

AxisPro Servo conversion instructions

How to get servo valve-like performance from a servo-performance proportional valve

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Global Product
Manager - Industrial
Valves

The AxisPro™ proportional industrial valve is a cost-effective and reliable alternative to the traditional servo valve.

AxisPro™ four-way solenoid-operated proportional valves offer high dynamic performance which enables them to be used in closed loop motion control applications previously only possible using conventional servo valves. Compared to servo valves, AxisPro proportional valves offer excellent performance and better reliability at a significantly lower price point.



Servo valves: expensive with limited availability

Servo valves provide excellent accuracy and high repeatability. Servo valve technology has been in constant use for over 70 years. But servo valves are typically more expensive than other valves: they require elaborate production methods (involving machining and assembling two stages). And when placed into service, servo valves require sophisticated electronic control cards—adding additional costs. In addition, servo valves require use of a pilot-filter (typically) supplied by the manufacturer, which can become contaminated and require costly maintenance.

The new AxisPro™ line of proportional directional valves provide a cost-effective alternative to traditional nozzle-flapper servo valves. Proportional valves, like AxisPro, benefit from a simpler mechanical design that costs less to manufacture, while utilizing onboard integrated electronics and feedback to achieve servo-quality spool control performance. Plus, since the AxisPro power stage directly drives the spool, there is increased robustness to contamination (no need for pilot stage filtration to protect the fragile nozzle-flapper interface of a traditional servo valve).

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Converting to AxisPro servo-performance valves: step-by-step

Note: This conversion process applies to AxisPro Level 1 valves. Contact your Eaton representative for information about converting to AxisPro Level 2 and Level 3 valves.

Converting to the AxisPro valve requires a simple six-step process:

- Step 1.** Determine maximum flow rate of the servo valve
- Step 2.** Choose the proper replacement AxisPro valve
- Step 3.** Define parameters
- Step 4.** Determine where motion control is handled
- Step 5.** Mount AxisPro Valve
- Step 6.** Wire AxisPro Valve

You will find model codes, installation dimensions and other useful information in the appendix.

Step 1: Determine maximum flow rate of the servo valve

Maximum flow and pressure rating is typically listed as part of the model code and appears on the on the model code/serial number label (Figure 1).

Note: The AxisPro valve is not recommended for pressure ratings higher than 350 bar.

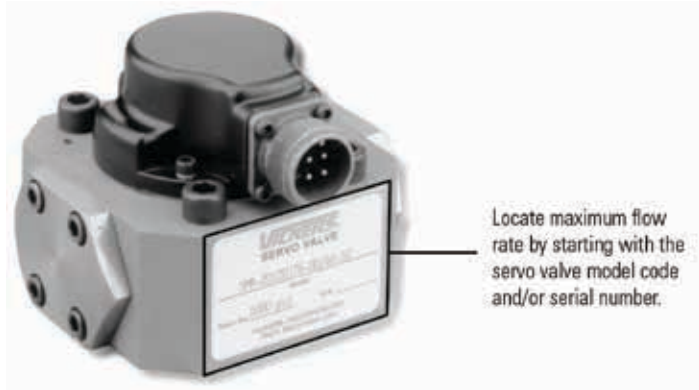


Figure 1. Locate serial number to determine flow rating.

Step 2: Choose the proper AxisPro replacement valve

Choose the proper AxisPro Level 1 replacement valve according to desired flow (note single-stage AxisPro valves have flows rated at 1000 psid pressure drop across the valve, i.e. 500 psi per metering edge):

- Flow < 10 gpm: choose the Eaton KBS1-3 proportional directional valve Size D03 mounting pattern
- Flow > 10 gpm: choose the Eaton KBS1-5 proportional directional valve Size D05 mounting pattern

To assist in choosing the right AxisPro model configuration, please refer to the appropriate AxisPro product catalogs, available on PowerSource.

Step 3: Define conditions, output and electrical connections

- 1. Define the AxisPro valve failsafe condition:** Servo valves typically define the failsafe condition as all ports blocked in the neutral position. Because proportional valves are driven by a solenoid in only one direction, it is necessary to match the correct failsafe condition of the servo valve in the AxisPro valve. Choose the forced position as an all ports blocked position for the new AxisPro valve.
- 2. Select the AxisPro valve spool and sleeve:** Spool/sleeve settings will vary according to the flow rate of the valve. Choose the correct flow when setting the valve by determining these parameters:
 - a. Symmetric vs. Asymmetric (valves are typically symmetric, but verify with your valve)
 - b. Correct failsafe position
 - c. Select flow rate. Using the spool sleeve codes, choose the correct flow rate that allows for at least the desired flow
- 3. Select command signal**
 - a. Select 1: +/- 10V Voltage command signal
 - b. Select 2: 4-20mA current command signal
 - c. Select 3: +/- 10mA current command signal
 - d. Select 4: +/- 15mA current command signal
 - e. Select 5: +/- 20mA current command signal
- 4. Select monitor output:** Use monitor output to locate the position of the valve spool for the PLC. Typical monitor output involves using the +/- 10V voltage feedback signal. The spool position may or may not be used in the existing system – ignore if not used/needed by the PLC. The AxisPro valve internally controls spool position, this external feedback is optional only for monitoring purposes.
 - a. Select 1: +/- 10V voltage feedback signal
 - b. Select 2: 4-20mA current feedback signal
- 5. Select electrical connection:** Typical use involves the 7 pin connector with plug
 - a. Select E: 7 pin connector with plug

