Proportional Directional Valves with Feedback
Content

INTRODUCTION

Typical section view ................................................................. 03
Model code ................................................................. 04
Spool data ................................................................. 05
Functional symbols ................................................................. 05

OPERATING DATA

Valves with amplifier, KBFD/TG4V-3 ................................................... 06
Valves without amplifier, KFD/TG4V-3 ................................................... 07
KBFD/TG4V-3 & KFD/TG4V-3 ................................................... 07
Pressure and flow rates ................................................................. 07

PERFORMANCE CURVES

Power capacity envelopes, single solenoid models ................................................... 08
Power capacity envelopes, double solenoid models ................................................... 08
Flow gain curves ................................................................. 09
Frequency response ................................................................. 09

INSTALLATION DIMENSIONS

KFDG4V-3 ................................................................. 10
KFTG4V-3 ................................................................. 10
KBFDG4V-3 ................................................................. 11
KBFTG4V-3 ................................................................. 11

SUBPLATES AND MOUNTING SURFACES

Mounting surface interface to ISO 4401 (size 03) ................................................... 12

ELECTRICAL INFORMATION

Block diagram voltage input (M1) ................................................... 13
Block diagram current input (M2) ................................................... 14
Wiring connection voltage input (M1) ................................................... 15
Wiring connections current input (M2) ................................................... 16

APPLICATION DATA

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to meet specific standards outlined in the European Electromagnetic Compatibility Directive (EMC) 2014/30/EU which repealed Directive 89/336/EEC, amended by Directives 91/263/EEC, 92/31/EEC, 93/68/EEC and 93/97/EEC. For instructions on installation requirements to achieve effective protection levels, see the leaflet and Installation Wiring Practices for Eaton’s Electronic Products leaflet 2468. Wiring practices relevant to this Directive are indicated by the Electromagnetic Compatibility (EMC).
Eaton® K(B)FD/ TG4V proportional valves are designed to provide a controlled oil flow in direct proportion to a command signal. They are available in two types: a double solenoid version that will provide reversible flow to an actuator and a single solenoid throttle version that provides a single direction of flow. Hydrostats are available for load compensation and parallel flow path modules are available that will boost the flow capacity of single solenoid throttle versions to nearly twice that of the standard valve. Additionally, both of these valve types can be supplied with or without an integral amplifier built directly onto the valve.

**KFD/TG4V-3**

This version is supplied without the integral amplifier.

**Features and benefits**
- Wide range of spool and flow rate options
- Electronic feedback LVDT ensures accurate spool position control
- Vibration and shock tested
- Supported by a broad range of amplifiers and auxiliary function modules Full CE electromagnetic compatibility

**KBFD/TG4V-3 A**

Range of proportional directional and throttle valves with integral control electronics. Factory-set adjustments of gain, spool deadband compensation and offset ensure consistent repeatability valve-to-valve.

The only electrical inputs required are power supply (24V) and a voltage command signal of ± 10V or 4-20 mA. The amplifier is housed in a robust metal enclosure, sealed against ingress of water and other fluids. Electrical connections are via a standard 7-pin plug.

A spool position monitor pin allows the function of the valve to be electrically monitored. Ramp functions, if required, can be generated externally.

**Features and benefits**
- Factory-sealed adjustments ensure valve to valve reproducibility
- Installation wiring reduced and simplified
- Standard 7-pin connector
- Standard 24V DC supply with wide tolerance band
- Optional ± 10V DC or 4-20 mA command signals
- Valve with integrated amplifier selected, ordered, delivered and installed as one performance-tested package
- Spool position monitor pin to help with troubleshooting
- Simple valve removal and replacement for service (plug and play)
- Vibration and shock tested
- Auxiliary DIN rail mounted electronic function modules available
- Full CE electromagnetic compatibility: 2014/30/EU
- IP65 and IP67 valve environmental protection rating
- Optional valve enable function
### Model codes

