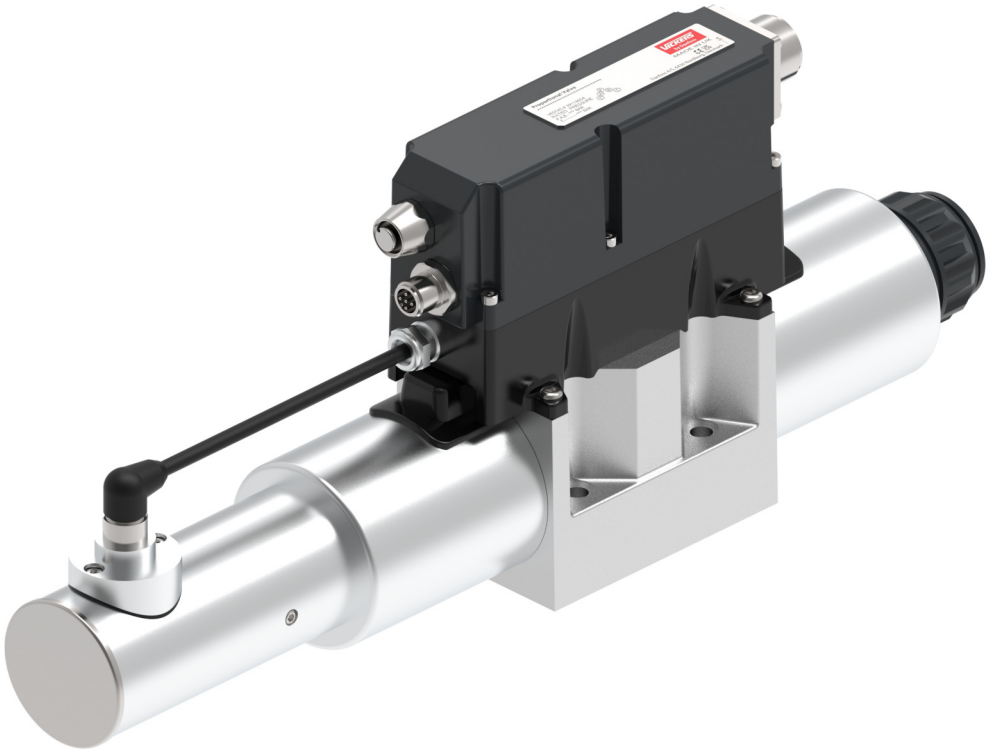
ENGINEERING
TOMORROW

User Guide

Vickers by Danfoss

KBFRG4 Proportional Directional Valve with Feedback

KBFRG4-05-XXXXXXXXXXX-NX1-X07-CO-N-01-H-001-00-ENXXX
Pressures to 350 bar (5100 psi)



VICKERS
by Danfoss

BC488356208781en-000101

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CE

This product has been designed and tested to meet specific standards outlined in the European Electromagnetic Compatibility Directive (EMC) 2014/30/EU which repealed Directive 89/336/EEC, amended by Directives 91/263/EEC, 92/31/EEC, 93/68/EEC and 93/97/EEC.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's Electronic Products leaflet 2468. Wiring practices relevant to this Directive are indicated by Electromagnetic Compatibility (EMC).

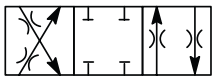
KBFRG4-05-XXXXXXXXXXX-NX1-X07-CO-N-01-H-001-00-ENXXX

The valve is a direct, solenoid operated ISO 4401 size 5 high performance proportional directional valve with spool position feedback. The integral amplifier, which is housed in a robust metal enclosure sealed against ingress of water and other fluids (IP67 rating), is positioned on top of the valve body. Powered by 24V nominal (18 -36V) supply, the amplifier features a CANbus interface.

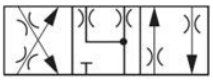
- Digital amplifier with analog and CANbus interface
- Special spools designed for customer requirements
- 700 hours salt spray rating
- Vibration resistant design
- Full CE electromagnetic compatibility- 2014/30/EU

Spool data

Spool symbols



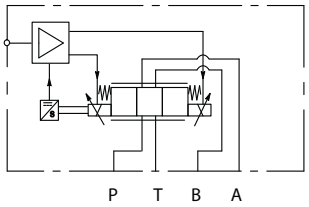
Spool type 2C



Spool type 33C

Functional symbol

Proportional directional valve (with integrated electronics)



