and then reinstall bleed screws, or...
- Remove both bleed screws, and use a standard oil can nozzle to pump fluid in one side until it flows, free of air bubbles, out the other side. Reinstall screws.

If there is no inherent back pressure in the tank port of the circuit, do not allow the tank line to empty. This may be prevented by installing a check valve in the tank line. The cracking pressure of the check valve should be in the range of 1.5-3 bar (22-45 psi).

⚠ WARNING

Valves with integral amplifiers are supplied with or without the metal 7-pin plug. The Vickers™ plug, part no. 934939, must be correctly fitted to ensure that the EMC rating and IP67 rating are achieved.

Subplates and mounting surfaces

General description

When a subplate is not used, a machined pad must be provided for valve mounting. Pad must be flat within 0,0127 mm (.0005 inch) and smooth within 1,6 µm (63 microinch). Mounting bolts, when provided by customer, should be ISO 898 class 12.9 or better.

Dimensional tolerances

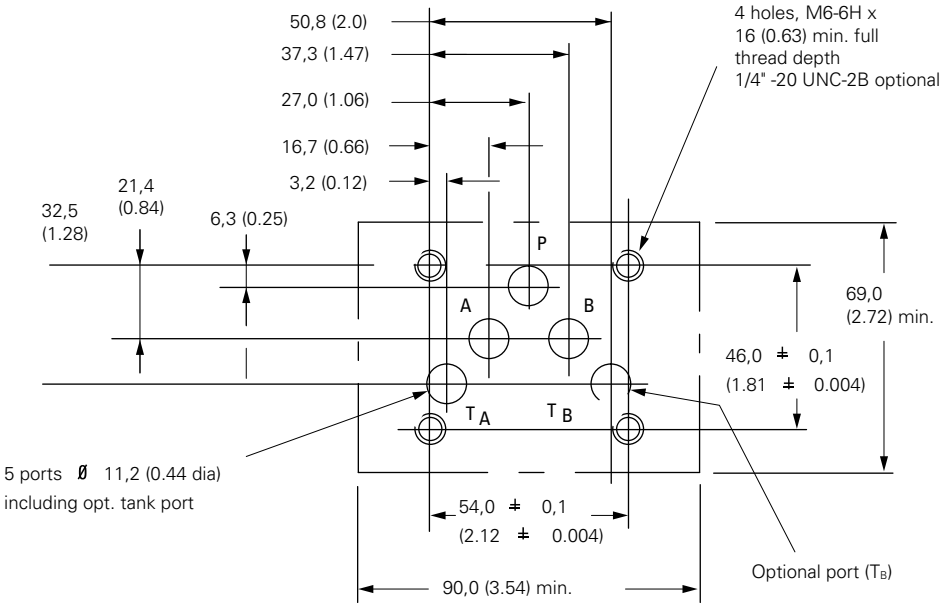
Dimensional tolerance on interface drawings is 0,2 mm (0.008") except where otherwise stated. ISO 4401 specifies inch conversion to 0.01".

Conversion from metric

IISO 4401 gives dimensions in mm. Inch conversions are accurate to 0.01" unless otherwise stated.

Mounting bolt tappings

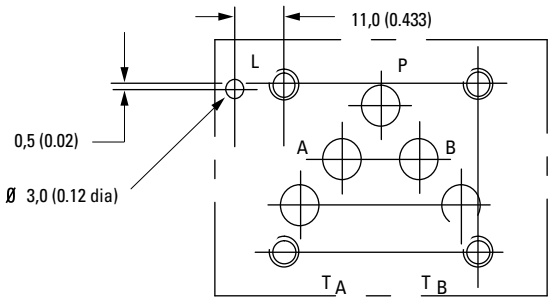
ISO 4401 gives metric thread tappings.
Alternate UNC tappings are Vickers recommendations that allow these plates and associated valves to be used up to their maximum pressures, when using Vickers recommended bolt kits, or bolts of an equivalent strength. It is recommended that Customer's own manifold blocks for UNC bolts should be tapped to the minimum depths given in the footnotes.



