Proportional Direction Valves without Feedback
Pressures to 315 bar (4500 psi)

KBD/TG4V-5, 1* Series
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**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.

**New Features and Benefits**

- State of the art digital electronic technology
- Rugged and robust die-cast 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

**Standard Features and Benefits**

- 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 Code

**KB** - Proportional valve with integral amplifier, B series

**D** - Directional valve

**T** - Throttle valve

**G** - Subplate mounted

**4** - Solenoid operated

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

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

**2** - Closed center

**33** - P port closed, A & B to tank

**KB  G  4 V  5 **  **  **  **  **  M  P*7 H  7 10**

**1** - 1* series - Subject to change

---

### Spool/Spring Arrangement

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

(See next page for Spool Configurations)

### Spool Flow Rating - at 5 bar (75 psi) per metering flow path

- **30** - 30 L/min (7.9 USgpm)
- **50** - 50 L/min (13.2 USgpm)
- **65** - 65 L/min (17.2 USgpm)
- **70** - 70 L/min (18.5 USgpm)

### Spool Metering Type

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

### 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)

### Manual Overrides

- **Z** - No overrides

---

**1** - +/- 10V control signal

**2** - 4-20 mA control signal

### 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

### Electrical Command Option

- **1** - 24V DC amplifier supply

### Coil Rating

- **H** - 24V DC amplifier supply

### T Port Pressure

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

---

### 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

Spool Symbols

### Available Spools for KBDG4V-5

<table>
<thead>
<tr>
<th>Spool Type 2C</th>
<th>Spool Type 33C</th>
</tr>
</thead>
</table>

#### 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.

<table>
<thead>
<tr>
<th>Spool Code</th>
<th>Spool Symbol</th>
<th>Flow Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>2C30N</td>
<td>2C</td>
<td>30 L/min (7.9 USgpm)</td>
</tr>
<tr>
<td>2C50N</td>
<td>2C</td>
<td>50 L/min (13.2 USgpm)</td>
</tr>
<tr>
<td>2C70N</td>
<td>2C</td>
<td>70 L/min (18.5 USgpm)</td>
</tr>
<tr>
<td>2C65S</td>
<td>2C</td>
<td>65 L/min (17.2 USgpm)</td>
</tr>
<tr>
<td>33C30N</td>
<td>33C</td>
<td>30 L/min (7.9 USgpm)</td>
</tr>
<tr>
<td>33C50N</td>
<td>33C</td>
<td>50 L/min (13.2 USgpm)</td>
</tr>
</tbody>
</table>

#### 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).

<table>
<thead>
<tr>
<th>Spool Code</th>
<th>Spool Symbol</th>
<th>Flow Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>2B30N</td>
<td>2B</td>
<td>30 L/min (7.9 USgpm)</td>
</tr>
<tr>
<td>2B50N</td>
<td>2B</td>
<td>50 L/min (13.2 USgpm)</td>
</tr>
<tr>
<td>2B70N</td>
<td>2B</td>
<td>70 L/min (18.5 USgpm)</td>
</tr>
</tbody>
</table>

