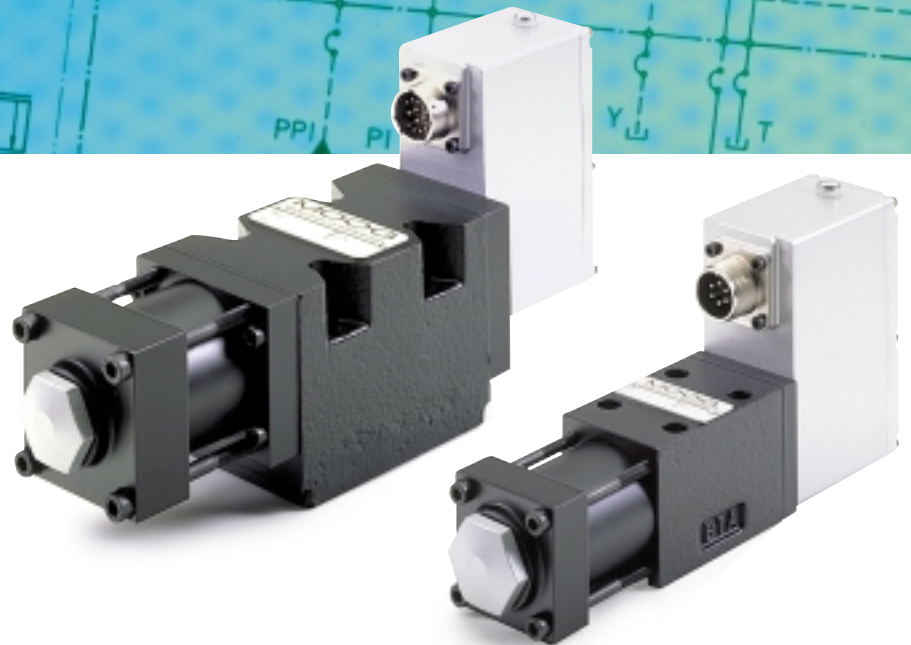
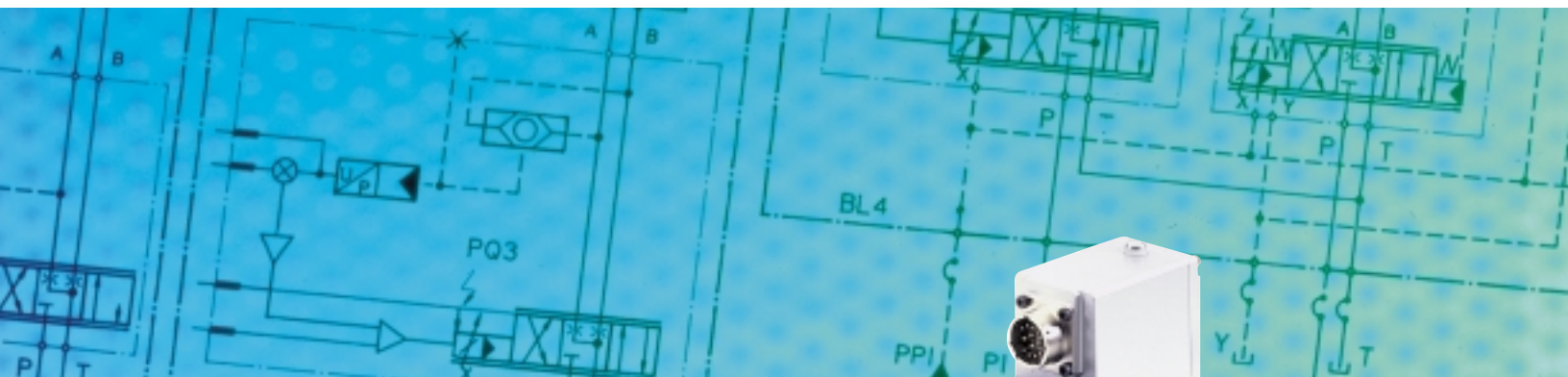


**D633 and D634 Series**  
Proportional Control Valves  
with Integrated 24 Volt Electronics  
ISO 4401 Size 03 and 05



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Technical Data	4-5
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## MOOG SERVO-PROPORTIONAL CONTROL VALVES

For over 25 years Moog has manufactured proportional control valves with integrated electronics. During this time more than 150,000 valves have been delivered. These proportional control valves have been proven to provide reliable control of injection and blow molding equipment, die casting machines, presses, heavy industry equipment, paper and lumber processing and other applications.

## D633/D634 SERVO-PROPORTIONAL CONTROL VALVES

The D633 and D634 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 or 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, as compared with most proportional solenoids with one force direction only.

Our DDV Servo-Proportional Control Valves have 24V DC on-board, closed loop spool position and drive electronics. This integrated electronic features SMD technology and is pulse width modulated (PWM).

### Important

Before installation of the valve into the system, the complete hydraulic system must be flushed.

Please read the notes in section "Electronics", page 6.



Our quality management system is certified in accordance with DIN EN ISO 9001.



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



Valves available with explosion protection to EN 50018 and 55019, class II 2G EExde B+H2 T4, DMT 00 ATEX E 037, 0470 at D633 series and II 2G EExde B+H2 T3, DMT 00 ATEX E 037, 0470 at D634 series.

Note: Installation dimensions and electric connection altered. Special data sheet on request.

Meets EN60529 class IP65 requirement.

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 has to check the suitability of the products described herein. In case of doubt, please contact Moog.