Step 4: Determine where motion control is handled: PLC or card

Motion is typically controlled through the servo card or through the PLC.

- If motion is controlled through the servo card, talk to your Eaton representative about using an AxisPro level 2 valve as a replacement valve
- If motion is controlled through the PLC:
 - Ensure the PLC parameter scaling is equivalent to the AxisPro valve parameters
 - Verify that the PLC PID parameters are performing well/as expected

Step 5: Mount the AxisPro valve in place of the servo valve

1. Verify installation dimensions for desired AxisPro valve model code
 - a. AxisPro valves may require a larger size envelope than servo valves
 - b. Verify there is adequate space to accommodate the AxisPro valve by measuring space around the mounted servo valve (Figure 2)

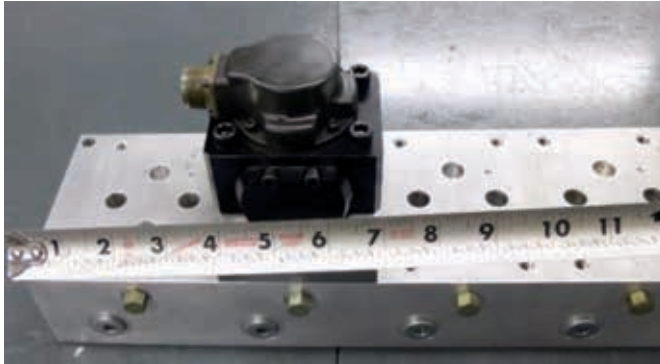


Figure 2. Verify adequate space to accommodate the AxisPro valve.

2. Determine required adapter plate
 - a. An AxisPro KBS1-3 valve requires a D03-to-S04 manifold adapter plate
 1. Order a D03-to-S04 manifold adapter plate
 2. Order four mounting screws:
 - a. UNC #10-24 x 1.00 long SHCS, or
 - b. ISO 6H M5-0.8 x 25mm SHCS mounting screws
 3. Order four O-rings (typically Viton 75 Durometer-012)
 - b. An AxisPro KBS1-5 valve requires a D05-to-S04-manifold adapter plate is required
 1. Order a D05-to-S04 manifold adapter plate
 2. Order four mounting screws, either:
 - a. UNC #10-24 x 1.00 long SHCS, or
 - b. ISO 6H M5-0.8 x 25mm SHCS
 - c. Order four O-rings (typically Viton 75 Durometer-014)
3. Remove servo valve by removing the 4 mounting bolts (Figure 3)

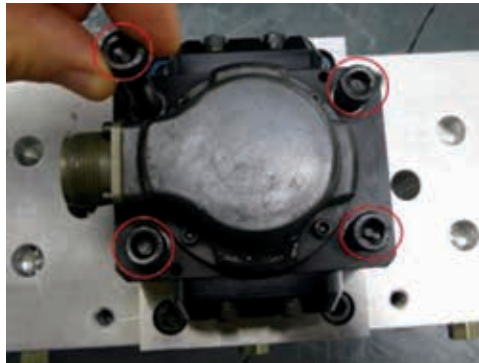


Figure 3. Remove the four mounting bolts to remove the servo valve.

4. Mount the adapter plate where the servo valve had been located (Figure 4)

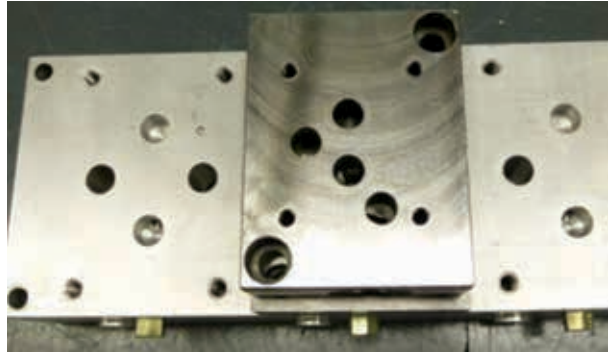
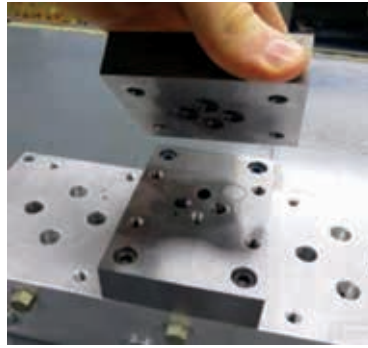


Figure 4. Mount adaptor plate to servo valve location.

