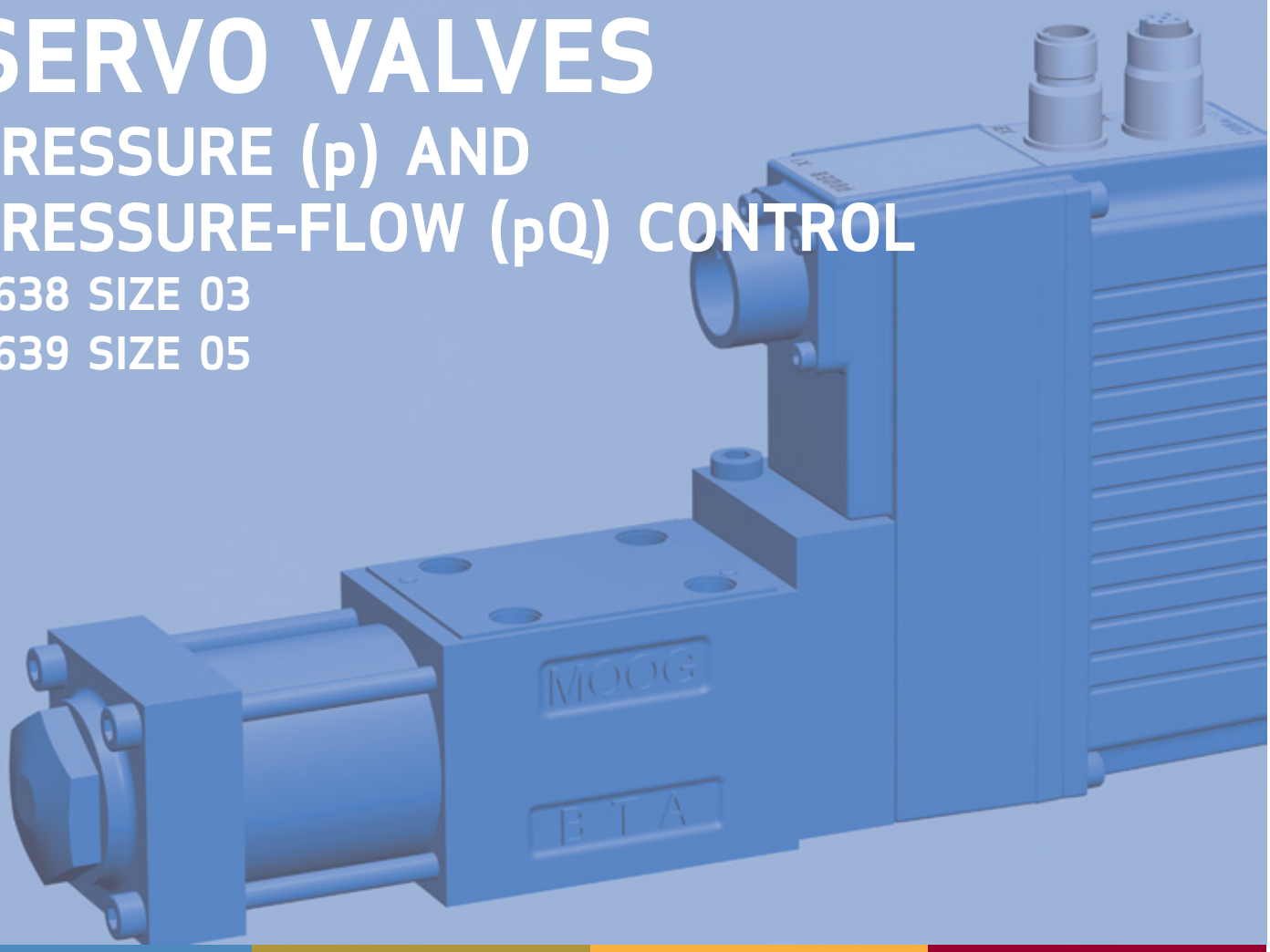
DIRECT DRIVE DIGITAL CONTROL SERVO VALVES

PRESSURE (p) AND PRESSURE-FLOW (pQ) CONTROL

D638 SIZE 03
D639 SIZE 05

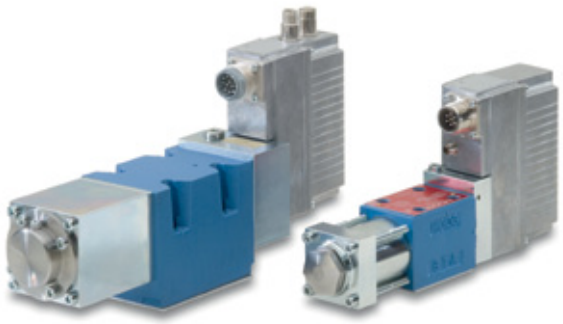


Rev.-, March 2014

HIGH-PERFORMANCE PRESSURE CONTROL WITH HIGHER DYNAMICS AND THE ABILITY TO EASILY AND EXACTLY TUNE THE PRESSURE CONTROLLER GAIN

MOOG

Whenever the highest levels of motion control performance and design flexibility are required, you'll find Moog expertise at work. Through collaboration, creativity and world-class technological solutions, we help you overcome your toughest engineering obstacles. Enhance your machine's performance. And help take your thinking further than you ever thought possible.



PRODUCT OVERVIEW

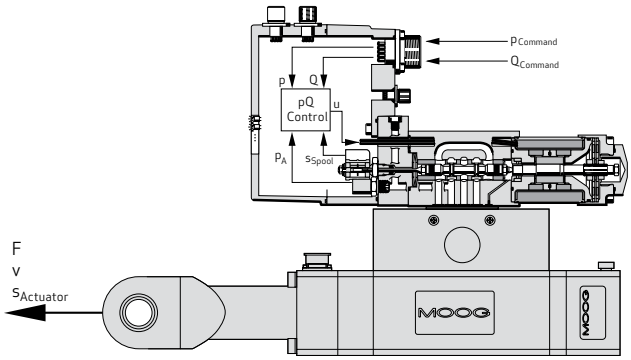
The Moog Digital Control Servo Valves (DCV) are closed-loop hydraulic products that are used in industrial machinery to precisely control fluid flow, pressure, position or force using advanced digital fieldbuses for communication (e.g. EtherCAT, PROFIBUS-DP, CANopen) or analog interfaces. The D638 and D639 series are equipped with an integrated pressure sensor in the A-channel as well as a digital pressure controller and are thus a compact pressure control unit.

For maximum flexibility, customers can choose to have an analog interface, fieldbus interface (e.g., EtherCAT, PROFIBUS DP, CANopen) or both combined in the same valve. Whether you need pressure (p) or flow and pressure limiting (pQ) control, this valve series has world-class, proven technology that makes it the performance leader in providing advanced functionality such as higher dynamics, easy parameter tuning and adaptation of flow characteristics.

With a robust design that offers proven reliability in some of the world's most demanding environments such as oil rigs, offshore wind turbines and steel mills, these valves can be tailored to your exact performance requirements. With proven hydraulic motion control and application expertise, Moog can help you select the version that best meets your needs.

This series also has a version certified for use in potentially hazardous environments (e.g., Explosion-Proof) with hot-swappable connectors and proven ability to withstand vibration and heavy use. Equipment protection with flameproof enclosures "d" and increased safety "e" with marking: II 2G Ex de IIC T5/T4/T3 Gb. For explosion proof valves technical data (outer dimensions and wiring) please contact Moog.

Control loop consisting of valve with integrated pQ control and cylinder



F	Force
p	Pressure
$p_{Command}$	Pressure command signal
p_A	Pressure actual value
Q	Flow
$Q_{Command}$	Flow command signal
$s_{Actuator}$	Actuator position
s_{Spool}	Spool stroke position
u	Correcting variable
v	Velocity

	D638 Servo Valve	D639 Servo Valve
Valve design	1-stage, with spool and bushing	
Size according ISO 4401	03	05
Mounting pattern	ISO 4401-03-03-0-05 (with or without leakage oil connection Y)	ISO 4401-05-05-0-05 (with or without leakage oil connection Y)
Rated flow at Δp_N 35 bar (500 psi)/spool land	5/10/20/40 l/min (1.3/2.6/5.3/10.6 gpm)	60/100 l/min (15.9/26.4 gpm)
Maximum flow	75 l/min (19.8 gpm)	180 l/min (47.6 gpm)
Maximum operating pressure - port P, A, B	350 bar (5,000 psi)	
Step response time for 0 to 100 % stroke	8 ms	13 and 16 ms

DESCRIPTION OF OPERATION

Direct Drive Digital Control Valves with p and pQ Control

Direct Drive Digital Control Valves

The D638 and D639 Series Valves, sizes 03 and 05 are Direct Drive Servo Valves. The valves are control valves for 2-, 2x2-, 3- and 4-way applications and are suitable for electrohydraulic control of pressure and flow even under high dynamic requirements.

Design and Application

A permanent magnet linear force motor is used to drive the spool. In contrast to proportional solenoid drives, the linear force motor drives the spool in both working directions from the spring-centered middle position. The strong actuating force of the spool, provides Moog Servo Valves with excellent static and dynamic characteristics.

p and pQ Functionality

The valves provide full pressure (p) and flow with pressure limiting (pQ) functionality. By using the pQ option of the D638 and D639 series, the control of flow and pressure is possible with just one valve instead of using 2 valves as in the past. The selection of p or pQ control mode can be made via the fieldbus interface.

Fieldbus Interface

A built-in fieldbus interface (e.g. CANopen, PROFIBUS-DP or EtherCAT) enables operating parameters to be set, activates the valve and monitors its performance. To reduce wiring, the fieldbus interface is provided with 2 connectors. DCVs may be integrated into the bus without any external T-joints. In addition, up to 2 analog input commands and up to 2 analog actual value outputs are available. The valves are also available without a fieldbus interface. In this case, the valve is controlled using analog inputs. Valve parameters are set using the integrated M8 service connector X10.

Axis Control

Axis Control functionality can also be added to the valve enabling closing of the external control loop and decentralized control in an automation system, all within the valve device. Data from external sensors can be evaluated by up to 3 analog inputs (V/A), SSI or Wheatstone Bridge.

For more information please see our Axis Control Valves catalogs or contact our application engineers for assistance.

Tuning of Pressure Controller Prior to Operation

The pressure control function can be modified by adjusting parameters in the valve software (i.e. linearization, ramping, etc.). Moog Valve and Pump Configuration Software parameters can be saved in different sets for specific tunings.

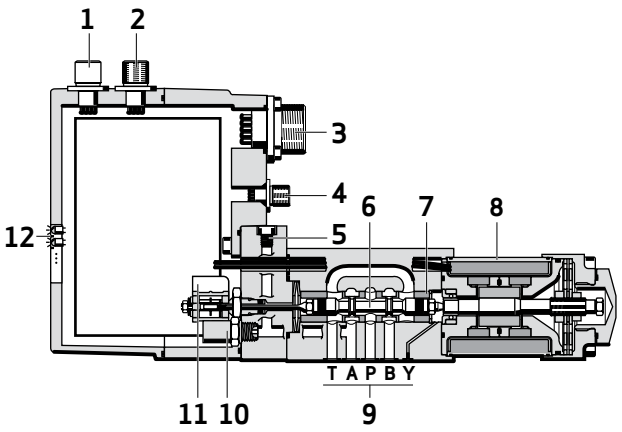
When sending to Moog, parameter sets can be used for next valve configuration or for next valve deliveries with customer specific settings.

DESCRIPTION OF OPERATION

Direct Drive Servo Valves with Integrated Digital Electronics and Integrated Pressure Sensor

- Fieldbus data transfer: Electrically isolated fieldbus interface
- Diagnostic capabilities: Integrated monitoring of important ambient and internal data. Valve parameters can be changed on site or remotely
- Flexibility: Since parameters may be downloaded using the fieldbus or a high level PLC program, valve parameters may be tuned during a machine cycle while the machine is operating
- Pressure control configuration: Up to 16 configurations may be saved and can be activated during operation
- Volume flow and pressure control using a single servo valve
- Direct drive with permanent magnet linear force motor that provides high actuating force, works in 2 directions
- Pilot oil not required
- Pressure-independent dynamic response
- Low hysteresis and high response characteristics
- Low power demand at and in the proximity of hydraulic zero. Hydraulic zero is the spool position at which the pressure of a symmetrical spool are equal in both blocked control ports
- If the electrical supply fails, a cable breaks or emergency stop is activated, the spool returns to the predefined spring-centered position without passing a fully open control port position (fail-safe) increasing safety

D638 Series Direct Drive Servo Valve



1 Fieldbus connector X4
2 Fieldbus connector X3
3 Valve connector X1
4 Service connector X10
5 Venting screw
6 Spool
7 Bushing
8 Linear force motor
9 Ports
10 Pressure transducer
11 Position transducer (LVDT)
12 Status LEDs

Description of Operation of the Permanent Magnet Linear Force Motor

The linear force motor is a permanent magnet excited differential motor.