#### 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.
Proportional Directional Valves without Feedback

KBD/TG4V-5

Data is typical with fluid at 36 cSt (168 SUS) and 50 C (122 F).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>24V DC (21V to 34V including 10% peak-to-peak ripple) max current 1.2A</td>
</tr>
<tr>
<td>Command signal (Volts)</td>
<td>0 to +10V DC, or 0 to –10V DC, or –10 V to +10 V DC</td>
</tr>
<tr>
<td>Input impedance</td>
<td>47 kΩ</td>
</tr>
<tr>
<td>Power supply current</td>
<td>max 1.2A</td>
</tr>
<tr>
<td>Common mode voltage to pin B</td>
<td>4V</td>
</tr>
<tr>
<td>Command signal (Current)</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>Input impedance</td>
<td>100Ω</td>
</tr>
<tr>
<td>Valve enable signal</td>
<td>Enable &gt;9.0V (34V max)</td>
</tr>
<tr>
<td></td>
<td>Disable &lt;2.0V</td>
</tr>
<tr>
<td>Input impedance</td>
<td>36 kΩ</td>
</tr>
<tr>
<td>7-pin plug connector</td>
<td>Pin Description</td>
</tr>
<tr>
<td></td>
<td>A Power supply positive (+)</td>
</tr>
<tr>
<td></td>
<td>B Power 0V</td>
</tr>
<tr>
<td></td>
<td>C Valve enable (PH7 &amp; PR7)</td>
</tr>
<tr>
<td></td>
<td>D Command signal (+V or current in)</td>
</tr>
<tr>
<td></td>
<td>E Command signal (–V or current return)</td>
</tr>
<tr>
<td></td>
<td>F Output monitor</td>
</tr>
<tr>
<td></td>
<td>G Protective ground</td>
</tr>
<tr>
<td>Electromagnetic compatibility (EMC)</td>
<td></td>
</tr>
<tr>
<td>Emission (10 V/m)</td>
<td>EN 50081-2</td>
</tr>
<tr>
<td>Immunity (10 V/m)</td>
<td>EN 50082-2</td>
</tr>
<tr>
<td>Monitor signal (pin F) KDB values</td>
<td>2V for 1.2 solinoid current</td>
</tr>
<tr>
<td>Output impedance</td>
<td>10kΩ</td>
</tr>
<tr>
<td>Power stage PWM frequency</td>
<td>1.2 kHz nominal</td>
</tr>
<tr>
<td>Step input response, with flow through P-A-B-T, Δp=5 bar (72 psi) per metering path, e.g. P-A</td>
<td>Time to reach 90% of required step: 115 ms 105 ms</td>
</tr>
<tr>
<td>Required flow step for 24V version:</td>
<td>0 to 100%</td>
</tr>
<tr>
<td></td>
<td>100% to 0</td>
</tr>
<tr>
<td>Reproducibility, valve-to-valve (at factory settings): Flow at 100% command signal</td>
<td>≤5%</td>
</tr>
<tr>
<td>Protection:</td>
<td>Reverse polarity protected</td>
</tr>
<tr>
<td>Electrical</td>
<td>IEC 529, Class IP67</td>
</tr>
<tr>
<td>Environmental</td>
<td></td>
</tr>
<tr>
<td>Ambient air temperature range for full performance</td>
<td>0° C to 70° C (32° F to 158° F)</td>
</tr>
<tr>
<td>Oil temperature range for full performance</td>
<td>0° C to 70° C (32° F to 158° F)</td>
</tr>
<tr>
<td>Minimum temperature at which valves will work at reduced performance</td>
<td>–20° C (–4° F)</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>–25° C to +85° C (–13° F to +185° F)</td>
</tr>
<tr>
<td>Supporting products:</td>
<td></td>
</tr>
<tr>
<td>Auxiliary electronic modules (DIN -rail mounting):</td>
<td>See catalog GB 2410A</td>
</tr>
<tr>
<td>EHA-CON-201-A2* signal converter</td>
<td></td>
</tr>
<tr>
<td>EHD-DSG-201-A-1* command signal generator</td>
<td>See catalog GB 2470</td>
</tr>
<tr>
<td>EHA-RMP-201-A-2* Ramp generator</td>
<td></td>
</tr>
<tr>
<td>EHA-PSU-201-A-10 Power supply</td>
<td></td>
</tr>
<tr>
<td>EHA-PID-201-A-20 PID controller</td>
<td></td>
</tr>
<tr>
<td>Ramp time</td>
<td>0-2 sec for full step input (0-100%)</td>
</tr>
<tr>
<td>Relative duty factor</td>
<td>Continuous rating (ED = 100%)</td>
</tr>
<tr>
<td>Hysteresis with flow through P-A-B-T</td>
<td>&lt;8% of rated flow</td>
</tr>
<tr>
<td>Mass:</td>
<td></td>
</tr>
<tr>
<td>KBDG4V-5</td>
<td>7.2 kg (15.9 lb) approx.</td>
</tr>
<tr>
<td>KBTG4V-5</td>
<td>5.7 kg (12.6 lb) approx.</td>
</tr>
</tbody>
</table>

KBDG4V-5 and KBTG4V-5 are limited to a maximum flow rate of 5 l/min (13 US gpm) at 24V DC.
### Operating Data

**Pressure and Flow Rates**

#### Maximum Pressures, Bar (PSI)

<table>
<thead>
<tr>
<th>Model</th>
<th>Port L Condition ▲</th>
<th>Ports P, A &amp; B</th>
<th>T</th>
<th>L ▲</th>
</tr>
</thead>
<tbody>
<tr>
<td>KBDG4V-5-<strong>C30N</strong></td>
<td>Externally drained</td>
<td>315 (4500)</td>
<td>210 (3000)</td>
<td>10 (142)</td>
</tr>
<tr>
<td>All KBDG4V-5 models</td>
<td>Blocked by mating surface</td>
<td>315 (4500)</td>
<td>160 (2300)</td>
<td>160 (2300)</td>
</tr>
<tr>
<td>KBTG4V-5</td>
<td>Externally drained</td>
<td>315 (4500)</td>
<td>210 (3000)</td>
<td>10 (142)</td>
</tr>
<tr>
<td></td>
<td>Blocked by mating surface</td>
<td>315 (4500)</td>
<td>160 (2300)</td>
<td>160 (2300)</td>
</tr>
</tbody>
</table>

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

#### Minimum Recommended Flow Rates

<table>
<thead>
<tr>
<th>Valve Size/Spool Code</th>
<th>L/min</th>
<th>In³/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>KBDG4V-5-<strong>C30N</strong></td>
<td>1,5</td>
<td>91</td>
</tr>
<tr>
<td>KBDG4V-5-<strong>C50N</strong></td>
<td>2,5</td>
<td>152</td>
</tr>
<tr>
<td>KBDG4V-5-<strong>C70N</strong></td>
<td>3,0</td>
<td>182</td>
</tr>
<tr>
<td>KBDG4V-5-<strong>C65S</strong></td>
<td>3,0</td>
<td>182</td>
</tr>
</tbody>
</table>