5. Mount the AxisPro valve to the adapter plate (Figure 5)

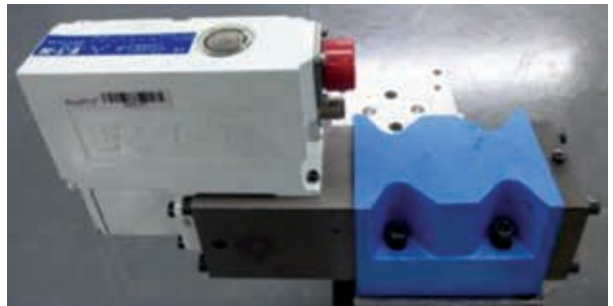
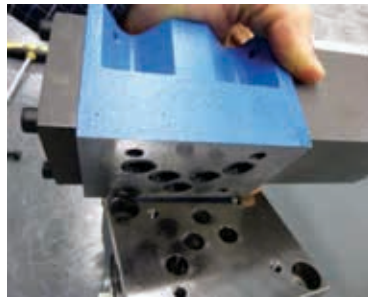


Figure 5. Mount the AxisPro valve to the adaptor plate.

Step 6. Wire the AxisPro valve

Note: While no external amplifier card is needed, the AxisPro valve does require a 24VDC power supply.

1. Supply 24V volts (DC) and rated to 3.5 Amps to AxisPro valve (Figure 6 and Figure 7).
 - a. Recommended power cable sizes for 24V are 0.75 mm² (18 AWG) up to 20m (65 ft.) and 1.00 mm² (16 AWG) up to 40 m (130 ft.).

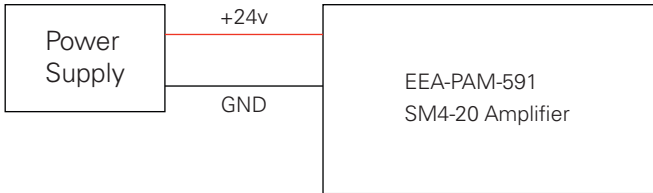


Figure 6. Wiring prior to mounting the AxisPro valve.

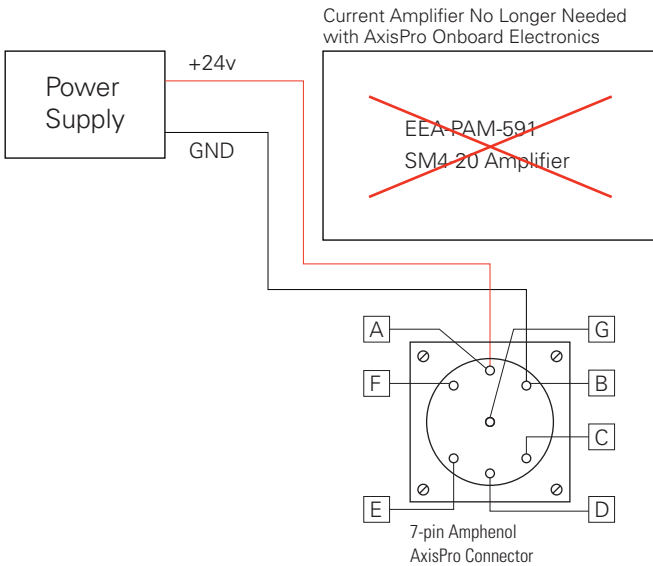


Figure 7. Wiring after mounting the AxisPro valve.

2. Connect input command signal from PLC to AxisPro valve.
 - a. Command signal goes to pin D with a ground reference at pin E (Figure 8 and Figure 9).

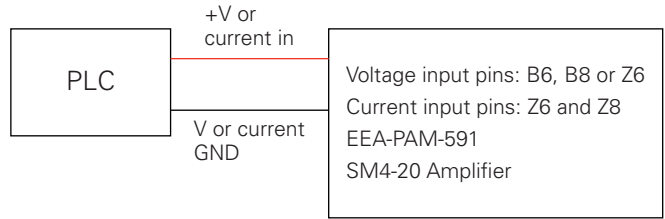


Figure 8. Before mounting the AxisPro valve, with no external feedback.