# FEATURES & BENEFITS

# D633/D634

### High Dynamics for Faster Step Response

The high natural frequency of the Direct Drive Valve (300 Hz  $\pm$  10%) results in one of the highest dynamic servo-proportional valves on the market.

### High Pressure Gain of Direct Drive Pilot Valve for Reliable Operation

The valve's high-pressure gain offers improved spool position control even in situations with high internal flow forces and contaminated fluids.

### Direct Drive Pilot Valve for Dynamic Performance Independent of System Pressure

The electro-mechanical design of the Direct Drive Valve results in dynamic performance of the valve that is independent of system pressure.

### Improved Resistance to Contamination Reduces Down Time

The DDV Series Valves have high spool driving forces offering greater chip shearing forces, making the valve more tolerant to contamination.

### Flexible Design Elements Optimize the Valve to Your Application

The DDV Series Valves offer a variety of flow characteristics such as linear, dual-gain, and curvilinear in flow ranges from 1.5 to 26 gpm (5 to 40 lpm).

### Fail-Safe Versions for Defined Spool Position at Loss of Power

The spring offers automatic centering of the spool at loss of power, without passing a load move position. In addition, a trim adjustment can be set to a customer's requirement.

### Low Current Consumption Saves Energy

The linear force motor allows for low current consumption in normal operation and near hydraulic null, saving energy especially in multiple valve applications.

### Monitoring Signal for Evaluating System Integrity

6+PE pole connector allows access to a standardized spool positioning monitoring signal with low residual ripple.

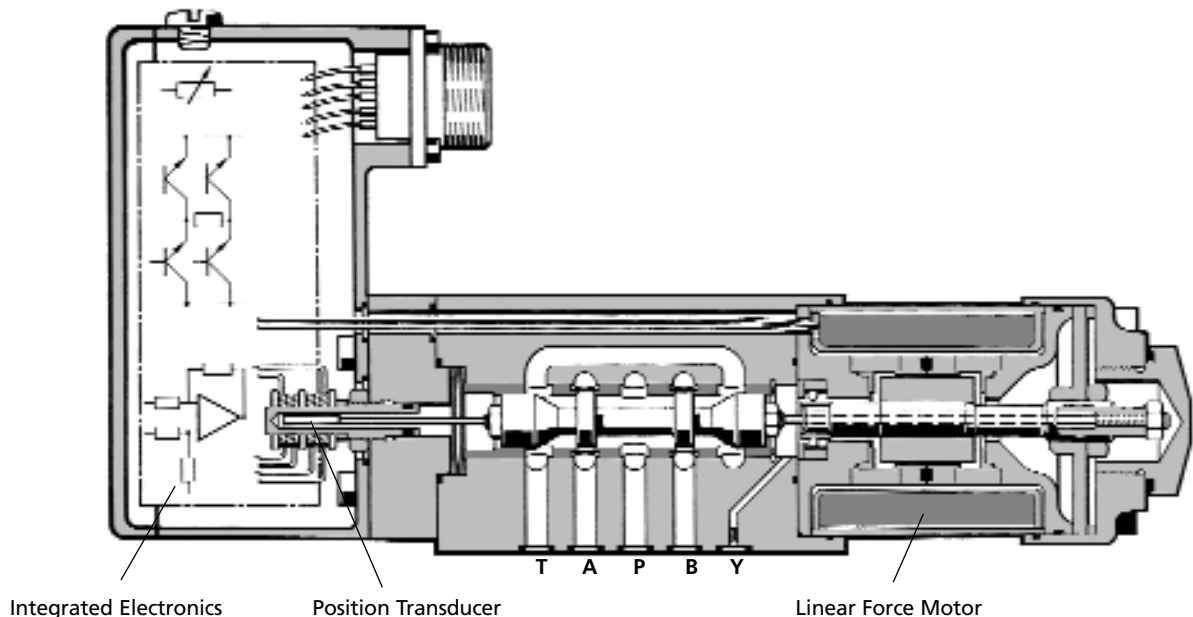
### High Flow Capability for High Velocity Applications

The D03 and D05 (NG6 and NG10) DDV Series valves offer high flow per body size.

### Low Hysteresis and Low Threshold for Better Control

The linear force motor combined with a spool and bushing design offers better overall system control.

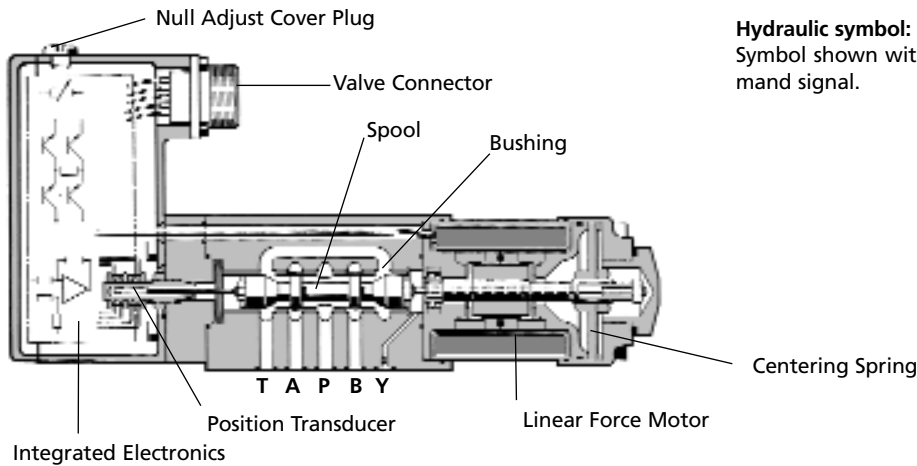
D633 Single Stage Proportional Control Valve



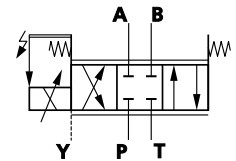
**OPERATING PRINCIPLES OF THE DIRECT DRIVE VALVES (DDV)**

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.