<p>| | | | | | | | | | | | | | | | |</p>
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</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>(B)</td>
<td>F</td>
<td>*</td>
<td>G</td>
<td>4</td>
<td>V</td>
<td>-3-</td>
<td>**</td>
<td>*</td>
<td>**</td>
<td>**</td>
<td></td>
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<td></td>
<td>**</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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</tr>
</tbody>
</table>

#### Valve type

- **K**: Proportional valve

#### Integral amplifier

- **B**: Integral amplifier “B” series. Omit for models without integral amplifier

#### Feedback arrangement

- **F**: Spool position

#### Control type

- **D**: Directional valve
- **T**: Throttle valve

#### Mounting

- **G**: Subplate mounted

#### Operation

- **4**: Solenoid operation

#### Pressure rating

- **V**: 350 bar (5000 psi) on ports P, A & B

#### Interface

- **3**: 9 C - All ports closed at center, KBD

### Flow rating ("B" port flow for asymmetric spools) K(B)FDG valves only

- 10 L/min (2.64 USgpm) (20N10 only)
- Omit for symmetrical spools

#### Manual overrides

- **Z**: No manual overrides

#### Solenoids energization identity

- **V**: Solenoid “A” is at port “A” end and Solenoid “B” is at port “B” end independent of spool type
- Blank US ANSI B93.9 standard (energize solenoid “A”, flow symbol is (P→A)

#### Command input

- **M**: Electrical feature flag (KF only)
  - **M1**: +/-10V command and +/-10V feedback
  - **M2**: 4-20mA command and +/-10V feedback
  - **M3**: +/-10V command and 4-20mA feedback
  - **M4**: 4-20mA command and 4-20mA feedback

#### Solenoid connector

- Omit for valves with integral amplifier KBF
- **U1**: ISO 4400/DIN 43650, non-integral amplifier type KF only (mating plug supplied)

#### Electrical connection (KBF valves only)

- **PE7**: 7-pin electrical plug with mating half
- **PH7**: As PE7 but with pin “C” used for enable signal

#### Coil rating

- **H**: 24 VDC amplifier supply

#### Port T pressure limit code

- **6**: For 2C**S spools
- **7**: For all other spools

#### Design number 1* & 2* series

- Subject to change

#### EN090

- Resin filled, 20G

#### EN119

- Polyurethane interface seals

**Note:** Additional configurations available upon request. Please contact your customer sales representative for details.

**All dimensions are in inches.**

**WARNING**

Valves with integral amplifier are supplied with or without the metal 7-pin plug. The Eaton 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 a proper seal
**Spool symbols**

**Available spools for K(B)FDG4V-3**

Spool type 2C**N, meter-in/meter-out

Spool type 5C**N, meter-in/meter-out (zero lap)

Spool type 2C28S, meter-out only

Spool 33C**N, meter-in/meter-out

Spool type 31C**N, meter-in/meter-out

**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).

**Available spools for K(B)FTG4V-3**

Spool type 2B**N, meter-in/meter-out

**Functional symbols**

**Model types KBFDG4V-3**

Proportional directional valve (with integrated electronics)

**Model types KBFTG4V-3**

Proportional throttle valve (with integrated electronics)

**Spool type and flow rating**

**Symmetric spools**

Base line starting at $\Delta p = 5$ bar (75 psi) per metering flow pat, e.g. B to T. For actual maximum flow refer to power capacity envelope curves.