Spool type and flow rating

Symmetric spools

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

Spool code	Spool symbol	Flow rating
2C75N	2C	75 L/min (19.8 USgpm)
2C70N	2C	70 L/min (18.5 USgpm)
2C50N	2C	50 L/min (13.2 USgpm)
33C75N	33C	75 L/min (19.8 USgpm)
33C70N	33C	70 L/min (18.5 USgpm)
33C50N	33C	50 L/min (13.2 USgpm)

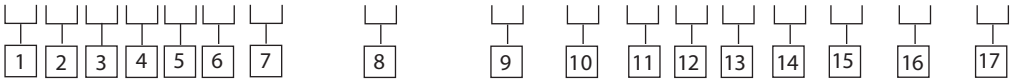
Asymmetric spools

Figure preceding metering type designator “N” e.g. (2C**N) is flow rating P–A, or A–T (“A” port flow). Figure after “N” (N***) is flow rating P–B, or B–T (“B” port flow).

Spool code	Spool symbol	Flow rating
2C75N45	2C	75 L/min (19.8 USgpm), “A” port flow
		45 L/min (11.9 USgpm), “B” port flow
2C50N25	2C	50 L/min (13.2 USgpm), “A” port flow
		25 L/min (6.6 USgpm), “B” port flow

Model codes

K B F R G 4 - 05 - ******** - N*1 - *07 - ** - N - 01 - H - 001 - 00 - EN*****



1 Valve type

K Proportional valve

2 Integral amplifier

B Integral amplifier "B" series

3 Feedback arrangement

F Spool position

4 Control type

R Directional control, Round shape solenoid

5 Mounting

G Subplate Mounted

6 Operation

4 Solenoid operated

7 Interface
ISO 4401

05 Size 05

8 Spool type, flow rating and metering

See functional symbols on page 3.

ΔP = 5bar (72 psi) per metering flow path, e.g. B to T

Symmetric Spools

0000002C75N	75 L/min (19.8 US gpm)
0000002C70N	70 L/min (18.5 US gpm)
0000002C50N	50 L/min (13.2 US gpm)
0000033C75N	75 L/min (19.8 US gpm)
0000033C70N	70 L/min (18.5 US gpm)
0000033C50N	50 L/min (13.2 US gpm)

Asymmetric Spools

00002C75N45	75 L/min (19.8 US gpm)," A" port flow 45 L/min (11.9 US gpm), "B" port flow
00002C50N25	50 L/min (13.2 US gpm)," A" port flow 25 L/min (6.6 US gpm)," B" port flow

9 Command input and feedback

N**11** +/-10V command, +/-10V feedback

N12 4mA to 20mA command, +/-10V feedback

10 Electrical Connection

C07 7 pin connector without plug, no enable
E07 7 pin connector with plug, no enable
H07 7 pin connector with plug, pin "c" enable
R07 7 pin connector without plug, pin "c" enable

11 Digital communication Interface

NS Not selected
CO CANopen

12 External sensor

N No option

13 Design version

01 Design series 01 (Subject to change)

14 Coil rating and overrides

H 24V DC Amplifier supply, Plain overrides

15 Software Version

001 Software version

16 Seals

00 FKM Seals

16 EN Options

Blank No EN special option selected
ENxxx Customer special

⚠ WARNING

The Danfoss plug, part no. 934939, must be correctly fitted to ensure that EMC and IP67 ratings 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.

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

KBFRG4-05-XXXXXXXXXXX-NX1-X07-CO-N-01-H-001-00-ENXXX Valves with Integral Amplifier

Data is typical with fluid at 36 cSt (168 SUS).