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



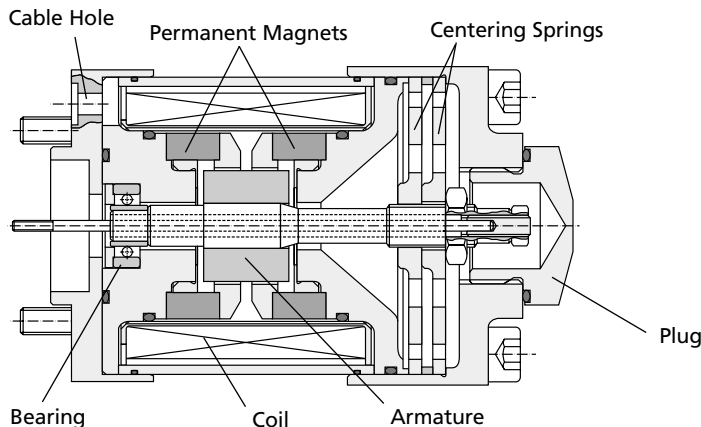
**OPERATING PRINCIPLES OF THE PERMANENT LINEAR FORCE MOTOR**

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.

stroking to centre position the spring force adds to the motor force and provides additional spool driving force which makes the valve very less contamination sensitive. The linear force motor needs very low current in the spring centered position.

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 back-

Proportional solenoid systems require for the same function two solenoids with more cabling. 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

Port P, A and B up to 5,000 psi [350 bar]  
 Port T see data of individual series

### Temperature Range

Ambient -4°F to +140°F [-20°C to +60°C]  
 Fluid -4°F to +176°F [-20°C to +80°C]

### Seal Material

NBR, FPM and others on request

### Operating Fluid

mineral oil based hydraulic fluid (DIN 51524, part 1 to 3), other fluids on request

### Viscosity

Recommended 15 to 100 mm<sup>2</sup>/s  
 Allowable 5 to 400 mm<sup>2</sup>/s

### 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 greatly effects the performance (spool positioning, high resolution) and wear (metering edges, pressure gain, leakage) of the valve.

### Recommended Cleanliness Class

For normal operation: ISO 4406 < 15/12  
 For longer life: ISO 4406 < 14/11

### Filter Rating recommended

For normal operation: β<sub>10</sub> ≥ 75 (10 μm absolute)  
 For longer life (wear): β<sub>6</sub> ≥ 75 (6 μm absolute)

### Installation Options

any position, fixed or movable

### Vibration

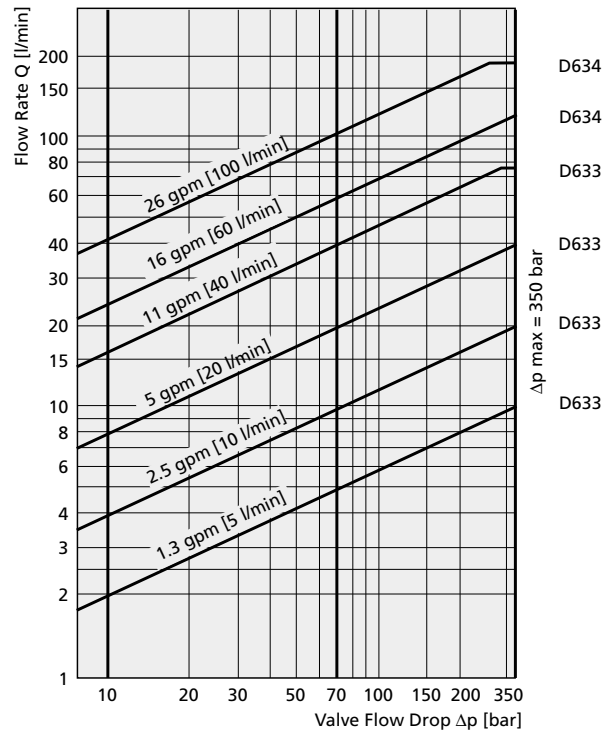
30 g, 3 axes

### Degree of Protection

EN60529 class IP 65, with mating connector mounted

### Shipping Plate

Delivered with an oil sealed shipping plate under the mounting surface.



### Valve Flow Diagram

Valve flow for maximum valve opening (100% command signal) as a function of the valve pressure drop

## VALVE FLOW CALCULATIONS

A valve's 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  $Dp_N = 35$  bar 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.

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

Q [gpm] = calculated flow

$Q_N$  [gpm] = rated flow

$\Delta p$  [psi] = actual valve pressure drop

$\Delta p_N$  [psi] = rated valve pressure drop

The 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.

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**GENERAL REQUIREMENTS FOR VALVE ELECTRONICS**

- > Supply 24 VDC, min. 19 VDC, max. 32 VDC
  - Current consumption  $I_{Amax}$ 
    - for D633 1,2 A
    - for D634 2,2 A
  - External fuse per valve
    - for D633 1,6 A (slow)
    - for D634 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 EN 55011:1998, class B, EN 50082-2:1995, performance criterion class A.
- > Minimum cross-section of all leads  $\approx 0,75 \text{ mm}^2$ .  
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 AM353E.

