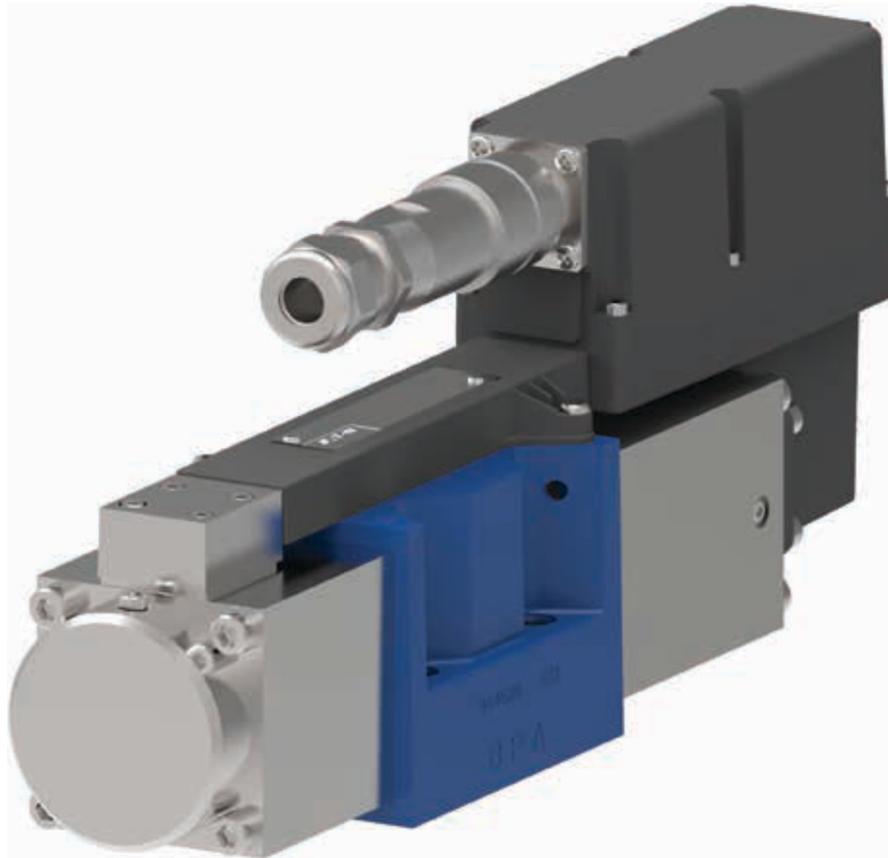


# Proportional Directional Valves with Feedback

K(B)FD/TG4V-5, 12 Series  
Pressures to 315 bar (4500 psi)



ENGINEERING  
TOMORROW

BC444061850959en-000101

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## 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to meet specific standards outlined in the European Electromagnetic Compatibility Directive (EMC) 2014/30/EU which repealed Directive 89/336/EEC, amended by Directives 91/263/EEC, 92/31/EEC, 93/68/EEC and 93/97/EEC.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 Danfoss' Electronic Products leaflet 2468. Wiring practices relevant to this Directive are indicated by  $\Delta$  Electromagnetic Compatibility (EMC).

Vickers® by Danfoss 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.

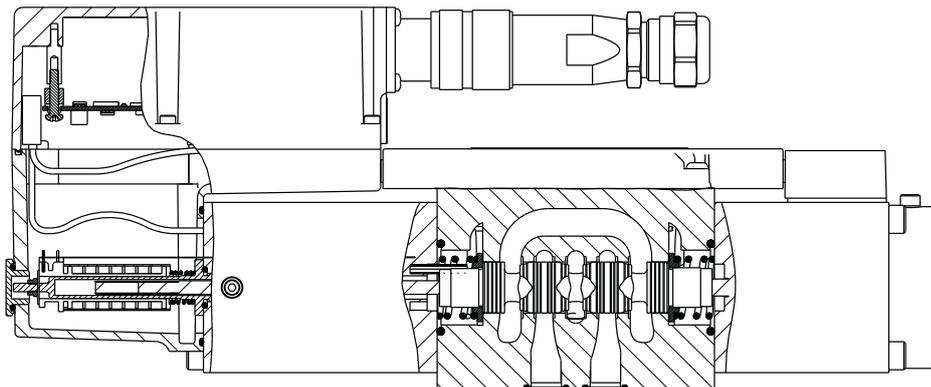
## KFD/TG4V-5

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.

### Typical section view



KBFD/TG4V-5-\*PE7, 1\* Design

## KBFD/TG4V-5

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  $\pm 10V$  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  $\pm 10V$  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 & play).
- Vibration and shock tested.
- Auxiliary DIN rail mounted electronic function modules available. Full CE electromagnetic compatibility.
- Full CE electromagnetic compatibility.- 2014/30/EU
- IP65 & IP67 valve environmental protection rating.
- Optional valve enable function.