Some of the magnetic force is already provided by the permanent magnets. This, using the same size, the force of the linear force motor is 2 to 3 times higher than the force produced by a proportional magnet and thereby results in a significantly lower power demand than the comparable proportional solenoid.

The linear force motor drives the servo valve's spool. The spool starting position is determined in the de-energized state by the centering springs. The linear force motor enables the spool to be deflected from the starting position in both directions. The actuating force of the linear force motor is proportional to the coil current.

The high forces of the linear force motor and centering springs effect precise spool movement even against flow and frictional forces.

FEATURES AND BENEFITS

Features	Benefits
All Digital Control Valves	
Moog offers the ability to exactly tailor hardware, configurations and functionality to the customer's application need	Optimize machine performance to gain competitive advantages
Improved dynamics over traditional proportional valve technology due to high performance design of hardware and software	Increases machine performance in areas such as higher acceleration, improved accuracy, leading to enhanced machine productivity
Availability of ATEX and IECEx approved versions with hot-swappable connectors and proven ability to withstand vibration and heavy use	Proven, reliable product for use in hazardous environments such as Oil and Gas Production
Availability of EtherCAT, Profibus and CANopen fieldbus communications and follow all relevant international standards	Proven technology that can be easily integrated in the customer's machine automation system, allowing for easy commissioning and tuning
Fieldbus connection allows reduced cabeling and less analog input/output (I/O) modules in complex systems	Save space and costs while obtaining more machine flexibility
Availability of diagnostic and condition monitoring data in the valve	Helps customers manage life cycle of the valve in order to optimize maintenance costs
Factory preset parameters optimized for flow control functionality	Valves are plug-and-play from the factory , offering higher accuracy and reducing your risk of installing new technology
Advanced tuning functionality such as non-linear flow curves and a variety of other parameters for complex machine operations via Moog Configuration software	Allows machine optimization and tailoring to exact customer specifications
D638 and D639 Series	
Integrated pressure sensor	Eliminate the need for an external pressure sensor and controller plus reduce cabling
Several sets of parameters allow switching between different pressure levels	Optimal pressure control at different operating points
Smooth transition from flow to pressure control due to sophisticated internal algorithms	Higher quality of end products, greater machine productivity and smooth process flow
One-to-one replacement of valve with new versions with the exact pressure control, performance and configuration	• Reduce machine lifetime operating costs and lower complexity of supply chain • Seamless upgrades with ability to use latest functionality
Easily configure pressure control parameters via Moog Configuration Software or use factory presets	• Easy repeatable commissioning and fast tuning on-site if needed • Improved performance as PID and other critical parameters are exactly set to optimize your application • Reduce risk of using new technology, save time due to exact repeatable settings
Can optimize pressure control or other parameter through the fieldbus on the fly while the machine is running	Actively tuned system enables compensation for system changes over time and yields higher finished part quality

SIZE 03 - D638 SERVO VALVE

General Technical Data

Valve design	1-stage, with spool and bushing
Mounting pattern	ISO 4401-03-03-0-05 (with or without leakage oil connection Y)
Installation position	In all orientations, venting screw has to be on top during venting
Weight	2.5 kg (5.5 lb)
Storage temperature range	-40 to +80 °C (-40 to +176 °F)
Ambient temperature range	-20 to +60 °C (-4 to +140 °F)
Vibration resistance	30 g, 3 axis, 10 Hz to 2 kHz
Shock resistance	50 g, 6 directions
$MTTF_d$ value according to EN ISO 13849-1	150 years

Hydraulic Data

Maximum operating pressure				
Port P, A, B	350 bar (5,000 psi)			
Port T without Y	50 bar (725 psi)			
Port T with Y	350 bar (5,000 psi)			
Port Y	Depressurized to tank[1]			
Rated flow at Δp_N 35 bar (500 psi)/spool land	5 l/min (1.3 gpm)	10 l/min (2.6 gpm)	20 l/min (5.3 gpm)	40 l/min (10.6 gpm)
Maximum flow	75 l/min (19.8 gpm)			
Leakage flow (rate) (≈ zero lap)[2]	0.15 l/min (0.04 gpm)	0.3 l/min (0.08 gpm)	0.6 l/min (0.16 gpm)	1.2 l/min (0.32 gpm)
Hydraulic fluid	Hydraulic oil as per DIN 51524 parts 1 to 3 and ISO 11158. Other fluids upon request.			
Temperature range	-20 to +80 °C (-4 to +176 °F)			
Viscosity range				
Recommended viscosity range at 38 °C (100 °F)	15 to 100 mm^2/s (cSt)			
Maximum permissible viscosity range at 38 °C (100 °F)	5 to 400 mm^2/s (cSt)			
Recommended cleanliness class as per ISO 4406				
For functional safety	18/15/12			
For longer service life	17/14/11			

Typical Static and Dynamic Data[2]

Step response time for 0 to 100 % stroke	8 ms
Threshold, typical (for Q control)	< 0.05 %
Threshold, maximum (for Q control)	< 0.1 %
Hysteresis, typical (for Q control)	< 0.05 %
Hysteresis, maximum (for Q control)	< 0.1 %
Null shift at ΔT = 55 K (131 °F) (for Q control)	< 1.5 %
Sample deviation of rated flow	< 3 %

1) In order to avoid an emptying of the return line, a back-pressure of 2 bar (29 psi) should be maintained on the T, T1 and Y connections.

2) Measured at 140 bar (2,000 psi) pilot or system pressure, oil viscosity 32 mm^2/s and oil temperature 40 °C (104 °F)

SIZE 03 - D638 SERVO VALVE

Electrical Data

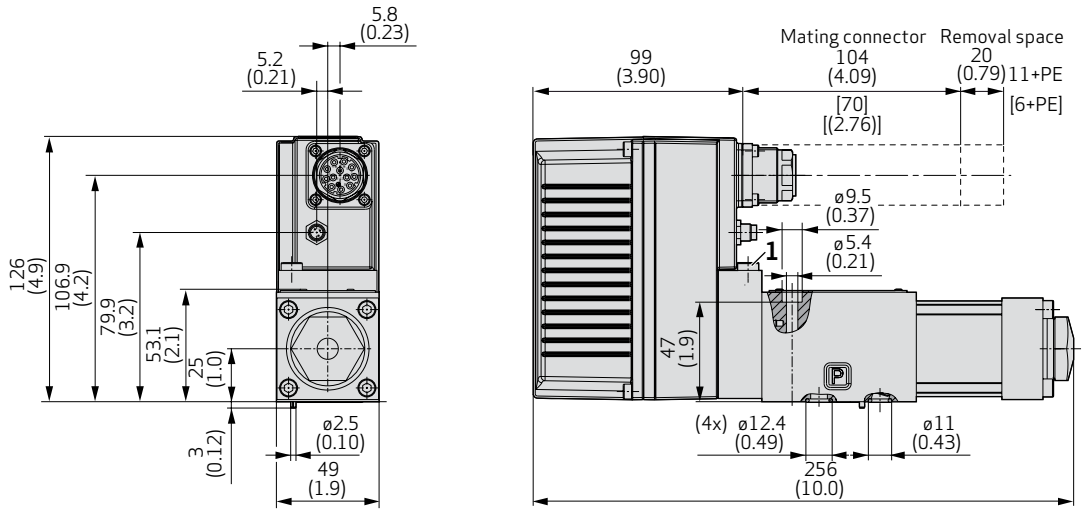
Duty cycle	100 %
Degree of protection according to EN 60529	IP65 with mounted mating plugs
Supply voltage[3)]	18 to 32 V_{DC}
Permissible ripple of supply voltage[4)]	±3 V_{RMS}
Maximum current consumption[5)]	1.7 A
Power consumption of the motor in middle position	9.6 W (0.4 A at 24 V_{DC})
Power consumption maximum	28.8 W (1.2 A at 24 V_{DC})
Fuse protection, external, per valve	2 A (slow)
EM compatibility	• Emitted interference as per EN 61000-6-4:2005 (CAN open and PROFIBUS-DP) • Emitted interference as per EN 61000-6-3:2005 (EtherCAT) • Immunity to interference as per EN 61000-6-2:2005 (evaluation criterion A)

3) All connected circuits must be isolated from the mains supply by "electrical separation" in accordance with EN 61558-1 and EN 61558-2-6. Voltages must be limited to the safety extra-low voltage range in accordance with EN 60204-1. We recommend the use of SELV/PELV power packs.

4) Frequency from 50 Hz to 10 kHz

5) Measured at ambient temperature 25 °C (77 °F) and supply voltage 24 V

Installation drawing



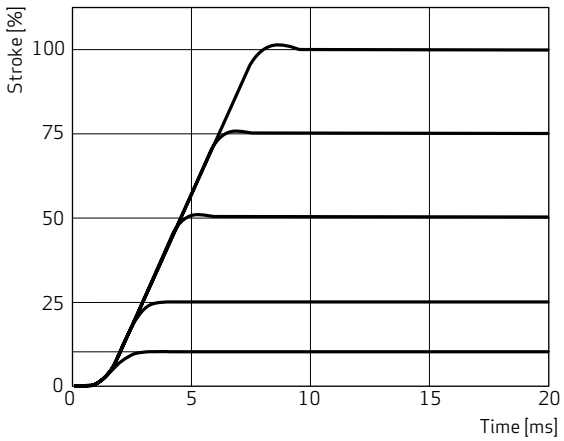
1 Venting screw

Note: See section "Installation Drawing Electronic Housing" for valves with fieldbus interface.