**VALVE ELECTRONICS WITH SUPPLY VOLTAGE 24 VOLT 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**

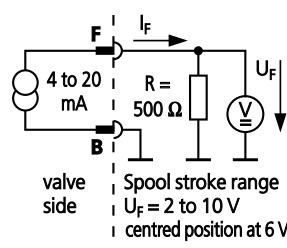
The actual spool position value can be measured at pin F (see diagram below). This signal can be used for monitoring and fault detection purposes. The spool stroke range corresponds to 4 to 20 mA.

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 to detect 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.

**CIRCUIT DIAGRAM**

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



**Note: Enable input**

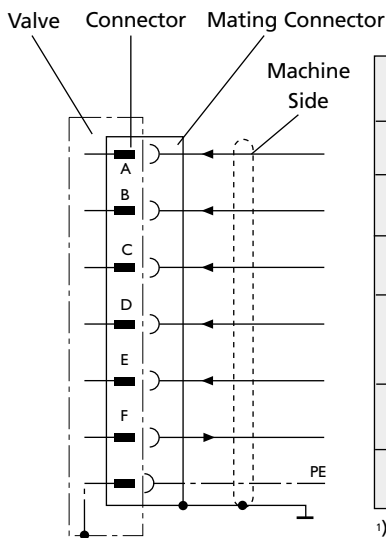
With enable signal off, the main spool will move to a safe position.

- a) Centered position (unbiased pilot valve function code A<sup>1)</sup>)
- b) End position (biased pilot valve function code B<sup>1)</sup>)

<sup>1)</sup> see type designation

**CONNECTOR WIRING**

Wiring for valves with 6+PE pole connector to EN 175201 Part 804<sup>2)</sup>, and mating connector (type R and S, metal shell) with leading protective earth connection ⊕.



Function	Voltage Command 0 to ±10 VDC	Current Command 0 to ±10 mA	Current Command + 4 ... +20 mA
Supply	24 VDC (19 to 32 VDC)	(D633 only 22 to 28 VDC)*	
Supply / Signal Ground	⊥ (0 V)		
Not Used			
Input Rated Command (Differential)	$U_{D,E} = 0$ to ±10 V $R_e = 10$ kΩ Input Voltage $U_{D,E}$ and $U_{E,B}$	Input Command Input Command (Inverted)	$I_D = -I_E: 0$ to ±10mA $I_E = -I_D: 0$ to ±10mA $R_e = 200$ Input Voltage for both signal types is limited to min. -15V, max. +24V
Output Actual Spool Position	$I_{F,B} = 4$ to 20mA. At 12 mA spool is centered position $R_L = 300$ to 500 Ω.		
Protective Earth			

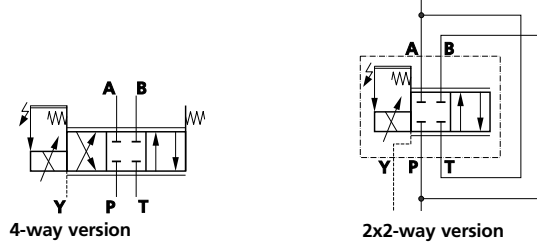
<sup>1)</sup> formerly DIN 43563, <sup>\*</sup>before 01.01.2001

## PERFORMANCE SPECIFICATIONS FOR STANDARD MODELS

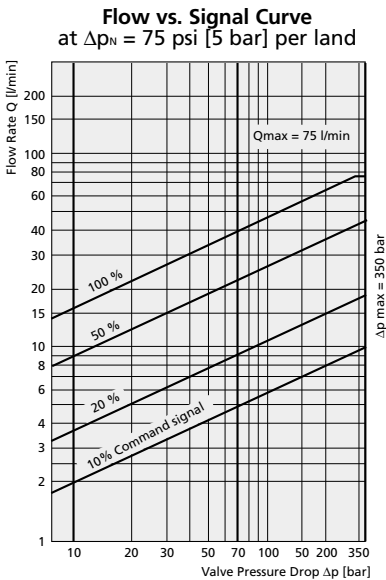
	English [Metric]	D633
Mounting Pattern (with or without leakage port Y*)		ISO 4401 - 03 - 03 - 0 - 94
Port Diameter	in [mm]	0.31 [7.9]
Valve Body Version		Single stage, spool in bushing 3-way, 4-way, 2x2-way directly, with permanent magnet linear force motor
Pilot Stage		
Pilot Connection		
Mass	lb [kg]	5.5 [2.5]
Rated Flow ( $\pm 10\%$ ) at $\Delta p_M = 500$ psi [35 bar] per land	gpm [l/min]	1.3 [5] / 2.6 [10] / 5.3 [20] / 10.6 [40]
Max. Valve Flow	gpm [l/min]	19.8 [75]
Operating Pressure max.		
Ports P, A, B	psi [bar]	5,075 [350]
Port T without Y	psi [bar]	725 [50]
port T with Y	psi [bar]	5,075 [350]
Port Y	psi [bar]	directly to tank
Response Time* for 0 to 100% stroke	[ms]	$\leq 12$
Threshold*	[%]	0.10
Hysteresis*	[%]	0.20
Null Shift* with $\Delta T = 55K$	[%]	1.5
Null Leakage Flow** total max. (~ critical lap)	gpm [l/min]	0.04 [0.15] / 0.08 [0.30] / 0.16 [0.60] / 0.32 [1.2]
Pilot Leakage Flow**	gpm [l/min]	
Pilot Flow** max., for 100% step input	gpm [l/min]	
Main Spool Stroke	in [mm]	
Spool Drive Area	in <sup>2</sup> [cm <sup>2</sup> ]	