Mounting surface interface ISO 4401

Size 05

This interface conforms to: ISO 4401-05-04-0-94 ANSI/B93.7M (and NFPA) size 05 CETOP R35H4.2-05 DIN 24340 Form A10



Interface with additional Drain port

The interface conforms to Vickers standard, plus hole "L" Typically used for proportional and other valves requiring an additional drain port.

Electrical information

Electrical block diagram

Wiring

Connections must be made via the 7-pin plug mounted on the amplifier. Recommended cable sizes are:

Power cables:

For 24V supply:

0,75 mm2 (18 AWG) up to 20m (65 ft)

1,00 mm2 (16 AWG) up to

40m (130 ft)

Signal cables:

0,50 mm2 (20 AWG)

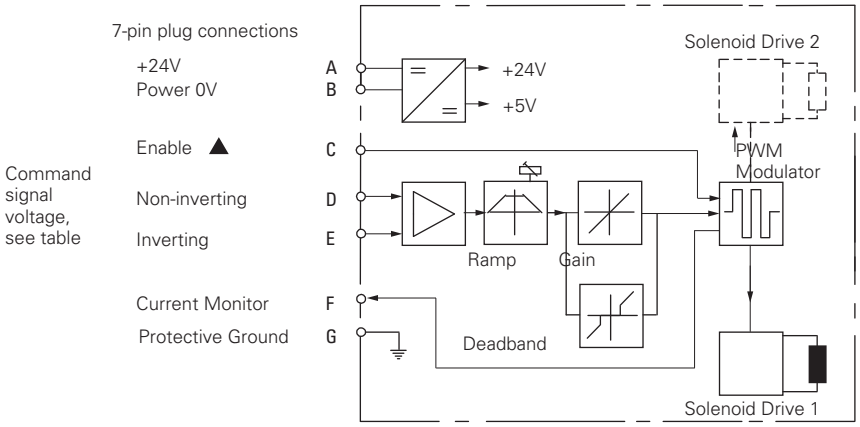
Screen (shield):

A suitable cable would have 7 cores, a separate screen for the signal wires and an overall screen.

Cable outside diameter 8,0-10,5 mm (0.31-0.41 inches)
See connection diagram on next page.

Command signals and outputs

7-pin plug			Flow direction
	Pin D	**Pin E**	
Command = Volts (±10V)	Positive	0V	
	0V	Negative	P to A
	U_D - U_E = Positive		
	Negative	0V	
	0V	Positive	P to B
	U_D - U_E = Negative		
	Pin D	Pin E	Flow direction
Command = Current (4-20mA)	more than 12 mA	Current return	P to A
	less than 12 mA	Current return	P to B



▲ Note: In valves with PH7 or PR7 type electrical connection.

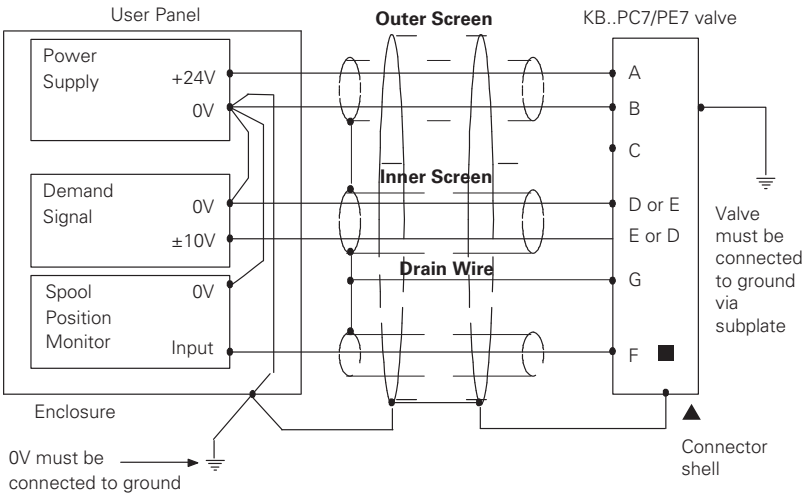
⚠ WARNING

All power must be switched off before connecting or disconnecting any plugs.