SIZE 03 - D638 SERVO VALVE

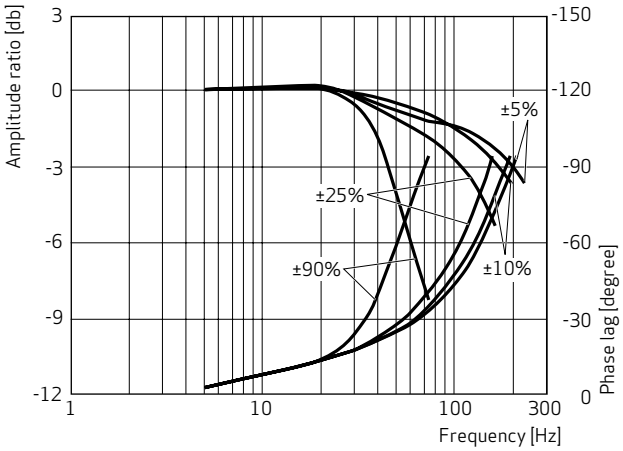
Step Response

5/10/20/40 l/min



Frequency Response

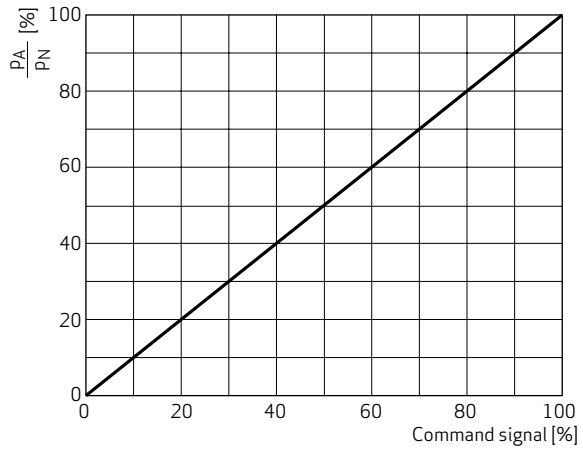
5/10/20/40 l/min



SIZE 03 - D638 SERVO VALVE

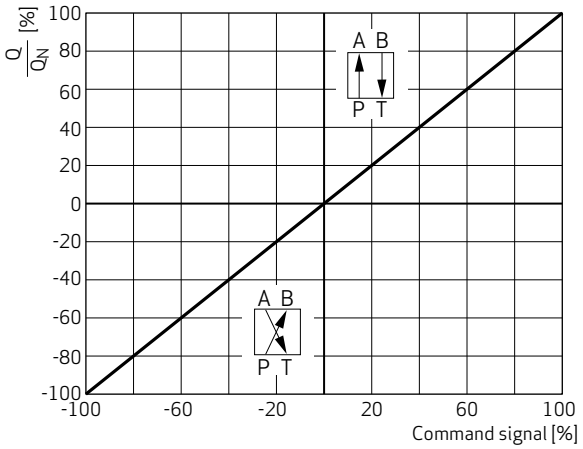
Pressure Signal

Pressure signal characteristics

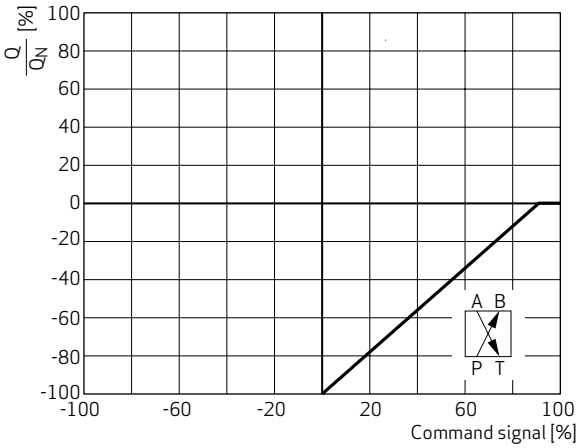


Flow Signal

Flow signal characteristic - in main line



Flow signal characteristic - in bypass line

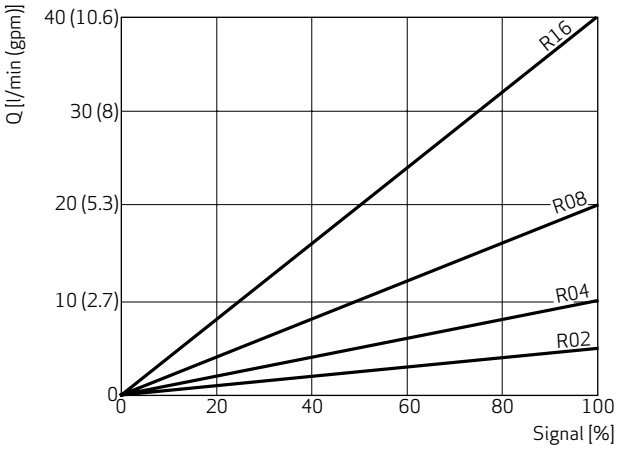


Note: Measured with system pressure p_p of 140 bar (2,000 psi), oil viscosity 32 mm^2/s and oil temperature of 40°C (104°F).

SIZE 03 - D638 SERVO VALVE

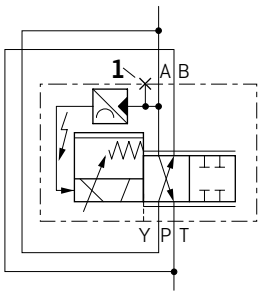
Typical Characteristic Curves

Flow signal curves at Δp_N = 35 bar (500 psi) per spool land

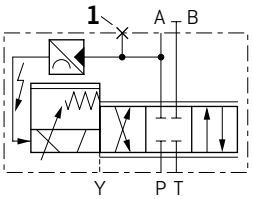


Hydraulic Symbol

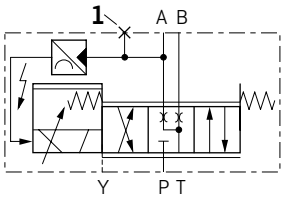
2x2-way valve in bypass line



3-way valve in main line



4-way valve in main line



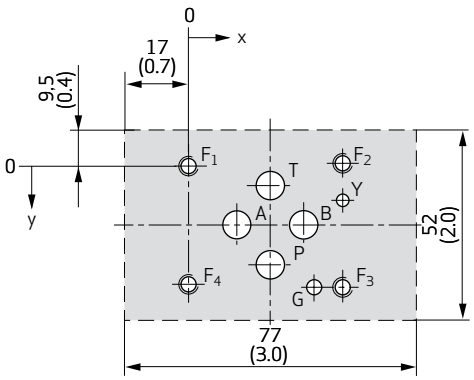
1 Venting screw

Hole Pattern of Mounting Surface

The mounting surface must conform to ISO 4401-03-03-0-05. Observe mounting length of minimum 77 mm (3.0 in) and O-ring recesses for Y.

For maximum flow the ports for P, T, A and B must be designed with Ø 7.5 mm (0.3 in), not according to the standard.

Evenness of connecting surface has to be 0.01 mm (0.0004 in) over 100 mm (3.94 in), average surface finish R_a better than 0.8 µm (0.0000314 in).



Designation		P	A	B	T	Y	F_1	F_2	F_3	F_4	G
Size Ø	**mm**	7.5	7.5	7.5	7.5	3.3	M5	M5	M5	M5	4.0
	in	0.30	0.30	0.30	0.30	0.13	M5	M5	M5	M5	0.16
Position X	**mm**	21.5	12.7	30.2	21.5	40.5	0	40.5	40.5	0	33
	in	0.846	0.5	1.189	0.846	1.594	0	1.594	1.594	0	1.299
Position Y	**mm**	25.9	15.5	15.5	5.1	9	0	-0.75	31.75	31	31.75
	in	1.02	0.61	0.61	0.201	0.354	0	-0.03	1.25	1.22	1.25

SIZE 05 - D639 SERVO VALVE

General Technical Data

Valve design	1-stage, with spool and bushing
Mounting pattern	ISO 4401-05-05-0-05 (with or without leakage oil connection Y)
Installation position	In all orientations, venting screw has to be on top during venting
Weight	7.9 kg (17.4 lb)
Storage temperature range	-40 to +80 °C (-40 to +176 °F)
Ambient temperature range	-20 to +60 °C (-4 to +140 °F)
Vibration resistance	30 g, 3 axis, 10 Hz to 2 kHz
Shock resistance	50 g, 6 directions
$MTTF_d$ value according to EN ISO 13849-1	150 years

Hydraulic Data

Maximum operating pressure		
Port P, A, B	350 bar (5,000 psi)	
Port T without Y	50 bar (725 psi)	
Port T with Y	210 bar (3,000 psi)	
Port Y	Depressurized to tank[1)]	
Rated flow at Δp_N 35 bar (500 psi)/spool land	60 l/min (15.9 gpm)	100 l/min (26.4 gpm)
Maximum flow	180 l/min (47.6 gpm)	
Leakage flow (rate) (≈ zero lap)[2)]	1.2 l/min (0.32 gpm)	2.0 l/min (0.53 gpm)
Hydraulic fluid	Hydraulic oil as per DIN 51524 parts 1 to 3 and ISO 11158. Other fluids upon request.	
Temperature range	-20 to +80 °C (-4 to +176 °F)	
Viscosity range		
Recommended viscosity range at 38 °C (100 °F)	15 to 100 mm^2/s (cSt)	
Maximum permissible viscosity range at 38 °C (100 °F)	5 to 400 mm^2/s (cSt)	
Recommended cleanliness class as per ISO 4406		
For functional safety	18/15/12	
For longer service life	17/14/11	

Typical Static and Dynamic Data[2)]

Step response time for 0 to 100 % stroke	13 ms	16 ms
Threshold, typical (for Q control)	< 0.05 %	
Threshold, maximum (for Q control)	< 0.1 %	
Hysteresis, typical (for Q control)	< 0.05 %	
Hysteresis, maximum (for Q control)	< 0.1 %	
Null shift at ΔT = 55 K (131 °F) (for Q control)	< 1.5 %	
Sample deviation of rated flow	< 3 %	

1) In order to avoid an emptying of the return line, a back-pressure of 2 bar (29 psi) should be maintained on the T, T1 and Y connections.

2) Measured at 140 bar (2,000 psi) pilot or system pressure, oil viscosity 32 mm^2/s and oil temperature 40 °C (104 °F)

SIZE 05 - D639 SERVO VALVE

Electrical Data

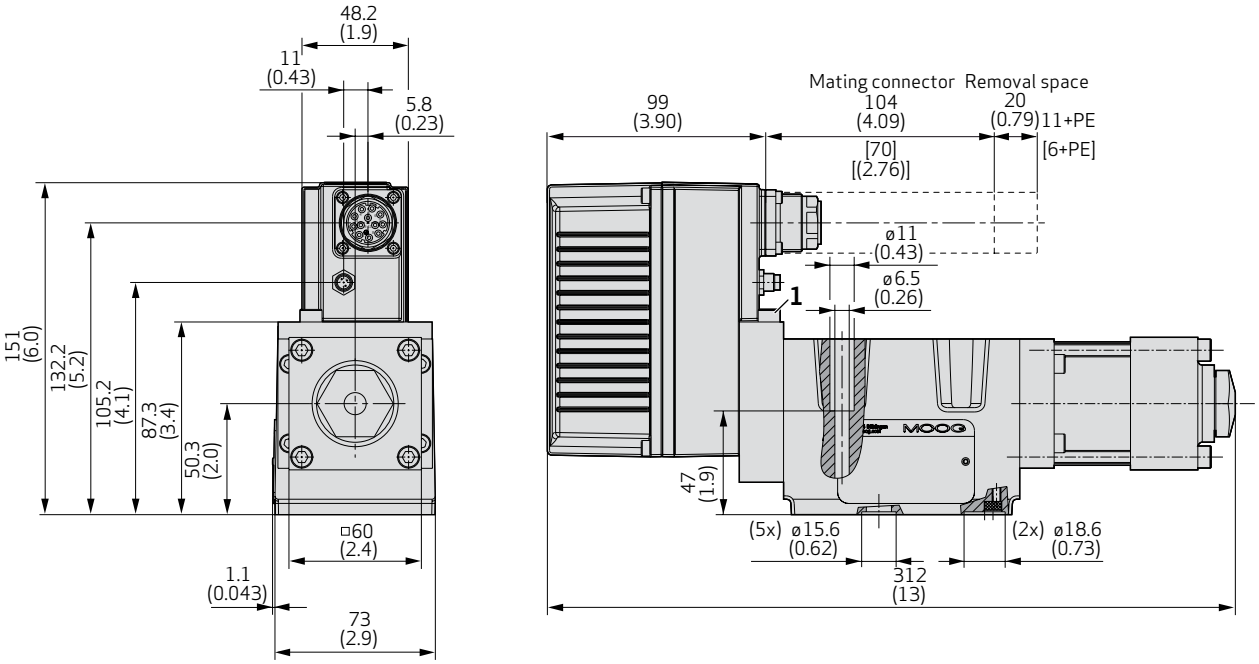
Duty cycle	100 %
Degree of protection according to EN 60529	IP65 with mounted mating plugs
Supply voltage[3)]	18 to 32 V_{DC}
Permissible ripple of supply voltage[4)]	±3 V_{RMS}
Maximum current consumption[5)]	3.0 A
Power consumption of the motor in middle position	9.6 W (0.4 A at 24 V_{DC})
Power consumption maximum	55.2 W (2.3 A at 24 V_{DC})
Fuse protection, external, per valve	3.15 A (slow)
EM compatibility	• Emitted interference as per EN 61000-6-4:2005 (CAN open and PROFIBUS-DP) • Emitted interference as per EN 61000-6-3:2005 (EtherCAT) • Immunity to interference as per EN 61000-6-2:2005 (evaluation criterion A)

3) All connected circuits must be isolated from the mains supply by "electrical separation" in accordance with EN 61558-1 and EN 61558-2-6. Voltages must be limited to the safety extra-low voltage range in accordance with EN 60204-1. We recommend the use of SELV/PELV power packs.

4) Frequency from 50 Hz to 10 kHz

5) Measured at ambient temperature 25 °C (77 °F) and supply voltage 24 V

Installation drawing



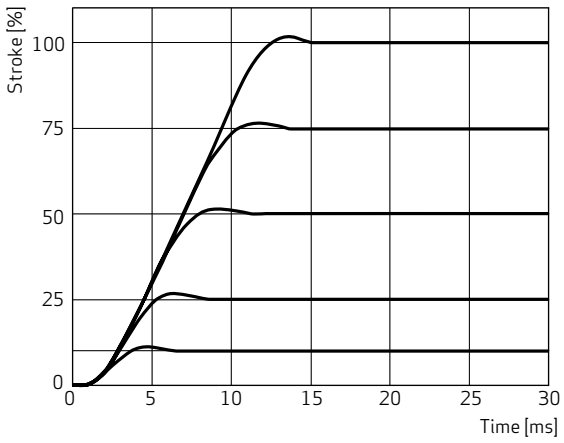
1 Venting screw

Note: See section "Installation Drawing Electronic Housing" for valves with fieldbus interface.