Power supply	24V DC (18V to 36V including 10% peak-to-peak max. ripple), Max. current 3A
Command signal	
Voltage mode (11) Analog input signal	±10V differential
Input impedance	47 kilo ohms
Current mode (21) Analog input signal	4mA to 20mA differential Pin D to Pin E
Input impedance	100 Ohms
CAN Mode • Digital input signal	-16384 to +16384
7-pin plug connector	See connector details Page 9
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 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 IEC 61000-4-8, Class A 100 A/m 50/60 Hz IEC 61000-4-9, Class B, 5000 A/m 8/20 µs IEC 61000-4-29 Voltage dip - 75% of Vnom for 3ms Short interruption - 0% of Vnom for 1ms Voltage Variation - 80% to 120% of Vnom for 10s
Power frequency magnetic field immunity test	
Pulse magnetic field immunity test	
Voltage dips and variation, short interruption	
Monitor point output (spool position)	±10.5V DC relative to Pin B
Output impedance	+/- 10V DC for full stroke 10KOhm
Power stage PWM frequency	10 kHz nominal
Step response, equal looped flow at Δp = 5 bar P to A	**Flow step**
P to A/B to T	10 to +90%: 20 ms 90 to +10%: 19 ms
P to B/A to T	-10 to -90%: 20 ms -90 to -10%: 18 ms
Flow hysteresis	< 0.5% of rated flow
Repeatability	Steady state repeatability of spool position for consistent external conditions including input waveform (duty cycle ≤ 4s)
Protection:	
Electrical	
Polarity	Reverse polarity protected
• Under voltage	Drive disabled below 18V and re-enabled at 22V
• Environmental	IP 67 (IEC 60529)
ROHS compliance	Electronic amplifier is compliant to 2011/65/EU ROHS2
Fluid viscosity	
• Full performance	13 to 54 cSt
• Reduced performance	13 to 500 cSt
Fluid cleanliness	18/16/13 or better as defined in ISO 4406 Compliant with the requirements equivalent of ISO 9223:1992 C3 and C4 available for special request
Corrosion Protection	
Vibration Random vibration (IEC 68-2-6)	7.77Grms; X,Y and Z Axis 8 hours per axis; 10 to 1500 Hz 50Grms X, Y, and Z Axis
Shock	
Operating temperature	-40°C to +85°C (40°F to 185°F) ambient (80°C maximum on valve body) (176)
Storage temperature range	-40°C to +85°C (40°F to 185°F)
Mass	5.9 kg

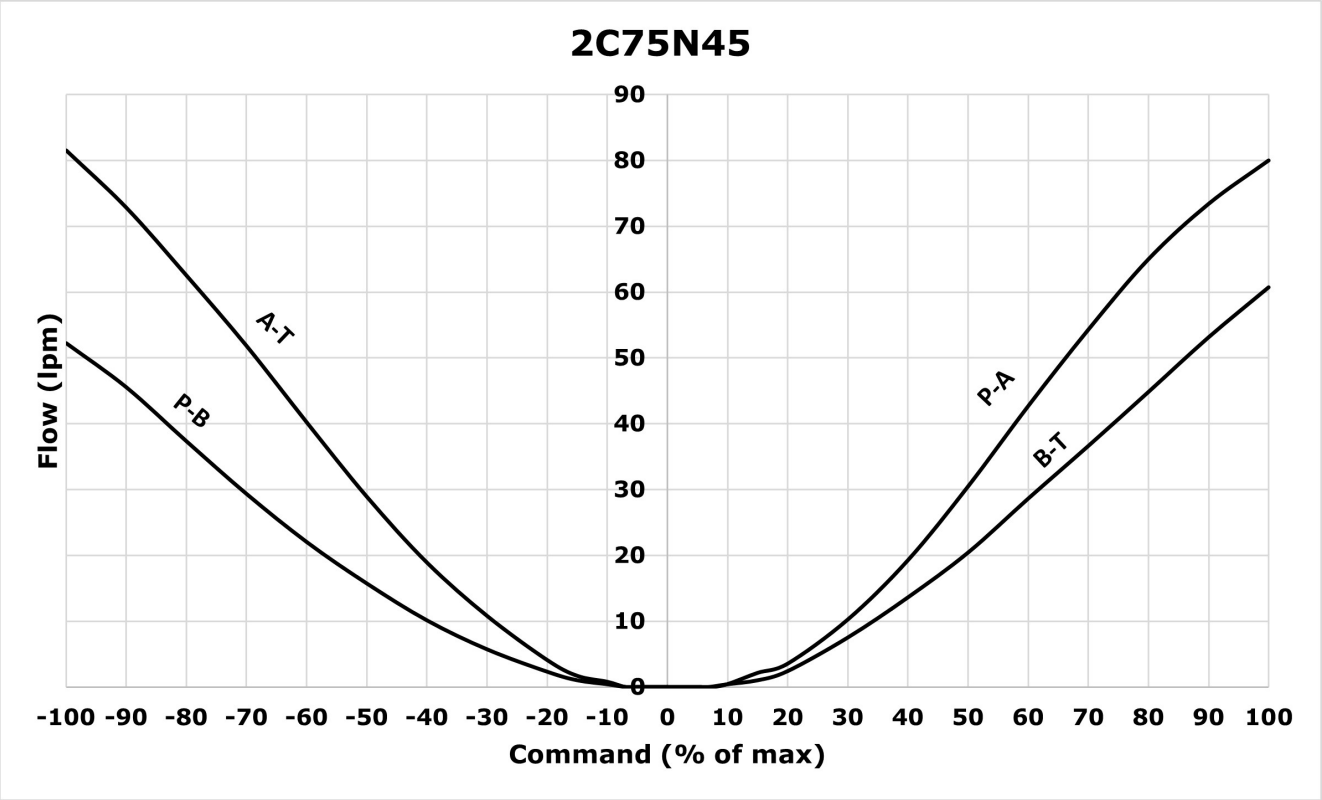
Data is typical with fluid at 36 cSt (168 SUS).

