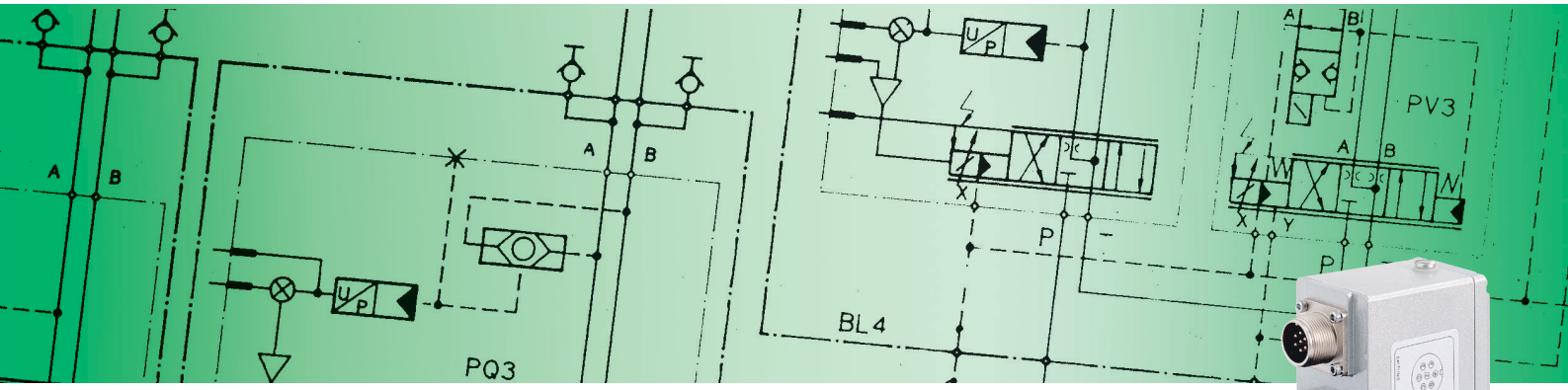
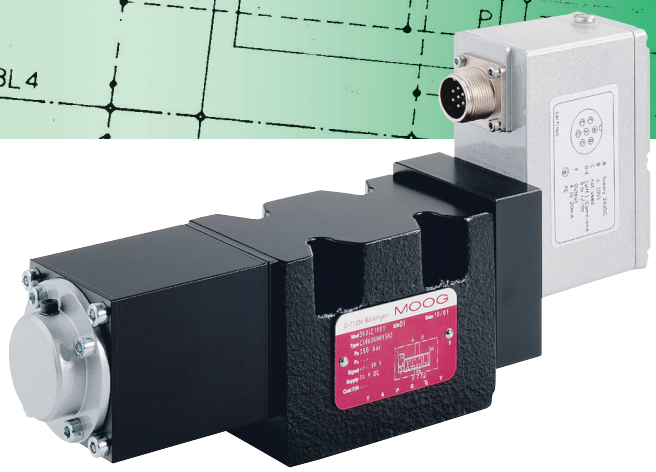
MOOG

D634-P Series

Direct Drive Proportional Valve
with Integrated 24 V Electronics
ISO 4401 Size 05





MOOG SERVO- AND PROPORTIONAL CONTROL VALVES

For over 50 years Moog has manufactured proportional control valves with integrated electronics. During this time more than 200,000 valves have been delivered. These servo-control valves have been proven to provide reliable control for injection and blow molding equipment, die casting machines, presses, heavy industry equipment, paper, and lumber processing and other applications.

D634-P SERIES PROPORTIONAL CONTROL VALVES

The D634-P Series are Direct Drive Valves (DDV) with electric closed loop spool position control.
These valves are throttle valves for 3-, 4-, and 2x2-way applications. They are suitable for electrohydraulic position, velocity, pressure and force control systems, including those with high dynamic response requirements.
The spool drive device is a permanent magnet linear force motor which can actively stroke the spool from its spring centered position in both directions. This is an advantage compared with proportional solenoids with one force direction only. The closed loop spool position electronics and pulse width modulated (PWM) drive electronics are integrated into the valve.
The integrated electronics of the valves is a new development featuring SMD technology with pulse width modulated (PWM) current output stage and requires a 24 VDC power supply.

CE

The valve series described in this catalogs have successfully passed EMC tests required by EC Directive. Please refer to the respective references in the electronics section.

