

*Powering Business Worldwide*

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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to meet specific standards outlined in the European Electromagnetic Compatibility Directive (EMC) 2014/30/EU which repealed Directive 89/336/EEC, amended by Directives 91/263/EEC, 92/31/EEC, 93/68/EEC and 93/97/EEC.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  $\Delta$  Electromagnetic Compatibility (EMC).

## KBFDG4V-5-2C75N45-Z-M1-PC7-H7-12-EN123/EN150

The valve is a direct, solenoid operated ISO 4401 size 5 high performance proportional directional valve with spool position feedback.

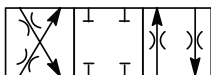
The integral amplifier, which is housed in a robust metal enclosure sealed against ingress of water and other fluids, is positioned on top of the solenoid. Powered by 24V nominal (18-36V) supply, the amplifier features a CANbus interface. The EN123 & EN150 designates special build for end customer Vestas:

- Special amplifier with CANbus interface
- Special spool designed to meet the flow requirements of the customer.
- Polyurethane interface seals
- Tuflok patched bolts
- Full CE electromagnetic compatibility.- 2014/30/EU

### Spool data

#### Spool symbols

Spool Type Series 2C75N45, meter-in/meter-out:  
Spool type and flow rating



#### Spool type and flow rating

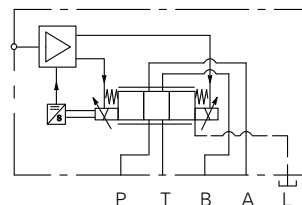
##### Asymmetric spools

Figure preceding metering type designator "N" (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

#### Functional symbol

Proportional directional valve (with integrated electronics)



## Model codes

<b>K</b>	<b>B</b>	<b>F</b>	<b>D</b>	<b>G</b>	<b>4</b>	<b>V</b>	<b>-5-</b>	<b>-2</b>	<b>C</b>	<b>7 5</b>	<b>N</b>	<b>4 5</b>	<b>-Z-</b>	<b>M1</b>	<b>***</b>	<b>H</b>	<b>7</b>	<b>12</b>	<b>E N 1 **</b>
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

<b>1</b>	<b>Valve type</b> K Proportional valve
<b>2</b>	<b>Integral amplifier</b> B Integral amplifier "B" series
<b>3</b>	<b>Feedback arrangement</b> F Spool position
<b>4</b>	<b>Control type</b> D Directional valve
<b>5</b>	<b>Mounting</b> G Subplate mounted
<b>6</b>	<b>Operation</b> 4 Solenoid operated
<b>7</b>	<b>Pressure rating</b> V 315 bar (4500 psi) on ports P, A & B
<b>8</b>	<b>Interface</b> ISO 4401 5 ISO 4401, size 05-04-0- 05 ANSI/B93.7M-D05. ISO 4401, size 05-06- 0-05 (with L ports)
<b>9</b>	<b>Spool type (center condition)</b> (see spool data Page 3) 2 All ports closed
<b>10</b>	<b>Spool/spring arrangement</b> C Spring centered, dual solenoid, directional valve

<b>11</b>	<b>Spool flow rating</b> $\Delta p = 5$ bar (75 psi) per metering flow path, e.g. B to T. (For actual maximum flow refer to power capacity envelope curves.) 75 75 L/min (19.8 USgpm)
<b>12</b>	<b>Spool metering type</b> N Meter-in and meter-out
<b>13</b>	<b>Flow rating ("B" port flow for asymmetric spools)</b> 45 45 L/min (11.9 USgpm)
<b>14</b>	<b>Manual overrides</b> Z No manual overrides
<b>15</b>	<b>Command input</b> M1 +/-10V command and +/-10V feedback
<b>16</b>	<b>Electrical connection</b> PE7 7-pin electrical plug with mating half
<b>17</b>	<b>Coil rating</b> H 24V DC amplifier supply
<b>18</b>	<b>Port T pressure limit code</b> 7 For spool 2C75N45 (see operating data page 5)
<b>19</b>	<b>Design number</b> 12 12 series
<b>20</b>	<b>CAN-Bus</b> EN123 With CAN-bus (Default) EN150 Analog input and output

### WARNING

The Eaton 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 a proper seal.

