MOOG

631 Series Servovalves

ISO 4401 Size 05

631 SERIES SERVOVALVES

The 631 Series flow control servovalves are throttle valves for 3- and preferably 4-way applications. They are a medium performance, two-stage design that covers the range of rated flows from 2.5 to 40 gpm at 1,000 psi valve drop. The output stage is a closed center, four-way sliding spool. The pilot stage is a symmetrical double-nozzle and flapper, driven by a double air gap, dry torque motor. Mechanical feedback of spool position is provided by a cantilever spring. The valve design is simple and rugged for dependable, long life operation.

These valves are suitable for electrohydraulic position, speed, pressure or force control systems with high dynamic response requirements.

Principle of operation
An electrical command signal (flow rate set point) is applied to the torque motor coils and creates a magnetic force which acts on the ends of the pilot stage armature. This causes a deflection of armature/flapper assembly within the flexure tube. Deflection of the flapper restricts fluid flow through one nozzle which is carried through to one spool end, displacing the spool.

Movement of the spool opens the supply pressure port (P) to one control port, while simultaneously opening the tank port (T) to the other control port. The spool motion also applies a force to the cantilever spring, creating a restoring torque on the armature/flapper assembly. Once the restoring torque becomes equal to the torque from the magnetic forces, the armature/flapper assembly moves back to the neutral position, and the spool is held open in a state of equilibrium until the command signal changes to a new level.

In summary, the spool position is proportional to the input current and with constant pressure drop across the valve, flow to the load is proportional to the spool position.

VALVE FEATURES

- 2-stage design with dry torque motor
- Low friction double nozzle pilot stage
- High spool driving forces
- D05 port pattern for 4-ports (external pilot supply is not per ISO 4401 location)
- Rugged, long-life design
- High resolution, low hysteresis
- Completely set-up at the factory
- Optional fifth port for separate pilot supply
- Field replaceable pilot filter

The actual flow is dependent upon electrical command signal and valve pressure drop. The flow for a given valve pressure drop can be calculated using the square root function for sharp edge orifices:

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

Q [gpm] = calculated flow
Q_N [gpm] = rated flow
Δp [psi] = actual valve pressure drop
Δp_N [psi] = rated valve pressure drop

ISO 9001 CERTIFIED

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 here. In case of doubt, please contact Moog Inc.

GENERAL TECHNICAL DATA

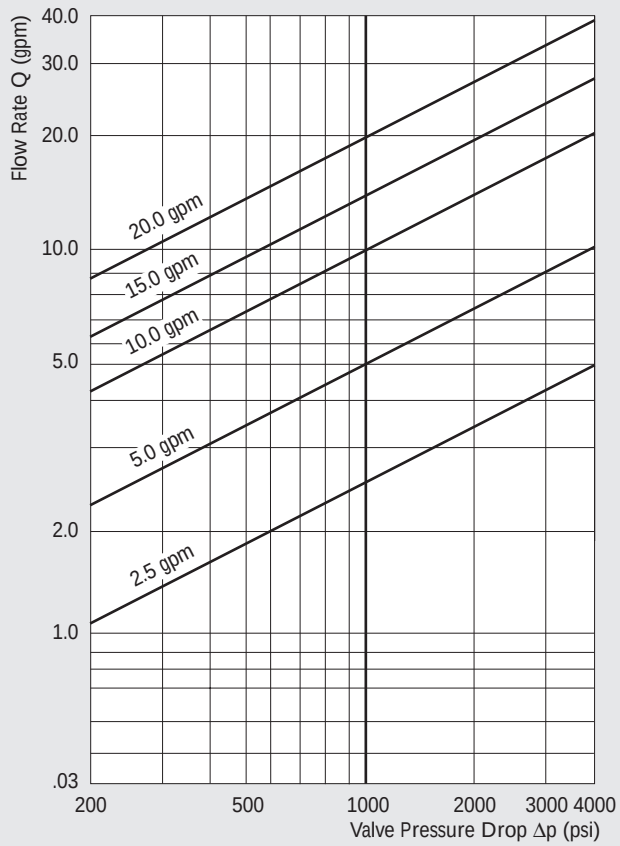
Operating Pressure*	
ports P, X, A and B	up to 3,000 psi
port T	up to 2,000 psi
Temperature Range	
Fluid	0˚F to 200˚F
Ambient	-40˚F to 275˚F
Seal Material	Viton, others on request
Operating Fluid	Compatible with common hydraulic fluids, other fluids on request.
Recommended viscosity	60 – 450 SUS @ 100˚F