\* Leakage port Y must be used; with 3- and 4-way function and  $p_T > 725$  psi [50 bar]; with 2x2-way function

\*\* measured at 3,000 psi [210 bar] pilot or operating pressure, respectively, fluid viscosity of 32 mm<sup>2</sup>/s and fluid temperature of 104°F [40°C]

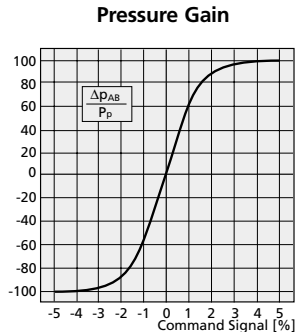
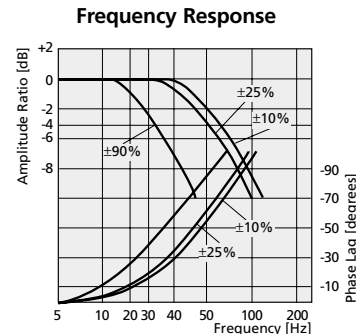
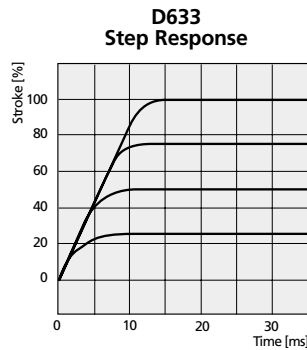


## PERFORMANCE SPECIFICATIONS FOR STANDARD MODELS



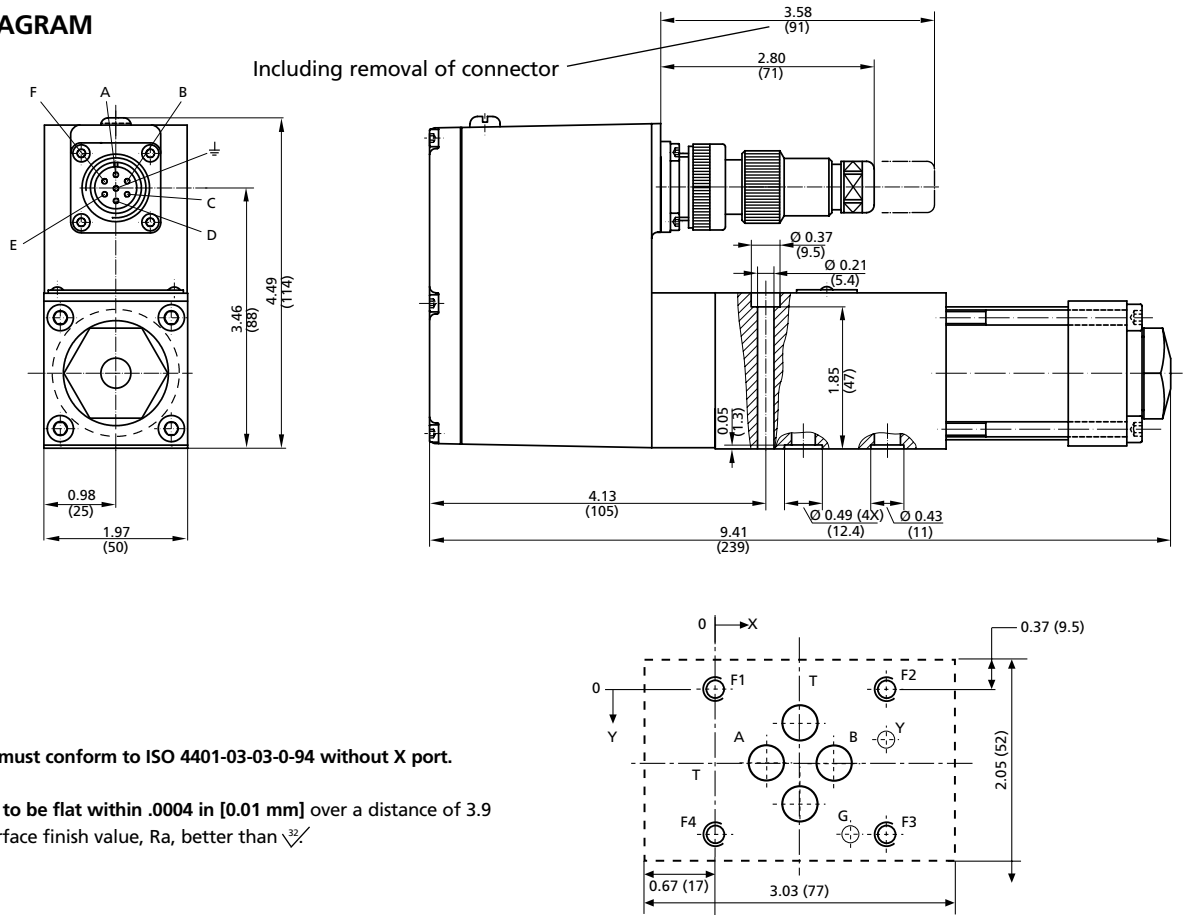
- Spool version A: ~critical lap, linear characteristic (21)
- Spool version D: 10% overlap, linear characteristic
- Spool version Y: ~critical lap, curvilinear characteristic (21)

Typical characteristic curves measured at 3,000 psi [210 bar] pilot or operating pressure, fluid viscosity of 32 mm<sup>2</sup>/s and fluid temperature of 104°F [40°C]





## INSTALLATION DIAGRAM



The mounting manifold must conform to ISO 4401-03-03-0-94 without X port.