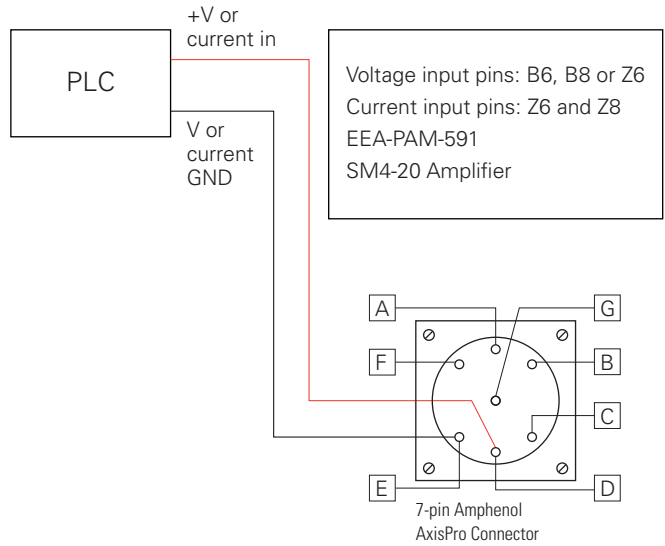
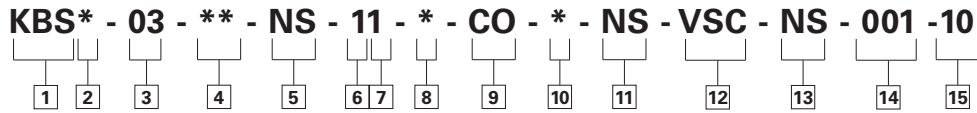


Figure 9. After mounting the Level 1 AxisPro valve.

Appendix

Model codes



2 Control Level

2 – Level 1 plus Network enabled and DS408 control modes

3 – Level 2 plus Integrated pressure and temperature sensors

6 Command Signal

1 – +/- 10V voltage command signal

Note: Command signal is shipped with 1 configuration. You may configure to other command signal options using Pro-FX: Configure software.

2 – 4-20mA current command signal

3 – +/- 10mA current command signal

4 – +/- 15mA current command signal

9 – Command over Fieldbus

7 Monitor Output

1 – ±10V voltage feedback signal

Note: Monitor Output is shipped with 1 setting. You may configure to other monitor signal options using Pro-FX: Configure software.

2 – 4-20mA current feedback signal

9 – Feedback over Fieldbus

8 Electrical Connection

C – 7 pin connector without plug

E – 7 pin connector with plug

Note: You may reconfigure pin “C” as the enable signal using Pro-FX configure software.

9 Digital Communication Interface

CO – CANOpen

10 External Sensor

A – 4 4-20mA external sensor analog inputs and 2 discrete inputs

D – 1 SSI external digital sensor input

11 Customer Application Programming Space

NS – Not Selected

CW – CODESYS White Space

12 Control Mode

VSC – Valve spool position control

Note: Control Mode is shipped in valve spool closed loop position control (VSC) configuration. You may reconfigure to other control mode options using Pro-FX: Configure software.

DPC - DS408 Drive Position Control Mode Enabled

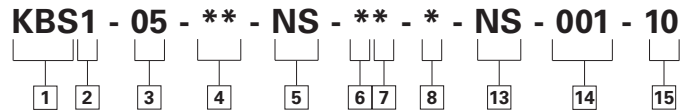
DSC – DS408 Drive Speed Control Mode Enabled

DFP – DS408 Drive Force/Pressure Control Mode Enabled

DPO – Eaton Custom Drive Pressure / Flow Control Mode Enabled

To find available product configurations go to www.eaton.com/AxisPro

Model codes



1 Valve Type

KBS – Servo performance proportional valve with integral amplifier and electronic feedback

2 1 – Level 1

3 Interface

05 – ISO 4401, size 05-04-0-05 ANSI/B93.7M-D05

4 Spool/Sleeve

- 1** – Symmetric -100ℓ/min - At Failsafe -all ports blocked (legacy 92L100)
- 2** – Symmetric - 80ℓ/min - At Failsafe -all ports blocked (legacy 92L80)
- 3** – Symmetric - 50ℓ/min - At Failsafe -all ports blocked (legacy 92L50)
- 4** – Symmetric - 25ℓ/min - At Failsafe -all ports blocked (legacy 92L25)
- 5** – Symmetric -100ℓ/min - At Failsafe -P port blocked, A,B,T connected (legacy 96L100)
- 6** – Symmetric - 80ℓ/min - At Failsafe -P port blocked, A,B,T connected (legacy 96L80)

- 7** – Symmetric - 50ℓ/min - At Failsafe -P port blocked, A,B,T connected (legacy 96L50)
- 8** – Symmetric - 25ℓ/min - At Failsafe -P port blocked, A,B,T connected (legacy 96L25)
- 17** – Asymmetric -100ℓ/min A; 70ℓ/min B - At Failsafe -all ports blocked (legacy 92L100N70)
- 18** – Asymmetric -100ℓ/min A; 50ℓ/min B - At Failsafe -all ports blocked (legacy 92L100N50)
- 19** – Asymmetric -100ℓ/min A; 25ℓ/min B - At Failsafe -all ports blocked (legacy 92L100N25)
- 20** – Asymmetric - 50ℓ/min A; 25ℓ/min B - At Failsafe -all ports blocked (legacy 92L50N25)
- 21** – Asymmetric -100ℓ/min A; 70ℓ/min B - At Failsafe -P port blocked, A,B,T connected (legacy 96L100N70)
- 22** – Asymmetric -100ℓ/min A; 50ℓ/min B - At Failsafe -P port blocked, A,B,T connected (legacy 96L100N50)

