Proportional Pressure Relief Valves
Technical Catalog

KBCG-3-1*
This product has been designed and tested to meet specific standards outlined in the European Electromagnetic Compatibility Directive (EMC) 89/336/EEC, amended by 91/263/EEC, 92/31/EEC and 93/68/EEC, article 5. For instructions on installation requirements to achieve effective protection levels, see this leaflet and the Installation Wiring Practices for Vickers™ Electronic Products leaflet 2488. Wiring practices relevant to this Directive are indicated by ⚠ Electromagnetic Compatibility (EMC).
General Description

An electro-hydraulic proportional relief valve designed to regulate pressure in a hydraulic system in proportion to an applied electrical input.

These open-loop, single-stage valves can be used for direct control of pressure in low flow systems, or for pilot control of larger pressure controls, and for such applications as pressure-controlled pumps.

The integral amplifier allows the pressure to be controlled from a low power command signal: either a voltage or current command. The amplifier is mounted in a robust metal housing and electrical connections are via an industry standard 7-pin plug. Factory-set adjustments ensure high reproducibility valve-to-valve.

Other Models
For proportional pressure relief valves with flow ratings up to 400 L/min (106 USgpm), see catalog V-VLPO-MC003-E (model types KBCG, sizes 6 and 8).

Features and Benefits
• Valve design ensures low hysteresis and good repeatability.
• Self-bleeding design simplifies installation and ensures consistent performance.
• When used for piloting a large pressure relief or reducing valve, a low minimum pressure is obtainable, combined with fast and stable response to step input signals.
• On-board ramp adjustment

Functional Symbol

Typical Section
### Model Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB</td>
<td>Proportional valve with integral amplifier, B series</td>
</tr>
<tr>
<td>C</td>
<td>Pressure relief</td>
</tr>
<tr>
<td>G</td>
<td>Subplate mounted</td>
</tr>
<tr>
<td>3</td>
<td>ISO 4401, size 3 (NFPA D03)</td>
</tr>
<tr>
<td>Blank</td>
<td>Right hand (standard)</td>
</tr>
<tr>
<td>L</td>
<td>Left hand</td>
</tr>
</tbody>
</table>

### Valve Type

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

### Type

- **C**: Pressure relief

### Mounting

- **G**: Subplate mounted

### Interface

- **3**: ISO 4401, size 3 (NFPA D03)

### Build Orientation

- **Blank**: Right hand (standard)
- **L**: Left hand

### Controlled Pressure Range

At rated flow of 1 L/min (0.26 USgpm)

- 40 - 2-40 bar (29-580 psi)
- 100 - 3-100 bar (44-1450 psi)
- 160 - 4-160 bar (58-2300 psi)
- 250 - 5-250 bar (73-3625 psi)
- 350 - 6-350 bar (87-5000 psi)

### Standard Features

- DZM- for KBCG3

### Electrical Command Options

1. +/- 10 volts control signal
2. 4-20 mA control signal

### Ramp Options

1. No ramp
2. Standard ramp (typically 65 ms)
3. Long ramp (typically 80 ms)

### Command/Pressure Characteristic

- **A**: Standard

### 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

### Coil Rating

- **H1**: 24V DC amplifier supply

### Design Number, 1st Series

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

### Warning

To conform to the EC Electromagnetic Compatibility directive (EMC) this KBCG valve must be fitted with a metal 7-pin plug. The screen of the cable must be securely connected to the shell of the metal connector. A suitable IP67 rated connector is available from Eaton, part no. 934939. Alternatively a non IP67 rated connector is available from ITT-Cannon, part no.CA 02 COM-E 14S A7 P.
Standard test conditions are with antiwear hydraulic oil at 36 cSt (168 SUS) and 40˚C (104˚F).

### Maximum Pressures:

<table>
<thead>
<tr>
<th>Port</th>
<th>Operating</th>
<th>Static</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>See [B] in “Model Code”</td>
<td>350 bar (5075 psi)</td>
</tr>
</tbody>
</table>

Port T:

- Operating: 2 bar (29 psi). See “Back pressure at port T” under “Installation and start-up” below.
- Static: 210 bar (3000 psi)

### Flow Limits:

<table>
<thead>
<tr>
<th>Flow</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated flow</td>
<td>1 L/min (0.26 USgpm)</td>
</tr>
<tr>
<td>Maximum flow</td>
<td>5 L/min (1.3 USgpm)</td>
</tr>
</tbody>
</table>

### Coil or Amplifier Rating

- 24V x 40W max. (22 to 36V including 10% pk.-to-pk. max. ripple)

### Command Signal:

- Volts (see model code [B] - 1): 0 to +10V or 0 to -10V
- Input impedance: 47 kΩ
- Common mode voltage to pin B: 4V
- Current (see model code [B] - 2): 4 to 20 mA
- Input impedance: 100Ω

### Valve Enable Signal:

- Enable: >9.0V (36V max)
- Disable: <2.0V
- Input impedance: 36 kΩ

### 7-pin Plug Connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Power supply positive (+)</td>
</tr>
<tr>
<td>B</td>
<td>Power supply 0V and current command return</td>
</tr>
<tr>
<td>C</td>
<td>Valve enable (PH7 &amp; PR7)</td>
</tr>
<tr>
<td>D</td>
<td>Command signal (+V or current in)</td>
</tr>
<tr>
<td>E</td>
<td>Command signal (-V or current GND)</td>
</tr>
<tr>
<td>F</td>
<td>Output monitor</td>
</tr>
<tr>
<td>G</td>
<td>Protective ground</td>
</tr>
</tbody>
</table>

