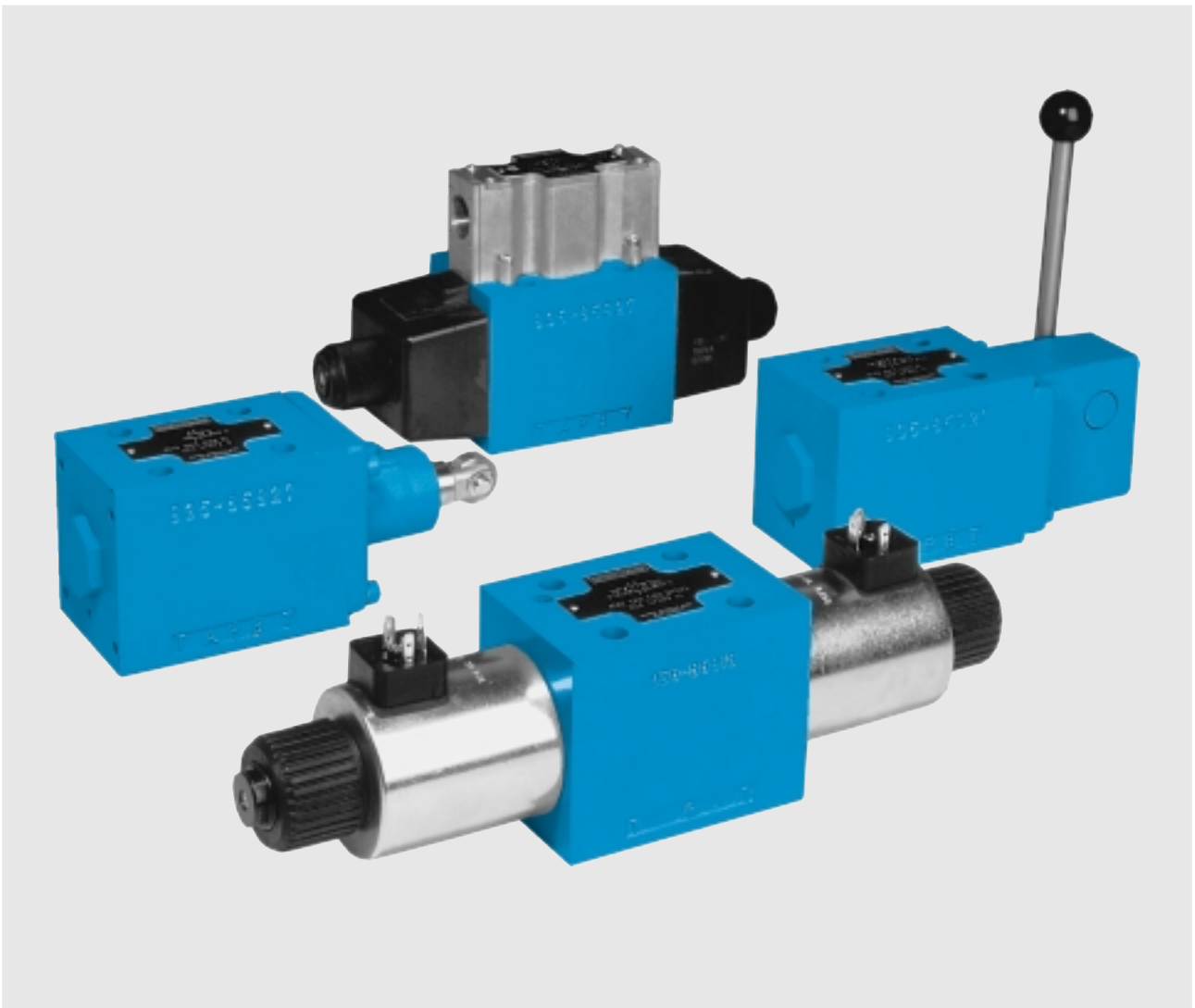


DENISON HYDRAULICS

Directional Control Valves

Series A4D02 – Design B, NFPA D05, Cetop 5



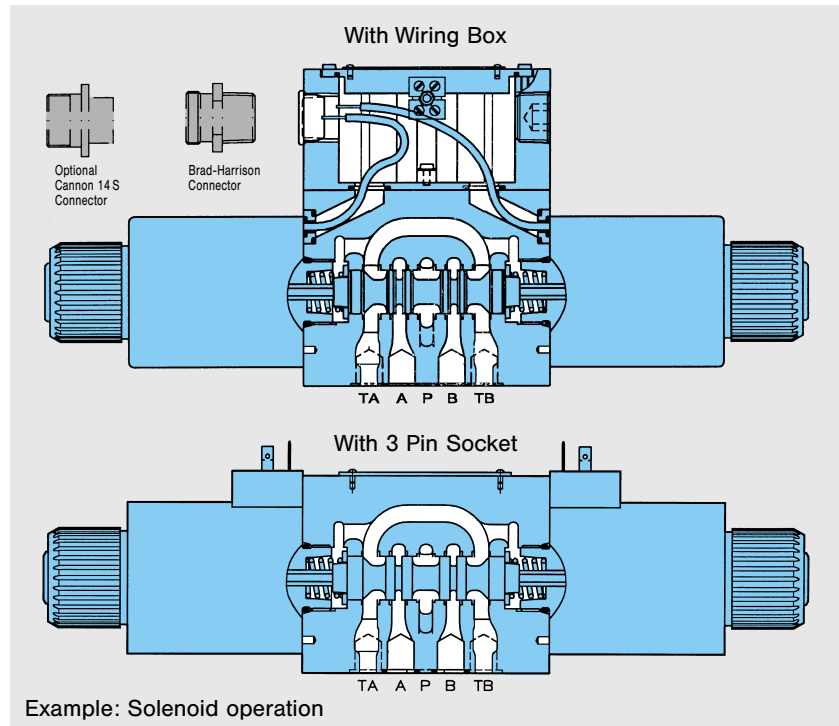
Publ. 4-AM 3300-B, replaces 4-AM 3300-A

DENISON Hydraulics

FEATURES, DESCRIPTION

FEATURES

- CSA certificate as standard.
- Low pressure drop at high flow rates, due to optimized flow paths in body and spool design. 5-chamber technology.
- Mounting configuration conforming to Cetop R35H, ISO 4401 and DIN 24340.
- Wide variety of spool types available, including detent.
- Interchangeability of spools and bodies due to high precision manufacturing processes.
- Soft Shift version (Code G3).
- Change of solenoid coil is fast and simple without any risk of oil leakage.
- Solenoid coil can be turned to any position.
- Pressure up to 210 bar (3000 psi) allowable on tank port as standard.
- All components designed and tested for a minimum life of 10 million cycles.
- Every valve is factory tested prior to delivery.
- Worldwide DENISON Service.



DESCRIPTION

DENISON's direct operated Directional Control Valve A4D02 conforms to Cetop 5 standard interface.

It is designed to be subplate or manifold mounted and to be used in conjunction with the stack valve system (see also publication 8-EN 5750).

Both the valve mounting interface and electrical connection methods available conform to the accepted International Standards Cetop, ISO and DIN.

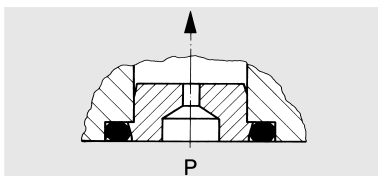
The five annuli body design gives a precise guide for the spool throughout its stroke. For any application not covered by the ordering code details, please contact your local DENISON office.

OPERATION

The Directional Control A4D02 consists principally of a spool, body, and either one or two actuators, depending on the application. The spool is shifted either by use of solenoids, mechanical or pneumatic actuator, allowing oil under pressure to flow from Port P to either port A or Port B and subsequently connecting the alternate port to tank.

De-energizing the actuator allows the spring to return the spool to the centre or offset position. The manual override pin(s) at the end of the solenoid tubes allows manual operation of the spool.

ORIFICE



In certain operating conditions a higher flow can take place than the functional limit of the valve permits.

In order to limit the flow through the valve it is recommended to fit an orifice-plug in the P-port.

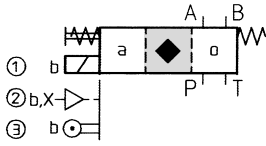
For order details refer to page 3 or 4.