# Model codes

K	(B)	F	*	G	4	V	-5-	**	*	**	*	**	-Z-	(V)	-(M)-	(U1)	(***)	-H-	*	12	EN***
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

**1 Valve type**  
**K** Proportional valve

**2 Integral amplifier**  
**B** Integral amplifier "B" series . Omit for models without integral amplifier

**3 Feedback arrangement**  
**F** Spool position

**4 Control type**  
**D** Directional valve  
**T** Throttle valve

**5 Mounting**  
**G** Subplate mounted

**6 Operation**  
**4** Solenoid operation

**7 Pressure rating**  
**V** 315 bar (4500 psi) on ports P, A & B

**8 Interface**  
**5** ISO 4401, size 05-04-0-05 ANSI/ B93 .7M-D05 .ISO 4401, size 05-06-0-05 (with L ports)

**9 10 2C - All ports closed at center, KBD**

**11 12 2C30N** 30 L/min symmetric, meter in/ meter out  
**2C50N** 50 L/min symmetric, meter in/ meter out  
**2C65S** 65 L/min meter out only  
**2C70N** 70 L/min symmetric, meter in/ meter out  
**2C50N25** 50 L/min /25 L/min , meter in/ meter out  
**2C75N45** 75 L/min /45 L/min , meter in/ meter out

**33C - P closed at center, A,B,T connected, KBD**

**33C30N** 30L/min symmetric, meter in/ meter out  
**33C50N** 50 L/min symmetric, meter in/ meter out  
**33C70N** 70 L/min symmetric, meter in/ meter out  
**33C50N25** 50 L/min /25 L/min , meter in/ meter out

**9C - zero lap**

**9C50N** 50 L/min symmetric, meter in/ meter out

**2B - single solenoid throttle valves, KBT**

**2B30N** 30 L/min symmetric, meter in/ meter out  
**2B50N** 50 L/min symmetric, meter in/ meter out  
**2B65S** 65 L/min meter out only  
**2B70N** 70 L/min symmetric, meter in/ meter out

**13 Flow rating ("B" port flow for asymmetric spools) K(B)FDG valves only**  
**25** 25 L/min (6.6 USgpm) (50N25 only)  
**45** 45 L/min (11.9 USgpm) (50N25 only)  
 Omit for symmetrical spools

**14 Manual Overrides**  
**Z** No manual overrides

**15 Solenoids energization identity**  
 (Non-integral amplifier types KF only, omit for valves with integral amplifier)  
**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))

**16 Command input**  
 (omit for valves with integral amplifier)  
**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

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

**18 Electrical connection (KBF valves only)**  
**PE7** 7-pin electrical plug with mating half  
**PH7** As PE7 but with pin "C" used for enable signal

**19 Coil rating**  
**H** 24 VDC amplifier supply

**20 Port T pressure limit code**  
**6** For 2C\*\*S spools  
**7** For all other spools

**21 Design number 12 series**  
 Subject to change

**22 EN090** Resin filled,20G  
**EN119** Polyurethane interface seals

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



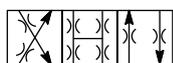
## WARNING

**Valves with integral amplifier are supplied with or without the metal 7-pin plug. The Danfoss 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.**

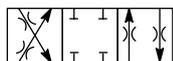
## Spool symbols

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

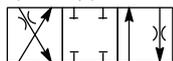
Spool type 9C\*\*N, meter-in/meter-out



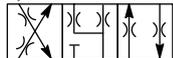
Spool type 2C\*\*N, meter-in/meter-out(zero lap)



Spool type 2C\*\*S, meter-out only



Spool 33C\*\*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-5

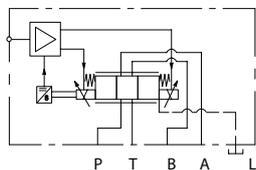
Spool type 2B\*\*N, meter-in/meter-out



## Functional symbols

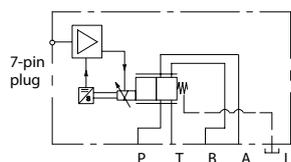
### Model types KBDG4V-5

Proportional directional valve (with integrated electronics)



### Model types KBFTG4V-5

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-5 valves

#### Spool code spool symbol flow rating

Spool code	Spool symbol	Flow rating
2C30N	2C	30 L/min (7.9 USgpm)
2C50N	2C	50 L/min (13.2 USgpm)
2C65S	2C	65 L/min (17.2 USgpm)
2C70N	2C	70 L/min (18.5 USgpm)
9C50N	9C	50 L/min (13.2 USgpm)
33C30N	33C	30 L/min (7.9 USgpm)
33C50N	33C	50 L/min (13.2 USgpm)
33C70N	33C	70 L/min (18.5 USgpm)

### For K(B)FTG4V-5 valves

#### Spool code spool symbol flow rating

Spool code	Spool symbol	Flow rating
2B30N	2B	30 L/min (7.9 USgpm)
2B50N	2B	50 L/min (13.2 USgpm)
2B65S	2B	65 L/min (17.2 USgpm)
2B70N	2B	70 L/min (18.5 USgpm)

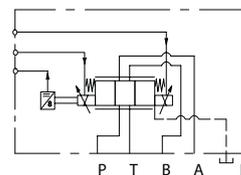
### For K(B)FDG4V-5 valves

#### Spool code spool symbol flow rating

Spool code	Spool symbol	Flow rating
2C50N25	2C	50 L/min (13.2 USgpm), "A" portflow 25 L/min ( 6.6 USgpm), "B" portflow
2C75N45	2C	75 L/min (19.8 USgpm), "A" portflow 45 L/min ( 11.9 USgpm), "B" portflow
33C50N25	33C	50 L/min (13.2 USgpm), "A" portflow 25 L/min ( 6.6 USgpm), "B" portflow

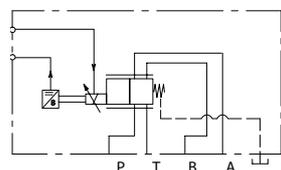
### Model types KFDG4V-5

Proportional directional valve (requires amplifier card)



### Model types KFTG4V-5

Proportional throttle valve (requires amplifier card)