- 23** – Asymmetric -100ℓ/min A; 25ℓ/min B - At Failsafe -P port blocked, A,B,T connected (legacy 96L100N25)
- 24** – Asymmetric - 50ℓ/min A; 25ℓ/min B - At Failsafe -P port blocked, A,B,T connected (legacy 96L50N25)
- 25** – 2-gain Symmetric -10ℓ/min @ 40% -100ℓ/min @100% -@Failsafe -all ports blocked (legacy 92L10T100)
- 26** – 2-gain Symmetric – 5ℓ/min @ 40% - 50ℓ/min @100% -@Failsafe -all ports blocked (legacy 92L05T50)
- 27** – 2-gain Symmetric –10ℓ/min @ 40% -100ℓ/min @100% -@Failsafe -P port blocked, A,B,T connected (legacy 96L10T100)
- 28** – 2-gain Symmetric – 5ℓ/min @ 40% - 50ℓ/min @100% -@Failsafe -P port blocked, A,B,T connected (legacy 96L05T50)

5 Valve Special Feature

NS – Not Selected

6 Command Signal

- 1** – +/- 10V voltage command signal
- 2** – +/- 4-20mA current

- 3** – +/- 10mA current command signal
- 4** – +/- 15mA current command signal
- 5** – +/- 20mA current command signal

7 Monitor Output

- 1** – ±10V voltage feedback signal
- 2** – 4-20mA current feedback signal

8 Electrical Connection

- C** – 7 pin connector without plug
- E** – 7 pin connector with plug
- H** – As E but with pin “C” used for enable signal
- R** – As C but with pin “C” used for enable signal