SYMBOLS

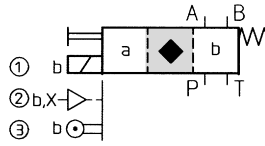
- ① 1-Solenoid operation
 - ② pneumatic operation
 - ③ Cam operation
- } A-Side

- ① 1-Solenoid operation
 - ② pneumatic operation
 - ③ Cam operation
- } B-Side

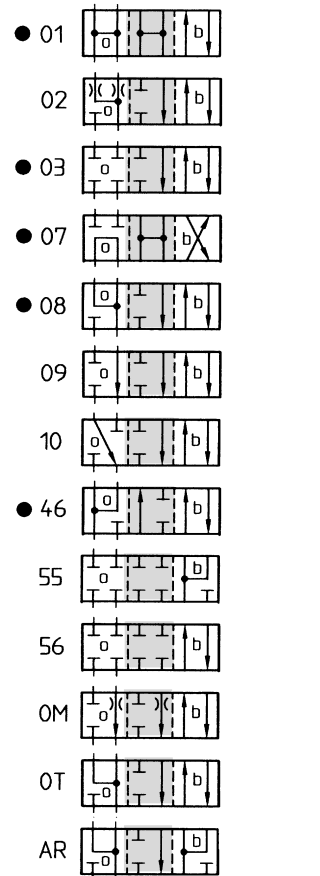
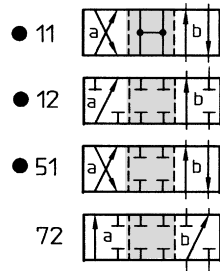
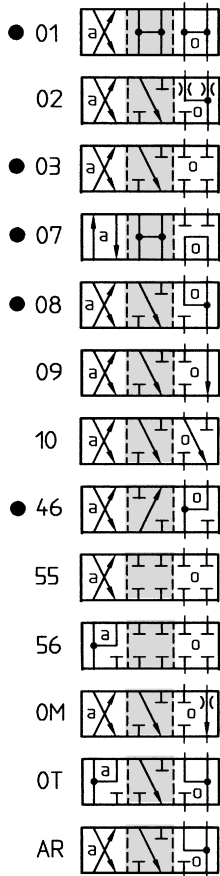
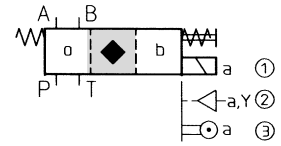
Spool position 06
Spring centering



Spool position 01
Spring offset



Spool position 05
Spring centering



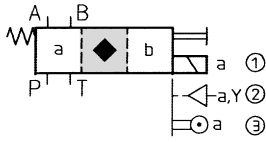
- standard spools
- ◆ transfer configuration only (not switched position)

SYMBOLS

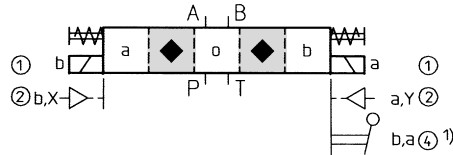
- ① 1-Solenoid operation
 - ② pneumatic operation
 - ③ Cam operation
- } B-Side

- ① 2-Solenoid operation
- ② pneumatic operation, both sides
- ④ Lever operation

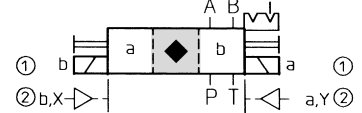
Spool position 02
Spring offset



Spool position 03
Spring centering

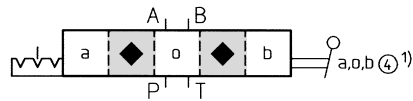


Spool position 09
2 pos. detents



- 11
- 12
- 51
- 72

Spool position 07
3 pos. detents



- 01
- 02
- 03
- 07
- 08
- 09
- 10
- 46
- 55
- 56
- 0M
- 0T
- AR

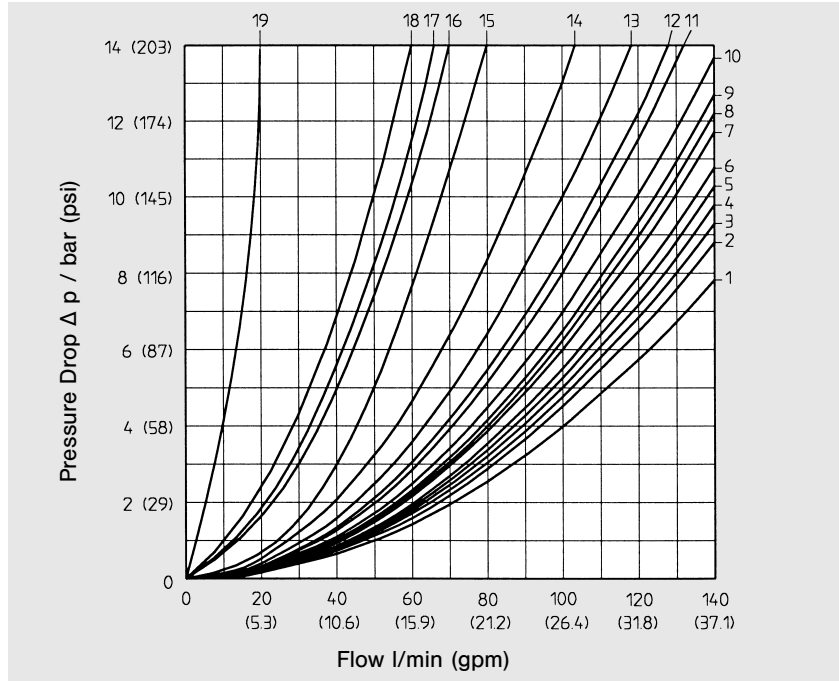
- 11
- 51
- 01
- 03
- 08
- 11
- 12
- 51

1) Lever operation only with spools 01, 03, 07, 08

- standard spools
- ◆ transfer configuration only (not switched position)

PRESSURE DROP

PRESSURE DROP



All performance data is recorded with port TA connected to tank. Additionally connecting also TB to tank, pressure drop can be reduced by 1.5... 3 bar. Oil temperature 50°C (122°F); oil viscosity 40 cSt.

Spool Type	Flow Direction				o-Position					b-Pos.		a-Pos.
	P-A	P-B	A-T	B-T	P-T	P-A	P-B	A-T	B-T	P-A	P-B	
01	1	1	4	10	14							
02	3	3	4	7				19	19			
03	3	3	5	8								
07	12	12	7	13	13							
08	3	3	3	6				17	18			
09	3	3	4	6					17			
10	3	3	3	9				16				
11	5	5	9	11								
12	4	4										
46	1	1	5	9								
51	5	5	10	11								
55	9	6	6							12		
56	7	7		12							13	
72	4	6										
0M	3	3	4	7								
0T	6	11	9			15		13	13			
AR	12	5	10				15	11	11			

CHARACTERISTICS, FUNCTIONAL LIMITS

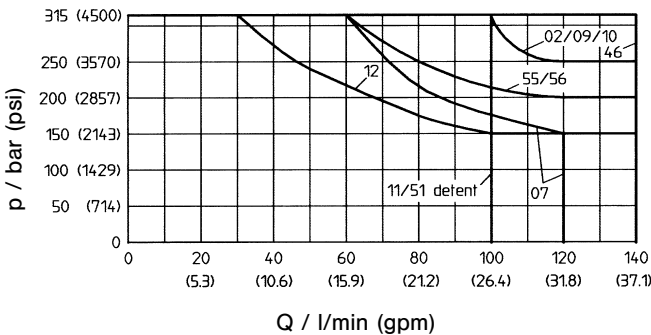
CHARACTERISTICS

- | | |
|--|---|
| <ul style="list-style-type: none"> • Design • Type of mounting • Mounting position • Ambient temperature range • Operating pressure (P, A, B) | <ul style="list-style-type: none"> Sliding spool valve Subplate Optional but horizontal optimal – 20... + 50 °C (0... 122 °F) up to 315 bar (4500 psi) up to 350 bar (5000 psi) on request |
| <ul style="list-style-type: none"> • Permissible tank, pressure (T) • Max. flow • Fluid | <ul style="list-style-type: none"> up to 210 bar (3000 psi) DC solenoids up to 140 bar (2000 psi) AC solenoids 140 l/min (37 gpm) see diagrams Mineral oil according to DIN 51524 and 51525
(For other fluids please consult DENISON) |
| <ul style="list-style-type: none"> • Viscosity range • Fluid temperature range • Contamination level | <ul style="list-style-type: none"> 10... 650 cSt, optimal 30 cSt – 18... + 80 °C (0... 176 °F) Max. permissible contamination level
confirming to NAS 1638 Class 8 (Class 9 for
15 Micron and smaller) or ISO 17/14 |

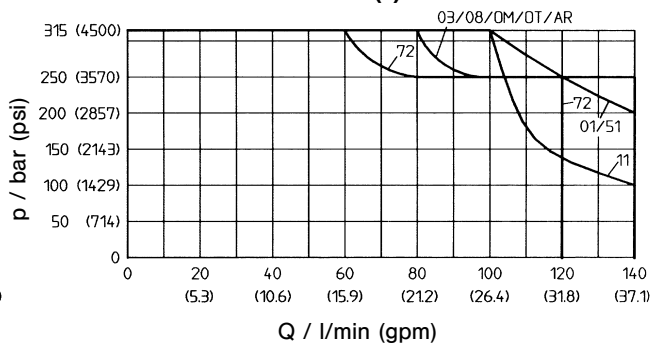
FUNCTIONAL LIMITS

The functional limits have been obtained with warm solenoid condition and at 10% undervoltage from the selected nominal value.
All flow data given is considered for 2 flow directions (e. g. P→B and simultaneously from A→T).
For single flow direction (4-Way-Valve used as 3-Way-Valve) the permissible flow rates will be reduced by as much as 25...30% in comparison to the data below.