Pressure rating

bar (psi)	Ports P, A, B	Port T
Valve KBFRG4-05	350 (5100)	210 (3000)

Rated Flow at Δp = 5 bar (75 psi) valve pressure drop

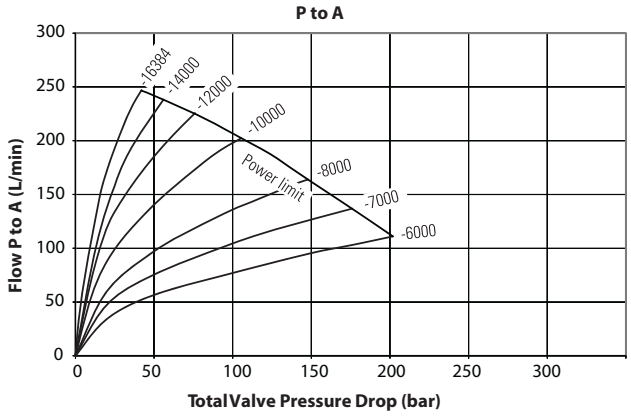
Amplifier adjusted from nominal 75 l/min P to A and 45 l/min P to B to the target flows illustrated.



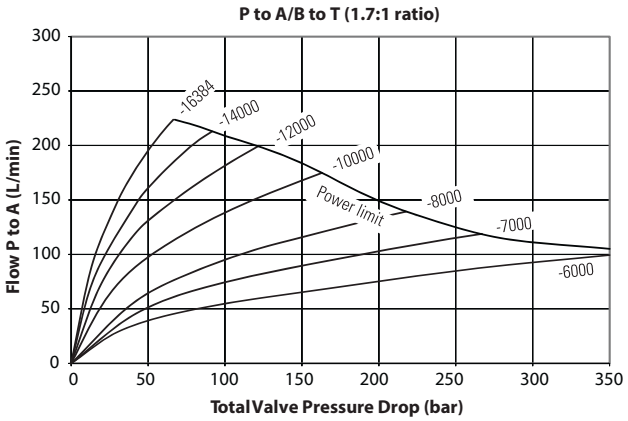
Power capacity envelopes

Spool type 2C75N45

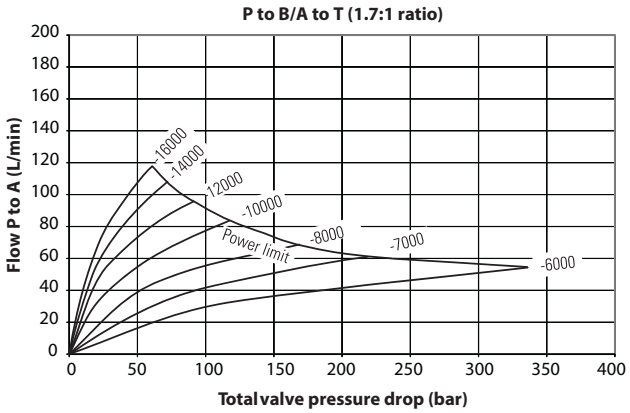
Single flow path P to A

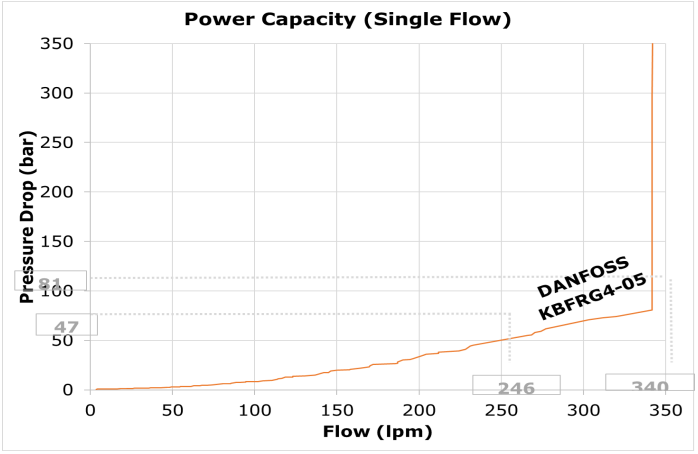