NOTICE

- ❒ Before installation of the valve into the system, the complete hydraulic system must be flushed.
- ❒ Please read the notes in section entiteled “Electronics”, page 6.

This catalog is for users with technical knowledge. To ensure that all necessary characteristics for function and safety of the system are given, the user must check the suitability of the products described herein. In case of doubt please contact Moog.

Our Quality Management System conforms to DIN EN ISO 9001.

BENEFITS OF DIRECT DRIVE SERVO VALVES (DDV)

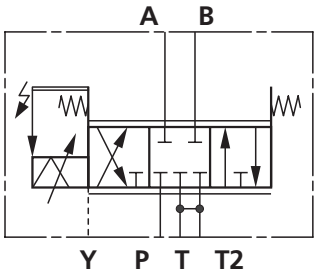
- ❒ Directly driven by a permanent magnet linear force motor with high force level
- ❒ No pilot oil flow required
- ❒ Pressure independent dynamic performance
- ❒ Low hysteresis and low threshold
- ❒ Low current consumption at and near hydraulic null
- ❒ Increased operation at limits (at high pressure drops)
- ❒ Standardized spool position monitoring signal with low residual ripple
- ❒ Electric null adjust
- ❒ With loss of supply voltage, a broken cable, or an emergency stop, the spool returns to its spring centered position without passing a load move position.

DIRECT DRIVEN PROPORTIONAL VALVE (DDV) OPERATING PRINCIPLE

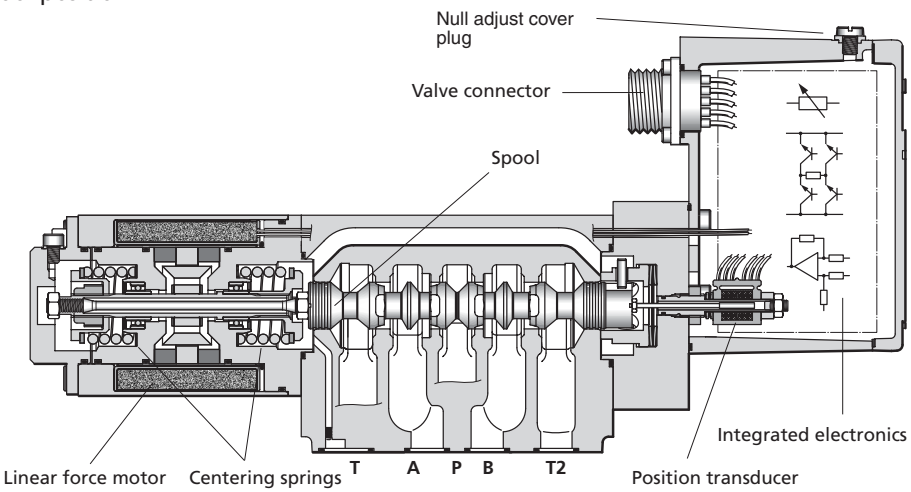
The position control loop for the spool with position transducer and linear force motor is closed by the integrated electronics. An electric signal corresponding to the desired spool position is applied to the integrated electronics and produces a pulse width modulated (PWM) current to drive the linear force motor. An oscillator excites the spool position transducer (LVDT), producing an electric signal proportional to spool position.

The demodulated spool position signal is compared with the command signal, and the resulting spool position error causes current in the force motor coil until the spool has moved to its commanded position, and the spool position error is reduced to zero. The resulting spool position is thus proportional to the command signal.

D634-P Series Single Stage Proportional Valve



Hydraulic symbol:
Symbol shown with electric supply on and zero command signal.