**For K(B)FDG4V-3 valves**

<table>
<thead>
<tr>
<th>Spool code</th>
<th>Spool symbol</th>
<th>Flow rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>2C03F</td>
<td>2C</td>
<td>3 L/min (0.79 USgpm)</td>
</tr>
<tr>
<td>2C07N</td>
<td>2C</td>
<td>7 L/min (1.85 USgpm)</td>
</tr>
<tr>
<td>2C13N</td>
<td>2C</td>
<td>13 L/min (3.43 USgpm)</td>
</tr>
<tr>
<td>2C20N</td>
<td>2C</td>
<td>20 L/min (5.28 USgpm)</td>
</tr>
<tr>
<td>2C30N</td>
<td>2C</td>
<td>30 L/min (7.92 USgpm)</td>
</tr>
<tr>
<td>2C28S</td>
<td>2C</td>
<td>28 L/min (7.40 USgpm)</td>
</tr>
<tr>
<td>33C03F</td>
<td>33C</td>
<td>3 L/min (0.79 USgpm)</td>
</tr>
<tr>
<td>33C07N</td>
<td>33C</td>
<td>7 L/min (1.85 USgpm)</td>
</tr>
<tr>
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</tr>
<tr>
<td>33C20N</td>
<td>33C</td>
<td>20 L/min (5.28 USgpm)</td>
</tr>
<tr>
<td>33C27N</td>
<td>33C</td>
<td>27 L/min (7.13 USgpm)</td>
</tr>
<tr>
<td>5C20N</td>
<td>5C</td>
<td>20 L/min (5.28 USgpm)</td>
</tr>
<tr>
<td>5C30N</td>
<td>5C</td>
<td>30 L/min (7.92 USgpm)</td>
</tr>
</tbody>
</table>

**For K(B)FTG4V-3 valves**

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<tr>
<th>Spool code</th>
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<th>Flow rating</th>
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<tr>
<td>2B03F</td>
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<td>03 L/min (0.79 USgpm)</td>
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<tr>
<td>2B07N</td>
<td>2B</td>
<td>07 L/min (1.85 USgpm)</td>
</tr>
<tr>
<td>2B13N</td>
<td>2B</td>
<td>13 L/min (3.43 USgpm)</td>
</tr>
<tr>
<td>2B20N</td>
<td>2B</td>
<td>20 L/min (5.28 USgpm)</td>
</tr>
<tr>
<td>2B27N</td>
<td>2B</td>
<td>27 L/min (7.13 USgpm)</td>
</tr>
<tr>
<td>2B30N</td>
<td>2B</td>
<td>30 L/min (7.92 USgpm)</td>
</tr>
</tbody>
</table>

**For K(B)FDG4V-3 valves**

<table>
<thead>
<tr>
<th>Spool code</th>
<th>Spool symbol</th>
<th>Flow rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>2C20N10</td>
<td>2C</td>
<td>20 L/min (5.28 USgpm), &quot;A&quot; port flow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 L/min (2.64 USgpm), &quot;B&quot; port flow</td>
</tr>
<tr>
<td>33C20N10</td>
<td>33C</td>
<td>20 L/min (5.28 USgpm), &quot;A&quot; port flow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 L/min (2.64 USgpm), &quot;B&quot; port flow</td>
</tr>
<tr>
<td>33C08N04</td>
<td>33C</td>
<td>08 L/min (2.11 USgpm), &quot;A&quot; port flow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>04 L/min (1.06 USgpm), &quot;B&quot; port flow</td>
</tr>
</tbody>
</table>

**Model types KFDG4V-3**

Proportional directional valve (requires amplifier card)

**Model types KFTG4V-3**

Proportional throttle valve (requires amplifier card)
K(B)FD/TG4V-3 valves with amplifier

KBFD/TG4V-3 valves with integral amplifier

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

<table>
<thead>
<tr>
<th>Power supply</th>
<th>24V DC (18 V to 36V including 10% peak-to-peak max. ripple) max current 3A</th>
</tr>
</thead>
</table>

Command Signal

Voltage mode M1
- Input impedance: 47K Ωm
- Common mode voltage to pin B: 18V (max)
- Current mode M2: 4-20 mA
- Input impedance: 100 Ω
- Max differential voltage to pin E to pin D: 10V

