MOOG

78 Series
Servovalves

78 SERIES SERVOVALVES

The 78 Series flow control servovalves are throttle valves for 3- and preferably 4-way applications. They are a high performance, two-stage design that covers the range of rated flows from 20 to 40 gpm at 1000 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 control forces
- High dynamics
- Rugged, long-life design
- High resolution, low hysteresis
- Completely set-up at the factory

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.

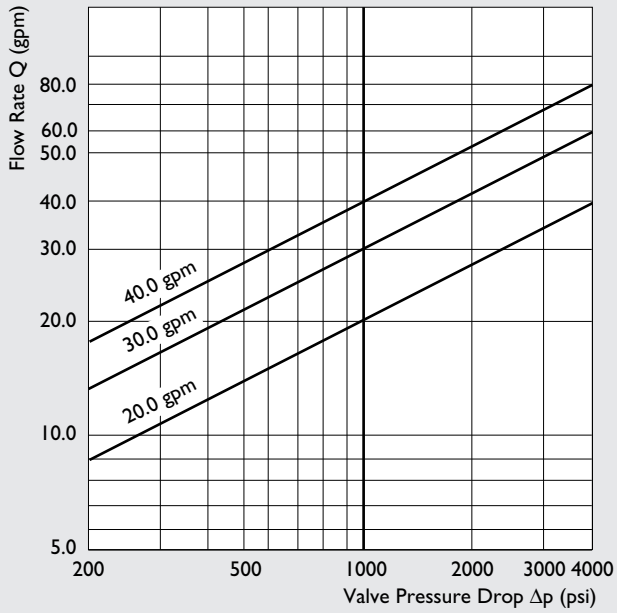
GENERAL TECHNICAL DATA

Operating Pressure	
ports P, T, A and B	up to 3,000 psi
Temperature Range	
Fluid	-40˚F to 275˚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

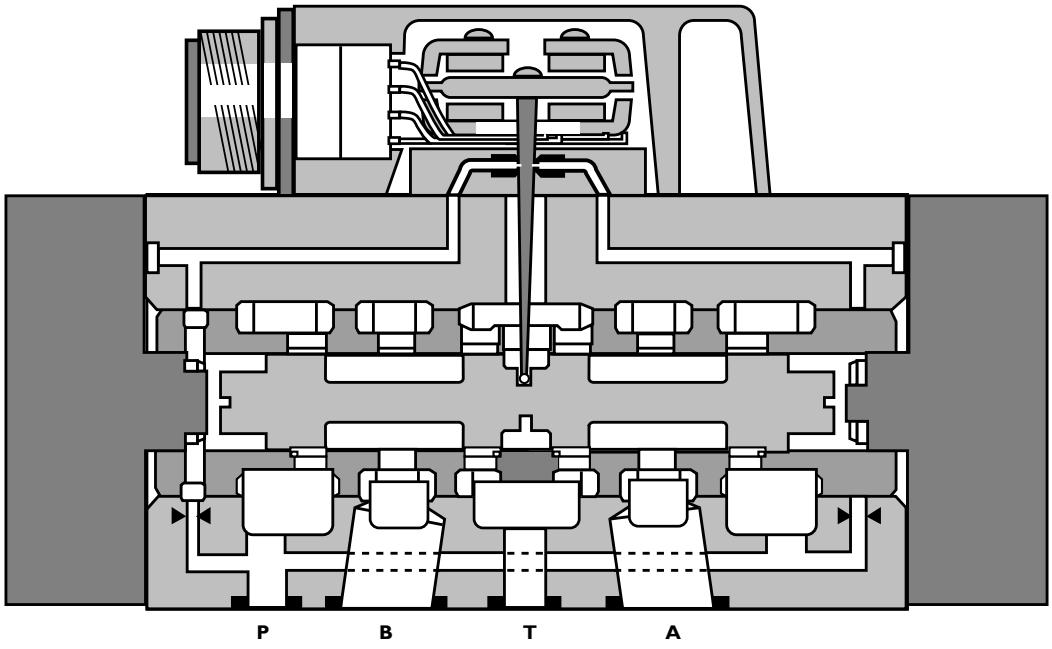
System Filtration: High pressure filter (without bypass, but with dirt alarm) mounted in the main flow and, if possible, directly upstream of the valve.