For spool types 2C and 33C

\[ \Delta p = 10 \text{ bar (142 psi)} \] 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:

KBDGMA-5-616877-10R or KBDGMA-5-02-139150-10S

Frequency Response

Max. system pressure = max. pressure for port T: 210 bar (3000 psi)

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

![Diagram of flow path](image)

Maximum system pressures for this configuration:

- With “L” port externally drained: 210 bar (3000 psi)
- With “L” port blocked: 160 bar (2320 psi)

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

![Diagram of parallel flow paths](image)

**B30N Spools**

**B50N Spools**

See catalog 2336, “Subplates and Auxiliary Connection Plates, Size 05”.

EATON Vickers Proportional Directional Valves without Feedback KBD/TG4V-5 May 2004
Performance Curves

KBDG4V-5 Double Solenoid Models
Flow gain
Single Flow Path P to A or P to B

**C30N Spools

Flow rate – L/min
Flow rate – US gpm
Command signal (% of max.)

**C50N Spools

Flow rate – L/min
Flow rate – US gpm
Command signal (% of max.)

**C2C55S Spools

Flow rate – L/min
Flow rate – US gpm
Command signal (% of max.)

KBDT4V-5 Double Solenoid Models
Flow gain
Looped Flow paths P to A, or B, plus B (or A) to T

**C30N Spools

Flow rate – L/min
Flow rate – US gpm
Command signal (% of max.)

**C50N Spools

Flow rate – L/min
Flow rate – US gpm
Command signal (% of max.)

**C70N Spools

Flow rate – L/min
Flow rate – US gpm
Command signal (% of max.)
Installation Dimensions

KBDG4V-5

mm (Inch)

 Orientation Rib
 A (+24V)
 B (Ground)
 C (Enable)
 D (+VE)
 E (-VE)
 F (Monitor Output)
 G (Earth Ground)

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

KBTG4V-5

mm (Inch)

Bleed Screw

3rd angle projection

B’B’ Port
‘P’ Port
‘A’ Port
‘L’ Port
‘T’ Port

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

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

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.

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).
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 (.008”) except where otherwise stated. ISO 4401 specifies inch conversion to 0.01”.

Conversion from Metric
ISO 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. See this leaflet and Installation Wiring Practices for Vickers\textsuperscript{TM} Electronic Products leaflet 2468. Recommended cable sizes are:

**Power cables:**

For 24V supply:
- 0.75 mm\(^2\) (18 AWG) up to 20m (65 ft)
- 1.00 mm\(^2\) (16 AWG) up to 40m (130 ft)

**Signal cables:**

0.50 mm\(^2\) (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

<table>
<thead>
<tr>
<th>7-pin plug connections</th>
<th>Flow direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin D</td>
<td>Pin E</td>
</tr>
<tr>
<td>Positive 0V</td>
<td>Negative</td>
</tr>
<tr>
<td>( U_D - U_E = \text{Positive} )</td>
<td>( U_D - U_E = \text{Negative} )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command = Volts (±10V)</th>
<th>Flow direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive 0V</td>
<td>Negative</td>
</tr>
<tr>
<td>( U_D - U_E = \text{Positive} )</td>
<td>( U_D - U_E = \text{Negative} )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command = Current (4-20mA)</th>
<th>Flow direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>more than 12 mA</td>
<td>Current return</td>
</tr>
<tr>
<td>less than 12 mA</td>
<td>Current return</td>
</tr>
<tr>
<td>Positive</td>
<td>Negative</td>
</tr>
</tbody>
</table>

\( \text{Note: In valves with PH7 or PR7 type electrical connection.} \)

\( \text{WARNING} \)

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

Typical Connection Arrangements

Wiring Connections

- Pin C may be connected to ground or left unconnected.

**WARNING**
Do not ground pin C. If the local ground (pin C) is not used for differential monitor electronics, do not use. Read monitor pin F with respect to ground.

---

Wiring Connections for 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.
Fluid Cleanliness
Proper fluid condition is essential for long and satisfactory life of hydraulic components and systems. Hydraulic fluid must have the correct balance of cleanliness, materials and additives for protection against wear of components, elevated viscosity and inclusion of air. Recommendations on contamination control methods and the selection of products to control fluid condition are included in Vickers publication 9132 or 561, “Vickers Guide to Systemic Contamination Control”. The book also includes information on the Vickers concept of “ProActive Maintenance”. The following recommendations are based on ISO cleanliness levels at 2 µm, 5 µm and 15 µm. 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

Vickers products, as any components, will operate with apparent satisfaction in fluids with higher cleanliness codes than those described. Other manufacturers will often recommend levels above those specified.

Experience has shown, however, that life of any hydraulic components is shortened in fluids with higher cleanliness codes than those listed above. These codes have been proven to provide a long trouble-free service life for the products shown, regardless of the manufacturer.

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 start-up 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:
The feedback/solenoid assembly installed in this valve should not be disassembled.