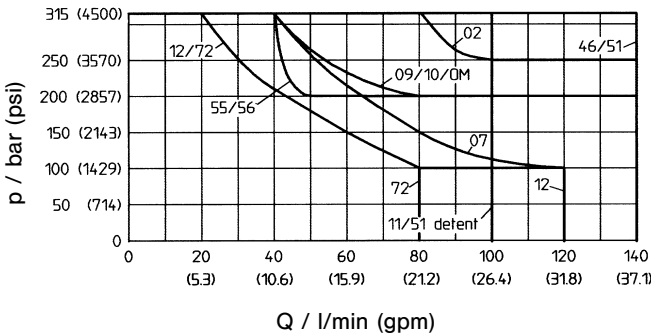
Valve with DC Solenoid(s)



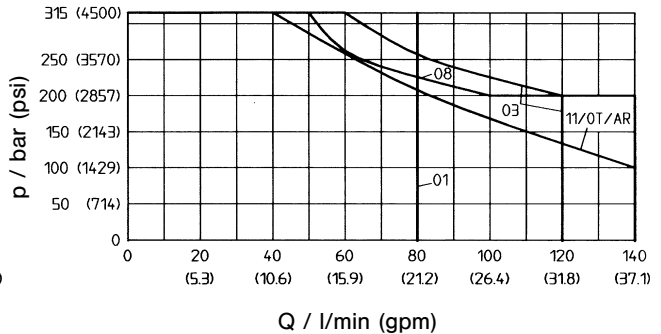
Valve with DC Solenoid(s)



Valve with AC Solenoid(s)



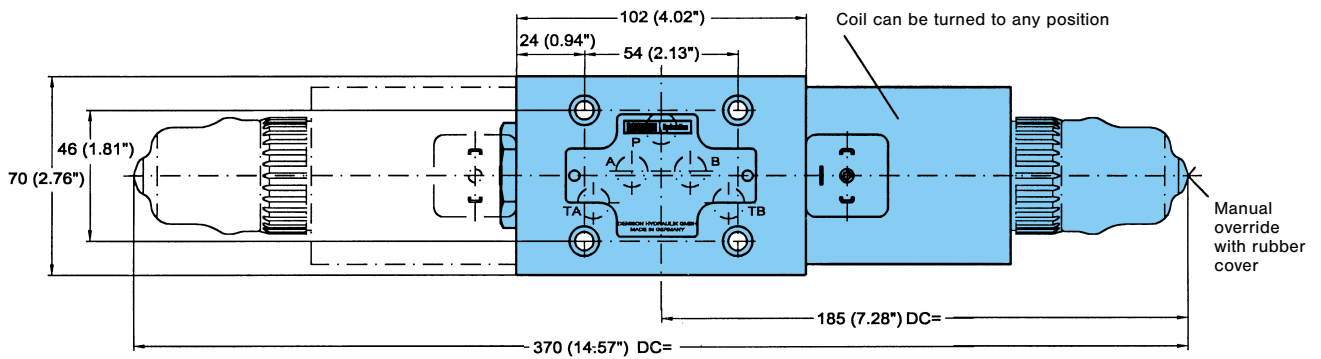
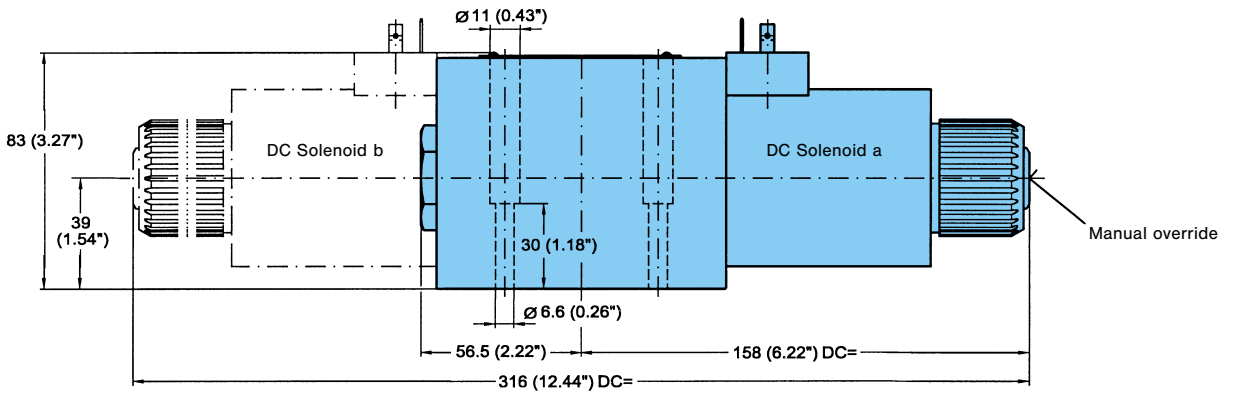
Valve with AC Solenoid(s)



If the performance characteristics outlined above do not meet your requirements, please consult your local DENISON Office.

1- AND 2-SOLENOID DC OPERATED VERSIONS, 3 PIN SOCKET

- Nominal voltage See ordering code on page 3
- Power input 48 W
- Solenoid response time
 - sol. energized ... 58 ms
 - sol. de-energized ... 39 ms
- Permissible voltage difference + 5% ... - 10%
- Max. coil temperature + 180°C (356°F)
- Temperature class H
- Relative operating period 100 %
- Type of protection IP 65
- Cycle (1/H) ... 13.000
- Weight (1 solenoid version) 5.2 kg (11.4 lbs)
- (2 solenoid version) 6.6 kg (14.5 lbs)