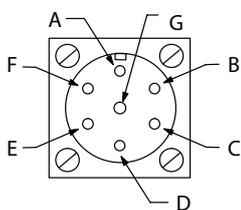
# Operating data

K(B)FD/TG4V-5 valves with amplifier

## KBFD/TG4V-5 valves with integral amplifier

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

Power supply	24V DC (18 V to 36V including 10% peak-to-peak max. ripple) max current 3A
Command signal	
Voltage mode M1	0 to +10V DC, or 0 to -10V DC, or -10V to +10V DC
· Input impedance	47kohms
· Commonmode voltage to pin B	18V (max)
Current mode M2	4-20 mA
· Input impedance	100 Ω
· Max differential voltage to Pin E to Pin B	10V
Valve enable signal for model codes PH7	
Enable	>8.5V (36V max)
Disable	<6.5 V
Input impedance	10 k ohms
7-pin plug connector	Pin Description
	A Power supply positive (+)
	B Power supply 0V
	C Not connected (PE7)
	C Valve enable (PH7)
	D Commandsignal (+V or current IN)
	E Commandsignal (-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: 10Vrms
· Signal/Control Port: 10Vrms
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	10KOhm
Current mode	4mA to 20mA
Output impedance	Upto 200 Ohm
Power stage PWM frequency	10 kHz nominal
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%	30 ms
100% – 0	40 ms
+90 – -90% (KBFDG4V3-3 only)	32 ms
Reproducibility, valve-to-valve (at factory settings):	≤ 5%
Flow at 100% command signal	

Protection	
Electrical	Reverse polarity protected
Environmental	IEC 60529, Class IP65 & 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-PSU-201-A-10 Power supply	See catalog GB 2410A
EHA-PID-201-A-20 PID controller	See catalog GB 2427

### KBFD/TG4V-5 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).

Max current, at 50° C (122° F)	2.7 A
Coil resistance, at 20° C (68° F)	1.87 Ω
Step response	
Step size (% of max spool stroke)	Time to reach 90% of required step:
0 to 100%	31 ms
100% to 0	30 ms
+90 to -90% (KFDG4V-5 only)	45 ms
Type of protection, with electrical plugs fitted correctly	IEC 60529, Class IP65
Electromagnetic compatibility (EMC)	
Emission (10V/m)	EN 50081-2
Immunity (10V/m)	EN 50082-2
Maximum allowable ambient air temperature	60° C (140° F)
Maximum allowable oil temperature	60° C (140° F)
Supporting products:	
Eurocard amplifiers	
EEA PAM 533 A/B/C/D/E/F	See catalog GB-2464

KFD/TG4V-5 and KBFD/TG4V-5 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-5	7.2 kg (15.86 lb) approx.
KBFDG4V-5	7.6 kg (16.76 lb) approx.
KFTG4V-5	5.5 kg (12.10 lb) approx.
KBFTG4V-5	5.9 kg (13.00 lb) approx.
Portable test equipment	
EBA TEQ 460 A 10	See catalog V-ELAC-TM001-E

## Pressure and flow rates

Maximum pressures, bar (psi)

Model	Port L condition	Ports P, A, B	T	T
All models for normal usage (L port not connected)	Normally blocked by mounting surface	315 (4500)	160 (2300)	160 (2300)
For K(B)FDG4V-5**C**N-Z models only a higher "T" port pressure is allowed if the "L" port is connected directly to tank	Drained directly to tank	315 (4500)	210 (3000)	210 (3000)

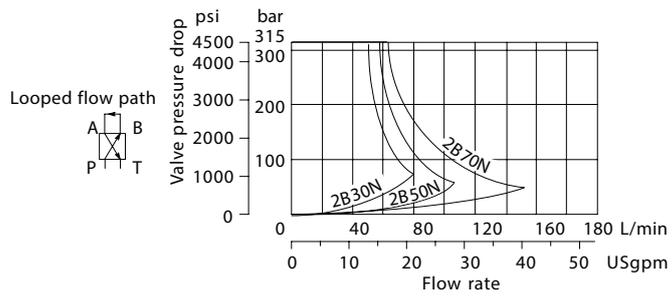
# Performance curves

Power capacity envelopes

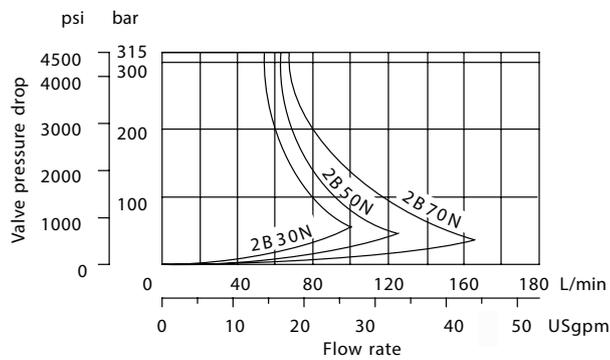
## Single solenoid models: K(B)FTG4V-5

Spool types as noted

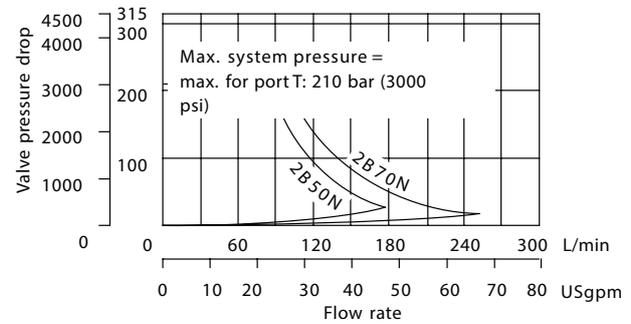
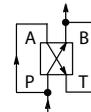
### Looped flow path