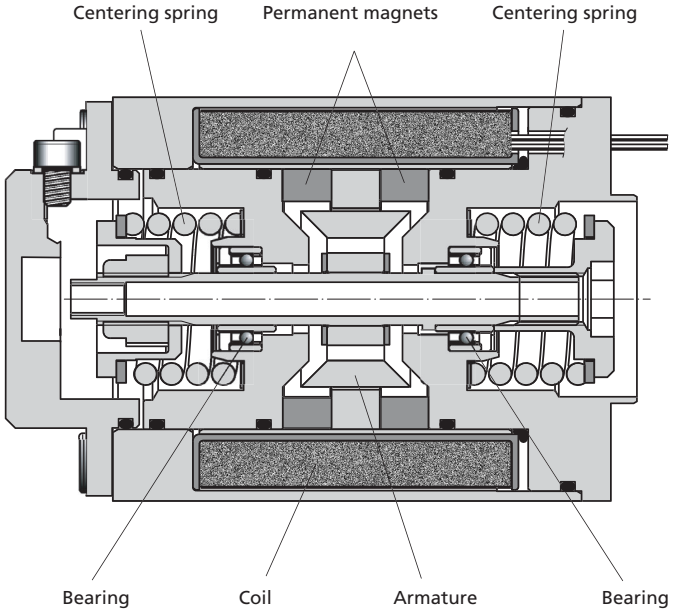


PERMANENT MAGNET LINEAR FORCE MOTOR OPERATION

The linear force motor is a permanent magnet differential motor. The permanent magnets provide part of the required magnetic force. For the linear force motor, the current needed is considerably lower than would be required for a comparable proportional solenoid.The linear force motor has a neutral mid-position from which it generates force and stroke in both directions. Force and stroke are proportional to current.

High spring stiffness and resulting centering force plus external forces (i.e. flow forces, friction forces due to contamination) must be overcome during out-stroking. During backstroking to center position, the spring force adds to the motor force and provides additional spool driving force which makes the valve much less contamination sensitive. The linear force motor needs very low current in the spring centered position.

Proportional solenoid systems require two solenoids with more cabling for the same function. Another solution uses a single solenoid, working against a spring. In case of current loss in the solenoid, the spring drives the spool to the end position by passing through a fully open position. This can lead to uncontrolled load movements.



PERFORMANCE SPECIFICATIONS FOR STANDARD MODELS

Operating pressure range		
Ports P, A and B		up to 350 bar (5000 psi)
Port T		up to 210 bar (3000 psi)
Temperature range		
Ambient		–20 °C to +60 °C (-4 °F to +140 °F)
Fluid		–20 °C to +80 °C (-4 °F to +170 °F)
Seal material		FPM, others upon request
Operating fluid		mineral oil based hydraulic fluid (DIN 51524, part 1 to 3), others upon request
Viscosity	recommended	15 to 100 mm^2/s (cSt)
	allowed	5 to 400 mm^2/s (cSt)

System filtration

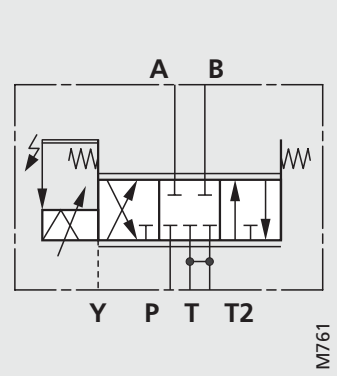
High pressure filter (without bypass, but with dirt alarm) mounted in the main flow and if possible, directly upstream of the valve.

Class of cleanliness

The cleanliness of the hydraulic fluid particularly effects the performance (spool positioning, high resolution) and wear (metering edges, pressure gain, leakage) of the proportional valve.

Recommended cleanliness class	
For normal operation	ISO 4406 < 15 / 12
For longer life (wear)	ISO 4406 < 14 / 11
Filter rating recommended	
For normal operation	$\beta_{10} \geq 75$ (10 µm absolute)
For longer life (wear)	$\beta_6 \geq 75$ (6 µm absolute)
Installation options	any position, fixed or movable
Vibration	30 g, 3 axes
Degree of protection	EN60529: Class IP 65 with mating connector mounted
Shipping plate	Delivered with an oil sealed shipping plate

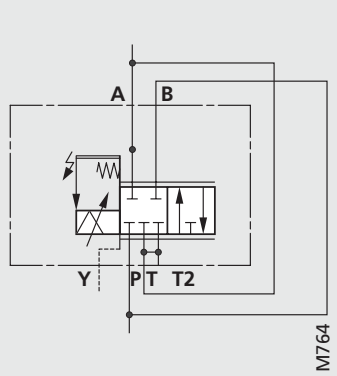
4-WAY FUNCTION



4-way version
spring centered

- ❒ Flow control (throttle valve) in port A and port B
- ❒ Port Y required if pressure p_T > 50 bar (715 psi) in port T
- ❒ for 3-way function close port A or port B of the manifold
- ❒ Spools with ~ axis cut or 10 % overlap available