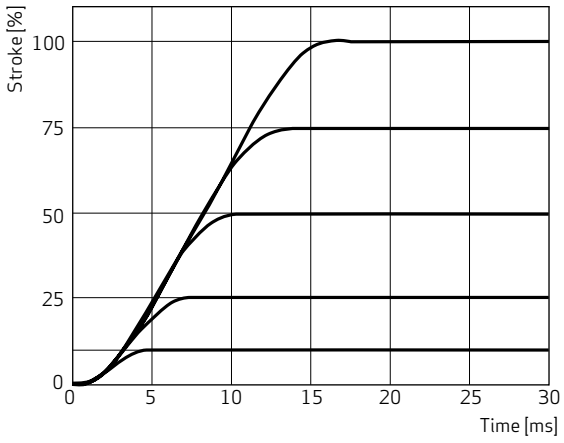
SIZE 05 - D639 SERVO VALVE

Step Response

60 l/min

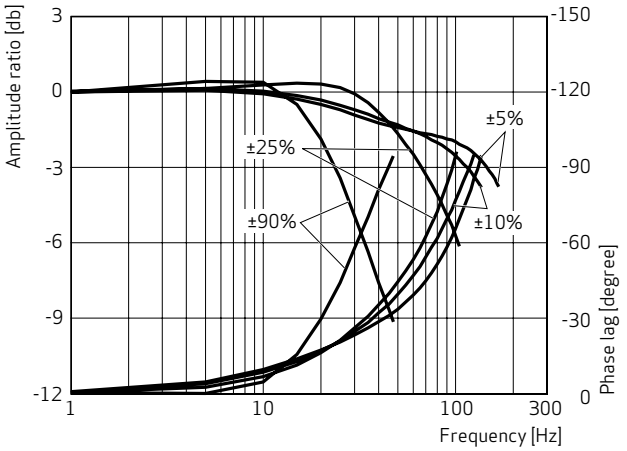


100 l/min

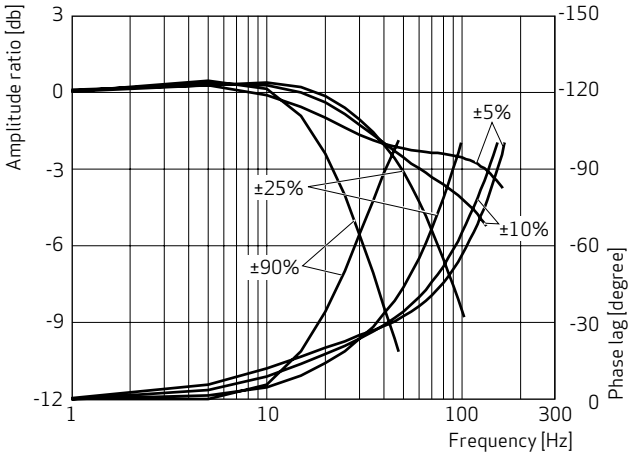


Frequency Response

60 l/min



100 l/min

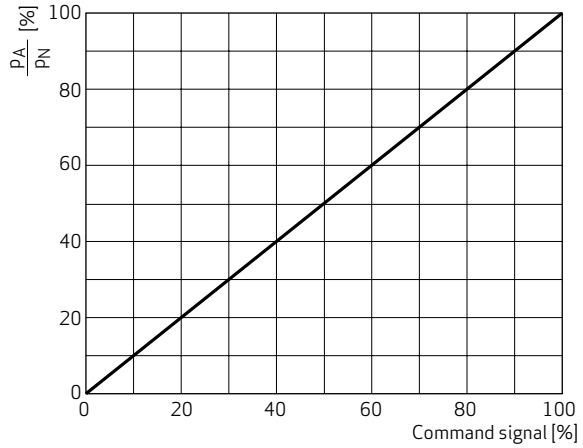


Note: Measured with system pressure p_p of 140 bar (2,000 psi), oil viscosity 32 mm^2/s and oil temperature of 40°C (104°F).

SIZE 05 - D639 SERVO VALVE

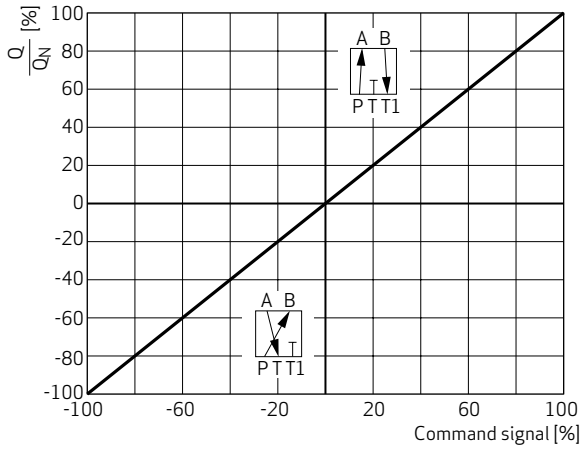
Pressure Signal

Pressure signal characteristics

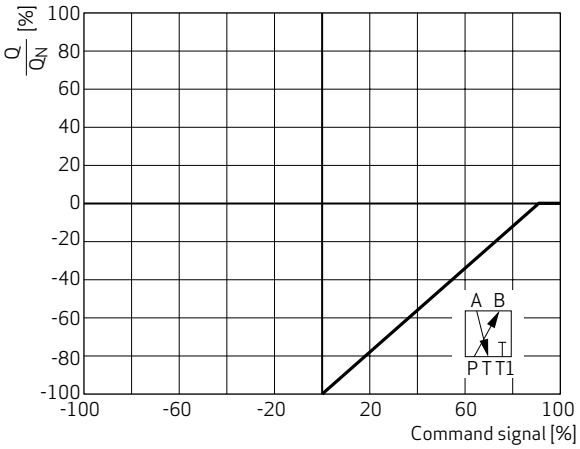


Flow Signal

Flow signal characteristic - in main line



Flow signal characteristic - in bypass line

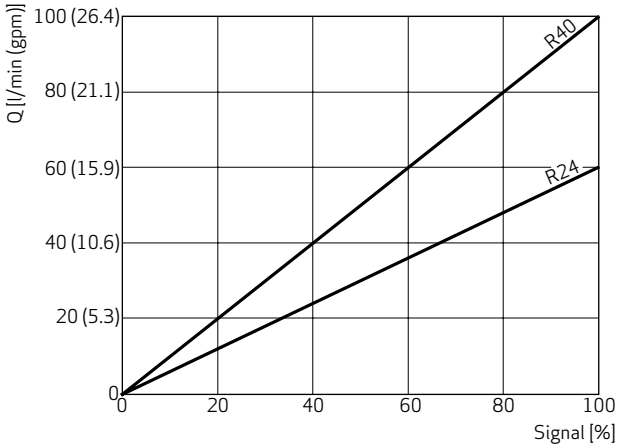


Note: Measured with system pressure p_p of 140 bar (2,000 psi), oil viscosity 32 mm^2/s and oil temperature of 40°C (104°F).

SIZE 05 - D639 SERVO VALVE

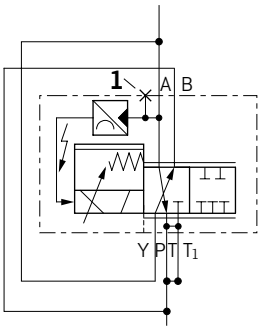
Typical Characteristic Curves

Flow signal curves at Δp_N = 35 bar (500 psi) per spool land

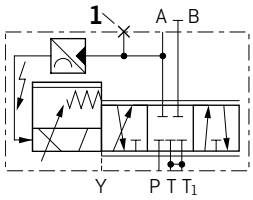


Hydraulic Symbol

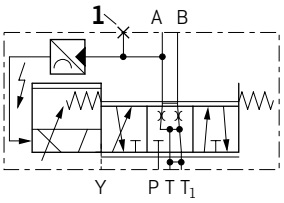
2x2-way valve in bypass line



3-way valve in main line



4-way valve in main line



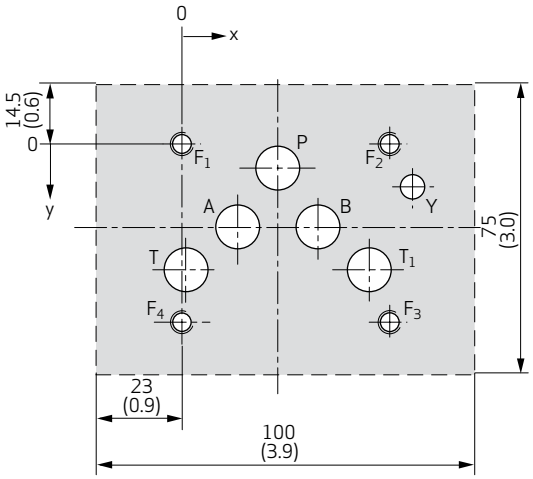
1 Venting screw

Hole Pattern of Mounting Surface

The mounting pattern must confirm to ISO 4401-05-05-0-05 with additional T_1. Observe mounting length of minimum 100 mm (3.94 in) and O-ring recesses for X and Y. For 4-way valves with Q > 150 l/min (39.6 gpm) the second tank port T_1 is required.

For maximum flow the ports for P, T, T_1, A and B must be designed with Ø 11.5 mm (0.45 in), not according to the standard.

Evenness of connecting surface has to be 0.01 mm (0.0004 in) over 100 mm (3.94 in), average surface finish R_a better than 0.8 µm (0.0000314 in).

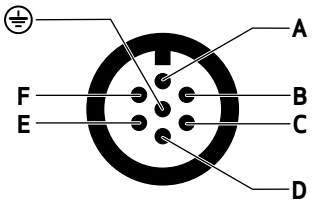


Designation		P	A	B	T	T_1	Y	F_1	F_2	F_3	F_4
Size Ø	**mm**	11.2	11.2	11.2	11.2	11.2	6.3	M6	M6	M6	M6
	in	0.44	0.44	0.44	0.44	0.44	0.25	M6	M6	M6	M6
Position X	**mm**	27	16.7	37.3	3.2	50.8	62	0	54	54	0
	in	1.063	0.657	1.469	0.126	2	2.441	0	2.126	2.126	0
Position Y	**mm**	6.3	21.4	21.4	32.5	32.5	11	0	0	46	46
	in	0.248	0.843	0.843	1.28	1.28	0.433	0	0	1.811	1.811

ELECTRONICS

Pin Assignment for Valves with 6-pole + PE Connector, Pin Contacts (X1) - p Control

According to EN 175201-804, mating connector (type R or S, metal) with preleading protective earth pin (⏚)
Note: Connector only used for p control



Pin	Pin assignment	Signal type[1]	
		Voltage floating	**Current floating[2]**
A	**Supply voltage**	24 V_{DC} (18 to 32 V_{DC}) referenced to GND (reverse polarity protected against GND)	
B	**GND**	Power ground/signal ground (enable and output)	
C	**Enable input**	U_{CB} > 8.5 to 32 V_{DC} referenced to GND: Valve ready for operation (enabled) U_{CB} < 6.5 V_{DC} referenced to GND: Valve disabled The input resistance is 10 kΩ	
D **E**	**Command signal - pressure control[3]**	$U_{in} = U_{DE}$ R_{in} = 20 kΩ	$I_{in} = I_D = -I_E$ R_{in} = 200 Ω I_{max} = ±25 mA
F	**Actual value - pressure**	I_{out}: 4 to 20 mA referenced to GND (I_{out} is proportional to pressure in port A; the output is short-circuit -proof); R_L = 0 to 500 Ω	
⏚	**Protective earth (PE)**	Connected with valve body	

1) Signal ranges see next page.
2) Command signals I_{in} < 3 mA (due to cable break, for example) indicates a failure of 4 to 20 mA signals. The valve reaction to this failure may be customized and activated by the customer.
3) The potential difference between pins D or E referenced to pin B must be between -15 and +32 V.

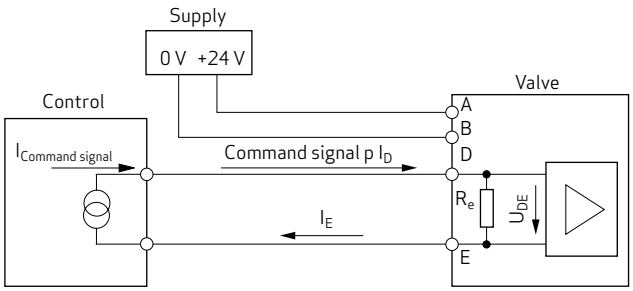
ELECTRONICS
Ordering Codes and Signals for Valves with 6-pole + PE Connector (X1) - p Control

Ordering code	Command signal p 0 to 100 % pressure		Actual value p 0 to 100 % pressure	
M	U_D - U_E	0 to 10 V	I_F	4 to 20 mA
X	I_D	0 to 10 mA	I_F	4 to 20 mA
E	I_D	4 to 20 mA	I_F	4 to 20 mA

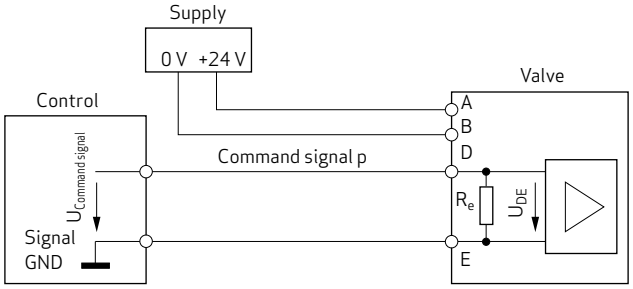
Note: See inside back cover for complete ordering information.