Port function
 P = Pressure
 T = Tank
 A & B = User

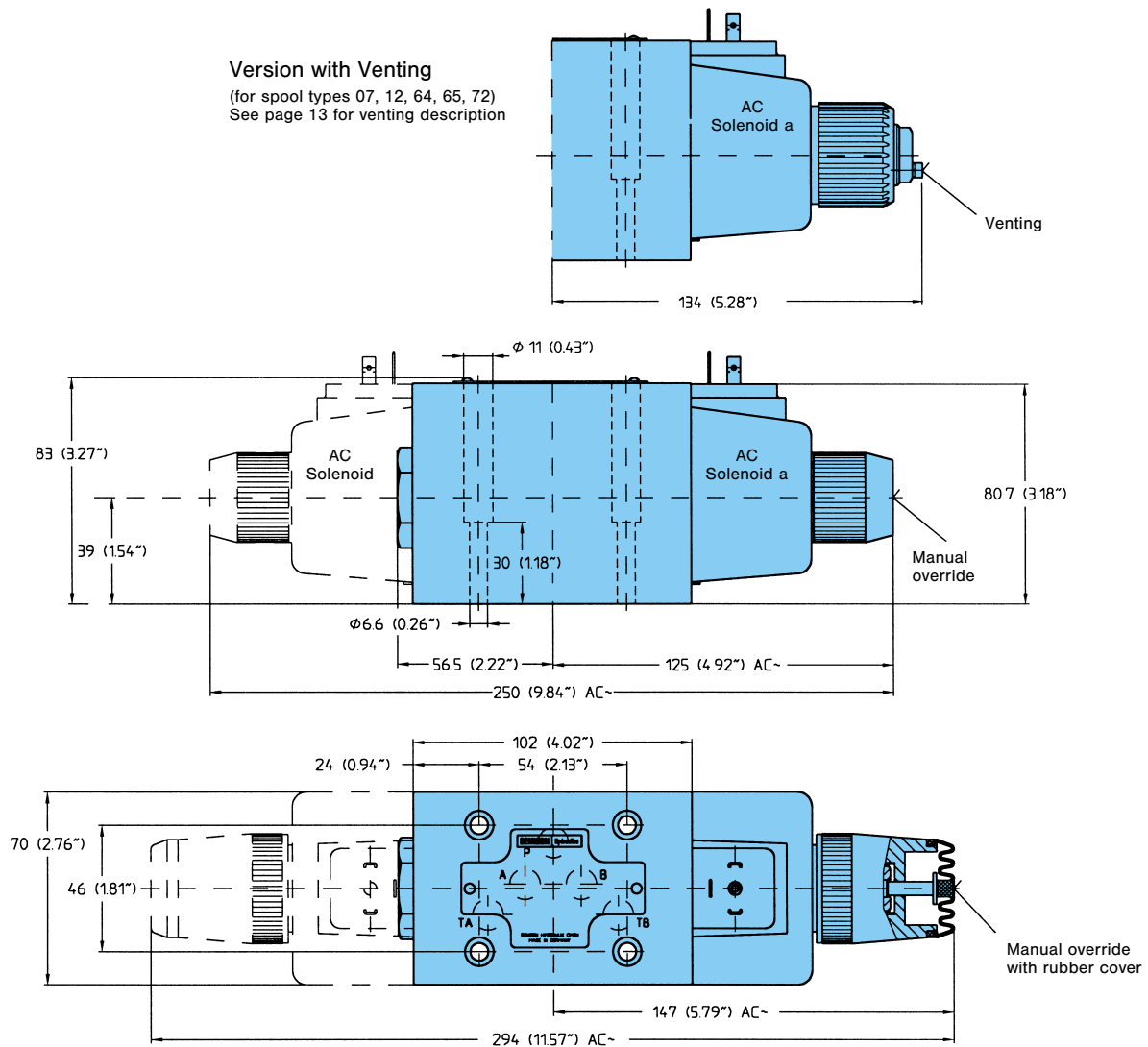
Seals for ports P, T, A, B

12.42 x 1.78	691-00014-0
--------------	-------------

1- AND 2-SOLENOID AC OPERATED VERSIONS, 3 PIN SOCKET

• Nominal voltage	See ordering code on page 3
• Power input	43 W
• Holding (115 V / 60 Hz)	102 VA
• Inrush (115 V / 60 Hz)	518 VA
• Solenoid response time	
– sol. energized	... 25 ms
– sol. de-energized	... 18 ms
• Permissible voltage difference	+ 5 % ... – 10 %
• Max. coil temperature	+ 180 °C (356 °F)
• Temperature class	H
• Relative operating period	100 %
• Type of protection	IP 65
• Cycle (1/H)	... 6.500
• Weight (1 solenoid version)	4.4 kg (9.7 lbs)
(2 solenoid version)	5.2 kg (11.4 lbs)

Version with Venting
(for spool types 07, 12, 64, 65, 72)
See page 13 for venting description



Port function

P = Pressure
T = Tank
A & B = User

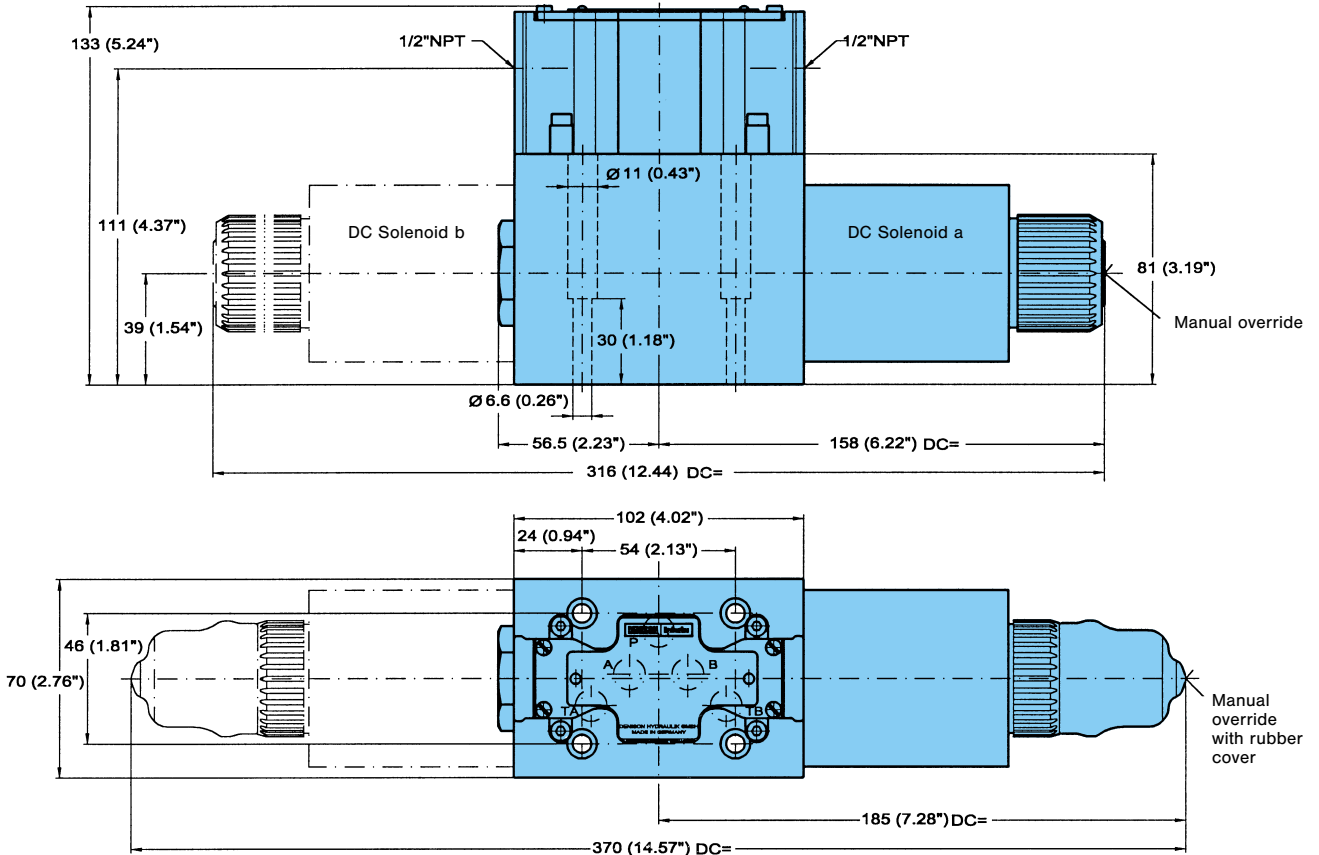
Seals for ports P, T, A, B

12.42 x 1.78

691-00014-0

1- AND 2-SOLENOID DC OPERATED VERSIONS, WIRING BOX

• Nominal voltage	See ordering code on page 3
• Power input	48 W
• Solenoid response time	
– sol. energized	... 58 ms
– sol. de-energized	... 39 ms
• Permissible voltage difference	+ 5% ... – 10 %
• Max. coil temperature	+ 180 °C (356 °F)
• Temperature class	H
• Relative operating period	100 %
• Type of protection	IP 65
• Cycle (1/H)	... 13.000
• Weight (1 solenoid version)	5.6 kg (12.4 lbs)
(2 solenoid version)	7.0 kg (15.5 lbs)



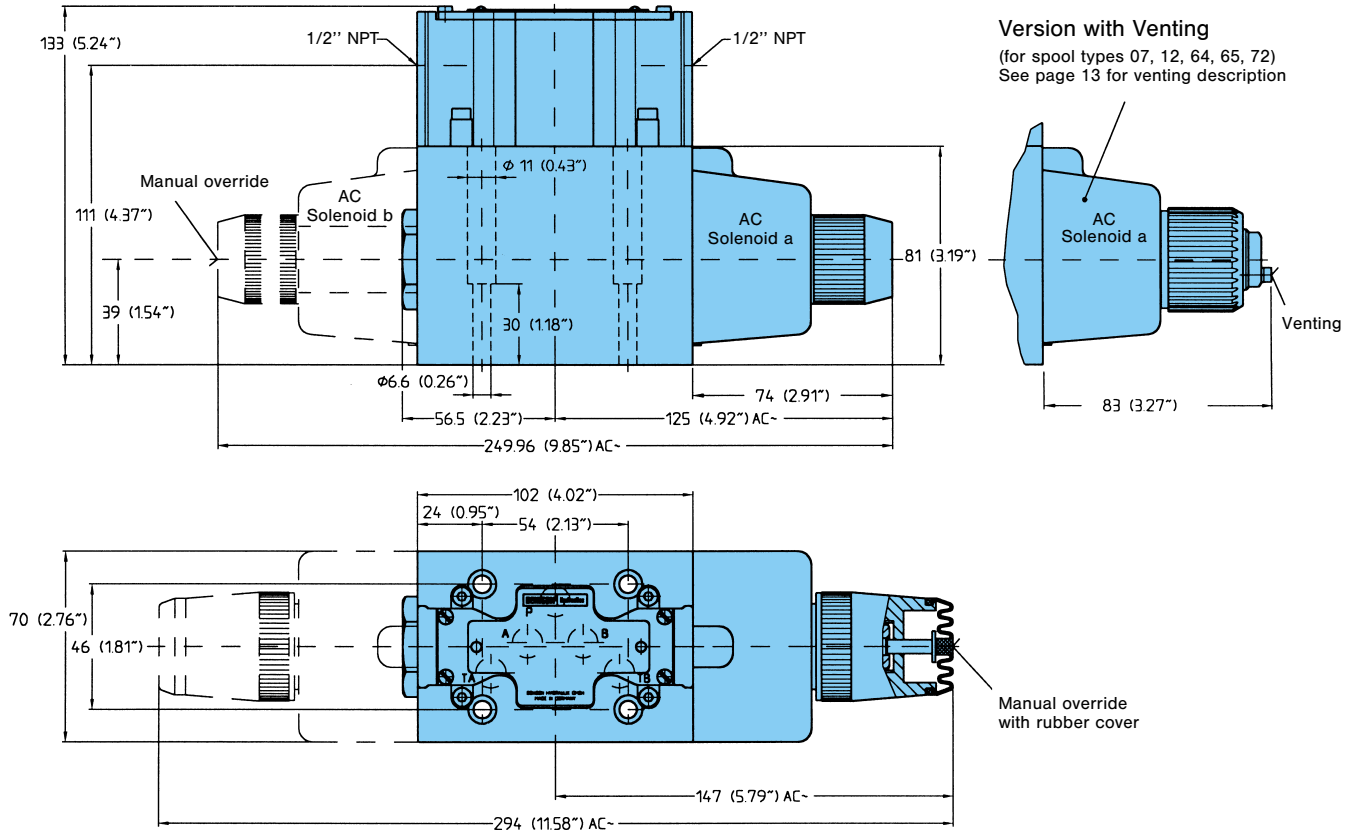
Port function
 P = Pressure
 T = Tank
 A & B = User