2X2-WAY FUNCTION



2x2-way version
(Y-Port required)

- ❒ Flow control (throttle valve) in port A
- ❒ Port Y required
- ❒ Connect externally port P with port B, and port A with port T

VALVE FLOW CALCULATIONS

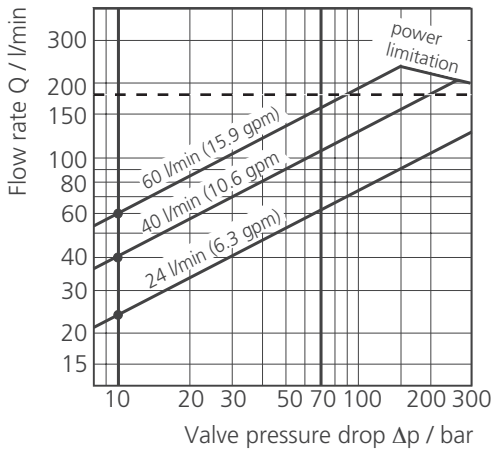
The actual valve flow is dependent on the spool position and the pressure drop across the spool lands.

At 100% command signal (i.e. +10 VDC = 100% valve opening), the valve flow at rated pressure drop Δp_N = 35 bar (500 psi) per metering land is the rated flow Q_N. For other than rated pressure drop, the valve flow changes at constant command signal according to the square root function for sharp edged orifices.

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

Q / l/min	=	calculated flow
Q_N / l/min	=	rated flow
Δp / bar	=	actual valve pressure drop
Δp_N / bar	=	rated valve pressure drop

The actual valve flow Q calculated in this way, should result in an average flow velocity in ports P, A, B or T of less than 30 m/s.



--- recommended flow rate limit
Q = 180l/min (47 gpm)

GENERAL REQUIREMENTS FOR VALVE ELECTRONICS

- ❒ Supply 24 V DC, min. 19 V DC, max. 32 V DC.
  Current consumption I_{Amax} : 2.2 A.
  External fuse per valve : 2.5 A (slow).
- ❒ All signal lines, also those of external transducers, shielded.
- ❒ Shielding connected radially to ⊥ (0 V), power supply side, and connected to the mating connector housing (EMC).
- ❒ **EMC:** Meets the requirements of emission: EN55011:1998+A1:1999 (limit class: B) and immunity: EN61000-6-2:1999.
- ❒ Minimum cross-section of all leads ≥ 0.75 mm^2 (0.001 in^2). Consider voltage losses between cabinet and valve.
- ❒ Note: When making electric connections to the valve (shield, protective earth), appropriate measures must be taken to ensure that locally different earth potentials do not result in excessive ground currents. See also Moog Application Note TN 353.

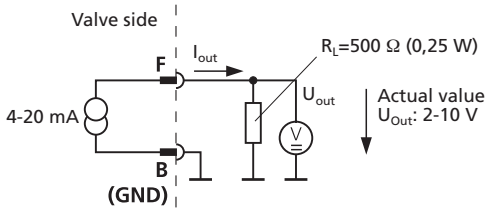
VALVE ELECTRONICS WITH 24 VOLT SUPPLY VOLTAGE AND 6+PE POLE CONNECTOR

Command signal 0 to ±10 mA floating,
Valves with current command input
The spool stroke of the valve is proportional to $I_D = -I_E$.
100% valve opening P ➡ A and B ➡ T is achieved at I_D = +10 mA. At 0 mA command, the spool is in centered position. The input pins D and E are inverting. Either pin D or E is used according to the required operating direction. The other pin is connected to signal ground at cabinet side.

Command signal 0 to ±10 V,
Valves with voltage command input
The spool stroke of the valve is proportional to $(U_D - U_E)$.
100% valve opening P ➡ A and B ➡ T is achieved at $(U_D - U_E)$ = +10 V.
At 0 V command, the spool is in centered position. The input stage is a differential amplifier. If only one command signal is available, pin D or E is connected to signal ground at cabinet side, according to the required operating direction.

Actual value 4 to 20 mA
The actual spool position value can be measured at pin F (see diagram below). This signal can be used for monitoring and fault detection purposes.
The spool stroke range corresponds to 4 to 20 mA.
The centered position is at 12 mA. 20 mA corresponds to 100% valve opening P ➡ A and B ➡ T . The position signal output 4 to 20 mA allows detecting a cable break when I_F = 0 mA.