Mounting surface needs to be flat within .0004 in [0.01 mm] over a distance of 3.9 in [100 mm]. Average surface finish value, Ra, better than  $\sqrt{3}$ .

	P	A	B	T	X*	Y	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	G
	Ø 0.295 [7.5]	Ø 0.295 [7.5]	Ø 0.295 [7.5]	Ø 0.295 [7.5]		Ø 0.13 [3.3]	M5	M5	M5	M5	0.157 [4.0]
x	0.846 [21.5]	0.50 [12.7]	1.189 [30.2]	0.846 [21.5]		1.59 [40.5]	0	1.59 [40.5]	1.59 [40.5]	0	1.30 [33.0]
y	1.02 [25.9]	0.61 [15.5]	0.61 [15.5]	0.20 [5.1]		0.345 [9.0]	0	-0.03 [-0.75]	1.25 [31.75]	1.22 [31.0]	1.25 [31.75]

\* Port X must not be drilled, not sealed at valve base.

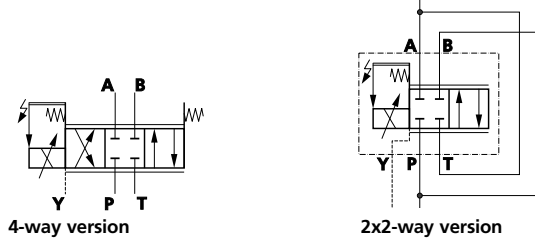
## SPARE PARTS AND ACCESSORIES

O-rings (included in delivery) for ports P, T, A, B for port Y	4 pieces ID 0.36 [9.25] x Ø 0.07 [1.8] 1 piece ID 0.30 [7.65] x Ø 0.07 [1.8]	NBR 90 Shore 45122-013 45122-012	FPM 90 Shore 42082-013 42082-012
Mating connector, waterproof IP65 (not included in delivery) 6+PE-pole	B97007-061	EN 175201 Part 804	for cable dia min. 0.39 [10.0 mm], max. 0.47 [12.0 mm]
Flushing Plates	for P, A, B, T, X, Y B46634-002		
Mounting Manifolds	see special data sheet		
Mounting Bolts (not included in delivery) M 5 x 55 DIN EN ISO 4762-10.9	A03665-050-055	required torque 8.5 Nm	required 4 pieces

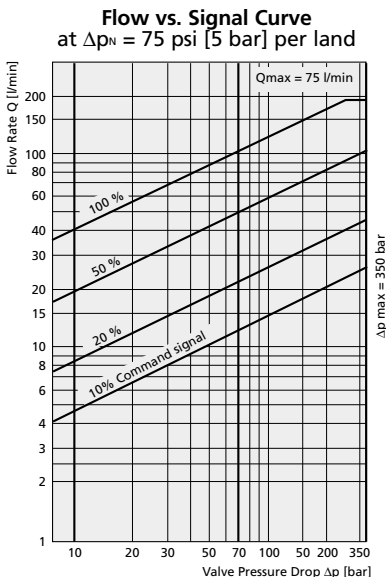
**PERFORMANCE SPECIFICATIONS FOR STANDARD MODELS**

	English [Metric]	D634
Mounting Pattern (with or without leakage port Y*)		ISO 4401 - 05 - 05 - 0 - 94
Port Diameter	in [mm]	0.45 [11.5]
Valve Body Version		Single stage, spool in bushing 3-way, 4-way, 2x2-way directly, with permanent magnet linear force motor
Pilot Stage		
Pilot Connection		
Mass	lb [kg]	13.9 [6.3]
Rated Flow ( $\pm 10\%$ ) at $\Delta p_N = 500$ psi [35 bar] per land	gpm [l/min]	16 [60] / 26 [100]
Max. Valve Flow	gpm [l/min]	48.9 [185]
Operating Pressure max.		
Ports P, A, B	psi [bar]	5,075 [350]
Port T without Y	psi [bar]	725 [50]
port T with Y	psi [bar]	5,075 [350]
Port Y	psi [bar]	directly to tank
Response Time* for 0 to 100% stroke	[ms]	$\leq 20$
Threshold*	[%]	0.10
Hysteresis*	[%]	0.20
Null Shift* with $\Delta T = 55K$	[%]	1.5
Null Leakage Flow** total max. (~ critical lap)	gpm [l/min]	0.32 [1.2] / 0.53 [2.0]
Pilot Leakage Flow**	gpm [l/min]	
Pilot Flow** max., for 100% step input	gpm [l/min]	
Main Spool Stroke	in [mm]	
Spool Drive Area	in <sup>2</sup> [cm <sup>2</sup> ]	

\* Leakage port Y must be used; with 3- and 4-way function and  $p_T > p_i$  [50 bar]; with 2x2-way function  
 \*\* measured at 3,000 psi [210 bar] pilot or operating pressure, respectively, fluid viscosity of 32 mm<sup>2</sup>/s and fluid temperature of 104°F [40°C]