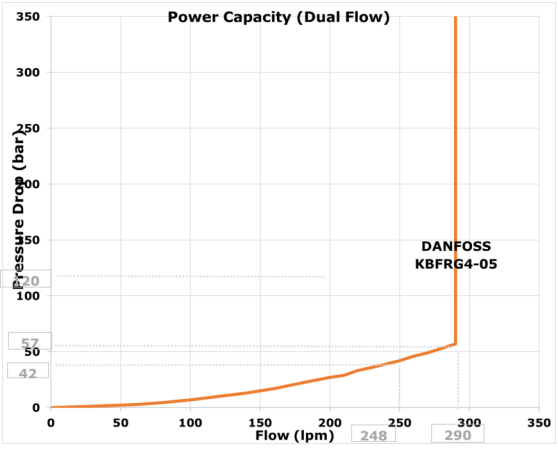
Dual Flow Path P to A/B to T



Dual Flow Path P to B/A to T



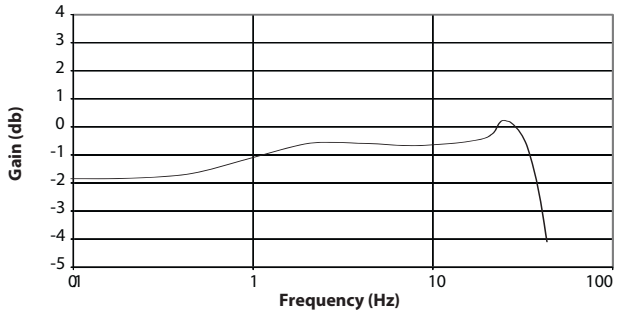




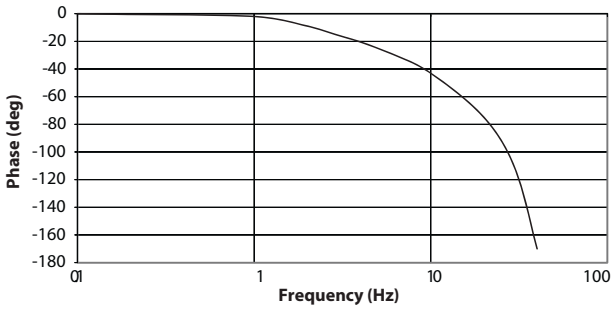
Frequency response (typical)

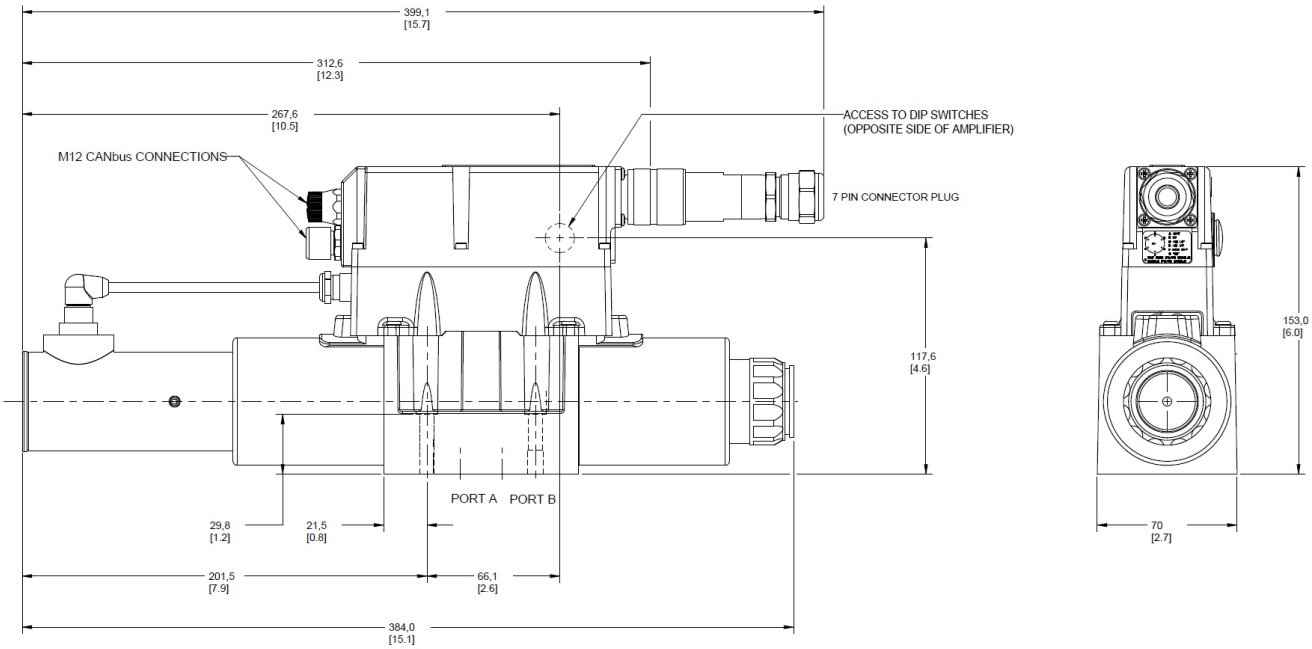
Signal to achieve 50 L/min ±10% looped equal flow P to B/A to T at Δp = 5 bar (75 psi) per metering edge at 0.1 Hz. KB valves are preset at the factory to compensate for the effect of spool overlap.