Circuit diagram for measurement of actual value I_F (position of spool) for valves with 6+PE pole connector



The position signal output 4 to 20 mA allows to detection of a cable break when I_F = 0 mA.
For failure detection purposes, it is advised to connect pin F of the mating connector and route this signal to the control cabinet.

WIRING FOR VALVES WITH 6+PE POLE CONNECTOR

To EN 175201 Part 804[1]), and mating connector (type R and S, metal shell) with leading protective earth connection (⏚).
See also Application Note AM 426 E.

Pin	Function	Current command 0 to ± 10 mA floating	Voltage command 0 to ± 10 V DC
A	Supply	24 V DC (19 to 32 V DC)	
B	Supply / Signal ground	⊥ (0 V)	
C	not used		
D	Input rated command (differential)	Input command I_D = - I_E: 0 to ± 10 mA Input command (inv.) I_E = - I_D: 0 to ± 10 mA (R_e = 200 Ω)	U_{D-E} = 0 to ± 10 V R_e = 10 KΩ
E		Input voltage U_{D-B} and U_{E-B} for both signal types is limited to min. -15 V, max. +24 V.	
F	Output actual valve spool position	I_{F-B} = 4 to 20 mA. At 12 mA spool is in centered position. R_L = 300 to 500 Ω	
⏚ PE	Protective earth		

[1]) formerly DIN 43563

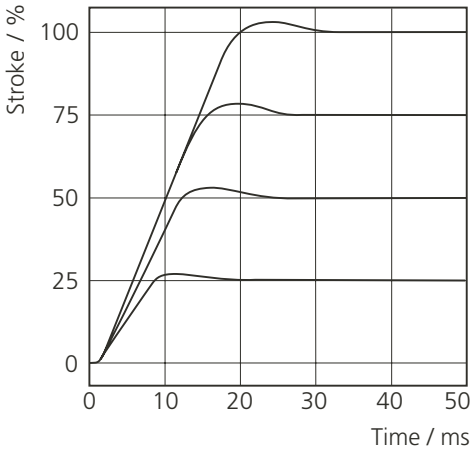
PERFORMANCE SPECIFICATIONS FOR STANDARD MODELS

Model . . . Type		D634
Mounting pattern with or without leakage port Y [3])		ISO 4401-05-05-0-94
Port diameter	mm (in)	11.5 (0.45)
Valve version [2])		Single stage, spool in bushing 3-way, 4-way, 2x2-way
Spool actuation		directly, with permanent magnet linear force motor
Pilot supply		none
Mass	kg (lb)	7.3 (16.1)
Rated flow (±10%) at Δp_N= 5 bar (71 psi) per land	l/min (gpm)	24 / 40 / 60 (6.3 / 10.6 / 15.8)
Max. valve flow	l/min (gpm)	185 (48.8)
Operating pressure max.		
Ports P, A, B	bar (psi)	350 (5000)
Port T without Y	bar (psi)	50 (715)
Port T with Y	bar (psi)	210 (3000)
Port Y	bar (psi)	directly to tank
Response time for 0 to 100% stroke, typical	ms	≤ 25
Threshold [1])	%	< 0.1
Hysteresis [1])	%	< 0.2
Null shift [1]) with ΔT = 55 K	%	< 1.5
Null leakage flow [1]) max. (axis cut)	l/min (gpm)	1.2 / 2.0 / 3.0 (0.32 / 0.53 / 0.79)

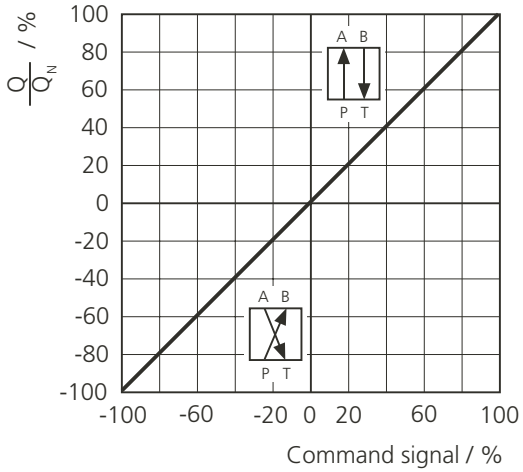
1) At operating pressure p_p = 140 bar (2000 psi), fluid viscosity of 32 mm²/s (0.05 in²/s) and fluid temperature of 40 °C (104 °F)
2) See symbols page 4
3) Leakage port Y must be used
   - ❒ with 3- and 4-way function and p_T > 50 bar (715 psi)
   - ❒ with 2x2-way function