Seals for ports P, T, A, B

12.42 x 1.78	691-00014-0
--------------	-------------

1- AND 2-SOLENOID AC OPERATED VERSIONS, WIRING BOX

• Nominal voltage	See ordering code on page 3
• Power input	43 W
• Holding (115 V / 60 Hz)	102 VA
• Inrush (115 V / 60 Hz)	518 VA
• Solenoid response time	
– sol. energized	... 25 ms
– sol. de-energized	... 18 ms
• Permissible voltage difference	+ 5% ... – 10%
• Max. coil temperature	+ 180 °C (356 °F)
• Temperature class	H
• Relative operating period	100 %
• Type of protection	IP 65
• Cycle (1/H)	... 6.500
• Weight (1 solenoid version)	4.9 kg (10.7 lbs)
(2 solenoid version)	5.6 kg (12.4 lbs)



Port function

P = Pressure
T = Tank
A & B = User

Seals for ports P, T, A, B

12.42 x 1.78	691-00014-0
--------------	-------------

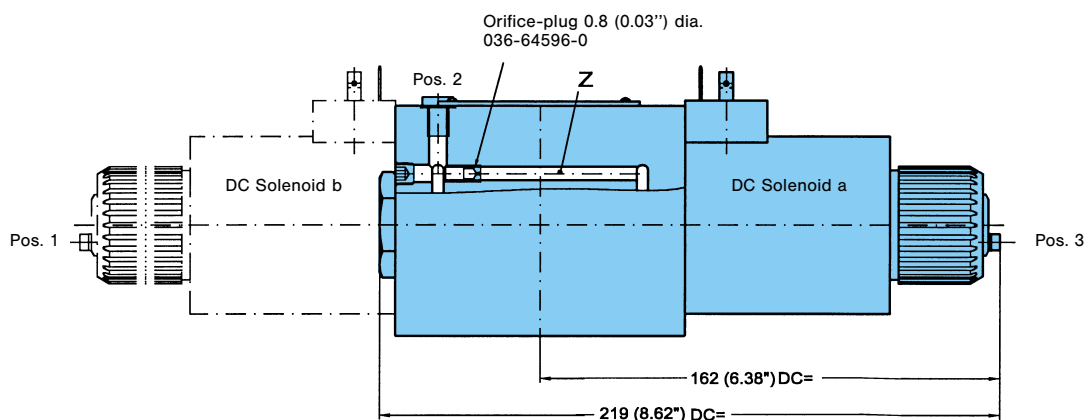
SOFT SHIFT VERSION, OPTION CODE G3

GENERAL

DENISON offers this Directional Control Valve in CETOP 5 size with a "Soft Shift" option (G3). An orifice fitted in channel Z permits an increase in the standard spool response time (for body type D with DC only).

The Option G3 delivers:

- Reduced pressure shocks in venting operations.
- Reduced system noise during spool transition.
- Increased lifetime of the valve and system.



FUNCTIONAL LIMIT

With body option "D" and "Soft Shift", the flow rating of the valve is reduced by approximately 25% of the nominal value.

VENTING

Ensure that channel Z is filled with oil at all times (as delivered, the channel is prefilled with oil).

Trouble-free operation of the valve can only be ensured when it is properly vented during the initial installation, and in case of service.

To vent this valve, please use the following procedure:

1. Remove the vent port screws pos. 1 ... 3.
2. Fill one of the vent ports with hydraulic fluid until this runs bubble free from the other vent ports.
3. Replace the vent port screws.

1 SOLENOID VERSION WITH POSITION CONTROL

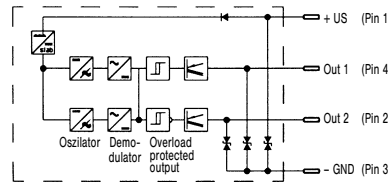
CHARACTERISTICS FOR THE INDUCTIVE DETECTOR

- | | |
|--|--|
| <ul style="list-style-type: none"> • Function • Supply voltage U_s
(full wave bridge with capacitor) • Reverse polarity protection • Ripple voltage • Current consumption • Outputs | <p>P-channel FET, contact positive
24 V \pm 20 % (19.2 V ... 28.8 V)</p> <p>max. 300 V installed
10 %
approx. 40 mA
NC contact positive
(no short circuit protection)</p> |
| <ul style="list-style-type: none"> • Output voltage <ul style="list-style-type: none"> - Signal L - Signal 0 • Output current • Environmental protection • Operating temperature range • Wire cross-sectional area • Tensile strength of transmitting conduit • CE Declaration of conformity no. | <p>$U_s - 2.5$ V
< 1.8 V</p> <p>< 400 mA at $U_s + 20$ %</p> <p>IP 65
0°C ... + 85°C
4 x 0.5 mm²
p dyn. 315 bar
00 02 002 9 93</p> |

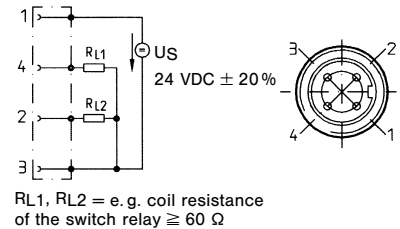
Attention:

EMC only ensured when using screened cables and screened plug casing!