-3 dB at 44 Hz



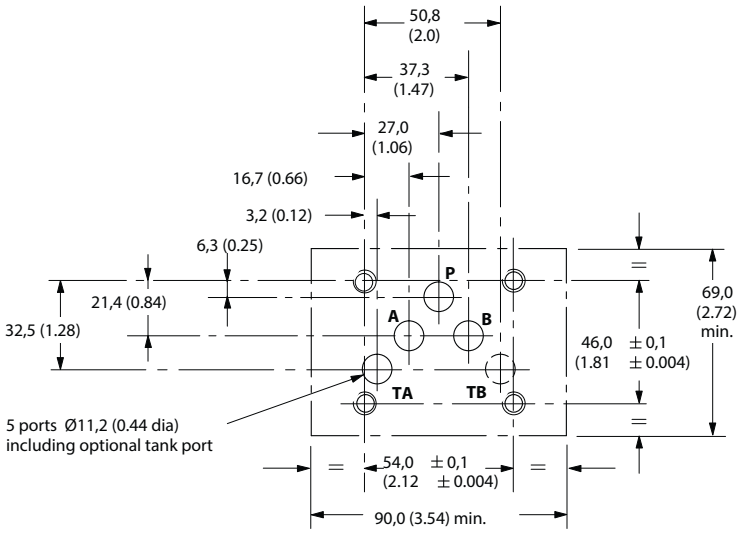
-90 degrees at 25 Hz



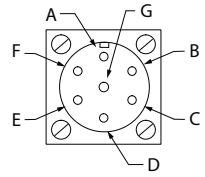


Mounting to ISO 4401 (Size 05)

This interface conforms to: ISO 4401-05-04-0-05
ANSI/B93.7M (and NFPA) size 05

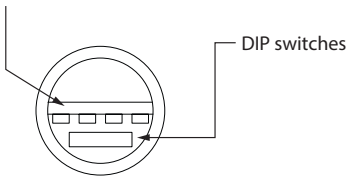


7-Pin DIN connector configuration



Pin	Description
A	+24V
B	0V
C	Valve enable
D/E	Demand
F	Output monitor
G	Protective ground

LED indications for faults

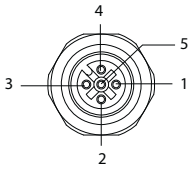


LED	Color	LED Function
LED1	Green	Valve Status
LED2	Green	CAN Run
LED3	Red	CAN Error
LED4	Red	Valve Diagnostics

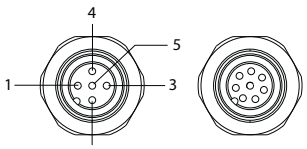
- LED 1 & LED 4 are used for valve operating state indication
- LED 2 & LED 3 are used for CANopen state indications