Command Signal

Command signal current floating, ordering code X or E

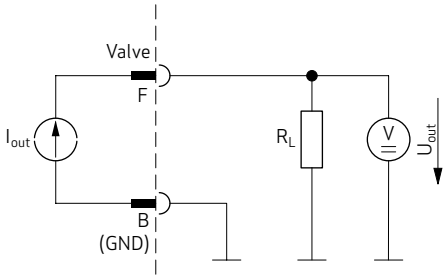


Command signal voltage floating, ordering code M



Actual value

Actual value I_{out} (pressure)

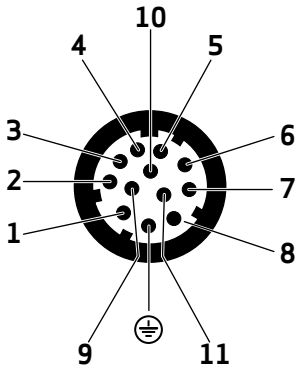


Actual value I_{out} = 4 to 20 mA
Actual value U_{out} = 2 to 10 V with resistor
R_L = 500 Ω (0.25 W) provided by customer

Note: For more information see Technical Notes TN 353 “Protective Grounding and Electrical Shielding of Valves” and TN 494 “Maximum Permissible Length of Electric Cables for Valves with Integrated Electronics”. Visit www.moog.com/industrial/literature to download document.

ELECTRONICS
Pin Assignment for Valves with 11-pole + PE Connector, Pin Contacts (X1) - p and pQ Control

According to EN 175201-804, mating connector (type E, metal) with preleading protective earth pin (⏚)
Note: Connector used for p and pQ control



Pin	Pin assignment	Signal type[1]	
		Voltage floating	**Current floating[2]**
1	**Not used**		
2			
3	**Enable input**	U_{3-10} > 8.5 to 32 V_{DC} referenced to GND: Valve ready for operation (enabled) U_{3-10} < 6.5 V_{DC} referenced to GND: Valve disabled The input resistance is 10 kΩ	
4	**Command signal - flow control**	$U_{in} = U_{4-5}$ R_{in} = 20 kΩ	$I_{in} = I_4 = -I_5$ (for $I_7 = 0$)[3] R_{in} = 200 Ω
5	**Reference point Input rated command**	Reference for pin 4 and 7[4]	
6	**Actual value - spool position**	I_{out}: 4 to 20 mA referenced to GND(I_{out} is proportional to the spool position, 12 mA corresponds to the valve middle position, the output is short-circuit-proof); R_L = 0 to 500 Ω	
7	**Command signal - pressure control**	$U_{in} = U_{7-5}$ R_{in} = 20 kΩ	$I_{in} = I_7 = -I_5$ (for $I_4 = 0$)[3] R_{in} = 200 Ω
8	**Actual value - pressure**	I_{out}: 4 to 20 mA referenced to GND (I_{out} is proportional to pressure in port A; the output is short-circuit -proof); R_L = 0 to 500 Ω	
9	**Supply voltage**	24 V_{DC} (18 to 32 V_{DC}) referenced to GND (reverse polarity protected against GND)	
10	**GND**	Power ground/signal ground (enable and output)	
11	**Digital output monitoring**	OFF: Indicates fault[5] Nominal output voltage: 24 V_{DC}, load type: Ohmic, inductive, lamp load Output current maximum 1.5 A (short-circuit-proof)[6]	
⏚	**Protective earth (PE)**	Connected with valve body	

1) Signal ranges see next page.
2) Command signals I_{in} < 3 mA (due to cable break, for example) indicates a failure of 4 to 20 mA signals. The valve reaction to this failure may be customized and activated by the customer.
3) As pin 5 is the common feedback for pin 4 and pin 7, $-I_5 = I_4 + I_7$ applies.
4) The potential difference between pins 4 or 5 or 7 referenced to pin 10 must be between -15 and +32 V.
5) Output can be programmed at the factory, "OFF" signal indicates fault (e.g. control error too high).
6) The currents drawn at the outputs pin 11 (referenced to GND) must be added to the valve supply current. The valve fuse must be configured for the total current.

ELECTRONICS
Ordering Codes and Signals for Valves with 11-pole + PE Connector (X1) - p and pQ Control

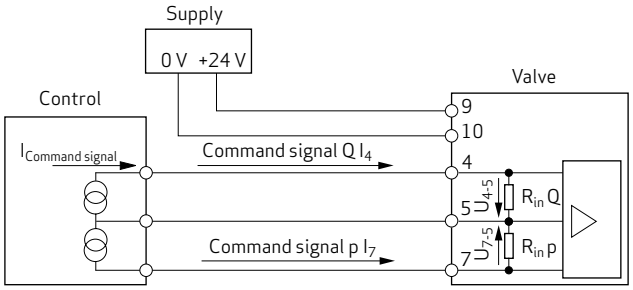
Ordering code	Command signal Q ±100% spool position		Actual value Q ±100 % spool position	
M	U_4 - U_5	-10 to +10 V	I_6	4 to 20 mA
X	I_4	-10 to +10 mA	I_6	4 to 20 mA
E	I_4	4 to 20 mA	I_6	4 to 20 mA

Ordering code	Command signal p 0 to 100 % pressure		Actual value p 0 to 100 % pressure	
M	U_7 - U_5	0 to 10 V	I_8	4 to 20 mA
X	I_7	0 to 10 mA	I_8	4 to 20 mA
E	I_7	4 to 20 mA	I_8	4 to 20 mA

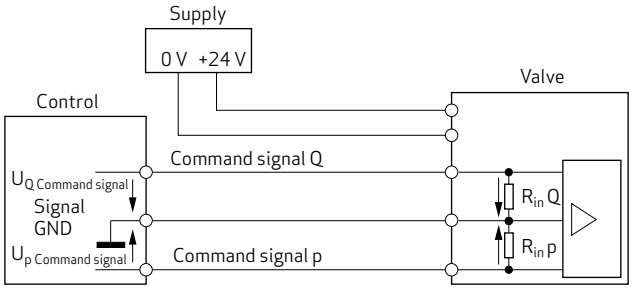
Note: See inside back cover for complete ordering information.

Command Signals

Command signal current floating, ordering code X or E

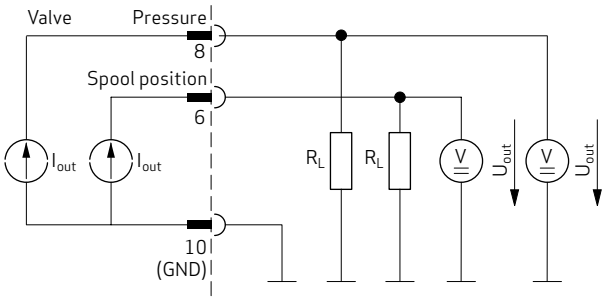


Command signal voltage floating, ordering code M



Actual Values

Actual value I_{out} (pressure and spool position)



Actual value I_{out} = 4 to 20 mA
Actual value U_{out} = 2 to 10 V with resistor
R_L = 500 Ω (0.25 W) provided by customer

Note: For more information see TN 353 Protective Grounding and Electrical Shielding of Valves and TN 494 - Maximum Permissible Length of Electric Cables for Valves with Integrated Eletronics. Visit www.moog.com/industrial/literature to download document.

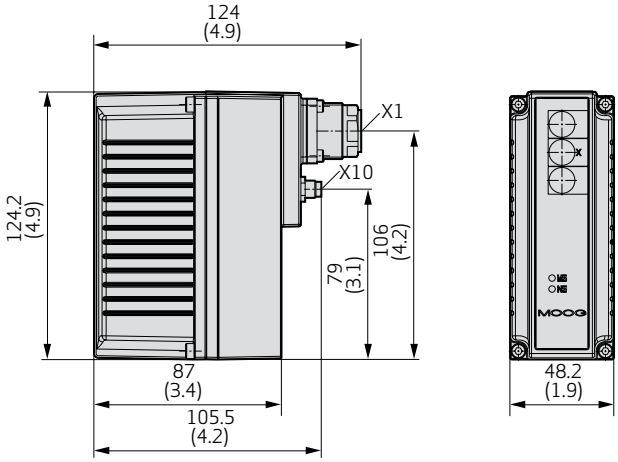
ELECTRONICS

Installation Drawings Electronic Housing

Installation Drawing for Valves with Analog Activation

Ordering code[1] O: Without fieldbus connector

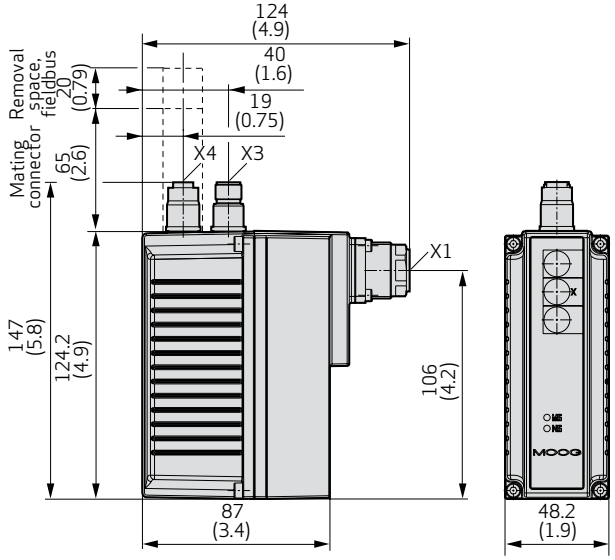
X1 Valve connector
X10 Service connector



Installation Drawing for Valves with CANopen Fieldbus Connector

Ordering code[1] C: CANopen

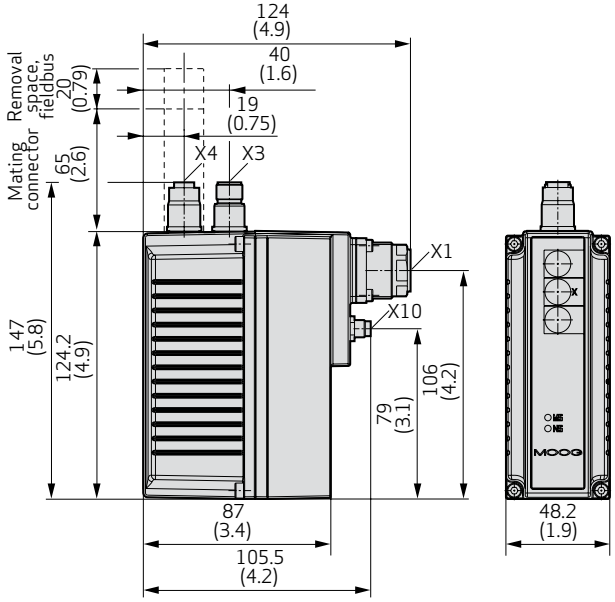
X1 Valve connector
X3 Fieldbus connector
X4 Fieldbus connector



Installation Drawings for Valves with EtherCAT or PROFIBUS-DP Fieldbus Connector

Ordering code[1] E: EtherCAT
Ordering code D: PROFIBUS-DP

X1 Valve connector
X3 Fieldbus connector
X4 Fieldbus connector
X10 Service connector



1) See inside back cover for complete ordering information.