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

**KBFDG4V-5-2C75N45-Z-M1-PC7-H7-12-EN123/EN150 Valves with Integral Amplifier**

**Data is typical with fluid at 36 cSt (168 SUS). For additional data, please refer to the standard version of the valve.**

Power supply	24V DC (18V to 36V including 10% peak-to-peak max. ripple), Max. current 3A
<b>Command signal</b>	
Voltage mode (M1):	
• Analog input signal	±10V differential
• Input impedance	47 kilo ohms
CAN Mode	
• Digital input signal	-16384 to +16384
7-pin plug connector	See connector details Page 9
<b>Electromagnetic compatibility (EMC)</b>	
	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
Power frequency magnetic field immunity test	IEC 61000-4-8, Class A 100 A/m 50/60 Hz
Pulse magnetic field immunity test	IEC 61000-4-9, Class B, 5000 A/m 8/20 μs
Voltage dips and variation, short interruption	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
<b>Monitor point output (spool position)</b>	±10.5V DC relative to Pin B
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
<b>Step response, equal looped flow at Δp = 5 bar P to A</b>	<b>Flow step</b>
P to A/B to T	10 to +90%: 22 ms 90 to +10%: 18 ms
P to B/A to T	-10 to -90%: 20 ms -90 to -10%: 20 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)
<b>Protection:</b>	
Electrical	
• Polarity	Reverse polarity protected
• Under voltage	Drive disabled below 18V and re-enabled at 22V
Environmental	IP 67 (IEC 60529)
<b>ROHS compliance</b>	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	
< 70 bar	18/16/13 or better as defined in ISO 4406
> 70 bar	17/15/12
Vibration	
Swept resonance (10 Hz to 55 Hz)	0.35 mm peak
Random vibration	7.77Grms; X,Y and Z Axis; 10 to 1500 Hz
IEC 68-2-6 (55 Hz to 500 Hz)	5g
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

# Pressure and flow rates

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

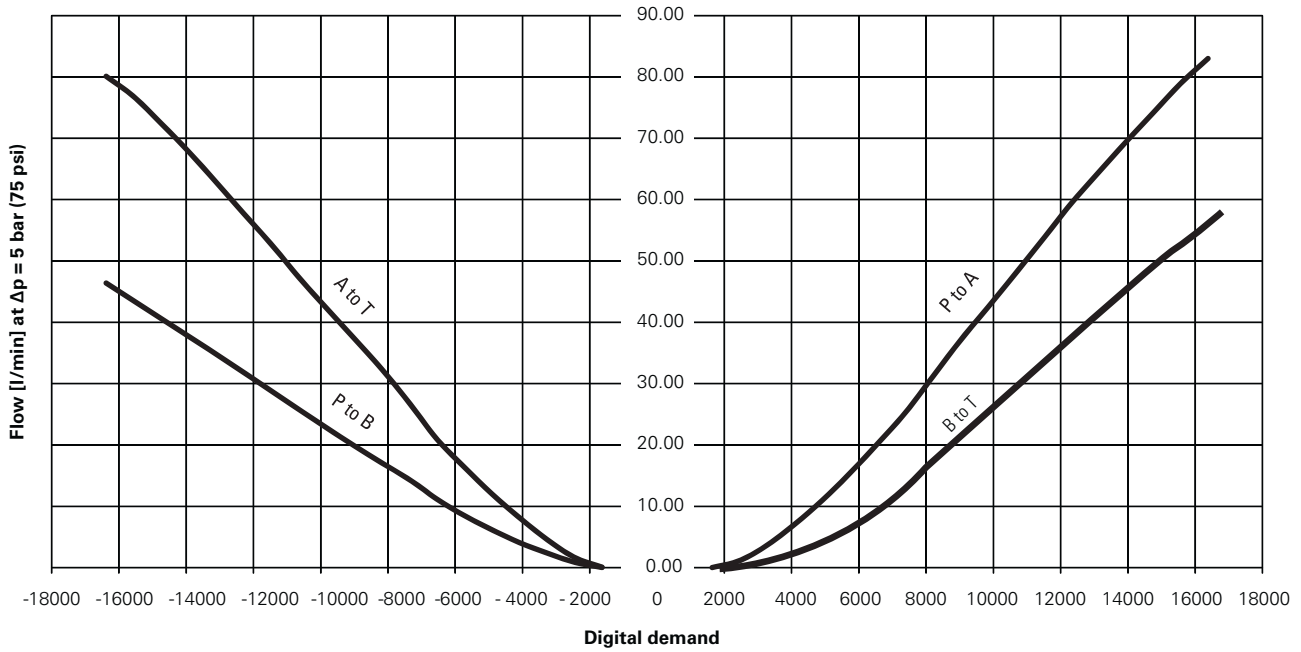
For additional data, please refer to the standard version of the valve.