### Single flow path

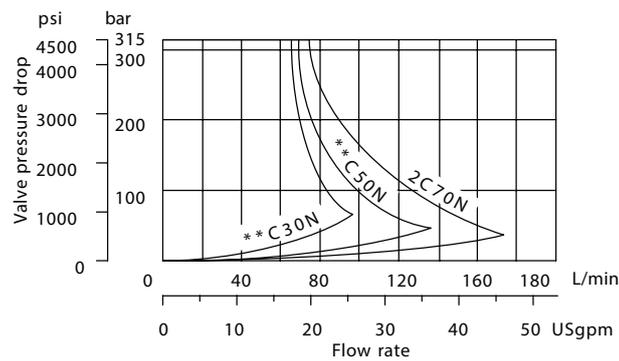
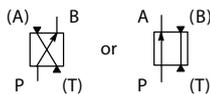


### Parallel flow path use parallel flow path module: KDGMA-5-616877-10R or KDGMA-5-02-139150-10S (see page 16)

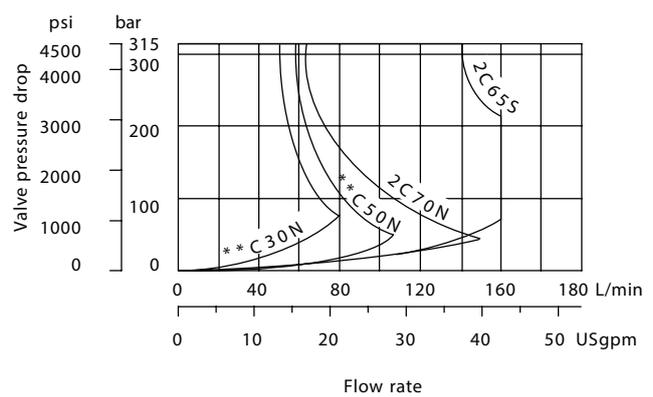
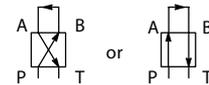


## Double solenoid models: K(B)FDG4V-5

Spool types as noted



### Looped flow path



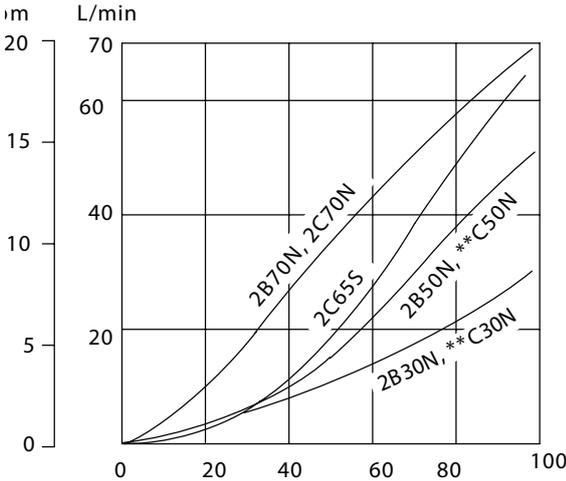
**Flow gain curves**

When using the single solenoid throttle valve (K\*FT), a dual flowpath module (page 16) can be used to approximately double the flow rate.

Curves shown include deadband compensation provided for the KF valve by the Vickers Eurocard Amplifier EEA-PAM-535-\*-32 (user adjustable).

KB valves are preset at the factory to compensate for the effect of spool overlap.

**K(B)FD/TG4V-5**  
Spool types as noted



Single flowpath (e.g. P-A) pressure drop,  $\Delta p = 5 \text{ bar}$  (72 psi) ■.

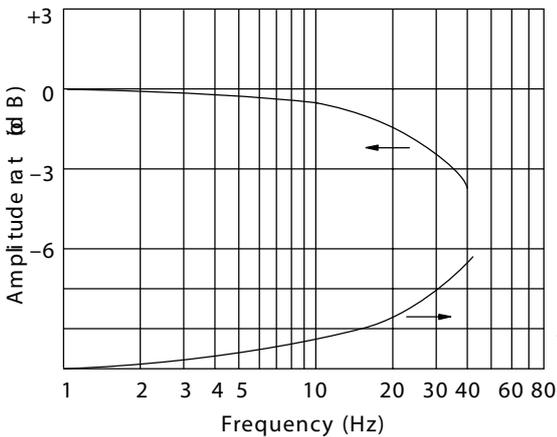
■ At other  $\Delta p$  values and within the power capacity envelopes, flow rates approximate to:

$$Q_x = Q_d \sqrt{\frac{\Delta p_x}{\Delta p_d}}$$

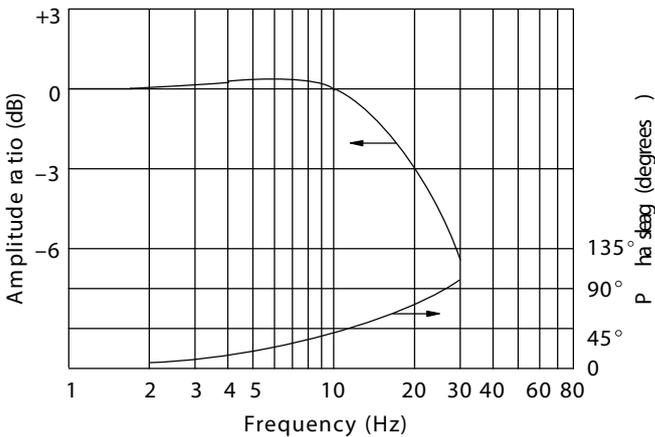
**Frequency response (typical)**

For an amplitude of  $\pm 25\%$  max. flow about the 50% flow, at  $\Delta p (P-B) = 5 \text{ bar}$  (72 psi)