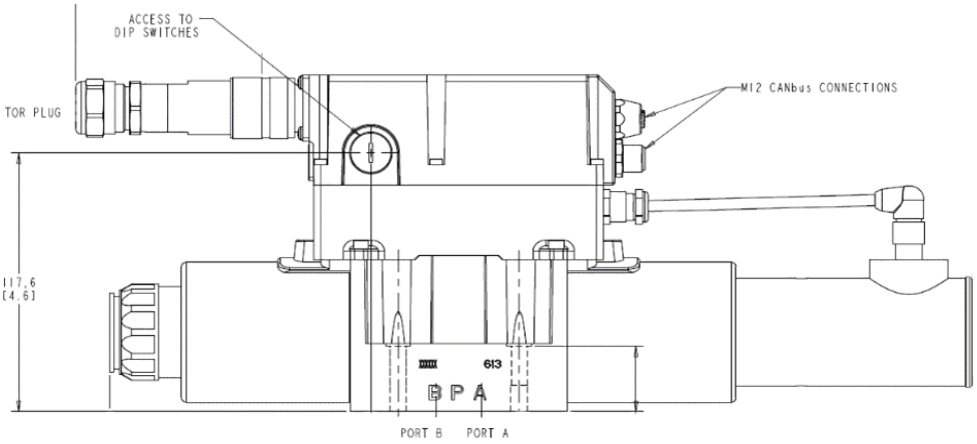
CAN connector configuration

M12 Female CAN Connector



Pin	Description
1	Not connected
2	Not connected
3	CAN Ground
4	CAN High
5	CAN Low





7-Pin plug command signals and outputs

	Pin D	Pin E	CANbus	Flow direction
Analogue	Positive	0V		P to A
Analogue	0V	Negative		P to A
Analogue	Negative	0V		P to B
Analogue	0V	Positive		P to B
Digital			Positive	P to A
Digital			Negative	P to B

⚠ WARNING

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

Baud rate & node ID setting

The baud rate and node ID can be set by SDO or 8 pin DIP switch. The default baud rate is 500 Kbps. Possible baud rates supported are 125 Kbps, 250 Kbps and 500 Kbps. The upper two MSB pins B7 & B6 are used for baud rate setting as per the table, while remaining 6 pins B5 to B0 are used for Node ID from 1 to 63.

DIP switch

Setting of node ID & baud rate:
Switch up = 0
Switch down = 1

Example for setting baudrate & node ID

- To set the Node ID use switch B0 (LSB) to B5 that is 6 bit node address; to set Node ID to 3 make switch B0 & B1 to 1 by pulling down, and remaining switches B2 to B5 make 0 by pulling up.
- To set the baud rate use switch B6 & B7 (MSB) that is 2 bit baud rate settings; to set baud rate at 500 Kbps make only switch B6 & B7 to 1 by pulling down.

CANbus connectors

The valve has two CANbus connectors in the form of 5-pin female and male M12 connectors. They are wired according to CANopen CIA standard. The valves comply to DS 301 and to DS 408 for valve control only.

Wiring

Connections must be made via the 7-pin plug mounted on the amplifier.

Recommended cable sizes are:

Power cables:

For 24V supply 0.75 mm2

(18 AWG) up to 20m (65 ft)

1.00 mm2 (16 AWG) up to 40m (130 ft)

Signal cables

0.50 mm2 (20 AWG)

Screen (shield):

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

Cable outside diameter

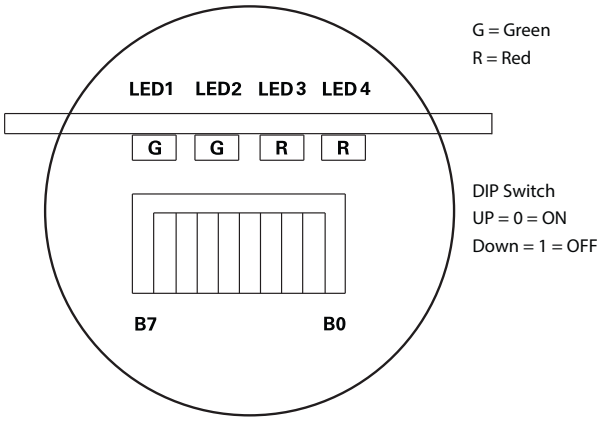
8.0-10.5 mm (0.31-0.41 in)