CHARACTERISTIC CURVES (TYPICAL)

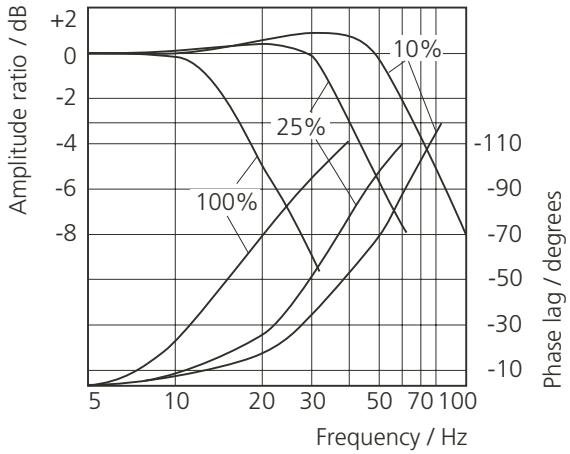
Step response



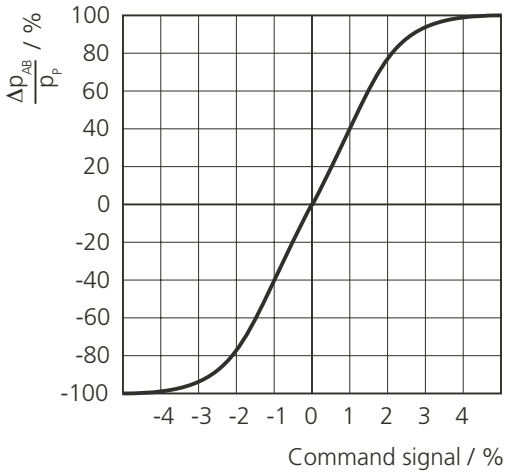
Flow signal characteristic curve



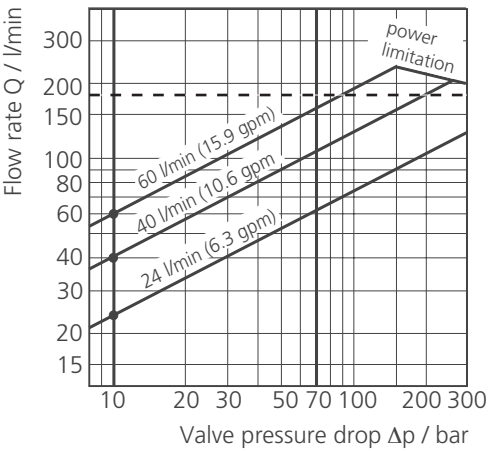
Frequency response



Pressure signal characteristic curve

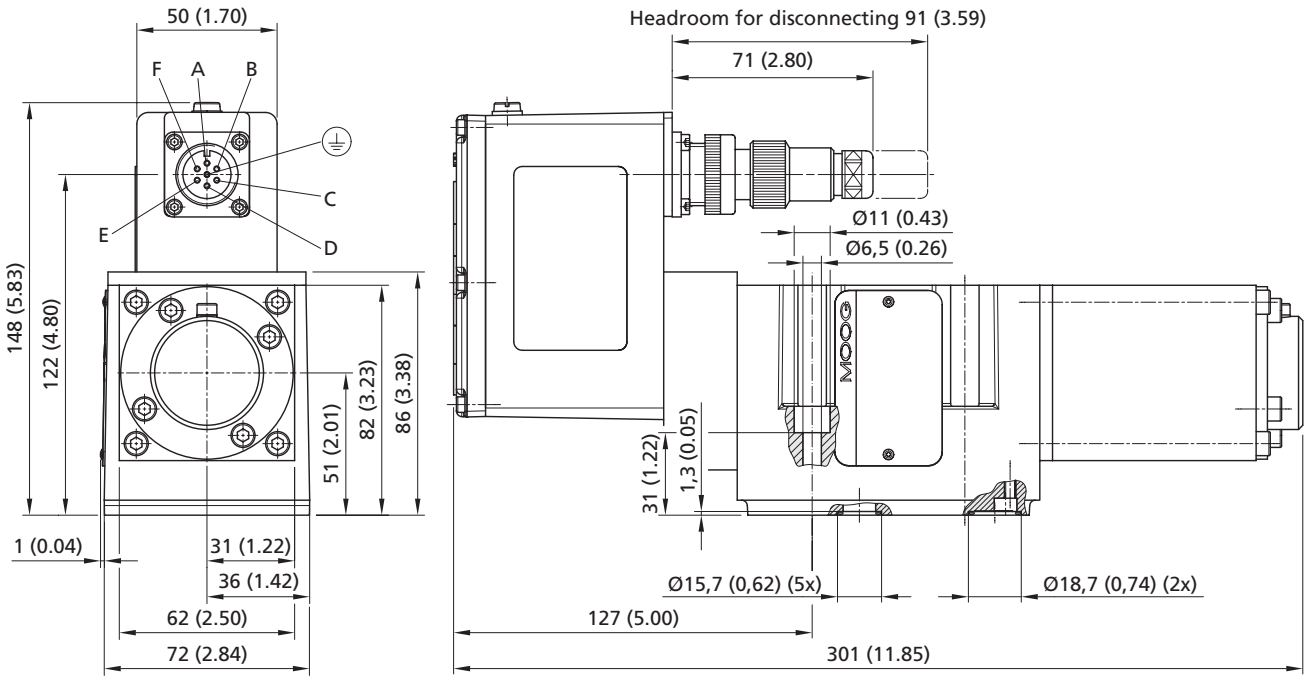


Valve flow diagram



----- recommended flow rate limit
Q = 180 l/min (47 gpm)

INSTALLATION DRAWING



Mounting pattern

ISO 4401-03-03-0-94, without X port

mm

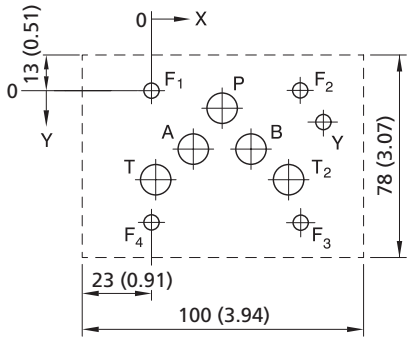
	P	A	B	T	T_2	X[1]	Y	F_1	F_2	F_3	F_4
	Ø11.2	Ø11.2	Ø11.2	Ø11.2	Ø11.2		Ø 6.3	M6	M6	M6	M6
x	27	16.7	37.3	3.2	50.8		62	0	54	54	0
y	6.3	21.4	21.4	32.5	32.5		11	0	0	46	46

inch

	P	A	B	T	T_2	X[1]	Y	F_1	F_2	F_3	F_4
	Ø0.44	Ø0.44	Ø0.44	Ø0.44	Ø0.44		Ø0,25	M6	M6	M6	M6
x	1.06	0.66	1.47	0.13	2.00		2.44	0	2.13	2.13	0
y	0.25	0.84	0.84	1.28	1.28		0.43	0	0	1.81	1.81

[1]) Port X must not be drilled, not sealed at valve base.