**KBFD/TG4V-5**



**KFD/TG4V-5**

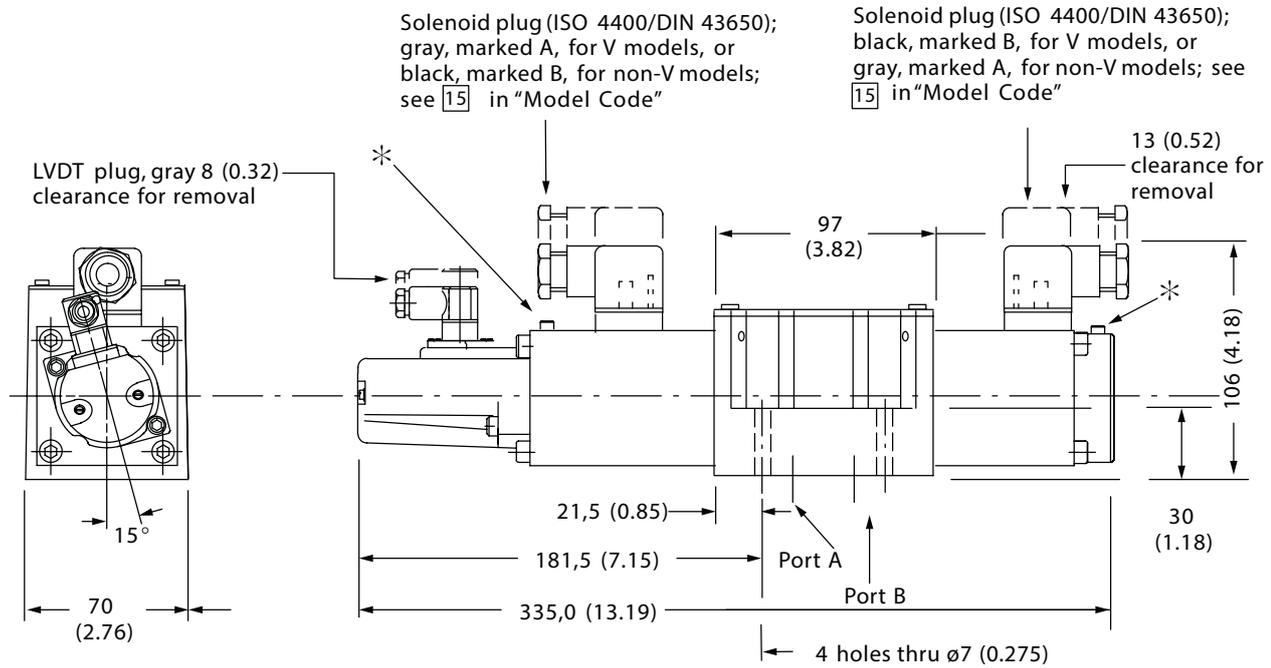
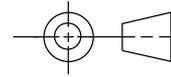


# Installation dimensions

## KFDG4V-5

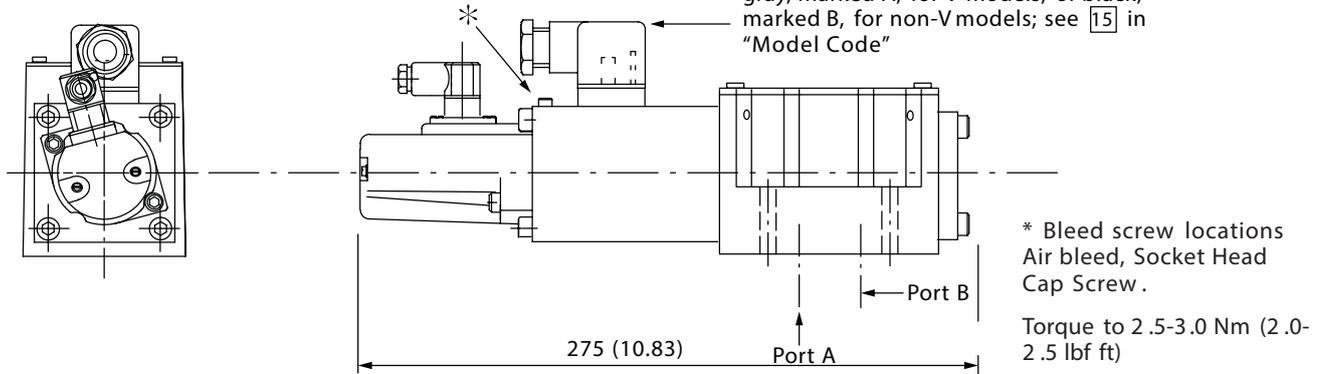
mm (inch)

3rd angle projection



## KFTG4V-5

mm (inch)