### Electromagnetic Compatibility (EMC):

- Emission (10 V/m): EN 50081-2
- Immunity (10 V/m): EN 50082-2
- Monitor signal (pin F): 1.7 V/amp solenoid current
- Output impedance: 10 kΩ

### Pressure Gain

- See graph

### Factory Setting - Maximum with 100% command signal.

### Pressure Override

- Typical times to reach 90% of commanded step:
  Model code [9]:
  - 0 to 100% step: 60 ms, 65 ms, 87 ms
  - 100 to 0% step: 48 ms, 55 ms, 73 ms

### Linearity, between 10% and 100% of controlled pressure range

- <4%

### Hysteresis

- <5% (with factory-set dither)

### Repeatability

- <±1.0% of rated pressure

### Reproducibility, valve-to-valve (at factory settings):

### Pressure at 100% command signal

- ≤5%
Protection:

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical</td>
<td>Reverse polarity protected</td>
</tr>
<tr>
<td>Environmental</td>
<td>IEC 529, Class IP67</td>
</tr>
<tr>
<td>Mass</td>
<td>2.2 kg (4.85 lb)</td>
</tr>
</tbody>
</table>

Supporting products:

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHA-CON-201-A-2* Signal converter</td>
<td>See catalog 2410B</td>
</tr>
<tr>
<td>EHD-DSG-201-A-1* Command signal generator</td>
<td>See catalog 2470</td>
</tr>
<tr>
<td>EHA-RMP-201-A-2* Ramp generator</td>
<td>See catalog 2410B</td>
</tr>
<tr>
<td>EHA-PID-201-A-2* PID controller</td>
<td>See catalog 2427</td>
</tr>
<tr>
<td>EHA-PSU-201-A-10 Power supply</td>
<td>See catalog 2410B</td>
</tr>
</tbody>
</table>

Installation and start-up:

- Port T should be piped directly to reservoir with minimum restriction. Any back pressure at this port is additive to the controlled pressure at port P. The recommended max. pressure at port T when the valve is controlling pressure is 2 bar (29 psi); the max. pressure at T under static conditions is 210 bar (3000 psi).
Performance Data

**Pressure Gain, Typical**

Typical pressure v. command signal response of KBCG-3-250 models

Test conditions:
Fluid = Antiwear hydraulic oil at 36 cSt (168 SUS)

![Pressure Gain Diagram](image)

**Pressure Override, Typical**

Test conditions:
Fluid = Antiwear hydraulic oil at 36 cSt (168 SUS)

![Pressure Override Diagram](image)
To bleed air, loosen plug in end of core tube; re-tighten to 2.4 +/- 0.2 Nm (1.85 +/- 0.15 lbf ft) after bleeding is complete.
Electrical Information

Block Diagram

7-pin plug connections

- +24V
  - Power 0V

Enable ▲

Command signal

Non-inverting

Inverting

Current monitor

Protective ground G

PWM modulator

Ramp

Gain

Solenoid drive

▲ In valves with PH7 or PR7 type electrical connection.

Wiring
Connections must be made via the 7-pin plug mounted on the amplifier. See this leaflet and Installation Wiring Practices for Vickers™ Electronic Products leaflet 2468. 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 should have at least 6 cores with pairs of conductors individually screened and an overall screen.
- Cable outside diameter 8,0-10,5 mm (0.31-0.41 inches).
- See connection diagrams on next page.

**Warning**
All power must be switched off before connecting or disconnecting any plugs.
Typical Connection Arrangements

Wiring Connections

![Diagram of wiring connections for a valve](image)

- Pin C may be connected to ground or left unconnected.
- Output monitor voltage (pin F) will be referenced to the power 0 volts (pin B).

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.

Wiring Connections for Valves with “Enable” Feature

![Diagram of wiring connections for a valve with enable feature](image)

▲ 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.
Further Information

Hydraulic Fluids
Materials and seals used in these valves are compatible with:
- Anti-wear petroleum oils...LHM
- Non-alkyl based phosphate esters..............LHFD
The extreme operating range is 500 to 13 cSt (270 to 70 SUS) but the recommended running range is 54 to 13 cSt (245 to 70 SUS). For further technical information about fluids see 694.

Contamination Control Requirements
Recommendations on contamination control methods and the selection of products to control fluid condition are included in publication 9132 or 561, "Guide to Systemic Contamination Control". The book also includes information on the 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:
- Up to 210 bar (3000 psi)..........................18/16/13
- Above 210 bar (3000 psi)......................17/15/12

Installation and Start-up Guidelines
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. If this proves to be the case any accumulated air can be bled from the solenoid bleed screw. This task is easier if the valve has been mounted base downwards. Good installation practice dictates that the tank port, and any drain port, are piped so as to keep the valve full of fluid once the system start-up has been completed.

Temperatures
For petroleum oil:
- Min.................................-20°C (-4°F)
- Max.................................+70°C (158°F)

For fluids where limits are outside those of petroleum oil, consult fluid manufacturer or Eaton representative. Whatever the actual temperature range, ensure that viscosities stay within those specified under "Hydraulic Fluids".

Ambient for:
- Valves at full performance specification: -20 to +70°C (-4 to +158°F).
- Valves, as above, will operate at temperatures of 0 to -20°C (32 to -4°F) but with a reduced dynamic response.
- Storage: -25 to +85°C (-13 to +185°F)

Seal Kit
02-352521