Mounting surface needs to be flat within 0.01 mm (0.0004 inch) over a distance of 100 mm (3.94 inch). Average surface finish value, Ra = 0.8 µm.



Spare parts and Accessories

O-Rings (included in delivery) for ports P,T,T2,A,B for port Y		5 pieces ID 12.4 x Ø 1.8 (ID 0.49 x Ø 0.07) 1 piece ID 15.6 x Ø 1.8 (ID 0.61 x Ø 0.07)	NBR 90 Shore 45122-004 45122-011	FPM 90 Shore 42082-004 42082-011
Mating connector, waterproof IP65 (not included in delivery) 6+PE-pole		B97007-061 EN 175201 Part 804	for cable dia	min. Ø 10 mm (0.394 in), max. Ø 12 mm (0.472 in)
Flushing plates	for P,A,B,T,T_2,X,Y B67728-001			
Flushing plates	for P,A,B,T,T_2,X,Y B67728-002			
Flushing plates	for P,A,B,T,T_2,X,Y B67728-003			
Mounting manifolds	on request			
Mounting bolts (not included in delivery) M 6 x 40 DIN EN ISO 4762-10.9	A03665-060-040	required torque 13 Nm (115 inch pounds)	required 4 pieces	

ORDERING INFORMATION

Model-Number

D	63	4	.	.	.	.	.