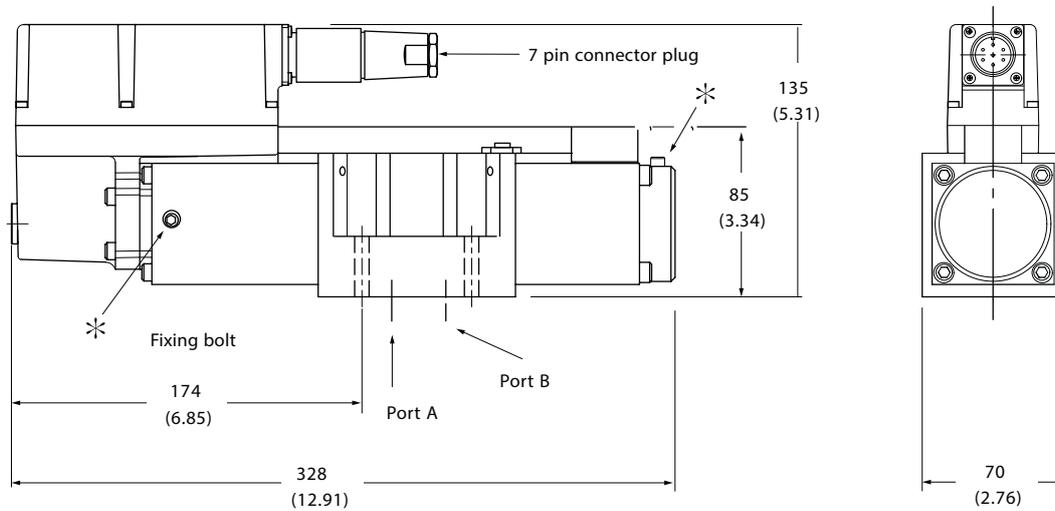
**Note:** For optimum valve operation, bleed the air from the proportional solenoids at initial start-up. This may be done as follows:

- 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).

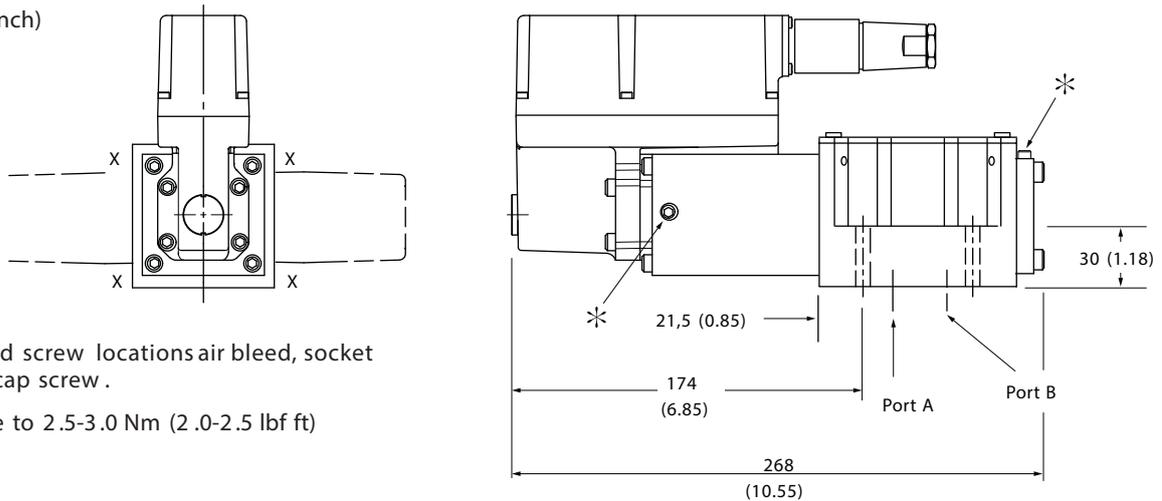
## KBFDG4V-5

mm (inch)



## KBFTG4V-5

mm (inch)



\* Bleed screw locations air bleed, socket head cap screw .

Torque to 2.5-3.0 Nm (2.0-2.5 lbf ft)

### **WARNING**

Valves with integral amplifiers are supplied with or without the metal 7-pin plug. The Danfoss 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

## General description

If 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".

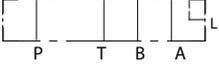
## Conversion for metric

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

## Mounting bolt tapping

ISO 4401 gives metric thread tappings. Alternate UNC tapping are Danfoss' recommendations that allow these plates and associated valves to be used up to their maximum pressures, when using Danfoss 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.

## Subplates

Description and mass kg (lb)	Functional symbol	Model code	Max. Pressure
Single-station subplate; rear ports P, T, A, B; side port L		KDGSM-5-67805-20 (SAE/UNF ports)	210 bar (3000 psi)
Cast iron 1.3 (2.9)		KDGSM-5-615225-10 1/2" BSPF ports	315 bar (4500 psi)
		KDGSM-5-615226-10 3/4" BSPF ports	
		EKD GSM-01Y-10-R	280 bar (4000 psi)



# Electrical information

## Block diagram Voltage input (M1) KBFDG4V-5

### KBFDG4V-5 wiring

Connections must be made via the 7-pin plug mounted on the amplifier. See page 15 of this leaflet and Danfoss' installation wiring practices for Vickers' electronic products, leaflet 2468.