Block diagram and connection of the inductive detector

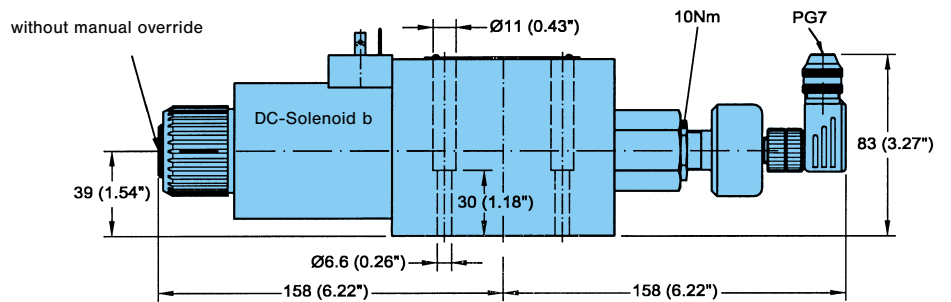


Socket connector



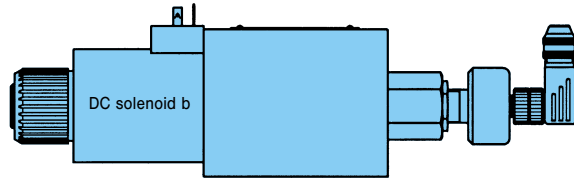
DIMENSIONS

Example: A4D02-*1**-01SA/SB
-06SA/SB

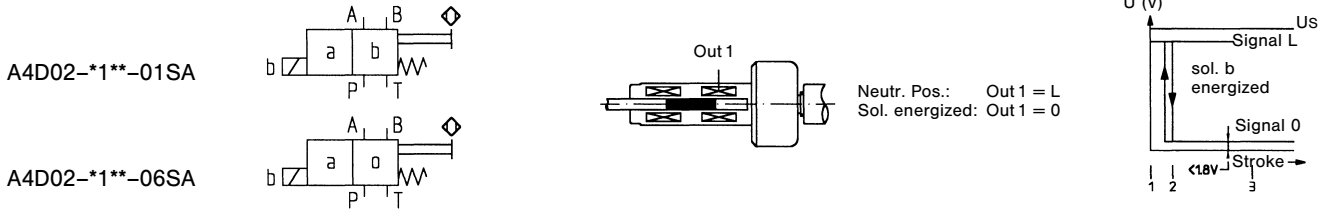


1 SOLENOID VERSION WITH POSITION CONTROL

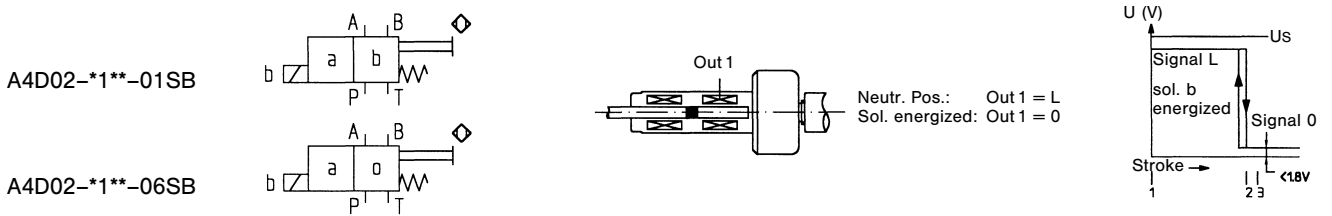
Spool Positions 01/06



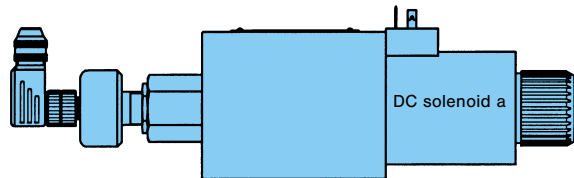
Neutral position controlled +



End position controlled +

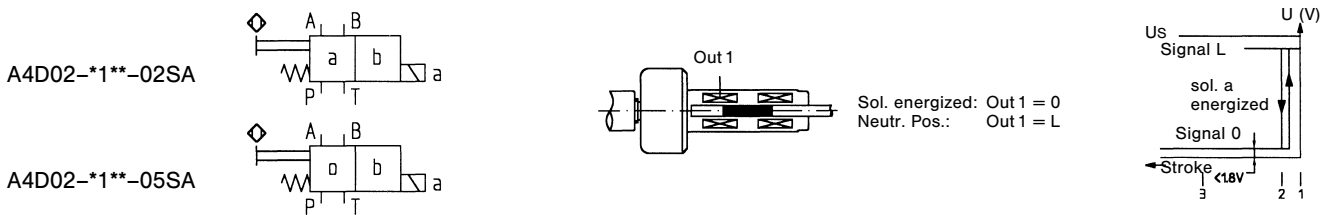


Spool Positions 02/05

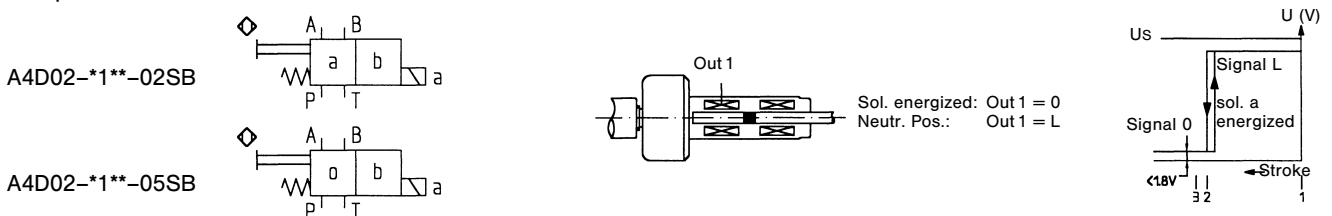


Pos. 1 = Neutral position
Pos. 2 = Switch point
Pos. 3 = End position

Neutral position controlled +



End position controlled +



Pos. 1 = Neutral position
Pos. 2 = Switch point
Pos. 3 = End position

2 SOLENOID VERSION WITH POSITION CONTROL

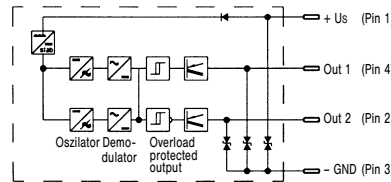
CHARACTERISTICS FOR THE INDUCTIVE DETECTOR

- | | |
|--|--|
| <ul style="list-style-type: none"> • Function • Supply voltage U_S
(full wave bridge with capacitor) • Reverse polarity protection • Ripple voltage • Current consumption • Outputs
 • Output voltage <ul style="list-style-type: none"> - Signal L - Signal 0 • Output current • Environmental protection • Operating temperature range • Wire cross-sectional area • Tensile strength of transmitting conduit • CE Declaration of conformity no. | <p>P-channel FET, contact positive
24 V \pm 20 % (19.2 V ... 28.8 V)</p> <p>max. 300 V installed
10 %
approx. 40 mA
NC contact positive
(no short circuit protection)</p> <p>$U_S - 2.5$ V
< 1.8 V
< 400 mA at $U_S + 20$ %
IP 65
0 °C ... + 85 °C
4 x 0.5 mm²
p dyn. 140 bar
00 02 002 9 93</p> |
|--|--|

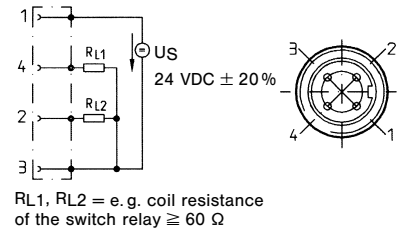
Attention:

EMC only ensured when using screened cables and screened plug casing!

Block diagram and connection of the inductive detector

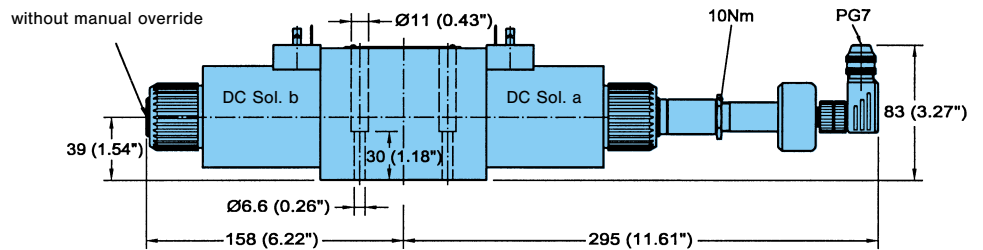


Socket connector



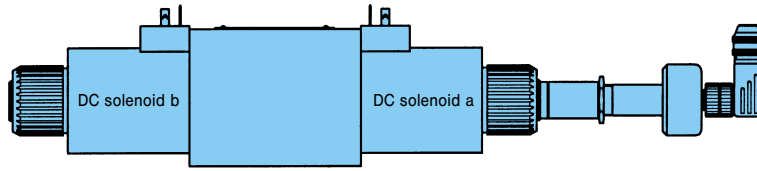
DIMENSIONS

Example: A4D02-32**-03SA/SC



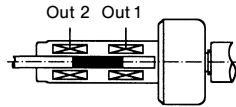
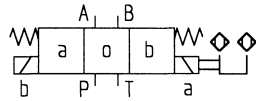
2 SOLENOID VERSION WITH POSITION CONTROL

Spool Position 03

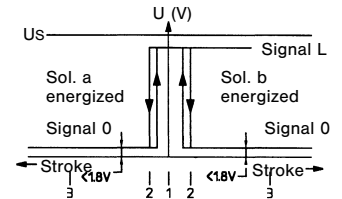


Neutral position controlled \pm

A4D02-32**-03SA

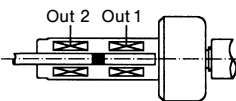
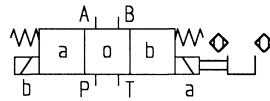


Sol. b energized: Out2 = 0
Neutr. Pos.: Out1 + 2 = L
Sol. a energized: Out1 = 0

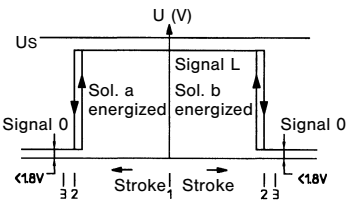


End position controlled \pm

A4D02-32**-03SC

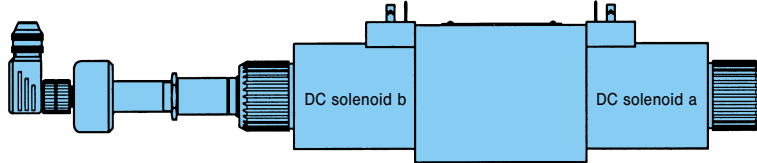


Sol. b energized: Out2 = 0
Neutr. Pos.: Out1 + 2 = L
Sol. a energized: Out1 = 0



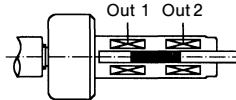
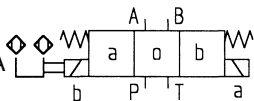
Pos. 1 = Neutral position
Pos. 2 = Switch point
Pos. 3 = End position