## Pressure rating

bar (psi)	Ports P, A, B	Port T without external drain	Port T with external drain	Drain port L
Valve KBFDG4V-5-2C75N45-Z-M1-PC7-H7-12-EN123/EN150	315 (4500)	160 (2300)	210 (3000)	50 (725)

Rated Flow at  $\Delta p = 5$  bar (75 psi) valve pressure drop

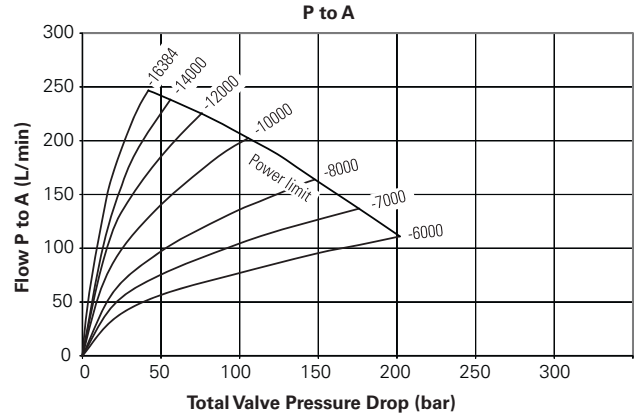
Amplifier adjusted from nominal 75 l/min P to A and 45 l/min P to B to the target flows illustrated.