13 Electrical Special Feature

NS – Not Selected

14 Software Revision

XXX – Software Revision

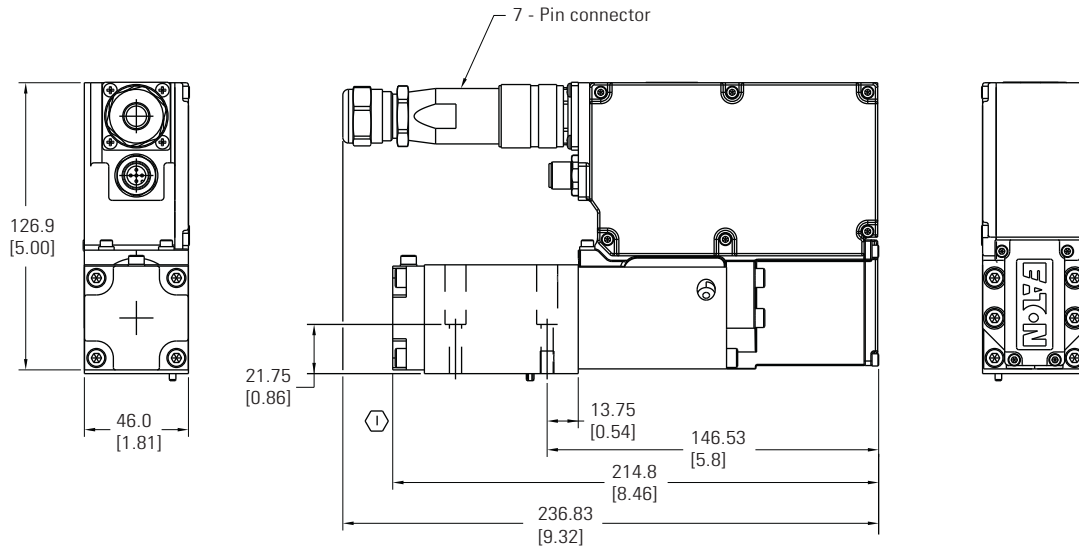
15 Design Number

10 series

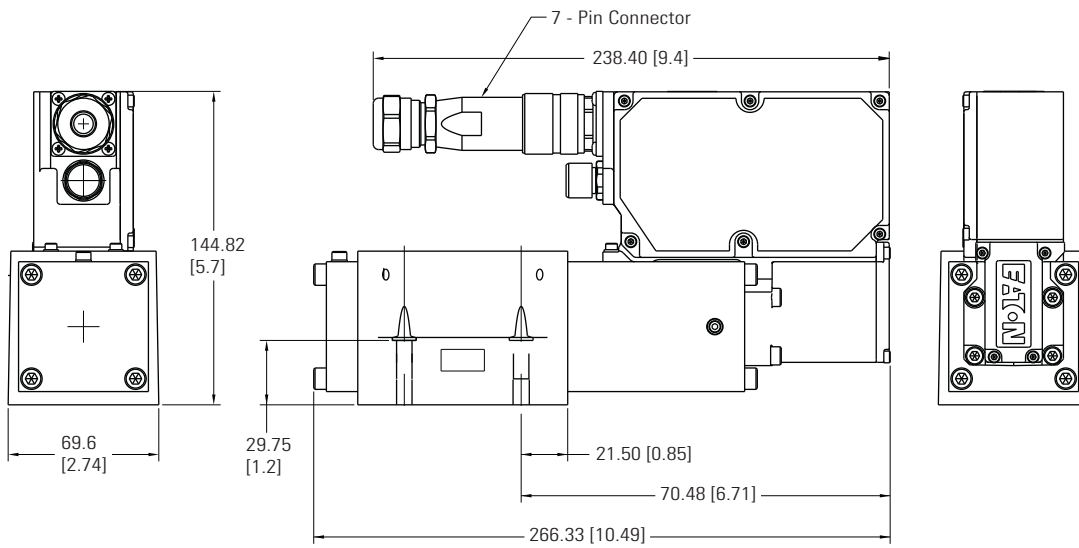
To find available product configurations go to www.eaton.com/AxisPro

Installation dimensions

KBS1-03



KBS1-05



Mounting surfaces

KBS1-03

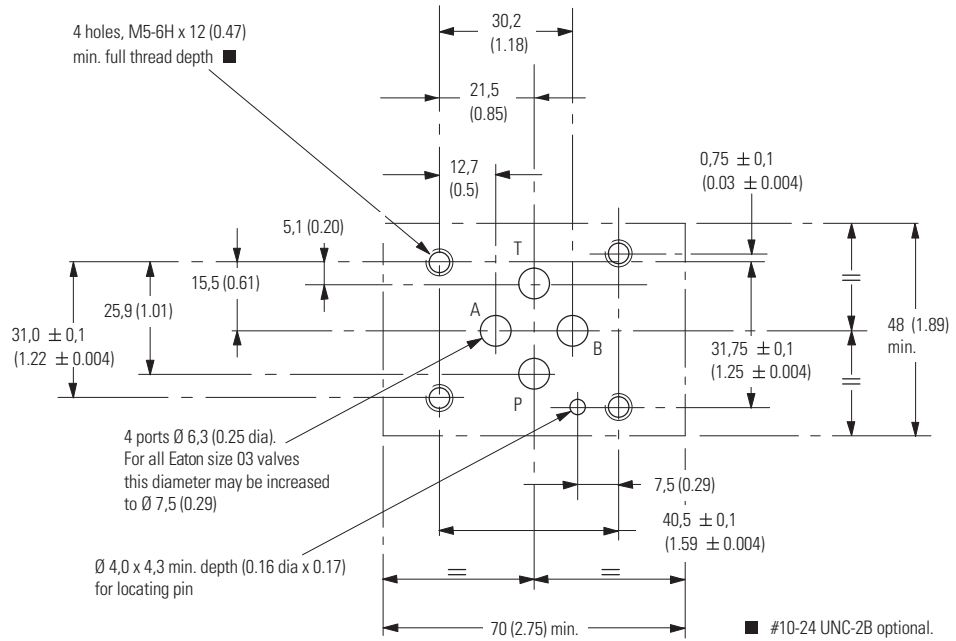
Mounting Surfaces to ISO 4401 (Size 03)