Block diagram

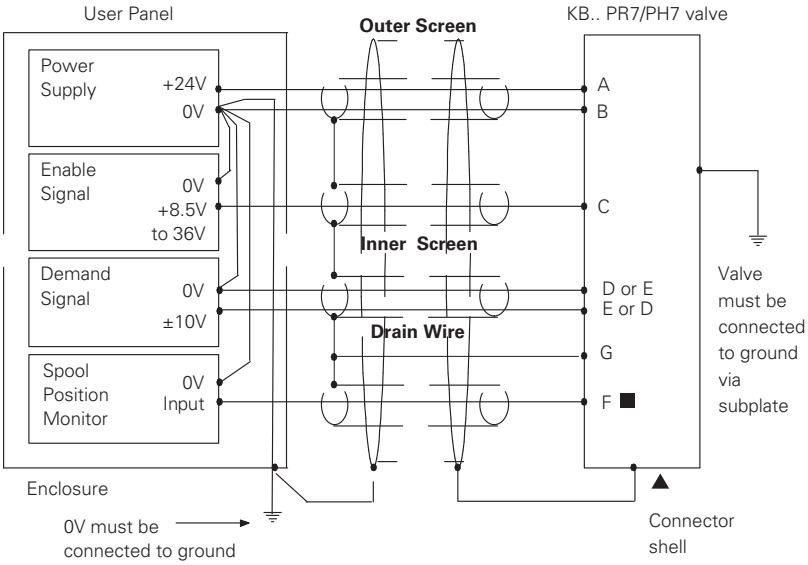
Voltage input (M1) wiring

■ Spool position monitor voltage (pin F) will be referenced to the KB valve local ground.



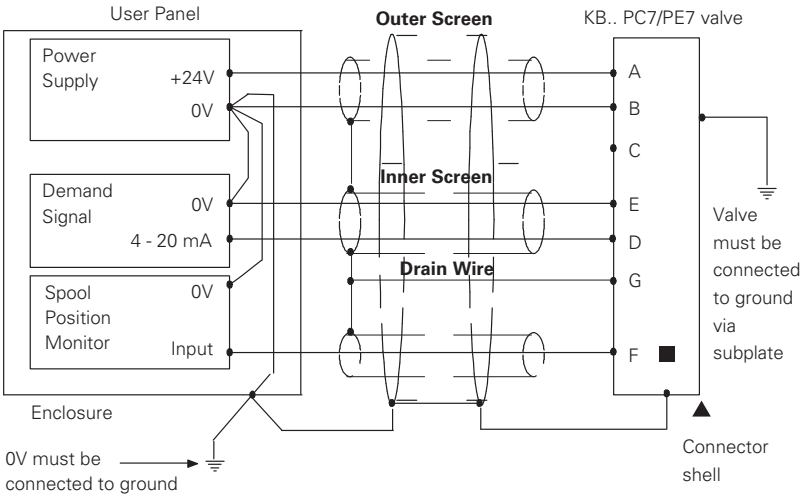
Wiring connections for M1 valves with enable feature

Note: ▲ In applications where the valve must conform to European RFI/EMC regulations, the outer screen (shield) must be connected to the outer shell of the 7 pin connector, and the valve body must be fastened to the earth ground. Proper earth grounding practices must be observed in this case, as any differences in command source and valve ground potentials will result in a screen (shield) ground loop.