ELECTRONICS

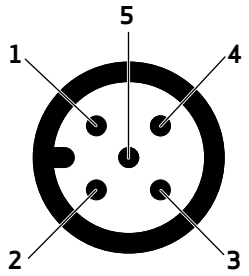
Fieldbus Connectors

CANopen Connectors (X3, X4)

- Ordering Code[1] C: CANopen
- Coding A
- Thread M12x1
- 5-pole

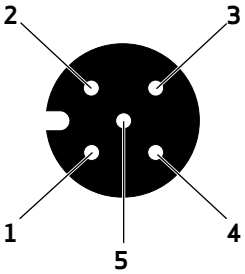
Pin	Signal X3, X4	Description
1	CAN_SHLD	Shield
2	CAN_V+	Not connected in the valve
3	CAN_GND	Mass
4	CAN_H	Transceiver H
5	CAN_L	Transceiver L

External thread, pin contact



View on CAN connector X3

Internal thread, socket contact



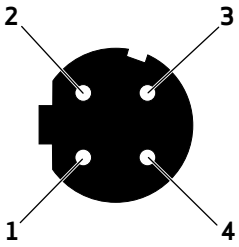
View on CAN connector X4

EtherCAT IN/OUT Connectors (X3, X4)

- Ordering Code[1] E: EtherCAT
- Coding D
- Thread M12x1
- 4-pole

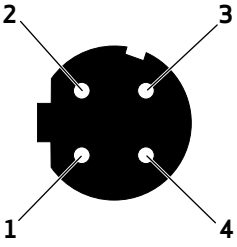
Pin	Signal X4 IN	Signal X3 OUT	Description
1	TX + IN	TX + OUT	Transmit
2	RX + IN	RX + OUT	Receive
3	TX – IN	TX – OUT	Transmit
4	RX – IN	RX – OUT	Receive

Internal thread, socket contact



View on EtherCAT connector X3

Internal thread, socket contact



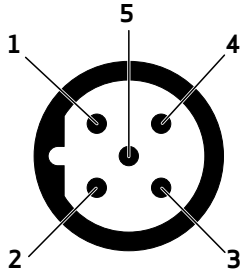
View on EtherCAT connector X4

PROFIBUS-DP Connectors (X3, X4)

- Ordering Code[1] D: PROFIBUS-DP
- Coding B
- Thread M12x1
- 5-pole

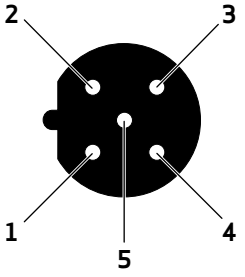
Pin	Signal X3, X4	Description
1	Profi V+	Power supply 5 V of terminal resistors
2	Profi A	Receive/transmit data –
3	Profi GND	Mass
4	Profi B	Receive/transmit data +
5	Shield	Shield

External thread, pin contact



View on PROFIBUS-DP connector X3

Internal thread, socket contact



View on PROFIBUS-DP connector X4

1) See inside back cover for complete ordering information.

DESCRIPTION OF OPERATION

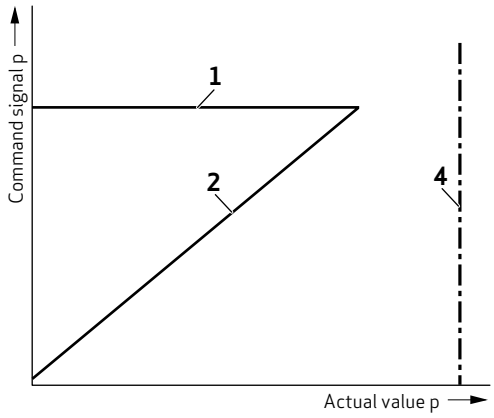
Modes

Pressure Control (p Control) Ordering Code 16: B1

In this operating mode of the servo valve, the pressure in port A is controlled either in the main line (ordering code 12: M) or bypass line (ordering code 12: B). The pressure in port A is proportional to the pressure command signal. The command signal (pressure command for port A) is transmitted to the valve electronics. A pressure transducer measures the pressure in port A and feeds this to the valve electronics. The electronics compare the actual pressure value and the pressure command signal and then generate an internal signal to compensate the deviation. The linear force motor brings the spool into the corresponding position.

For this operating mode both a 6-pole + PE or a 11-pole + PE valve connector can be used (ordering code 9: S or 9: E).

Pressure control



1 Maximum command signal p
2 Actual value p
4 Q limit value (100 %)

DESCRIPTION OF OPERATION

Modes

Flow Control with Pressure Limiting (pQ Control) Ordering Code 16: C1

This is a combination of flow and pressure control for which both command signals (flow and pressure) must be present. Thus, a 11-pole + PE valve connector is required (ordering code 9: E).

During the pQ function, the required spool position calculated by the pressure controller is compared with the external spool position command. The smaller of the two is fed into the spool position control loop.

The result of this action is to give spool position control until the actual pressure value starts to exceed the pressure command signal, at which point pressure control takes over.

The following are examples of possible combinations:

- Flow control with maximum pressure limiting control
- Flow control with minimum pressure limiting control

Flow Control with Maximum Pressure Limiting Control Ordering Code 12: N or 12: C

When the actual pressure value reaches the pressure limit (command signal), the pressure controller starts to limit the spool command signal accordingly.

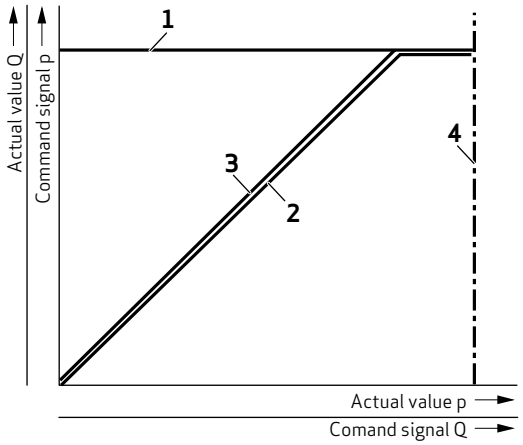
If the pressure limit value is exceeded, the pressure control loop reduces or closes the P → A port and if necessary opens the A → T port to maintain the pressure at a level no higher than the pressure limit.

Flow Control with Minimum Pressure Limiting Control Ordering Code 12: K

When the actual pressure value reaches the minimum limit, the pressure controller starts to limit the spool command signal accordingly.

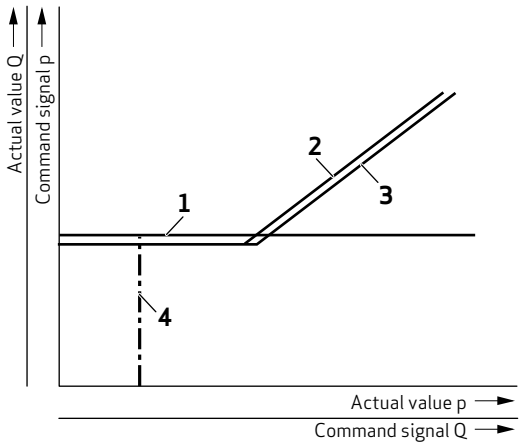
If the pressure limit value is not reached (i.e. is below the set limit), the pressure controller reduces or closes the A → T port and opens the P → A port to maintain the pressure at a level no lower than the pressure limit.

Flow control with maximum pressure limiting control



1 Maximum command signal p
2 Actual value p
3 Limiting
4 Maximum command signal Q

Flow control with minimum pressure limiting control

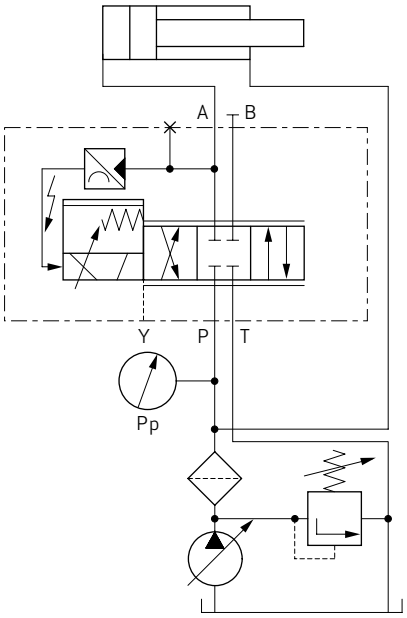


1 Minimum command signal p
2 Actual value p
3 Limiting
4 Minimum command signal Q

DESCRIPTION OF OPERATION

Modes

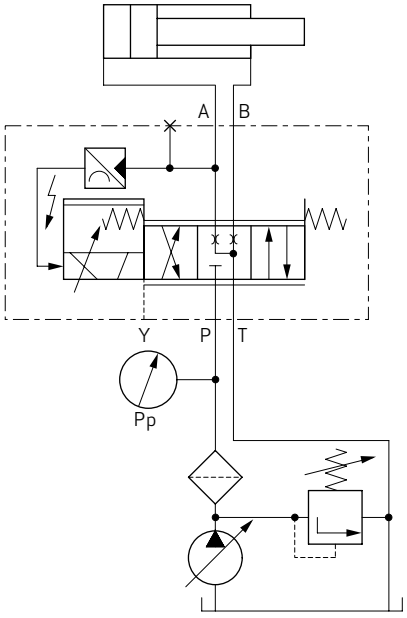
3-way valve in main line



Optional Y external

The device operates as a 3-way pressure reducing or limiting valve with flow from P → A or A → T.
Only one load port is used.

4-way valve in main line



Optional Y external

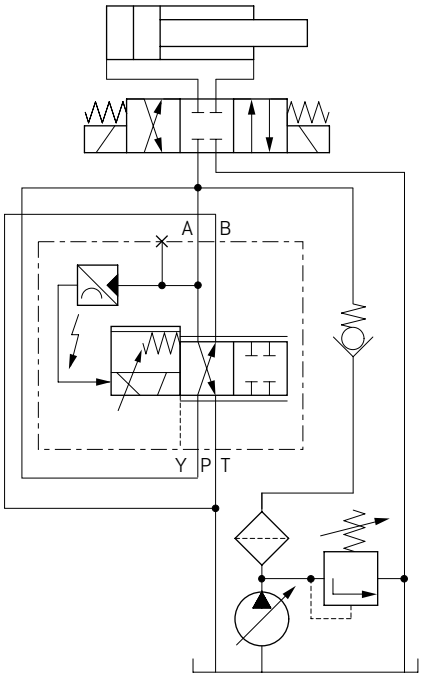
From P→ A the valve operates like a 3-way pQ-valve.
From P → B it allowes only flow modulation.

This means the direction of the load motion can be reversed (open loop velocity control for load retract).

DESCRIPTION OF OPERATION

Modes

2x2-way valve in bypass line



Optionally Y external

The device has parallel flow paths and operates as an electrically adjustable pressure relief valve from A → T and P → B.

At zero command signal the valve is fully open, i.e. the pressure in the load ports is zero apart from minor pressure build up due to line leakage.

FLOW CALCULATION

When the valve is open, the prevailing flow is dependent not only on the spool position, (i.e. the opening cross section of the valve), but also on the pressure drop at the individual lands. When the valve is deflected at 100 %, it delivers the rated flow with the rated pressure drop.

The rated flow of a servo valve corresponds to a pressure drop of 35 bar (500 psi) per land, equating to 70 bar (1,000 psi) for two lands. When a valve is opened at 100 %, the flow can be calculated as a function of the actual pressure drop with the aid of the formula below or taken from the diagram.

$$Q = Q_N \cdot \sqrt{\frac{\Delta p}{\Delta p_N}}$$

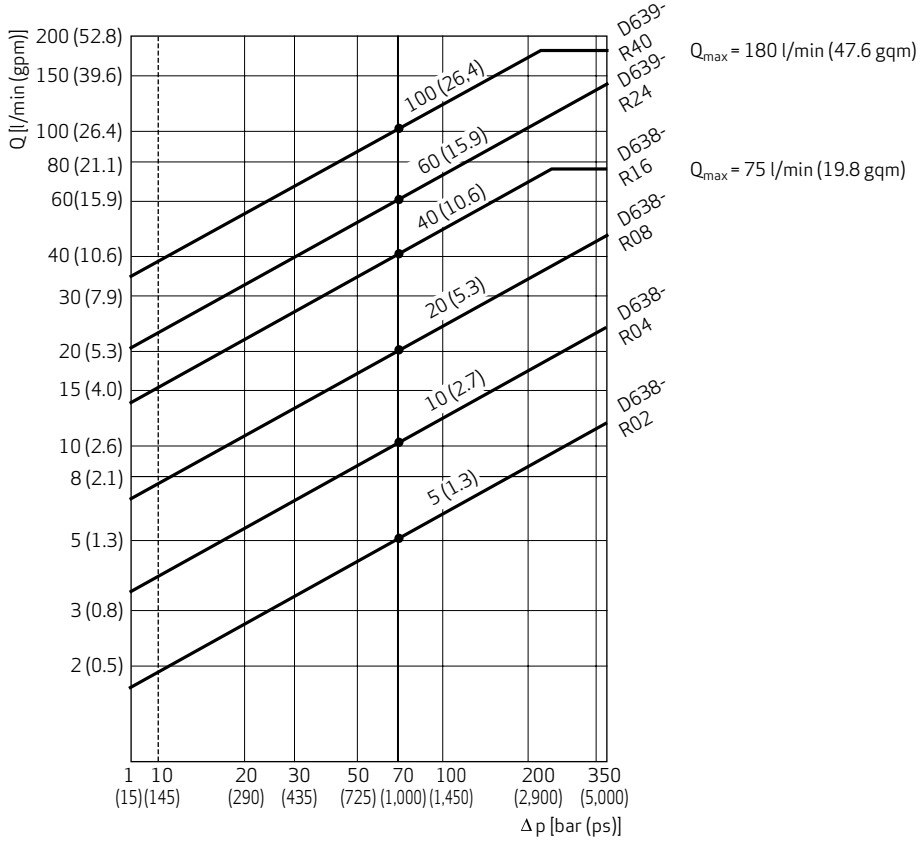
Q [l/min (gpm)]	actual flow
Q_N [l/min (gpm)]	rated flow
Δp [bar (psi)]	actual pressure drop per spool land
Δp_N [bar (psi)]	rated pressure drop per spool land

The actual flow in the valve ports must not exceed a mean flow velocity of approximately 30 m/s (96.5 ft/s) due to the risk of cavitation. When operating the valves close to these application limits, it is necessary to drill the ports to the maximum possible diameters (see specifications for the respective valve).