Spool Position 03

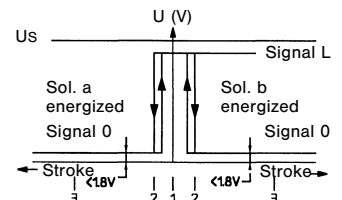


Neutral position controlled \pm

A4D02-32**-03TA

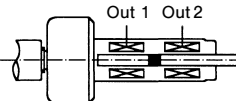
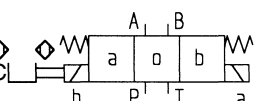


Sol. b energized: Out1 = 0
Neutr. Pos.: Out1 + 2 = L
Sol. a energized: Out2 = 0

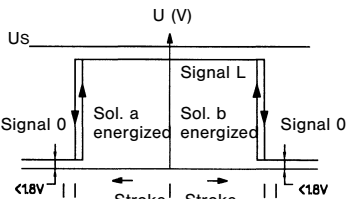


End position controlled \pm

A4D02-32**-03TC



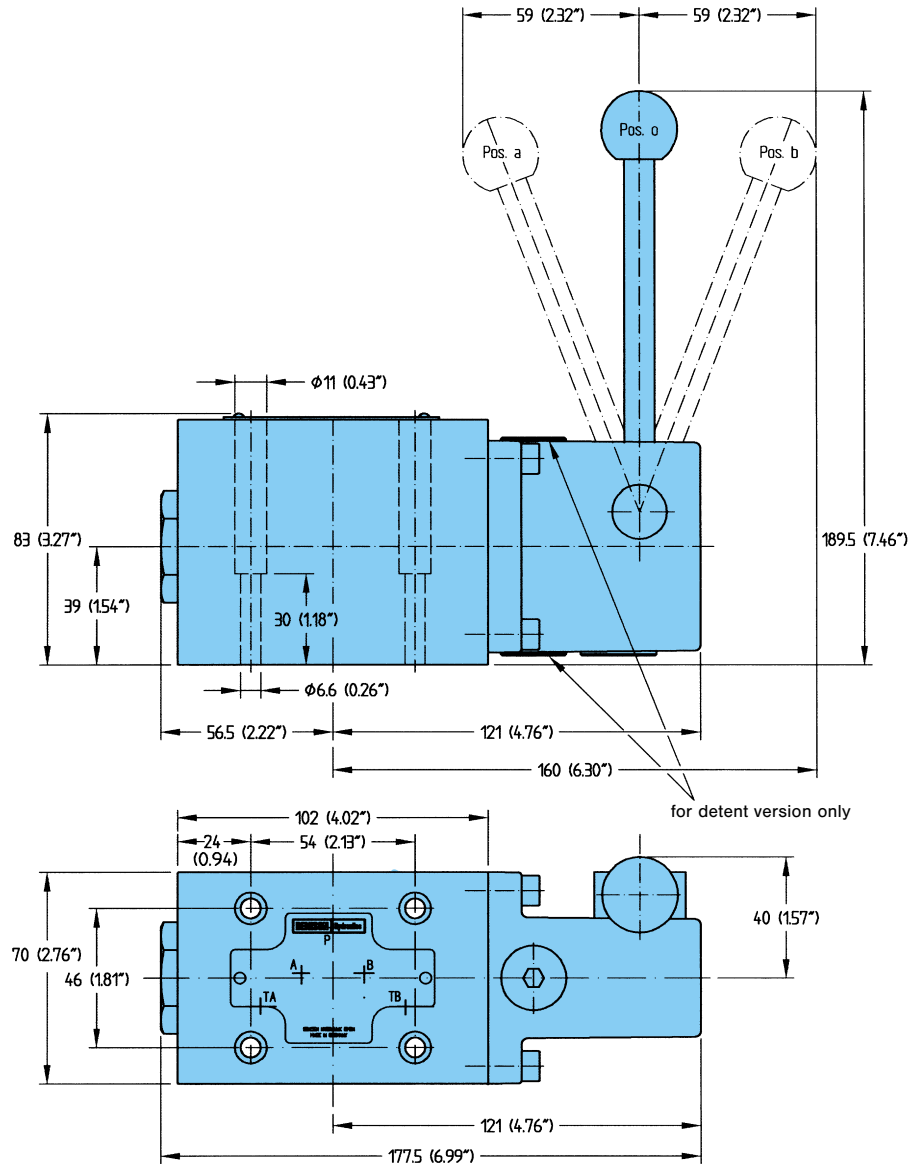
Sol. b energized: Out1 = 0
Neutr. Pos.: Out1 + 2 = L
Sol. a energized: Out2 = 0



Pos. 1 = Neutral position
Pos. 2 = Switch point
Pos. 3 = End position

LEVER OPERATED VERSION

- Functional limits (at 315 bar / 4500 psi)
 - 120 l/min (31.7 gpm) for spools 01, 03, 08
 - 100 l/min (26.4 gpm) for spools 07, 11, 51
 - 60 l/min (15.9 gpm) for spool 12
- Max. tank pressure: 160 bar (2300 psi)
- Operating force: 30 N (6.7 lbs)
- Weight: 5.2 kg (11.4 lbs)



Port function

P = Pressure
 T = Tank
 A & B = User

Seals for ports P, T, A, B

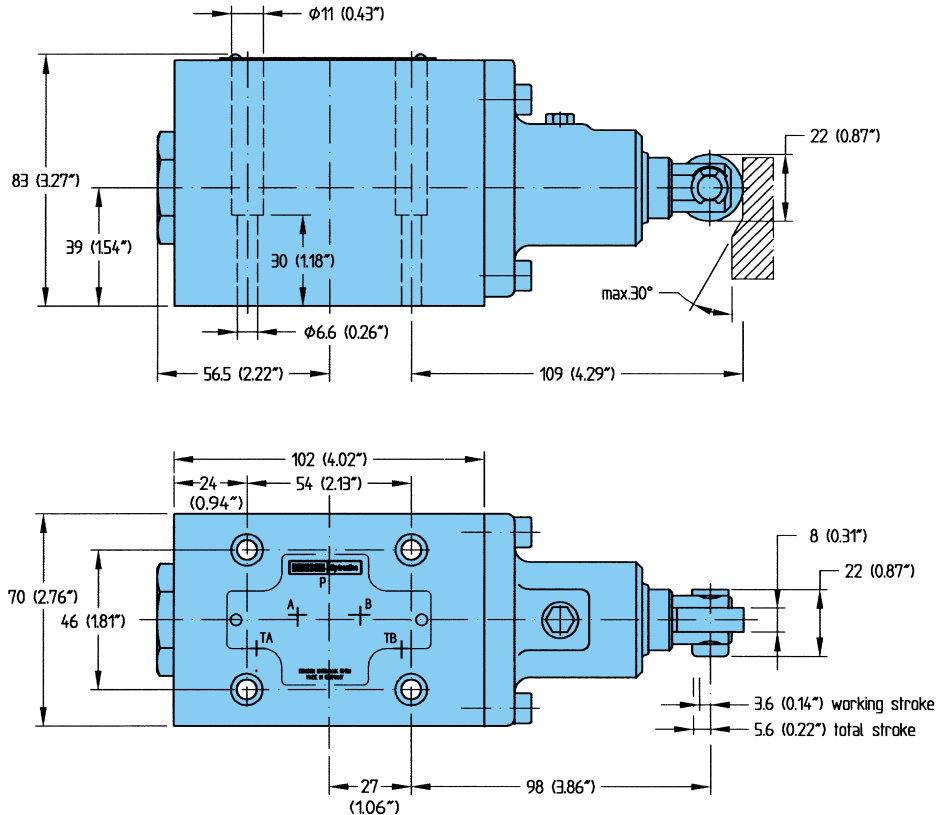
12.42 x 1.78	691-00014-0
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CAM OPERATED VERSION