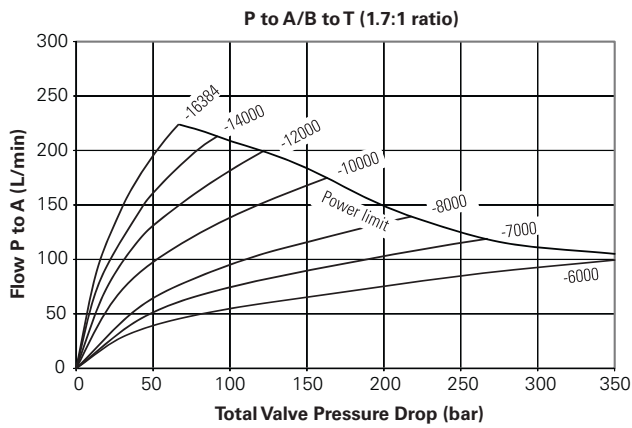
## Power capacity envelopes

Spool type 2C75N45

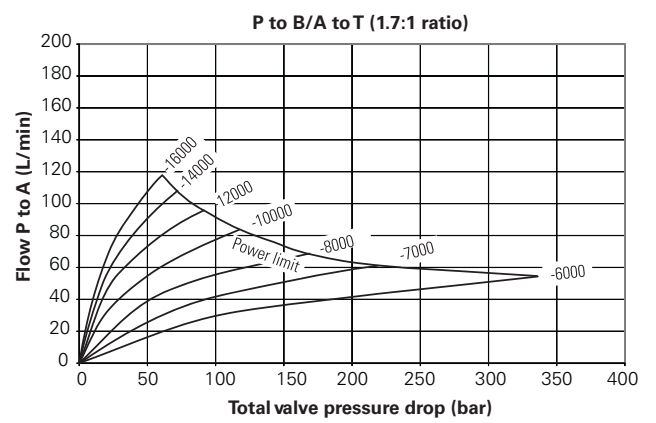
### Single flow path P to A



### Dual Flow Path P to A/B to T



### Dual Flow Path P to B/A to T

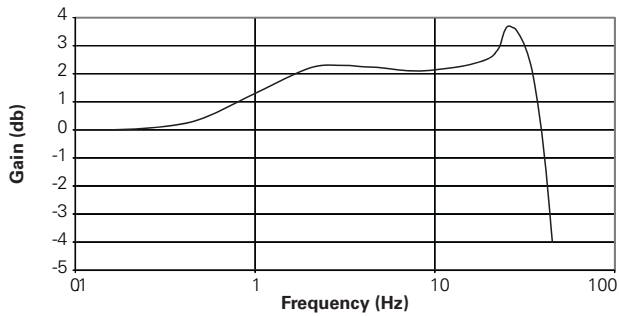


## Performance curves

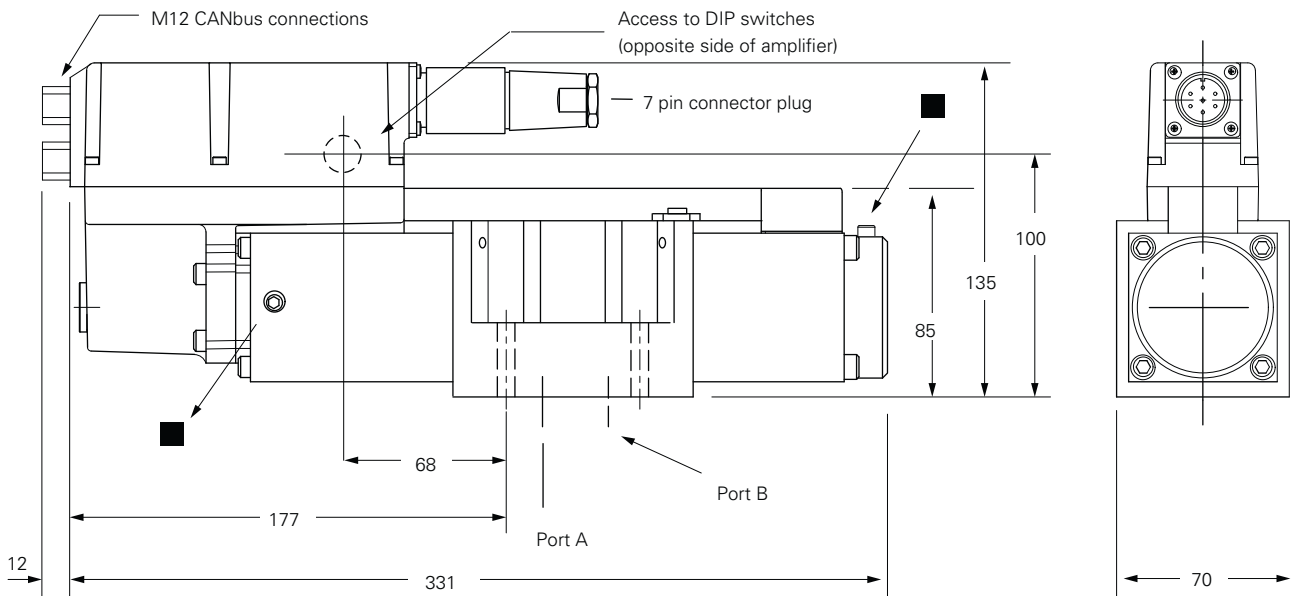
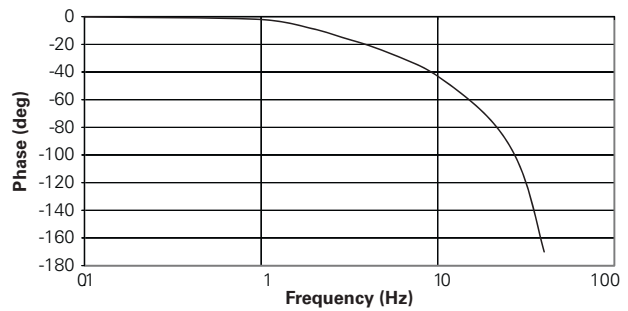
### Frequency response (typical)

Signal to achieve 50 L/min  $\pm 10\%$  looped equal flow P to B/A to T at  $\Delta p = 5$  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



■ Air bleed, socket head cap screw, torque to 2,5-3,0 Nm (2.0-2.5 lbf ft)

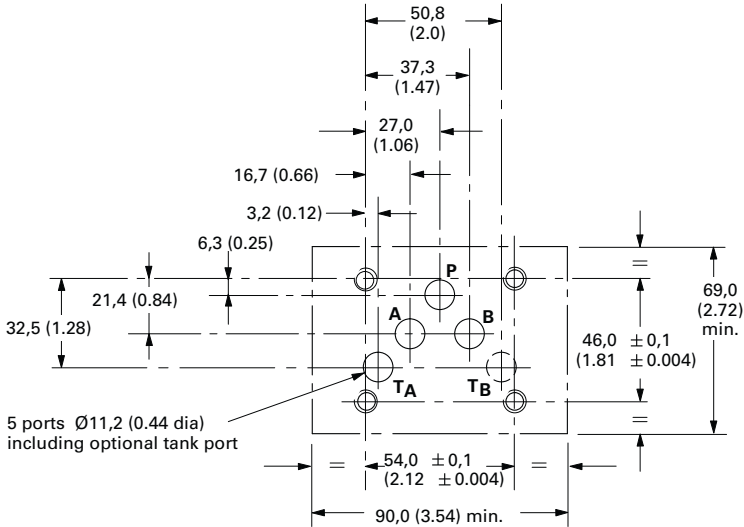
### **⚠ WARNING**

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 seal.