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

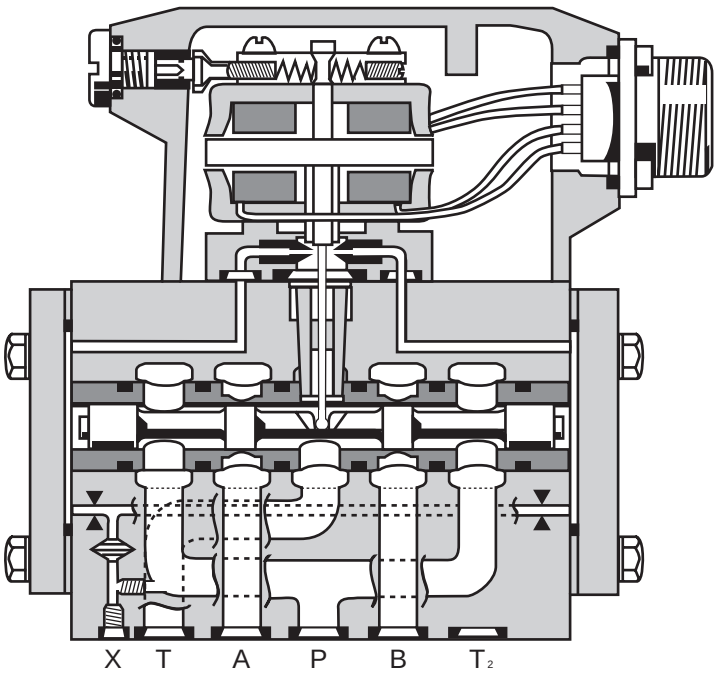
Class of Cleanliness: The cleanliness of the hydraulic fluid greatly effects the performance (spool positioning, high resolution) and wear (metering edges, pressure gain, leakage) of the servovalve.

Recommended Cleanliness Class	
For normal operation	ISO 4406 < 14/11
For longer life	ISO 4406 < 13/10
Filter Rating recommended	
For normal operation	$ß_{10} \geq 75$ (10 µm absolute)
For longer life	$ß_5 \geq 75$ (5 µm absolute)
Installation Operations	Any position, fixed or movable.
Vibration	30 g, 3 axes
Weight	4.6 lbs
Degree of Protection	EN50529P: class IP65, with mating connector mounted.
Shipping Plate	Delivered with an oil sealed shipping plate.

* Special order 4,500 psi



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



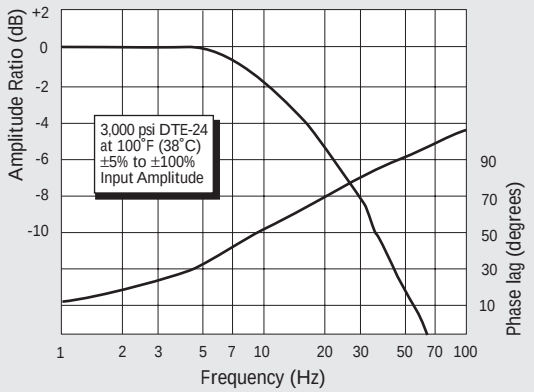
Model…Type			**631-……..**				
Mounting Pattern			ISO 4401-05-05-0-94 (for 4 ports)				
Valve Body Version			4-way				
			2-stage with spool–bushing assembly				
Pilot Stage			Nozzle/Flapper, Highflow				
Pilot Connection	Optional, Internal or External		X				
Rated Flow	($\pm$10%) at Δp_N = 1,000 psi						
	Standard	[gpm]	2.5	5.0	10.0	15.0	20.0
	High Response	[gpm]	2.5	5.0	10.0	15.0	20.0
Response Time*	Standard	[ms]	40	40	40	40	40
	High Response	[ms]	15	15	15	15	15
Threshold*		[%]	< 1				
Hysteresis*		[%]	< 5				
Null Shift	at ΔT = 100˚F	[%]	< 3				
Null Leakage Flow‡	max.	[gpm]	0.35 to .55				