• Functional limit (at 315 bar / 4500 psi)	120 l/min (31.7 gpm) for spools 01, 03, 08 100 l/min (26.4 gpm) for spools 07, 11, 12, 51																																	
• Operating force F(N) ¹⁾	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3" style="text-align: center;">at tank pressure 0 bar / psi</th> <th colspan="3" style="text-align: center;">at tank pressure 60 bar (858 psi)</th> </tr> <tr> <th style="text-align: center;">neutral</th> <th style="text-align: center;">working stroke</th> <th style="text-align: center;">total stroke</th> <th style="text-align: center;">neutral</th> <th style="text-align: center;">working stroke</th> <th style="text-align: center;">total stroke</th> </tr> </thead> <tbody> <tr> <td>at operating pressure 100 bar (1430 psi)</td> <td>80 N (18 lbs)</td> <td>215 N (48 lbs)</td> <td>360 N (81 lbs)</td> <td>155 N (35 lbs)</td> <td>290 N (65 lbs)</td> <td>435 N (98 lbs)</td> </tr> <tr> <td>200 bar (2860 psi)</td> <td>80 N (18 lbs)</td> <td>255 N (57 lbs)</td> <td>360 N (81 lbs)</td> <td>155 N (35 lbs)</td> <td>330 N (74 lbs)</td> <td>435 N (98 lbs)</td> </tr> <tr> <td>315 bar (4500 psi)</td> <td>80 N (18 lbs)</td> <td>295 N (66 lbs)</td> <td>360 N (81 lbs)</td> <td>155 N (35 lbs)</td> <td>370 N (83 lbs)</td> <td>435 N (98 lbs)</td> </tr> </tbody> </table>	at tank pressure 0 bar / psi			at tank pressure 60 bar (858 psi)			neutral	working stroke	total stroke	neutral	working stroke	total stroke	at operating pressure 100 bar (1430 psi)	80 N (18 lbs)	215 N (48 lbs)	360 N (81 lbs)	155 N (35 lbs)	290 N (65 lbs)	435 N (98 lbs)	200 bar (2860 psi)	80 N (18 lbs)	255 N (57 lbs)	360 N (81 lbs)	155 N (35 lbs)	330 N (74 lbs)	435 N (98 lbs)	315 bar (4500 psi)	80 N (18 lbs)	295 N (66 lbs)	360 N (81 lbs)	155 N (35 lbs)	370 N (83 lbs)	435 N (98 lbs)
at tank pressure 0 bar / psi			at tank pressure 60 bar (858 psi)																															
neutral	working stroke	total stroke	neutral	working stroke	total stroke																													
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200 bar (2860 psi)	80 N (18 lbs)	255 N (57 lbs)	360 N (81 lbs)	155 N (35 lbs)	330 N (74 lbs)	435 N (98 lbs)																												
315 bar (4500 psi)	80 N (18 lbs)	295 N (66 lbs)	360 N (81 lbs)	155 N (35 lbs)	370 N (83 lbs)	435 N (98 lbs)																												

¹⁾ depending on operating and tank pressure at max. flow

- Max. tank pressure 160 bar (2300 psi)
- Weight 4.4 kg (9.7 lbs)



Port function

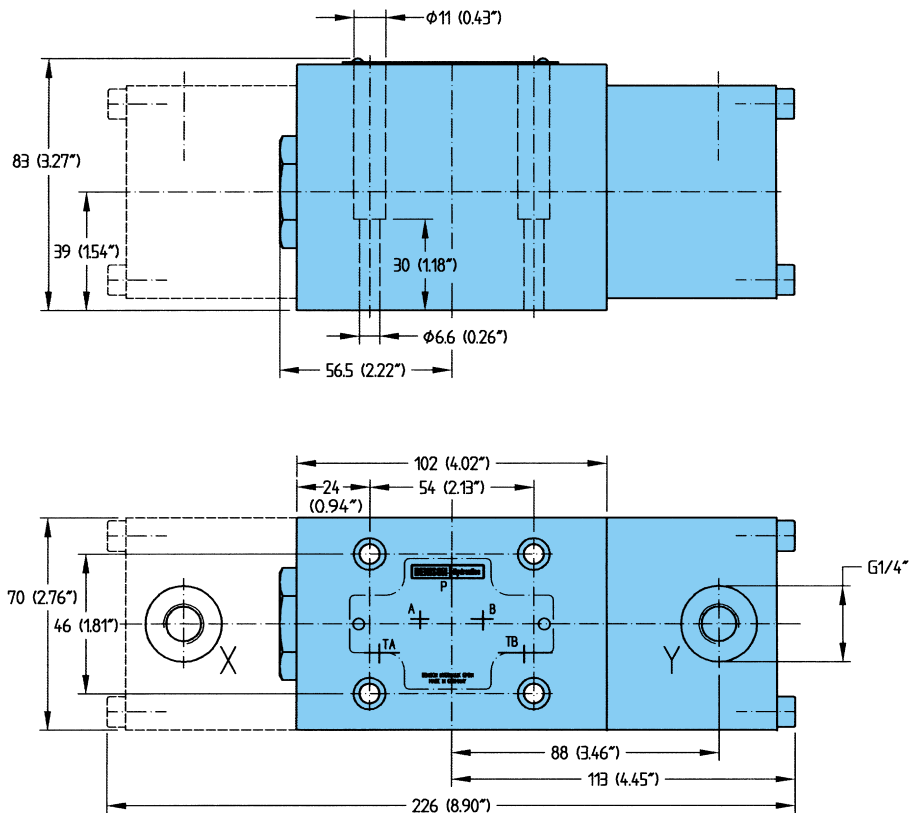
- P = Pressure
- T = Tank
- A & B = User

Seals for ports P, T, A, B

12.42 x 1.78	691-00014-0
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PNEUMATICALLY OPERATED VERSION

- Functional limit
(at 315 bar / 4500 psi)
 - 140 l/min (37.0 gpm) for spool 46
 - 100 l/min (26.4 gpm) for spools 01, 02, 09, 10, 11, 51
 - 80 l/min (21.1 gpm) for spools 03, 08, 0M, 0T, AR
 - 60 l/min (15.9 gpm) for spools 07, 55, 56, 72
 - 30 l/min (7.9 gpm) for spool 12
- Note: See curves on page 8 for functional limits below 315 bar (4500 psi)
- Pilot pressure
 - 4 ... 12 bar (58 ... 174 psi)
 - tank pressure 0 bar / psi min. 4 bar (58 psi)
 - tank pressure 160 bar (2300 psi) min. 6 bar (87 psi)
 - max. allowed 12 bar (174 psi)
- Tank pressure max. 160 bar (2300 psi)
- Pilot volume 8.1 cm³ (0.5 in³)
- Response time ¹⁾
 - on 80 ... 200 ms
 - off 120 ... 200 ms
- ¹⁾ depending on pilot pressure and pipe length
- Weight
 - operated one side 5.3 kg (11.7 lbs)
 - operated both sides 7.0 kg (15.4 lbs)



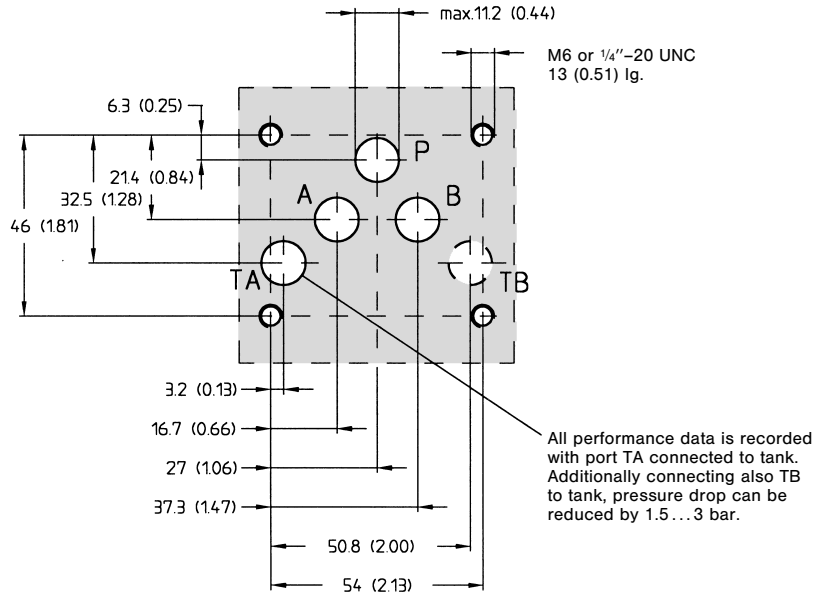
Port function
 P = Pressure
 T = Tank
 A & B = User
 X & Y = Pilot ports

Seals for ports P, T, A, B

12.42 x 1.78	691-00014-0
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MOUNTING CONFIGURATION – ACCESSORIES

Mounting configuration confirming to CETOP, ISO and DIN



Block mounting face

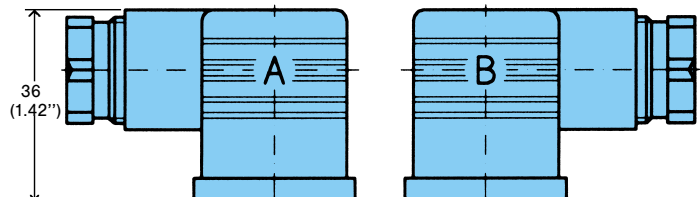
Flatness 0.01 mm / 100 mm (.003/3.93 inches) length

Surface finish $\sqrt{0.8}$

4 Mounting Screws	Order No.
M 6 x 40, DIN 912; 12.9	361-08244-8
or	
1/4"-20 UNC x 1 1/2" (SAE)	358-12200-0

Torque 15 Nm

PLUG-IN CONNECTORS CONFIRMING TO ISO 4400



Versions	A-Side (grey)	B-Side (black)
Standard <250 V PG 11	167-01007-8	167-01008-8
with LED (red) 15...30 V	167-01100-8	167-01101-8
with bridge rectifier 12...250 V	167-01076-8	167-01014-8

The product described is subject to continual development and the manufacturer reserves the right to change the specifications without notice.