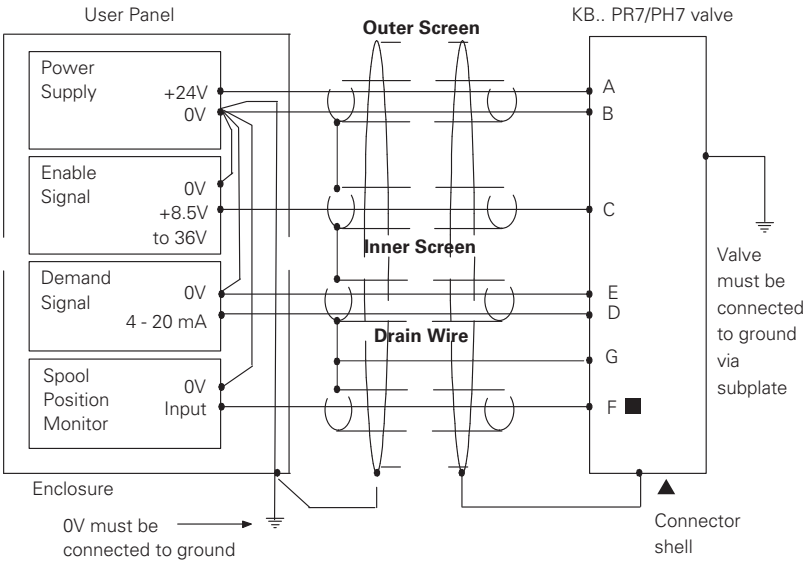
Current input (M2) wiring

■ Spool position monitor voltage (pin F) will be referenced to the KB valve local ground.



Wiring connections for M2 valves with enable feature

Note: ▲ In applications where the valve must conform to European RFI/EMC regulations, the outer screen (shield) must be connected to the outer shell of the 7 pin connector, and the valve body must be fastened to the earth ground. Proper earth grounding practices must be observed in this case, as any differences in command source and valve ground potentials will result in a screen (shield) ground loop.



⚠ WARNING

Electromagnetic Compatibility (EMC)
It is necessary to ensure that the valve is wired up as above. For effective protection the user electrical cabinet, the valve subplate or manifold and the cable screens should be connected to efficient ground points. The metal 7 pin connector part no. 934939 should be used for the integral amplifier. 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. It is important to connect the 0V lines as shown above. The multi-core cable should have at least two screens to separate the demand signal and monitor output from the power lines. The enable line to pin C should be outside the screen which contains the demand signal cables.

Hydraulic fluids and fluid cleanliness

Recommendations on contamination control methods and the selection of products to control fluid condition are included in Eaton Hydraulic Fluid Recommendation 03-401-2010 rev 1.

For products in this catalog the recommended levels are:

0 to 70 bar (1000 psi) – 18/**16/13**

70 + bar (1000 + psi) – 17/**15/12**

Hydraulic fluids

Materials and seals used in these valves are compatible with antiwear hydraulic oils, and non-alkyl-based phosphate esters. The extreme operating viscosity range is 500 to 13 cSt (2270 to 70 SUS) but the recommended running range is 54 to 13 cSt (245 to 70 SUS).

Installation

The proportional valves in this catalog can be mounted in any attitude, but it may be necessary in certain demanding applications, to ensure that the solenoids are kept full of hydraulic fluid. Good installation practice dictates that the tank port and any drain port are piped so as to keep the valves full of fluid once the system startup has been completed.

Mounting bolt kits

BK02-156493M (metric) BK590716 (inch)

If not using Vickers recommended bolt kits, bolts used should be to ISO 898, 12.9 or better.

Seal kits

KBDG4V-5 4998180-001

KBTG4V-5.....4998179-001

Plugs

7-pin plug (metal).....934939

7-pin plug (plastic).....694534

(metal plug must be used for

full EMC protection)

Note: An alternative metal connector which gives EMC protection but not IP67 rating is available from ITT-Cannon, part number CA06-COM-E- 14S-A7-S.

Service information

The products from this range are preset at the factory for optimum performance; disassembling critical items would destroy these settings. It is therefore recommended that should any mechanical or electronic repair be necessary they should be returned to the nearest Vickers repair center. The products will be refurbished as necessary and retested to specification before return.

Field repair is restricted to the replacement of the seals.

Note: The feedback/solenoid assembly installed in this valve should not be disassembled.

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