* Measured at 3,000 psi pilot or operating pressure

‡ Measured at 1,000 psi pilot or operating pressure

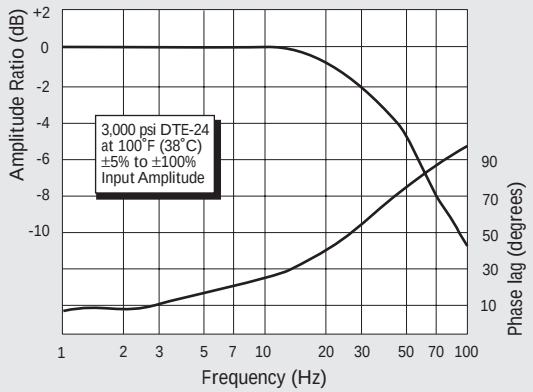
Typical Characteristic Curves with ±5% and ±100% input signal, measured at 3,000 pilot or operating pressure.

Standard Valves



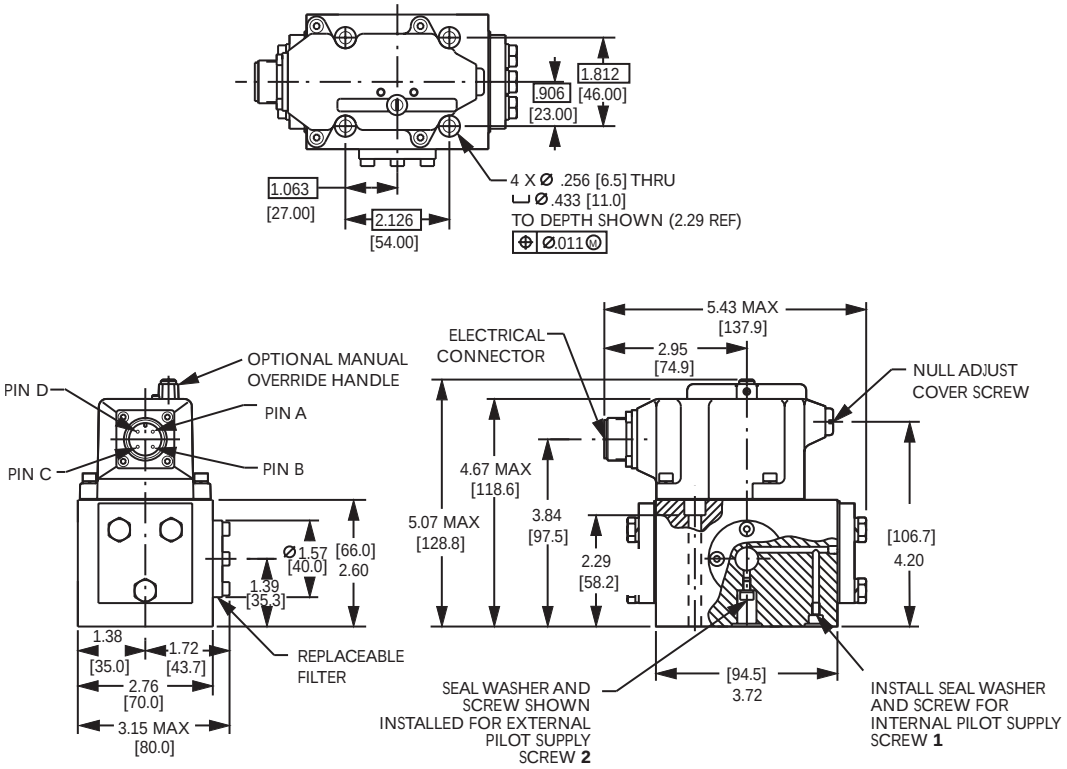
Frequency Response of Standard Servovalves