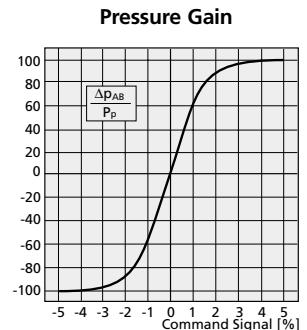
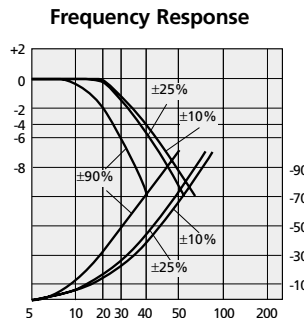
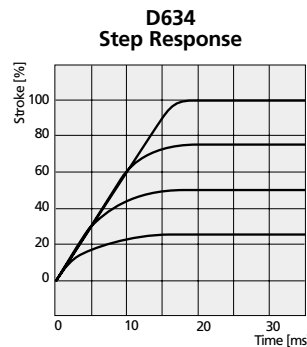


**PERFORMANCE SPECIFICATIONS FOR STANDARD MODELS**

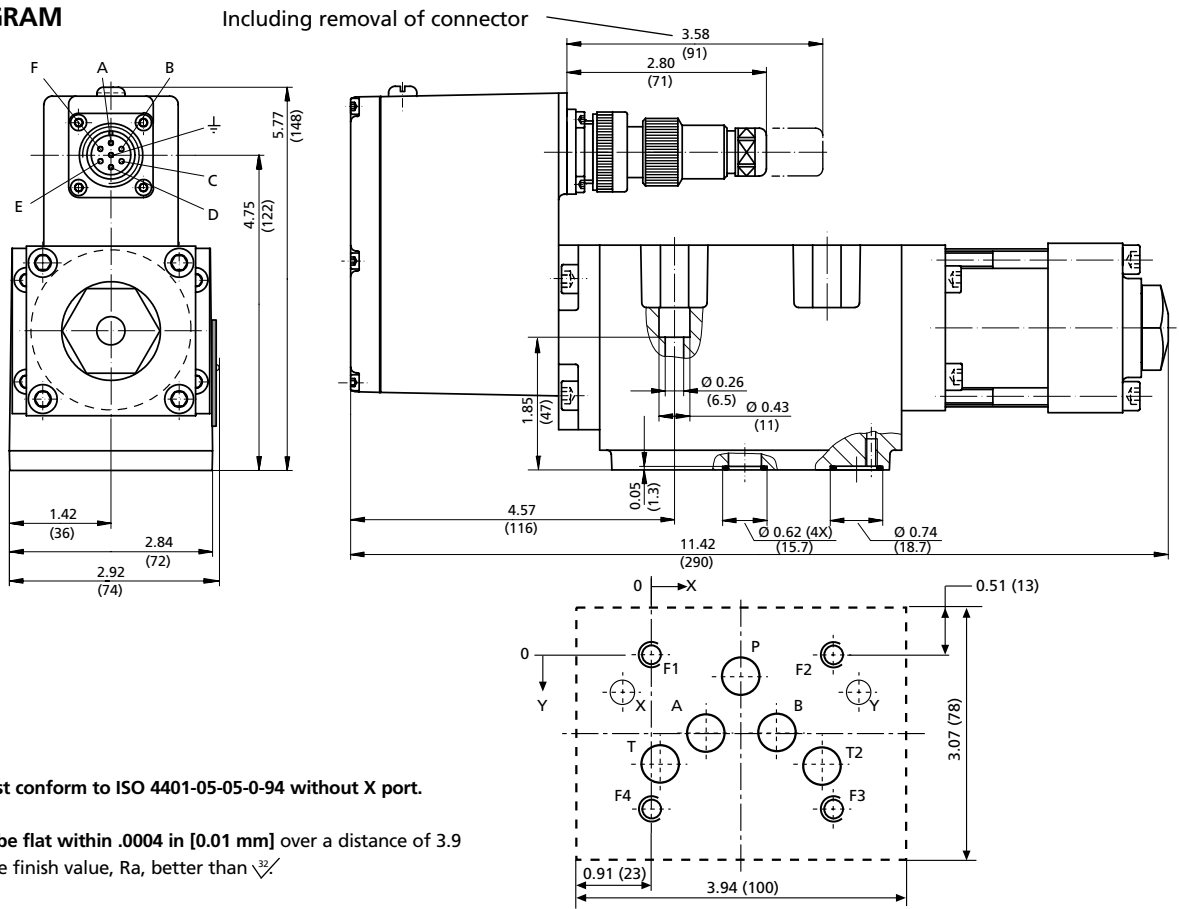


Spool version A: ~critical lap, linear characteristic (21)  
 Spool version D: 10% overlap, linear characteristic  
 Spool version Y: ~critical lap, curvilinear characteristic (21)

Typical characteristic curves measured at 3,000 psi [210 bar] pilot or operating pressure, fluid viscosity of 32 mm<sup>2</sup>/s and fluid temperature of 104°F [40°C]



## INSTALLATION DIAGRAM



The mounting manifold must conform to ISO 4401-05-05-0-94 without X port.