This interface conforms to:
ISO 4401-03-02-0-94
plus location pin hole

ANSI/B93.7M (and NFPA)
size 03

CETOP R35H4.2-4-03, plus
location pin hole

DIN 24340 Form A6 plus
location pin hole



KBS1-05

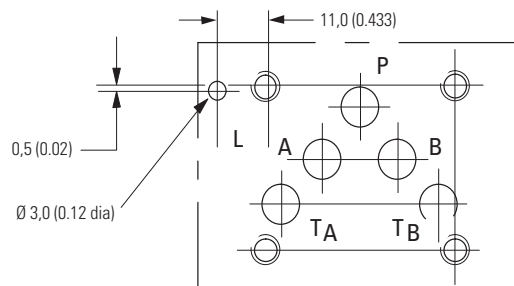
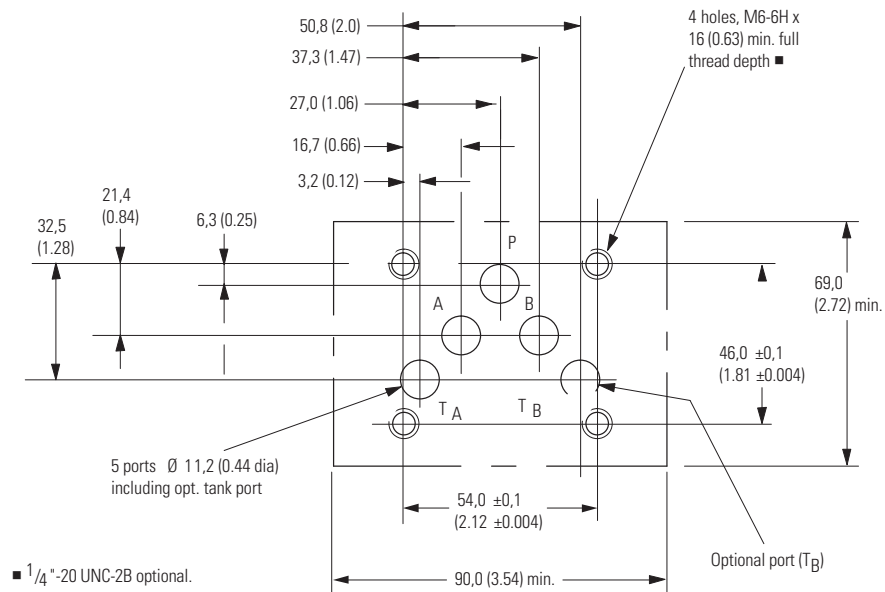
Mounting Surface Interface to ISO 4401 (Size 05)

This interface conforms to:
ISO 4401-05-04-0-05

ANSI/B93.7M (and NFPA)
size 05

CETOP R35H4.2-05

DIN 24340 Form A10

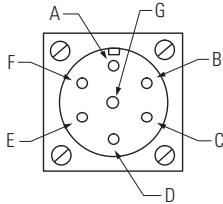


Operating data

KBS1-03

Connector Details

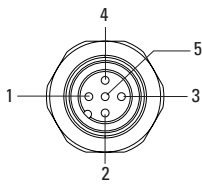
7-pin plug connector



Pin	Description
A	Power supply positive (+)
B	Power supply 0V and current command return
C	Not connected (Field 8 = C,E)
C	Valve enable (Field 8 = H,R)
D	Command signal (+V or current in)
E	Command signal (-V or current GND)
F	Output monitor
G	Protective earth

Note:
Present at location 1 of the electronics enclosure (see figure 1 below).
To ensure EMI protection use only metal shielded mating connectors. Mating 7-pin (connector) is Eaton part number 934939

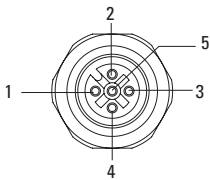
M12 5-pin CAN Connector (Male)



Pin	Description
1	CAN shield
2	Not Connected
3	Power supply 0V
4	CAN High
5	CAN Low

Note:
Present at location 2 and 4 of the electronics enclosure (see figure 1 below). Selection based on model code field number 9, present when CO option enabled.
To ensure EMI protection use only metal shielded mating connectors
Use only shielded twisted pair (STP) cables for mating connection.

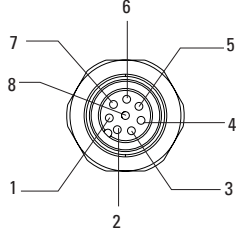
M12 5-pin CAN Connector (Female)



Pin	Description
1	CAN shield
2	Not Connected
3	Power supply 0V
4	CAN High
5	CAN Low

Note:
Present at location 5 of the electronics enclosure (see figure 1 below). Selection based on model code field number 9, present when CO option enabled.
To ensure EMI protection use only metal shielded mating connectors
Use only shielded twisted pair (STP) cables for mating connection.

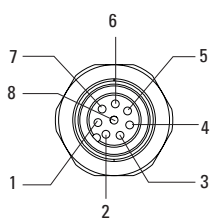
M12 8-pin External Digital Sensor



Pin	Description
1	Power supply 0V
2	+24V Supply
3	CLK-
4	DATA-
5	DATA+
6	Not Connected
7	CLK+
8	Not Connected

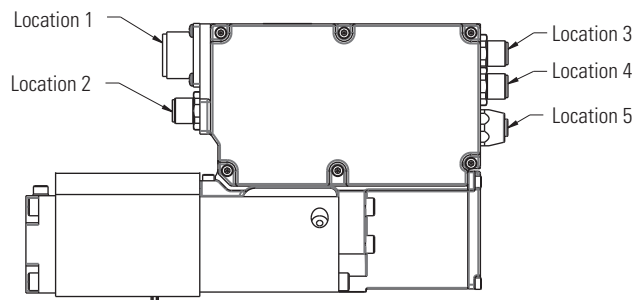
Note:
Present at location 3 of the electronics enclosure (see figure 1 below). Selection based on model code field number 10, present when D option enabled.
To ensure EMI protection use only metal shielded mating connectors
24V to Power supply 0V (pin 2, 1) short circuit protected (max current 1.5 A).
Use only shielded twisted pair (STP) cables for mating connection.