#### Power cables:

For 24V supply 0.75 mm<sup>2</sup> (18 AWG) up to 20m (65 ft)

1.00 mm<sup>2</sup> (16 AWG) up to 40m (130 ft)

#### Signal cables:

0.50 mm<sup>2</sup> (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)

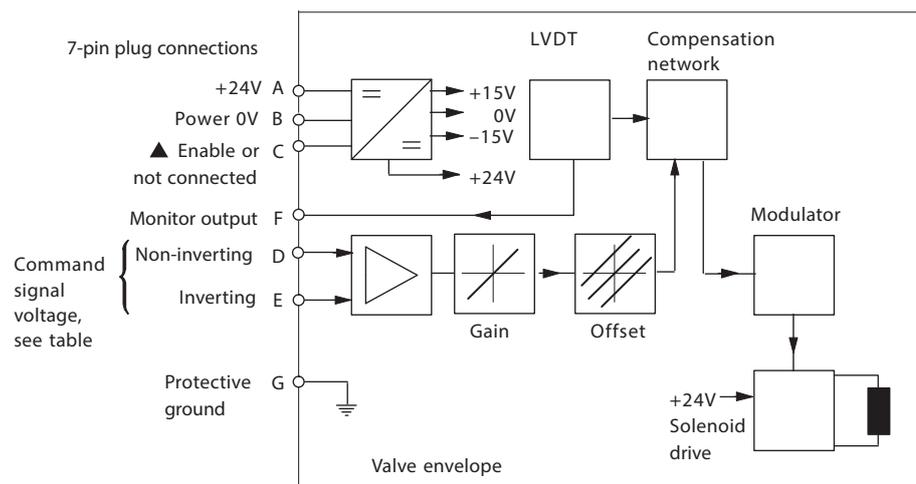
See connection diagram on page 16.

### KFDG4V-5 wiring

Wiring details for these valves are contained in the appropriate Eurocard literature and Danfoss' installation wiring practices for Vickers' electronic products leaflet 2468

#### Command signals and outputs, M1

7-pin plug		Flow direction
Pin D	Pin E	
Positive	OV	
OV	Negative	P to A
	$U_d - U_e = \text{Positive}$	
Negative	OV	
OV	Positive	P to B
	$U_d - U_e = \text{Negative}$	



▲ Pin C is used for a valve enable signal with electrical connections PH7

### WARNING

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

## Block diagram Current input (M2) KBFDG4V-5

### KBFDG4V-5 wiring

Connections must be made via the 7-pin plug mounted on the amplifier. See page 15 of this leaflet and Danfoss' installation wiring practices for Vickers' electronic products, leaflet 2468 .

#### Recommended cable sizes are:

##### Power cables:

For 24V supply

0.75 mm<sup>2</sup> (18 AWG) up to 20m (65 ft) 1.00 mm<sup>2</sup> (16 AWG) up to 40m (130 ft)

##### Signal cables:

0.50 mm<sup>2</sup> (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 17.

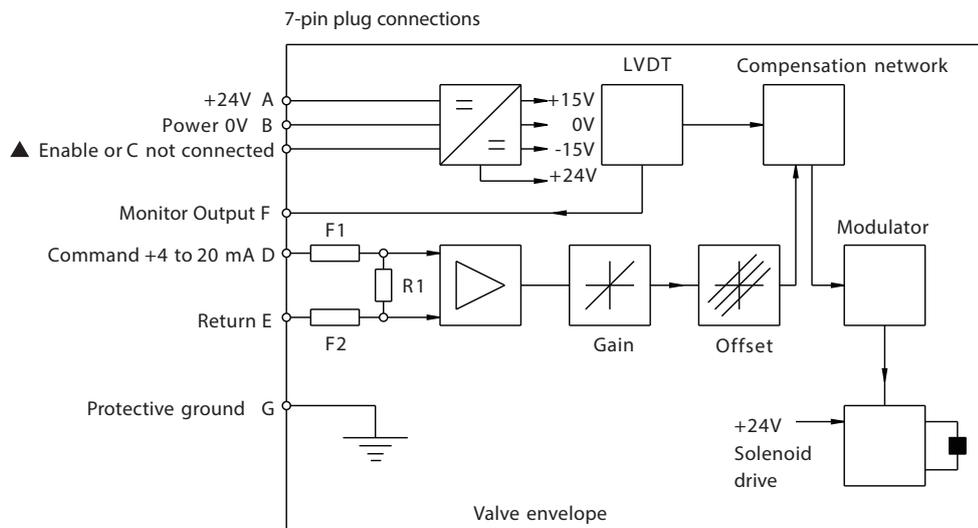
### KFDG4V-5 wiring

Wiring details for these valves are contained in the appropriate Eurocard literature and Danfoss' installation wiring practices for Vickers' electronic products leaflet 2468 .

#### Command signals and outputs, M2

7-pin plug

Pin D	Pin E	Pin B	Flow direction
More than 12 mA	Current return	Power ground	P to A
Less than 12 mA	Current return	Power ground	P to B