Mounting surface needs to be flat within .0004 in [0.01 mm] over a distance of 3.9 in [100 mm]. Average surface finish value, Ra, better than  $\sqrt{}$

	P	A	B	T	T <sub>2</sub>	X*	Y	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>
	Ø 0.441 [11.2]	Ø 0.441 [11.2]	Ø 0.441 [11.2]	Ø 0.441 [11.2]	Ø 0.441 [11.2]		Ø 0.248 [6.3]	M5	M5	M5	M5
x	1.063 [27.0]	0.657 [16.7]	1.469 [37.3]	0.126 [3.2]	2.0 [50.8]		2.44 [62.0]	0	2.126 [54.0]	2.126 [54.0]	0
y	0.248 [6.3]	0.843 [21.4]	0.843 [21.4]	1.28 [32.5]	1.28 [32.5]		0.433 [11.0]	0	0	1.811 [46.0]	1.811 [46.0]

\* Port X must not be drilled, not sealed at valve base.

## SPARE PARTS AND ACCESSORIES

O-rings (included in delivery) for ports P, T, A, B for port Y	5 pieces ID 0.48 [12.4] x Ø 0.07 [1.8] 1 piece ID 0.61 [15.6] x Ø 0.07 [1.8]	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. 0.39 [10.0 mm], max. 0.47 [12.0 mm]
Flushing Plates	for P, A, B, T, T <sub>2</sub> , X, Y B67727-001		
Flushing Plates	for P, A, B, T, T <sub>2</sub> , X, Y B67727-002		
Flushing Plates	for P, A, B, T, T <sub>2</sub> , X, Y B67727-003		
Mounting Manifolds	see special data sheet		
Mounting Bolts (not included in delivery) M 6 x 60 DIN EN ISO 4762-10.9	A03665-060-060	required torque 13 Nm	required 4 pieces

**Model Number**

D63 . . . . .

**Type Designation**

. . . . .

**Series**

3	Size 03
4	Size 05

**Specification Status**

-	Series specification
E	Preseries specification
K	explosion proof version upon request
Z	Special specification

**Model Designation**

	Assigned at the factory
--	-------------------------

**Factory Identification**

**Valve Version**

R	With integrated electronics
---	-----------------------------

**Rated Flow**

	Q <sub>v</sub> [l/min] at Δp <sub>v</sub> = 500 psi[35 bar] Δp <sub>v</sub> = 75 psi[5 bar] per land		Series
02	5	2	D633
04	10	4	D633
08	20	8	D633
16	40	16	D633
24	60	24	D634
40	100	40	D634

**Maximum Operating Pressure**

K	350 bar
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**Bushing Spool Type**

O	4-way: axis cut, linear characteristic
A	4-way: 1.5 to 3% overlap, 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 VDC (22 to 28 VDC)
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**Signals for 100% Spool Stroke**

	Command	Output
M	±10 VDC	+4 to +20 mA
P	0 to ±10 mA	+4 to +20 mA
S	+4 to +20 mA	+4 to +20 mA
X	±10 mA, floating	+4 to +20 mA

**Valve Connector**

S	6+PE pole (7/8-20 UNF 2A) DIN 43563
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**Seal Material**

N	NBR (Buna)
V	FPM (Viton)
	Other materials on request

**Y - Port**

0	Closed with plug	PT max = 715 psi[50 bar]
1	Open, with filter insert	P <sub>r</sub> > 715 psi[50 bar]

**Spool Position without Electrical Supply**

M	Mid-position
A	P ↔ B, A ↔ T (10% open, min.)
B	P ↔ B, A ↔ T (10% open, min.)
	Other openings on request

**Linear Force Motor**

	Series
1	Standard D633
2	Standard D634

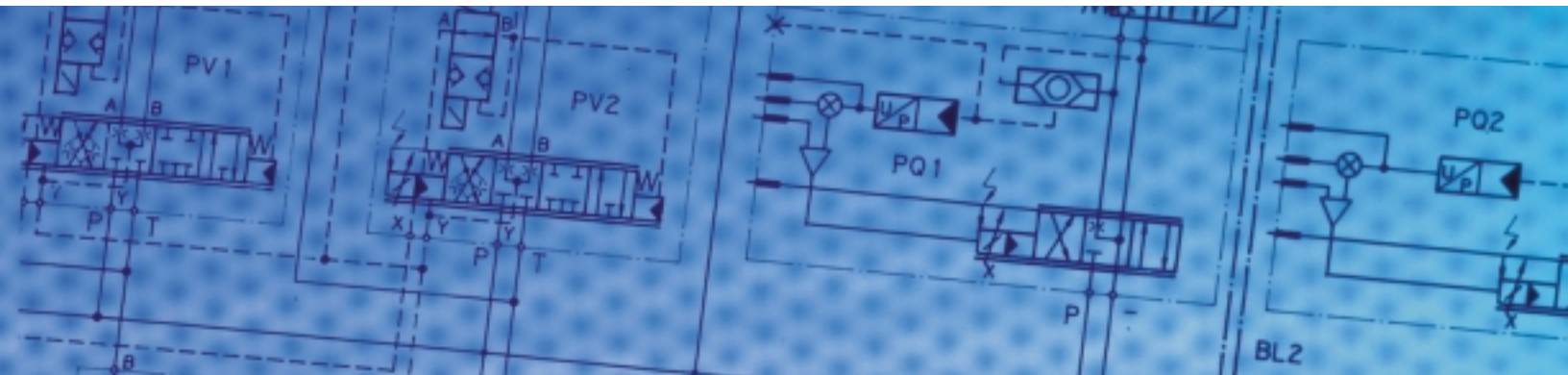
Preferred configurations are highlighted. Options may increase price. Technical changes are reserved. All combinations may not be available. For special options, letters not on the information above may be applied. Please contact Moog.







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