B7	B6	B5	B4	B3	B2	B1	B0	HEX	Baud rate B7/ B6	Node ID B5... B0
0	0	0	0	0	0	0	0	00	20 kBaud	Default (Node ID 1)
0	0	0	0	0	1	0	1			
Up to									20 kBaud	Node ID = 1...63
0	0	1	1	1	1	1	1	3F		
0	1	0	0	0	0	0	0	40	125 kBaud	Default (Node ID 1))
0	1	0	0	0	0	0	1	41		
Up to									125 kBaud	Node ID = 1...63
0	1	1	1	1	1	1	1	7F		
1	0	0	0	0	0	0	0	80	250 kBaud	Default (Node ID 1))
1	0	0	0	0	0	0	1	81		
Up to									250 kBaud	Node ID = 1...63
1	0	1	1	1	1	1	1	BF		
1	1	0	0	0	0	0	0	CO	500 kBaud	Default (Node ID 1))
1	1	0	0	0	0	0	1	C1		
Up to									500 kBaud	Node ID = 1...62
1	1	1	1	1	1	1	0	FE		
1	1	1	1	1	1	1	1	FF	250 kBaud	Node ID = 63

LED Indications

A total of four LEDs are present in the valve. Two LEDs (one red & one green) are used as per CANopen DS303 standard, while remaining two LEDs are used for valve operating state indication.

- LED 1 & LED 3 are used for valve operating state indication.
- LED 2 & LED 4 are used for CANopen state indications.



LED Codes in CAN command mode	LED 1 (Green)	LED 2 Green (CAN)	LED 3 (Red)	LED 4 (Red) (CAN)
Bootload active	-	Blink (triple flash)	On	On
Software run Initialization	-	Blink	Blink	Blink
Software run CAN active	-	On	Blink	Blink
Software run CAN active valve active	Blink	On	-	-
Software run CAN active Valve fault	-	On	Blink (5 Hz)	Blink
Valve fault: - Overvoltage supply - Undervoltage supply - Over temperature - Coil short	-	On	Blink (5 Hz)	Blink
Valve Fault: - LVDT signal error	-	On	Blink (10Hz)	Blink

LED Codes in Analog command mode	LED 1 (Green)	LED 2 Green (CAN)	LED 3 (Red)	LED 4 (Red) (CAN)
Bootload active	-	Blink (triple flash)	On	On
Software run Initialization CAN inactive Valve active	Blink	Blink	-	Blink
Software run CAN active Valve active	Blink	On	-	Off
Software run CAN active Valve fault	-	On	Blink (5 Hz)	Blink
Valve Fault: - Over voltage supply - Under voltage supply - Over temperature - Coil short	-	On	Blink (5 Hz)	Blink
Valve Fault: - LVDT signal error	-	On	Blink (10Hz)	Blink

CANopen LED Indications details

Red ERROR LED 1	State	Descriptions
Off	No error	Device is active
Single flash	Warning limit reached	At least one of the error counters of CAN controller has reached the warning level (too many error frames)
Fast blinking	Auto baud rate/LSS	Auto baudrate detection in progress (alternatively blinking)
Double flash	Error control event	A guard event (NMT Slave) or a heartbeat event has occurred.
On	Bus Off	The CAN controller is bus off

Green RUN LED 3	State	Descriptions
Fast blinking	Auto baud rate detection	Fast blinking until baud rate has been set
Single flash	Stopped	The device is in stopped state
Blinking	Preoperational	The device is in pre-operational state
On	Operational	The device is in operational state

Red ERROR LED 4	State	Descriptions
Off	No error	Device is active
Single flash	Warning limit reached	At least one of the error counters of CAN controller has reached the warning level (too many error frames)
Fast blinking	Auto baud rate/LSS	Auto baudrate detection in progress (alternatively blinking)
Double flash	Error control event	A guard event (NMT Slave) or a heartbeat event has occurred.
On	Bus Off	The CAN controller is bus off

Green RUN LED 2	State	Descriptions
Fast blinking	Auto baud rate detection	Fast blinking until baud rate has been set
Single flash	Stopped	The device is in stopped state
Blinking	Preoperational	The device is in pre-operational state
On	Operational	The device is in operational state

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 the Danfoss publication 9132 or 561 "Guide to Systemic Contamination Control"., which also includes information on the Danfoss concept of proactive maintenance.

The following recommendations are based on ISO 4406 cleanliness levels at 4 µm, 6 µm and 14 µm: For products in this catalog the recommended levels are 18/16/13.

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 are piped so as to keep the valves full of fluid once the system start-up has been completed.

Seal kit

For KBFRG4-05- 02-332751

Plug

For KBFRG4-05
7-pin plug (metal): 934939

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.

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