M12 8-pin External Analog Sensor Port



Pin	Description
1	Speed Sensor Input1
2	Speed Sensor Input2
3	4-20mA External Sensor Signal1
4	+15V Supply
5	4-20mA External Sensor Signal2
6	Power supply 0V
7	4-20mA External Sensor Signal3
8	4-20mA External Sensor Signal4

Note:
Present at location 3 of the electronics enclosure (see figure 1 below). Selection based on model code field number 10, present when A option enabled.
To ensure EMI protection use only metal shielded mating connectors
15V to Power supply 0V (pin 4, 6) short circuit protected (max current 500 mA).



Note: See above for connector plugs specifications.

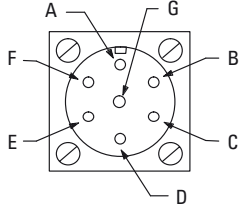
Figure 1

Operating data

KBS1-05

Connector Details

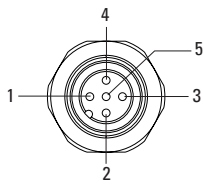
7-pin plug connector



Pin	Description
A	Power supply positive (+)
B	Power supply 0V and current command return
C	Not connected (Field 8 = C,E)
C	Valve enable (Field 8 = H,R)
D	Command signal (+V or current in)
E	Command signal (-V or current GND)
F	Output monitor
G	Protective earth

Note:
Present at location 1 of the electronics enclosure (see figure 1 below).
To ensure EMI protection use only metal shielded mating connectors. Mating 7-pin (connector) is Eaton part number 934939

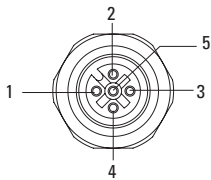
M12 5-pin CAN Connector (Male)



Pin	Description
1	CAN shield
2	Not Connected
3	Power supply 0V
4	CAN High
5	CAN Low

Note:
Present at location 2 and 4 of the electronics enclosure (see figure 1 below). Selection based on model code field number 9, present when CO option enabled.
To ensure EMI protection use only metal shielded mating connectors
Use only shielded twisted pair (STP) cables for mating connection.

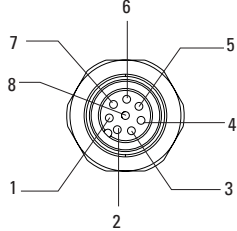
M12 5-pin CAN Connector (Female)



Pin	Description
1	CAN shield
2	Not Connected
3	Power supply 0V
4	CAN High
5	CAN Low

Note:
Present at location 5 of the electronics enclosure (see figure 1 below). Selection based on model code field number 9, present when CO option enabled.
To ensure EMI protection use only metal shielded mating connectors
Use only shielded twisted pair (STP) cables for mating connection.

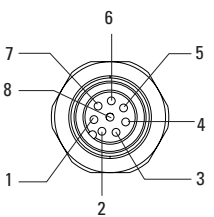
M12 8-pin External Digital Sensor



Pin	Description
1	Power supply 0V
2	+24V Supply
3	CLK-
4	DATA-
5	DATA+
6	Not Connected
7	CLK+
8	Not Connected

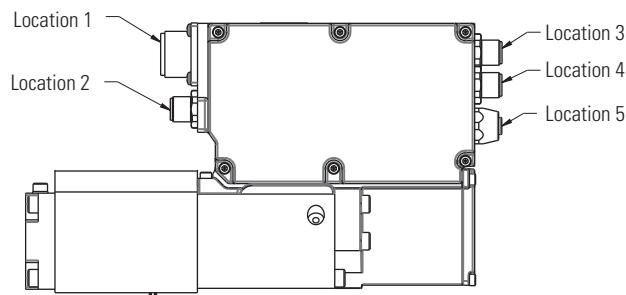
Note:
Present at location 3 of the electronics enclosure (see figure 1 below). Selection based on model code field number 10, present when D option enabled.
To ensure EMI protection use only metal shielded mating connectors
24V to Power supply 0V (pin 2, 1) short circuit protected (max current 1.5 A).
Use only shielded twisted pair (STP) cables for mating connection.

M12 8-pin External Analog Sensor Port



Pin	Description
1	Speed Sensor Input1
2	Speed Sensor Input2
3	4-20mA External Sensor Signal1
4	+15V Supply
5	4-20mA External Sensor Signal2
6	Power supply 0V
7	4-20mA External Sensor Signal3
8	4-20mA External Sensor Signal4

Note:
Present at location 3 of the electronics enclosure (see figure 1 below). Selection based on model code field number 10, present when A option enabled.
To ensure EMI protection use only metal shielded mating connectors
15V to Power supply 0V (pin 4, 6) short circuit protected (max current 500 mA).



Note: See above for connector plugs specifications.

Figure 1