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

#### Command signals and outputs, M2

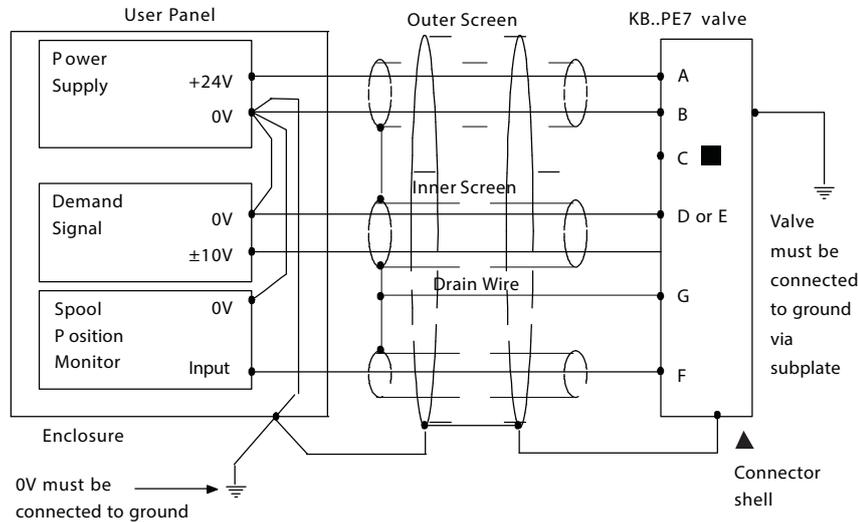
### WARNING

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

# Electrical information

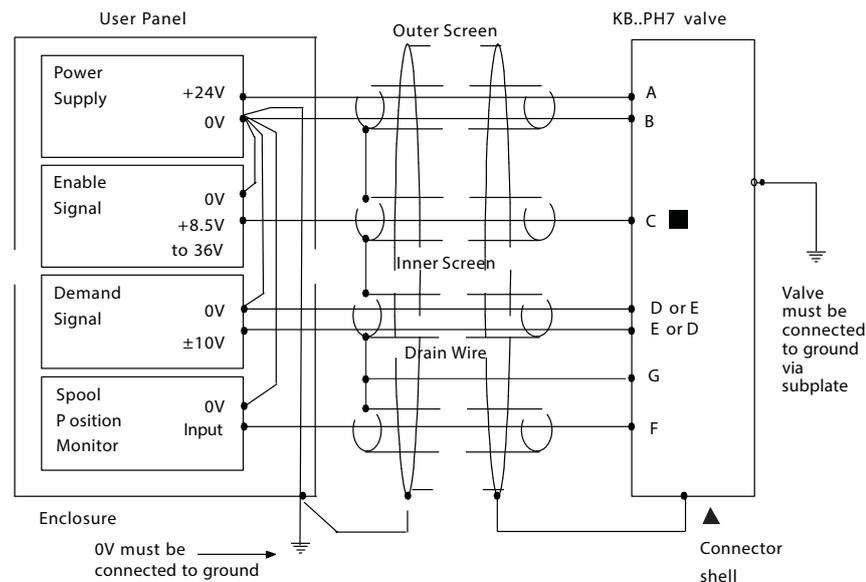
## Wiring connections | Voltage input (M1)

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



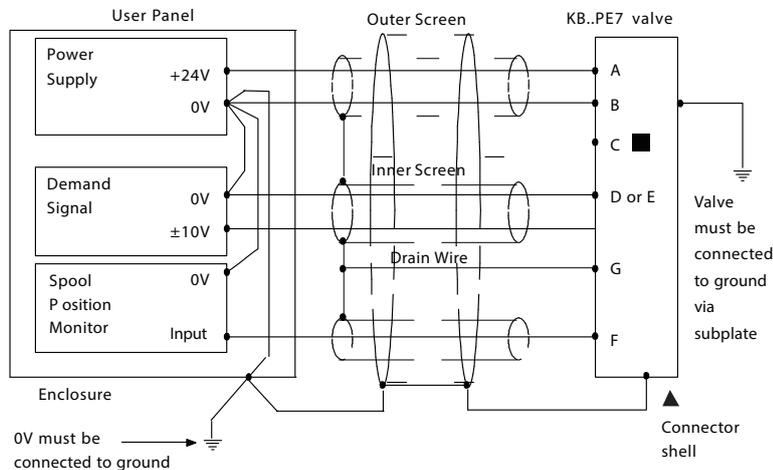
## Wiring connections for M1 valves with enable feature

**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.



## ⚠ WARNING

### Electromagnetic Compatibility (EMC)

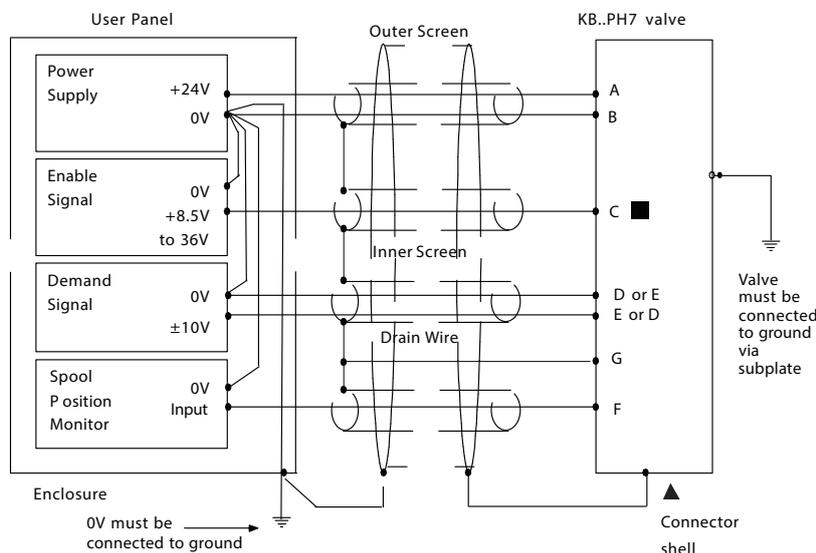
It is necessary to ensure that the valve is wired up as above. For effective protection the user electrical cabinet, the valve subplate or manifold and the cable screens should be connected to efficient ground points. The metal 7-pin connector part no. 934939 should be used for the integral amplifier. 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 subplate 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 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.



# 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 Danfoss' publication 9132 or 561, "Vickers Guide to Systemic Contamination Control". The book also includes information on the Danfoss 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

Danfoss 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). For further technical information about fluids see "Technical Information" leaflet B-920 or I-286S.

## 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 Danfoss 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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