### Mounting to ISO 4401 (Size 05)

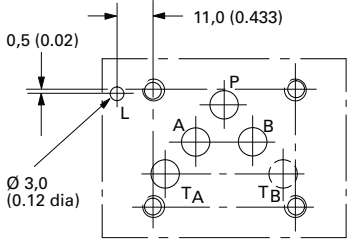
This interface conforms to: ISO 4401-05-04-0-05  
ANSI/B93.7M (and NFPA) size 05



### Interface with additional drain port

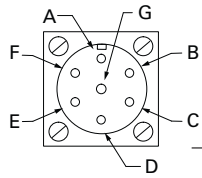
The interface conforms to ISO 4401-05-06-0-05

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

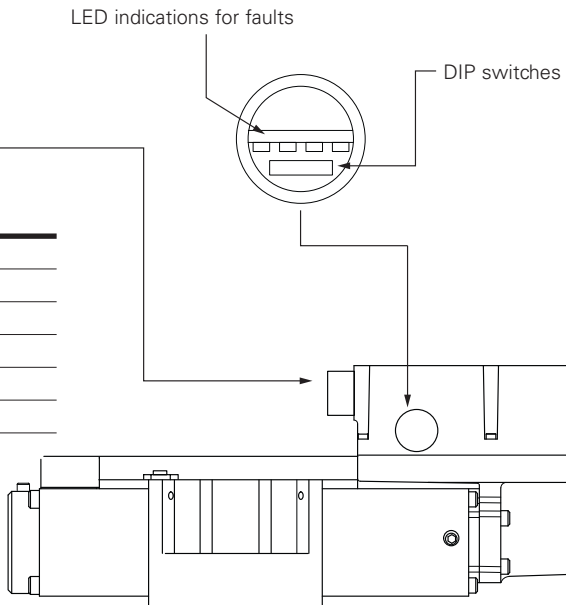


### 7-Pin DIN connector configuration

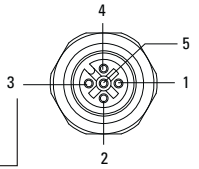
### CAN connector configuration



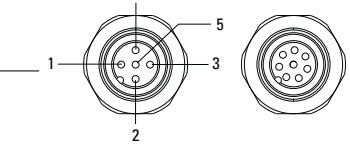
Pin	Description
A	+24V
B	0V
C	Valve enable
D/E	Demand
F	Output monitor
G	Protective ground



### M12 Female CAN Connector



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



### M12 Male CAN Connector

## Electrical information

### 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. Refer to Eaton's Installation Wiring Practices for Eaton 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

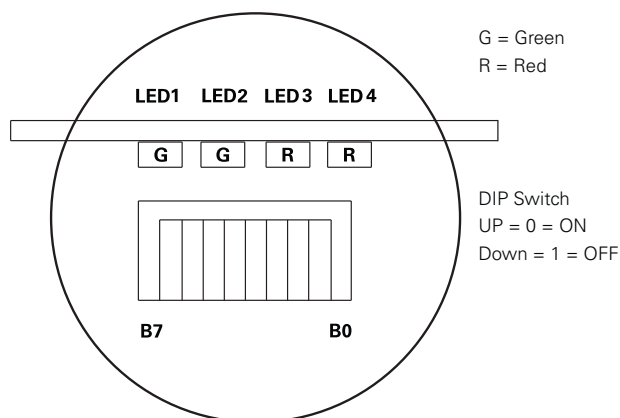
8.0-10.5 mm (0.31-0.41 in)

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	C0	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

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 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

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 Eaton publication 9132 or 561 "Guide to Systemic Contamination Control", which also includes information on the Eaton 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 70 bar (1000 psi): 18/16/13 Above 70 bar (1000 + psi) 17/15/12

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). 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.

### Seal kit

For KBFDG4V-5-2C75N45-Z-M1- PC7-H7-12-EN123/EN150 02-332751

### Plug

For KBFDG4V-5-2C75N45-Z-M1- PC7-H7-12-EN123/EN150 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 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.

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