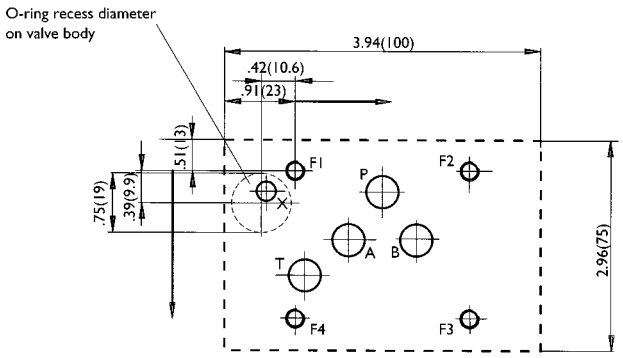
High Response Valves



Frequency Response of High Response Servovalves

631 SERIES
INSTALLATION DRAWINGS





The mounting manifold must conform to ISO 4401-05-05-0-94*
***** Note:** Location of X port in valve body does **not** correspond to ISO standards.
Mounting surface needs to be flat within 0.001[0.03] TIR and a $\sqrt{32}$ [ΔΔ] finish.

	P	A	B	T	X*	F_1	F_2	F_3	F_4
	Ø0.45	**Ø0.45**	**Ø0.45**	**Ø0.45**	Ø0.25	M6	M6	M6	M6
x	1.06	0.66	1.47	0.13	-0.35	0	2.13	2.13	0
y	0.25	0.84	0.84	1.20	0.25	0	0	1.81	1.81

CONVERSION INSTRUCTION

For operation with internal or external pilot connection.

Pilot flow supply	Set screw (M4 X 6 DIN 912) bore **1**	bore **2**
Internal P	closed	open
External X	open	closed

ELECTRICAL CONNECTIONS

Rated current and coil resistance
A variety of coils are available for 631 Series Servovalves, which offer a wide choice of rated current. See Table 1.

Coil connections
A four-pin electrical connector (that mates with an MS310614S-2S) is standard. All four torque motor leads are available at the connector so external connections can be made for series, parallel, or differential operation.

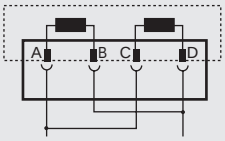
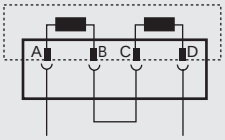
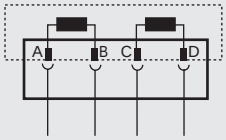
631 Series Servovalves can be supplied on special order with other connectors or a pigtail.

Servoamplifier
The servovalve responds to input current, so a servoamplifier that has high internal impedance (as obtained with current feedback) should be used. This will reduce the effects of coil inductance and will minimize changes due to coil resistance variations.

ELECTRICAL CONNECTIONS

(Examples with typical 631 series coils)

Connector MS310614S-2S

		Parallel	Series	Single
				
Coil Resistance	[Ω]	14	56	28
Rated Current	[mA]	±100	±50	±100
Inductance	[H]	0.2	0.8	0.2
Electrical Power	[W]	.14	.14	.28
Connectors for Valve Opening P ◗ B, A ◗ T		A and C (+) B and D (-)	A (+), D (-) B and C connected	A (+), B (-) or C (+), D (-)

Note: Before applying electrical signals, the pilot stage has to be pressurized.

TABLE 1

Nominal Resistance Per Coil at 77°F (25°C) Ω	Recommended Rated Current–mA		Approximate Coil Inductance*–Henrys		
	Parallel, Differential or Single Coil Operation	Series Coils	Single Coils	Series Coils	Parallel Coils
28	±100	±50	0.2	0.8	0.2
300	±30	±15	2	7	2

* Measured at 50 Hz

631 SERIES
ORDERING INFORMATION
SPARE PARTS AND ACCESSORIES

Model Number

631 • • • • • •

Type Designation

• • • • • • • • • • • •

Optional Feature	
	Series specification
K	Intrinsically safe

Model Designation	
	Assigned at the factory

Factory Identification (Revision Level)