Type designation

.	.	.	.	.	.	.	.	.	.	.	.	.

Series

4	Size 05

Specification-Status

–	Series specification
E	Preseries specification
Z	Special specification

Model designation

	assigned at the factory

Factory identification

Valve version

P	with integrated electronics ; spool in body

Rated flow

	Q_N / l/min at Δp_N = 35 bar (Q_N / gpm at Δp_N = 500 psi)	Δp_N = 5 bar per land (Δp_N = 71 psi per land)	Series
24	60 (15.9)	24 (6.3)	D634 - P
40	100 (26.3)	40 (10.6)	D634 - P
60	160 (42.3)	60 (15.9)	D634 - P

Maximum operating pressure

K	350 bar (5000 psi)

Bushing / Spool type

A	4-Way: ~ axis cut, linear characteristic
D	4-Way: 10% overlap, linear characteristic
Z	2x2-Way: P ◗ A, B ◗ T, with Y-port only
X	Special spool on request

Supply voltage

2	24 V DC (19 to 32 V DC)

Signals for 100% spool stroke [1)]

	Command	Output
M	±10 V DC	+ 4 to + 20 mA
X	±10 mA, floating deadband compensation on request	+ 4 to + 20 mA

Valve connector

S	6+PE pole EN 175201 Part 804

Seal material

V	FPM (Viton)
N	NBR (Buna), others on request

Y-port

0	closed with plug p_{Tmax} = 50 bar (715 psi)
3	open, with filter insert p_T > 50 bar (715 psi)

Spool position without electric supply

M	mid position
F	P ◗ B, A ◗ T connected (10% open)
D	P ◗ A, B ◗ T connected (10% open) other openings on request

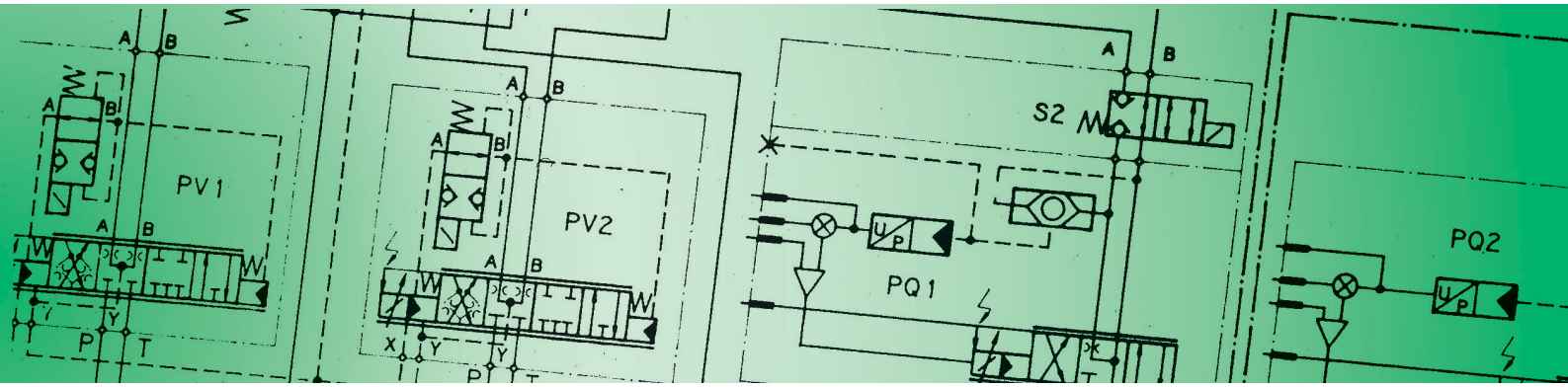
Linear motor

6	Standard

Options may increase price and delivery.
All combinations may not be available.
Preferred configurations are highlighted.
Technical changes are reserved.

[1)] input voltage limited, see page 6

Argentina
Australia
Austria
Brazil
China
Finland
France
Germany
India



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Ksis / Wacker / 1000