For ISO 4401 size 05 mounting surfaces the second tank port must additionally be connected starting from a flow Q exceeding 150 l/min (39.6 gpm).

The ports inside the manifold should exceed the valve ports by one or two sizes to achieve the maximum flow.

Flow diagram



ELECTRONICS

Digital Valve Electronics

The valve electronics is based on microprocessor hardware with corresponding A/D-D/A converters for analog input and output signals. All functions of the valve are integrated in the firmware. The digital electronics offer the following advantages over conventional analog electronics:

- Greater flexibility: Ability to change the valve parameters easily using configuration software and the possibility of linearizing flow curves
- Higher reliability due to integrated monitoring functions
- Easier maintenance due to diagnostic capability and recording the fault history
- Remote maintenance and setup

Using the optional fieldbus interface cuts down the amount of wiring needed and eliminates the need for control interfaces in the PLC.

In the basic version the valve has a standard connector, and service connector and does not include the fieldbus interface. In this case the valve is actuated via an analog command signal.

The service connector offers the possibility to connect the valve to a PC or Notebook via an USB-to-CAN adaptor (see accessories). Its CANopen interface offers access to the valve parameters, which can be changed and monitored, as well as diagnosing valve performance and possible faults.

The flexibility of the integrated firmware enables the user to optimize the valve characteristic on-site as required by the application:

- Adapting the valve flow curve to the needs of the controlled system
- Adjusting the maximum valve opening separately for each direction of motion
- Defining fault reactions

The results obtained by the parameter changes can be viewed and analyzed directly using the built-in data logger. The parameters optimized during commissioning can be saved and copied. When the valve is replaced or used for series applications no tuning is required. The valves are supplied with a predefined parameter set if required.

Optional Fieldbus Interface

When the valves are operated with a fieldbus, they are parameterized, activated and monitored via the fieldbus. CANopen, PROFIBUS-DP or EtherCAT interfaces are available. Other fieldbus communication protocols are available upon request. The fieldbus interface is equipped with two bus connectors (IN/OUT) for cost-effective wiring. Valves can be integrated directly into the bus without any external T-joints. The electrically isolated fieldbus interface ensures reliable data transfer. Data from additional analog inputs or from SSI and encoders can be transmitted via fieldbus (inputs available upon request).

FIELDBUS INTERFACE

Modern automation technology is characterized by an increasing decentralization of processing functions via serial data communication systems. The use of serial bus systems in place of analog signal transfer guarantees greater system flexibility with regard to alterations and expansions.

There is also considerable potential for saving project planning and installation costs in many areas of industrial automation. Further possibilities of parameterization, better diagnostics and a reduction of the number of variants are advantages which have only been made possible by the use of field buses.

VDMA Profile

In a working group within the VDMA (German Machinery and Plant Manufacturers' Association), a profile was created in collaboration with numerous well-known hydraulic system manufacturers. This profile describes the communication between hydraulic components via a fieldbus and defines uniform functions and parameters. In this way, a standardized exchange format covering all manufacturers was created.

DCVs and ACVs can be equipped with the following fieldbus interfaces: CANopen, PROFIBUS-DP or EtherCat.

CANopen

According to EN 50325-4 CAN bus was originally developed for use in automobiles, but has also been used for years a variety of industrial applications. The CAN bus is primarily designed for transmission reliability and speed.

The CAN bus has the following general features:

- Multi-master system: Each node can transmit and receive
- Topology: Line structure with short stub cables
- Network expansion and transmission rates:
  - Up to 25 m (80.4 ft) at 1 Mbit/s
  - Up to 5,000 m (16,090 ft) at 25 kbit/s
- Addressing type: Message-orientated via identifiers. Priority assignment of messages possible via identifiers
- Safety: Hamming distance=6, i.e. up to 6 individual errors per message are detected.
- Bus physics: ISO 11898
- Maximum number of nodes: 110 (64 without repeaters)

PROFIBUS-DP

According to EN 61158, PROFIBUS-DP was developed for process and manufacturing industries. It is thereby supported by numerous control system manufacturers.

PROFIBUS-DP has the following features:

- Multi-master system: The masters share access time and initiate communication. The slaves react only upon request
- Topology: Line structure with short stub cables
- Network expansion and transmission rates:
  - Up to 100 m (321.8 ft) at 12 Mbit/s
  - Up to 1,200 m (3,861.6 ft) at 9,6 kbit/s per segment
- Use of repeaters possible
- Addressing type: Address-orientated. Priority/cycle time assignment of messages via master configuration
- Bus physics: EIA-485
- Maximum number of nodes: 126 (32 without repeaters)

EtherCAT

According to IEC/PAS, 62407 EtherCAT was developed based on the Ethernet as an industry bus based on Ethernet to meet the increasing demands for faster cycle times. The EtherCAT bus is designed for high data transmission rates and fast cycle times.

The EtherCAT bus has the following features:

- Single-master system: The master initiates communication. The slaves react only upon request
- Topology: Line, star, tree and ring structure based on the daisy chain principle
- Network expansion and transmission rates: 100 m (321.8 ft) between two nodes at 100 Mbit/s
- Addressing type: Address-orientated, one telegram for all nodes
- Bus physics: Fast Ethernet 100 Base Tx
- Maximum number of nodes: 65,535

CONFIGURATION SOFTWARE

The Windows-based "Moog Valve and Pump Configuration Software" enables fast and convenient commissioning, diagnostics and configuration of the valve. It is possible to transfer data from the PC to the valve or to process the valve's current settings on the PC. The valve can be controlled by means of graphical control elements. Status information, command signals, actual values and characteristic curves are represented in graphical form. System parameters can be recorded and visualized via an integrated data logger.

System Requirements

The configuration software can be installed on a computer with the following minimum requirements:

- IBM PC-compatible
- Windows XP/7/8
- 1 GB RAM
- 1 GB free hard disk space
- Monitor resolution 1,024 x 768 pixels
- Keyboard, mouse

Recommended Requirements

- IBM PC-compatible
- Windows 7

Equipment

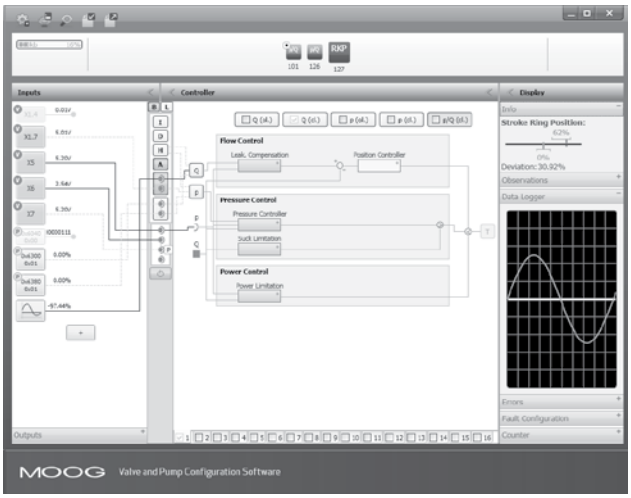
The following equipment is also required to be able to use the software (see also list of accessories):

- USB port
- USB to CAN adapter
- Configuration/commissioning cable
- Adapter for service connector (not required for CANopen fieldbus)
- Valve electrically connected and power supply switched on

Note

Configuration or commissioning with the "Moog Valve and Pump Configuration Software" can be performed via:

- Fieldbus connectors on valves with CANopen fieldbus
- Integrated service connector on valves with PROFIBUS-DP or EtherCAT fieldbus or on valves with analog activation



Download

The software is available free of charge from Moog upon request. Please visit www.moog.com/industrial/downloads to download the software.

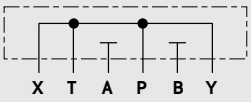
ACCESSORIES AND SPARE PARTS

Series-specific Accessories and Spare Parts

Spare Parts Direct Drive DCV with p and pQ Control - Size 03 - D638 Servo Valve

Part name	Description	Material	Part number
O-ring for ports P, T, A, B	4 pieces, inner Ø 9.25 mm (0.36 in) x Ø 1.8 mm (0.07 in)	FKM 90 Shore	CB35150-013
		HNBR 90 Shore	B97009-013
O-ring for port Y	1 piece, ID 7.65 x Ø1.8 (ID 0.3 x Ø0.07)	FKM 90 Shore	CB35150-012
		HNBR 90 Shore	B97009-012
Service sealing for venting screw	1 piece	FKM 90 Shore	B97018-060-002
		HNBR 90 Shore	B97018-060-003
Service sealing set	O-rings for ports P, T, A, B, Y	FKM 90 Shore	B97215-V630F63
		HNBR 90 Shore	B97215-H630F63

Accessories Direct Drive DCV with p and pQ Control - Size 03 - D638 Servo Valve

Part name	Description	Remark	Part number
Flushing plate	P, A, B, T, X, Y		B46634-002
Mounting screws	4 pieces M5x55, ISO 4762-10.9, tightening torque 6.8 Nm (60 lbf in)		A03665-050-055
Shipping plate	1 piece		B46035-001

Documents Direct Drive DCV with p and pQ Control - Size 03 - D638 Servo Valve

Part name	Description	Remark	Part number
ATEX and IECEx manuals D636 and D638 Series Servo Valves	Manuals	Visit www.moog.com/industrial/literature to download a document using the part number in a search	CDS29587
Manual D636 and D638 Series Servo Valves			B95872

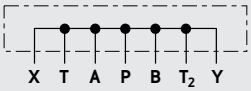
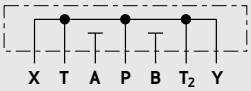
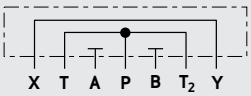
ACCESSORIES AND SPARE PARTS

Series-specific Accessories and Spare Parts

Spare Parts Direct Drive DCV with p and pQ Control - Size 05 - D639 Servo Valve

Part name	Description	Material	Part number
O-ring for ports P, T, T_1, A, B	5 pieces, inner Ø 12.4 mm (0.49 in) x Ø 1.8 mm (0.07 in)	FKM 90 Shore	CB35150-004
		HNBR 90 Shore	B97009-004
O-ring for ports X, Y	2 pieces, inner Ø 15,6 mm (0.6 in) x Ø 1,8 mm (0.07 in)	FKM 90 Shore	CB35150-011
		HNBR 90 Shore	B97009-011
Service sealing set	Contains the following O-rings: • 5 pieces for P, T, T_1, A, B inner Ø 12.4 (0.49) x Ø 1.8 mm (0.07 in) • 2 pieces for X, Y inner Ø 15.6 (0.61) x Ø 1.8 mm (0.07 in) • 1 piece for filter inner Ø 12.0 (0.47) x Ø 2.0 mm (0.08 in) • 1 piece for filter cover inner Ø 17.1 (0.67) x Ø 2.6 mm (0.10 in)	FKM 90 Shore	B97215-V681-10
		HNBR 90 Shore	B97215-H681-10

Accessories Direct Drive DCV with p and pQ Control - Size 05 - D639 Servo Valve

Part name	Description	Remark	Part number
Flushing plate	P, A, B, T, T_1, X, Y		B67728-001
	P, T, T_1, X, Y		B67728-002
	P, T, T_1 and X, Y		B67728-003
Mounting screws	4 pieces M6x60, ISO 4762-10.9, tightening torque 11 Nm (97 lbf in)		A03665-060-060
Shipping plate	1 piece		A40503

Documents Direct Drive DCV with p and pQ Control - Size 05 - D639 Servo Valve

Part name	Description	Remark	Part number
ATEX and IECEx manuals D637 and D639 Series Servo Valves	Manuals	Visit www.moog.com/industrial/literature to download a document using the part number in a search	CDS29577
Manual D637 and D639 Series Servo Valves			CA61892