Enable signal for model codes PH7
- Enable >8.5V (36V max)
- Disable <6.5V
- Input impedance: 10K Ωm

7-pin plug connector
- Pin Description:
  - A: Power supply positive (+)
  - B: Power Supply 0V
  - C: Not connected (PE7)
  - D: Command signal (+V or current IN)
  - E: Command signal (–V or current GND)
  - F: Output monitor
  - G: Protective ground

Electromagnetic compatibility (EMC)

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, Class A 150 KHz to 80 MHz
  - DC Power Port : ±1kV
  - Signal/Control Port : ±1kV

RF Electromagnetic Field, 80 MHz to 2700 MHz, 10V/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 : ±2kV
  - Signal/Control Port : ±1kV

Electrostatic discharges (ESD) IEC 61000-4-2, Class B
  - Air ±8kV,
  - Contact ±4kV

Threshold command voltage (minimum voltage for minimum flow): 0.25V

Monitor signal (pin F)
- KBFD valves: ± 10V DC for full spool stroke
- KBFT valves: 0 to -10 V DC for full spool stroke
- Voltage mode: +/- 10V DC for full stroke
- Output impedance: 10KΩm
- Current mode: 4mA to 20mA
- Output impedance: Upto 200 Ωm
- Power stage PWM frequency: 10 kHz nominal
- Electronic amplifier is compliant to 2011/65/EU ROHS2

Step input response with flow through P–A–B–T Δ p=5 bar (75 psi) per metering path, e.g. P–A

Required flow step:
- Time to reach 90% of required step:
  - 0 – 100%: 17 ms
  - 100% – 0: 16 ms
  - +90 – -90% (KBFDG4V-3 only): 25 ms

Reproducibility, valve-to-valve (at factory settings):
- Flow at 100% command signal: ± 5%
KFD/TG4V-3 valves without amplifier

KFD/TG4V-3 Valves without Integral amplifier (requires a Eurocard Amplifier, refer to supporting products)

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

| Protection | Electrical | Reverse polarity protected  |
| Environmental | IEC 60529, Class IP65 and IP67  |

| ROHS compliance | Electronic amplifier is compliant to 2011/65/EU ROHS2  |

| Ambient air temperature range for full performance | -40°C to +85°C (-40°F to 185°F)  |
| Oil temperature range for full performance | 0°C to 70°C (32°F to 158°F)  |
| Minimum temperature at which valves will work at reduced performance | -40°C (-40°F)  |
| Storage temperature range | -40°C to +85°C (-40°F to 185°F)  |

| Supporting products auxiliary electronic modules (DIN -rail mounting): |
|-------------------------------|-------------------------------|
| EHD-DSG-201-A-1* command signal generator | See catalog GB 2470  |
| EHA-RMP-201-A-2* Ramp generator | See catalog GB 2410A  |
| EHA-PID-201-A-2* PID controller | See catalog GB 2427  |
| EHA-PSU-201-A-10 Power supply | See catalog GB 2410A  |

KFD/TG4V-3 and KBFD/4V-3 valves (all valves)

| Relative duty factor | Continuous rating (ED = 100%)  |
| Hysteresis with flow through P–A–B–T | <1% of max stroke (center-to-offset)  |

| Mass: |
|-----------------|-----------------|
| KFDG4V-3 | 2.7 kg (5.9 lb) approx.  |
| KBFDG4V-3 | 3.1 kg (6.8 lb) approx.  |
| KFTG4V-3 | 2.1 kg (4.6 lb) approx.  |
| KBFTG4V-3 | 2.5 kg (5.5 lb) approx.  |

Pressure and flow rates

Maximum pressures, bar (psi)