Valve Version	
P	Standard response
H	High response

Rated Flow		
	Q_N[gpm] at Δp_N = 1,000 psi	
	Standard	High Response
10	2.5	2.5
20	5.0	5.0
38	10.0	10.0
60	15.0	15.0
80	20.0	20.0

Maximum Operating Pressure p_p and Body Material	
F	3,000 psi aluminum
J	4,500 psi steel

Main Spool Type	
O	4-way / axis cut / linear
A	4-way / < +/-3% overlap - critical lap / linear
D	4-way / +/-10% overlap / linear

Signals for 100% Spool Stroke	
Q	±15 mA series (±30 mA parallel)
R	±50 mA series (±100 mA parallel)
Y	Special signal

Valve Connector	
B	Connector C2 (B) – side (LH)
X	Special connector

Seal Material	
V	Viton
N	NPR (Buna)
	Others on request

Pilot Connections and Pressure		
	Pressure [psi]	Supply
A	250 to 3,000	internal
C	250 to 3,000	external
J	4,500	internal
L	4,500	external

Spool Position without Electrical Signal	
M	Mid position

Pilot Stage	
F	Standard dynamics (P version)
G	Improved dynamics (H version)

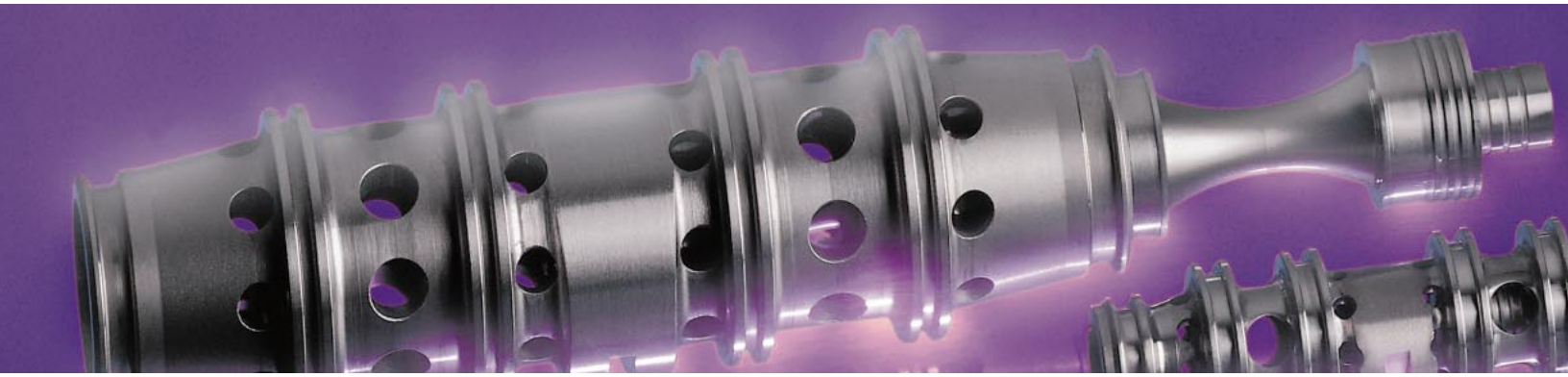
Preferred configurations highlighted.
All combinations may not be available.
Options may increase price and delivery.
Technical changes are reserved.

SPARE PARTS AND ACCESSORIES

O-Rings (included in delivery),	FPM 85 Shore	
for P,T,A and B	ID 0.472 x 0.079	G2141-12-20
for X	ID 0.315 x 0.079	G2141-8-20
Mating Connector, waterproof IP 65 (not included in delivery)		
	P/N 49054F14S2S (MS3106F14S-2S)	
Flushing Block	P/N B67728-002	

Mounting Bolts (not included in delivery)	
1/4 - 20 NC x 2-3/4 long (4 pieces)	P/N A31324-144B
Replaceable Filter	P/N A67999-100
Filter Replacement Kit (includes service manual)	P/N B52555RK69K1

Australia	Mulgrave
Brazil	São Paulo
Denmark	Cöpenhagen
England	Tewkesbury
Finland	Espoo
France	Rungis
Germany	Böblingen



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