ACCESSORIES AND SPARE PARTS

Series-independent Accessories

Accessories Direct Drive DCV with p and pQ Control - D638 and D639

Part name	Description	Remark	Part number
Dust protection cap for fieldbus connectors X3, X4	For external thread M12x1, metal	Required for operation without mating connector (IP protection)	C55823-001
	For internal thread M12x1, metal		CA24141-001
Dust protection cap for service connector X10	For internal thread M8x1, plastics		CA23105-080-010
Mains power connection	Power supply cable, length 2 m (6.4 ft)		B95924-002
	SELV power pack 24 V_{DC}, 10 A		D137-003-001
Mating connector	Cable with straight mating connector 11-pole + PE	5, 10, 20 or 25 m, e.g. for 5 m specify 005, other length upon request	C21031-xxx-001
	Cable with straight mating connector 6-pole + PE		C21033-xxx-001
	Mating connector, elbow 6-pole + PE	In accordance with EN 175201-804, type S, metal, IP65, cable Ø 8 to 12 mm (0.31 to 0.47 in)	B97069-061
	Mating connector, straight 11-pole + PE	In accordance with EN 175201-804, type R, metal, IP65, cable Ø 11 to 13 mm (0.433 to 0.512 in)	B97067-111
	Mating connector, straight 6-pole + PE	In accordance with EN 175201-804, type R, metal, IP65, crimp contact Ø 0.75 to 1.5 mm^2 (0.0012 to 0.0023 in^2), conus Ø 12.2 mm (0.48 in), cable Ø 9 to 12 mm (0.35 to 0.47 in), sealing element Ø 9 to 13 mm (0.35 to 0.51 in)	B97007-061
Service and commissioning set	Adapter for service connector X10, M8x1 to M12x1		CA40934-001
	Configuration/commissioning cable 2 m (6.4 ft), M12x1 to EIA-232		TD3999-137
	USB to CAN adapter (IXXAT)		C43094-001
	Moog Valve and Pump Configuration Software	Download software free of charge at www.moogsoftwaredownload.com	

ACCESSORIES AND SPARE PARTS

Series-independent Accessories

Documents Direct Drive DCV with p and pQ Control - D638 and D639

Part name	Description	Remark	Part number
Installation Instruction D636, D637, D638 and D639 Series Servo Valves	Installation Instructions	Visit www.moog.com/industrial/literature to download a document using the part number in a search	B97072-636
Manual DCV Electrical Interfaces	Manuals		CA63420
Manual DCV with CANopen Interface			CDS33853
Manual DCV with EtherCAT Interface			CDS33722
Manual DCV with PROFIBUS Interface			CDS33854
Technical Note TN 353	Protective Grounding and Electrical Shielding of Hydraulic Valves with Integrated Electronics		CA58437
Technical Note TN 494	Maximum Permissible Length of Electric Cables for Valves with Integrated Eletronics		CA48851

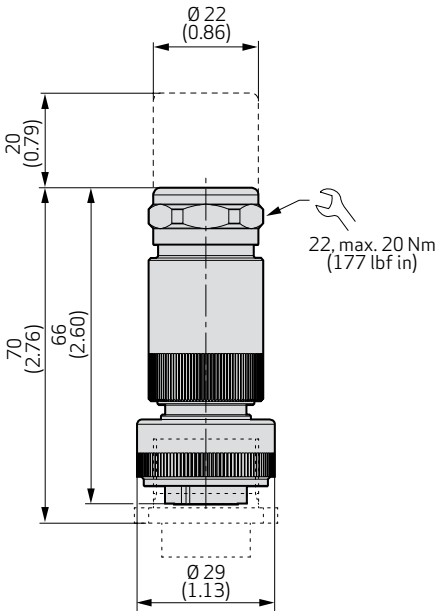
ACCESSORIES AND SPARE PARTS

Accessories - Installation Drawings

Mating Connector, Straight 6-pole + PE

In accordance with EN 175201-804, type R, metal, IP65, crimp contact Ø 0.75 to 1.5 mm² (0.0012 to 0.0023 in²), conus Ø 12.2 mm (0.48 in), cable Ø 9 to 12 mm (0.35 to 0.47 in), sealing element Ø 9 to 13 mm (0.35 to 0.51 in)

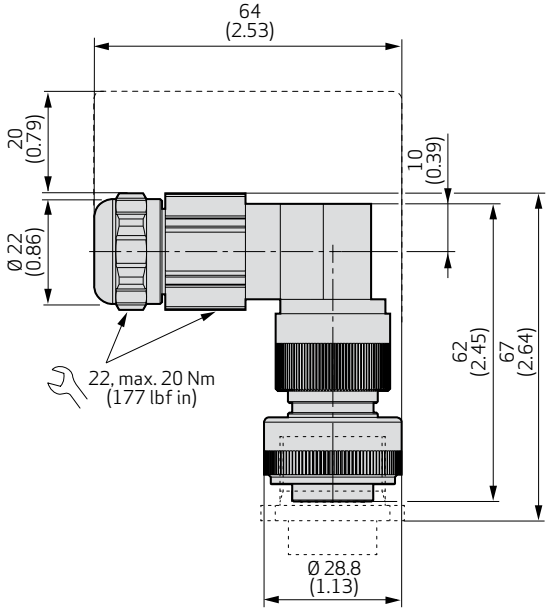
Part number B97007-061



Mating Connector, Elbow 6-pole + PE

In accordance with EN 175201-804, type S, metal, IP65, cable Ø 8 to 12 mm (0.31 to 0.47 in)

Part number B97069-061



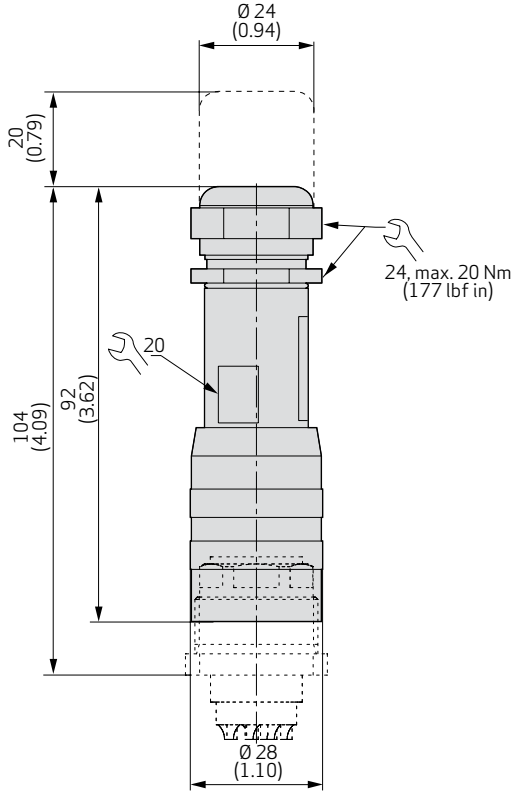
ACCESSORIES AND SPARE PARTS

Accessories - Installation Drawings

Mating Connector, Straight 11-pole + PE

In accordance with EN 175201-804, type R, metal, IP65, cable Ø 11 to 13 mm (0.433 to 0.512 in)

Part number B97067-111



MOOG GLOBAL SUPPORT

Moog Global Support is our promise to offer world-class Repair and Maintenance Services delivered expertly by our trained technicians. With the reliability only available from a leading manufacturer with facilities around the world, Moog offers you service and expertise you can count on to keep your equipment operating as it should.

This promise offers many benefits to our customers including:

- Reduce your downtime by keeping critical machines running in peak performance
- Protect your investment by ensuring reliability, versatility and long-life of products
- Better plan your maintenance activities and make systematic upgrades
- Leverage our flexible programs to meet the unique service requirements of your facility

Look to Moog for global support including:

- Repair services using OEM parts are performed by trained technicians to the latest specifications
- Stock management of spare parts and products to prevent unplanned downtime
- Flexible programs, tailored to your needs such as upgrades, preventative maintenance and annual/multi-year contracts
- On-site services bring the expertise to you, providing quicker commissioning, set-up and diagnostics
- Access to reliable services that are guaranteed to offer consistent quality anywhere in the world

For more information on Moog Global Support visit www.moog.com/industrial/service.

ORDERING CODE

Model number (assigned at the factory)

Type designation

											1	2	3	4	5	6	7	8	…
D638 or D639						-					**R**								

Specification status	
–	Series specification
Z	Special specification

Model designation

Variant

1	**Valve type**
R	Servovalve with integrated digital electronics

2	**D638: Rated flow per spool land [l/min (gpm)]**	
	For Δp_N = 35 bar (500 psi)	For Δp_N = 5 bar (75 psi)
02	5 (1.3)	2 (0.5)
04	10 (2.7)	4 (1.0)
08	20 (5.3)	8 (2.1)
16	40 (10.6)	16 (4.2)

2	**D639: Rated flow per spool land [l/min (gpm)]**	
	For Δp_N = 35 bar (500 psi)	For Δp_N = 5 bar (75 psi)
24	60 (15.9)	24 (6.3)
40	100 (26.4)	40 (10.6)

3	**Pressure range [bar (psi)]**
	Maximum operating pressure[1)]
W	25 (363)
V	100 (1,450)
U	160 (2,320)
T	250 (3,625)
K	350 (5,076)

4	**Bushing/spool design**
O	4-way: zero lap, linear flow characteristic
A	4-way: 1.5 to 3 % positive overlap, linear flow characteristic
D	4-way: 10 % positive overlap, linear flow characteristic
B	3-way: P→A, A→T, 1.5 to 3 % positive overlap, linear flow characteristic
H	4-way: P→A and P→B 20 % positive overlap, A→T and B→T 15 % negative overlap, linear flow characteristic
X	Special spool upon request

5	**Linear force motor**	**Series**
1	Standard	D638
2	Standard	D639

6	**Spool position without electrical supply**
M	Center position
F	P→B, A→T connected (approximately 10 % open)
D	P→A, B→T connected (approximately 10 % open)

7	**Y port**
0	Closed with screw plug p_{Tmax} = 50 bar (725 psi)
3	Open with filter element p_T >50 bar (725 psi), $p_{T\,max}$ see maximum operating pressure in ordering code position 3

8	**Seal material**
H	HNBR
V	FKM

1) Set pressure can vary from the maximum operating pressure

ORDERING CODE

9	10	11	12	13	14	15	16
…		2					

16	Device capability
B1	p control
C1	pQ control

15	Service connector X10
O1	Without[9]
K1	With[8]

14	Fieldbus connector X3, X4
C	CANopen
D	PROFIBUS-DP[7]
E	EtherCAT[7]
O	Without fieldbus connector[7]

13	Enable function					
A	**B**	**K**	**L**	**M**	**R**	
X	–	X	–	X	–	If the enable signal is low: The spool moves to a closed loop controlled neutral position (the HOLD position).
–	X	–	X	–	X	If the enable signal is low: The linear force motor is de-energized. The spool moves to its spring centered position (as defined at position 6 of the order code).
–	–	X	X	–	–	Monitoring of the safe position of the spool at pin 11[5]. The range of the safe position can be freely defined (the default range is around the spring centered position). HIGH: Within the safe position range LOW: Outside of the safe position range
–	–	–	–	X	X	Monitoring of the spool control error at pin 11[5]. The threshold for the spool control error can be freely defined (the default value is >30 % of maximum spool stroke after 500 ms). HIGH: Control error is below the threshold LOW: Control error is above the threshold

12	Valve function
M	Pressure control in main line[6]
B	Pressure control in bypass line[6]
N	Flow control in main line with maximum pressure limiting control[5]
C	Flow control in bypass line with maximum pressure limiting control[5]
K	Flow control in main line with minimum pressure limiting control[5]

11	Supply voltage
2	24 V_{DC}, for more information, see section "Electronics"

10	Command signals for flow Q and pressure p	
	Input Q	Input p
M	± 10 V	0 to 10 V
X	± 10 mA	0 to 10 mA
E	4 to 20 mA	4 to 20 mA
9	Fieldbus[4]	Fieldbus[4]
Y	Further upon request	
Actual valve: Spool position or pressure 4 to 20 mA		

9	Valve connector X1
S	6-pole + PE EN 175201 part 804[3]
E	11-pole + PE EN 175201 part 805[2]

2) For pQ control or p control with monitoring at pin 11

3) For p control

4) Only in conjunction with fieldbus connector "C, D, E" (changeover to analog signals "M, X, E" possible)

5) Only in combination with valve connector X1 "E" and device capability "C1"

6) Only in combination with valve connector X1 "S" and device capability "B1"

7) Valve parameterization with commissioning software "Moog Valve and Pump Configuration Software" using M8 service connector

8) Only in conjunction with fieldbus connector "D, E, O"

9) Only in conjunction with fieldbus connector "C"

TAKE A CLOSER LOOK.

Moog designs a range of motion control products that complement the performance of those featured in this document.
Visit our website for more information and contact the Moog facility nearest you.

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