<table>
<thead>
<tr>
<th>Model</th>
<th>Port L condition</th>
<th>Ports P, A, B</th>
<th>T</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>All models for normal usage (L port not connected) 105 (1500)</td>
<td>Normally blocked by mounting surface</td>
<td>315 (4500)</td>
<td>160 (2300)</td>
<td>160 (2300)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>350 (5000)</td>
<td>105 (1500)</td>
</tr>
<tr>
<td>For KB/FDGDG4V-3<strong>C</strong>N/F-Z models only a higher <strong>T</strong> port pressure is allowed if the <strong>L</strong> port is connected directly to tank.</td>
<td>Drained directly to tank</td>
<td>350 (5000)</td>
<td>210 (3000)</td>
<td>10 (150)</td>
</tr>
</tbody>
</table>

| Supporting products auxiliary electronic modules (DIN -rail mounting): |
|-------------------------------|-------------------------------|
| EHA-PID-201-A-2* PID controller | See catalog GB 2427  |
| EHA-PSU-201-A-10 Power supply | See catalog GB 2410A  |
Performance curves

Power capacity envelopes

Single solenoid models:

K(B)FTG4V-3
Spool types as noted

Double solenoid models:

K(B)FDG4V-3
Spool types as noted
When using the single solenoid throttle valves version (K*FT) a parallel flowpath module can be used to approximately double the flow rate.

**K(B)FD/TG4V-3**

Spool types as noted

KBF valves are preset at the factory to compensate for the effect of spool overlap. Curves shown include deadband compensation provided for the KF valve by Eaton’s Eaton Eurocard Amplifier EEA-PAM-533-*-32 (user adjustable).

**Performance curves**

**Flow gain curves**

Single flowpath (e.g. P–A) pressure drop, \( \Delta p = 5 \text{ bar (72 psi)} \). At other \( \Delta p \) values and within the power capacity envelopes, flow rates approximate to:

**Frequency response (typical)**

For an amplitude of \( \pm 25\% \) max. flow about the 50\% flow, at \( \Delta p \) (P–B) = 5 bar (72 psi)
Installation dimensions

**KFDTG4V-3 / KFTG4V-3**

Spool types as noted

Solenoid plug (ISO 4400/DIN 43650); gray, marked A, for V models, or black, marked B, for non-V models; see [15] in “Model Code”

Solenoid plug (ISO 4400/DIN 43650); black, marked B, for V models, or gray, marked A, for non-V models; see [15] in “Model Code”

---

**KFDTG4V-3**

mm (inch)

![Diagram of KFDG4V-3]

- 40.00 (1.89)
- 13.75 (0.54)
- 68.00 (2.68)
- 21.00 (0.83)
- 8700 (3.43)
- 155.00 (6.10)
- 270.00 (10.63)

**KFTG4V-3**

mm (inch)

![Diagram of KFTG4V-3]

- 13.75 (0.54)
- 155.00 (6.10)
- 225.00 (8.86)
- 68.00 (2.68)
- 21.00 (0.83)
- 8700 (3.43)

---

▲ Mounting surface seals supplied

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

- The valve may be pressurized by removing the bleed screws until no bubbles appear and then reinstalling 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 22 - 45 psi (1.5 - 3 bar).
**WARNING**

Valves with integral amplifiers are supplied with or without the metal 7-pin plug. The Eaton 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 2.0-2.5 Nm (1.5-2.0 lbf ft) to effect a proper seal.
Subplates and mounting surfaces

Mounting surface to ISO 4401 (Size 03)

This interface conforms to: ISO 4401-03-02-0-05

- 4 holes, M5-6H x 12 (0.47)
- min. full thread depth
- 4 ports Ø 6.3 (0.25 dia).
  For all Eaton size 03 valves
  this diameter may be increased
  to Ø 7.5 (0.29)
- Ø 4.0 x 4.3 min. depth (0.16 dia x 0.17)
  for locating pin

#10-24 UNC-2B optional

Interface with additional drain port

ANSI/B93.7M (and NFPA) size 03 CETOP R3SH4.2-4-03, plus
location pin hole.

Typically used for proportional and other valves requiring an
additional drain port.
Electrical information

Block diagram
Voltage input
(M1) KBFDG 4V-3

KBFDG4V-3 wiring
Wiring Connections must be made via the 7-pin plug mounted on the amplifier. See page 15 of this leaflet and Eaton's Installation Wiring Practices for Eaton 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 would have seven 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 page 15.

KFDG4V-3 wiring
Wiring details for these valves are contained in the appropriate Eurocard literature and Eaton's Installation Wiring Practices for Eaton Electronic Products leaflet 2468.

Command signals and outputs, M1

<table>
<thead>
<tr>
<th>7-pin plug</th>
<th>Flow direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin D</td>
<td>Pin E</td>
</tr>
<tr>
<td>Positive</td>
<td>OV</td>
</tr>
<tr>
<td>OV</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>P to A</td>
</tr>
<tr>
<td></td>
<td>$U_2 - U_1 = $</td>
</tr>
<tr>
<td>Negative</td>
<td>OV</td>
</tr>
<tr>
<td>OV</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>P to B</td>
</tr>
<tr>
<td></td>
<td>$U_2 - U_1 = $</td>
</tr>
</tbody>
</table>

$ \triangle $ Pin C is used for a valve enable signal with electrical connections PH7

WARNING
All power must be switched off before connecting or disconnecting any plugs.
Block diagram
Current input (M2)
KFSDG4V-3

KBSDG4V-3 wiring
Connections must be made via the 7-pin plug mounted on the amplifier. See page 15 of this leaflet and Eaton’s Installation Wiring Practices for Eaton Electronic Products, leaflet 2468.

Recommended cable sizes are:

**Power cables:**
For 24V supply 0.75 mm² (18 AWG) up to 20 m (65 ft) 1.00 mm² (16 AWG) up to 40 m (130 ft)

**Signal cables:**
0.50 mm² (20 AWG)

**Screen (shield):**
A suitable cable would have seven 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 page 16.

**WARNING**
All power must be switched off before connecting/disconnecting any plugs.

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**KFDG4V-3 wiring**
Wiring details for these valves are contained in the appropriate Eurocard literature and Eaton’s Installation Wiring Practices for Eaton Electronic Products leaflet 2468.

**Command signals and outputs, M2**

<table>
<thead>
<tr>
<th>7-pin plug</th>
<th>Pin D</th>
<th>Pin E</th>
<th>Pin B</th>
<th>Flow direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>More than 12 mA</td>
<td>Current return</td>
<td>Power ground</td>
<td>P to A</td>
</tr>
<tr>
<td></td>
<td>Less than 12 mA</td>
<td>Current return</td>
<td>Power ground</td>
<td>P to B</td>
</tr>
</tbody>
</table>

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**Electrical information**

**Offset**

**Modulator**

**Valve envelope**

**7-pin plug connections**

- +24V A
- Power 0V B
- ▲ Enable or C not connected
- Monitor Output F
- Command +4 to 20 mA D
- Return E
- Protective ground G

- ▲ Pin C is used for a valve enable signal with electrical connections PH7.
- R1 Shunt resistor 100R
- F1, F2 Resettable fuse

**Compensation network**

**LVDT**

**Gain**

**Offset**

**Solenoid drive**

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**WARNING**
All power must be switched off before connecting/disconnecting any plugs.
Electrical information

Wiring connections
Voltage input (M1)

- 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.
Wiring connections
Current input (M2)

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

Wiring connections for M2 valves with enable feature

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.
Application data

**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 Eaton’s publication 9132 or 561, “Eaton Guide to Systemic Contamination Control”. The book also includes information on the Eaton’s 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:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Level 2</th>
<th>Level 5</th>
<th>Level 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 70 bar (1000 psi)</td>
<td>18/16/13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70 + bar (1000 + psi)</td>
<td>17/15/12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Eaton 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.

**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 Eaton 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.