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	$\beta_{10} \geq 75$ (10 µm absolute)
For longer life	$\beta_5 \geq 75$ (5 µm absolute)
Installation Operations	Any position, fixed or movable.
Vibration	30 g, 3 axes
Weight	6.3 lbs (2.9 kg)
Shipping Plate	Delivered with an oil sealed shipping plate.



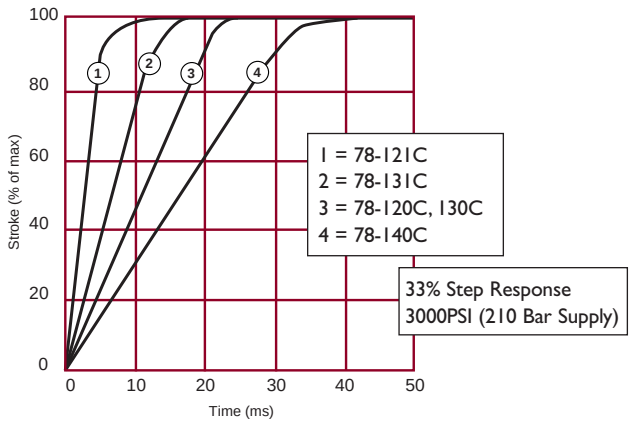
Valve Flow Diagram
Valve flow for maximum valve opening (100% command signal) as a function of the valve pressure drop.



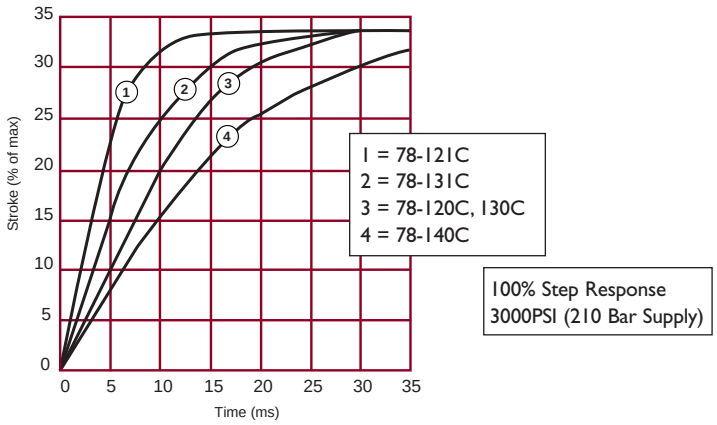
Model…Type			**78…….**		
Valve Body Version			4-way 2-stage with spool–bushing assembly		
Pilot Stage			Nozzle/Flapper, Highflow		
Pilot Connection			Internal only		
Rated Flow	(±10%) at Δp_N = 1,000 psi				
	Standard	[gpm]	20.0	30.0	40.0
	High Response	[gpm]	20.0	30.0	40.0
Response Time*	Standard	[ms]	30.0	30.0	40.0
	High Response	[ms]	15.0	20.0	N/A
Threshold*		[%]	< 0.5%		
Hysteresis*		[%]	< 3.0%		
Null Shift	at ΔT = 100°F	[%]	< 2.0%		
Null Leakage Flow*	max.	[gpm]	0.65 to 0.92		

* Measured at 1,000 psi pilot or operating pressure

Step Response



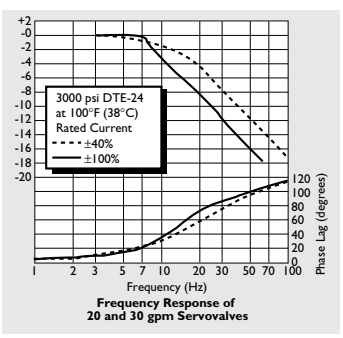
Reduced Amplitude Step Response



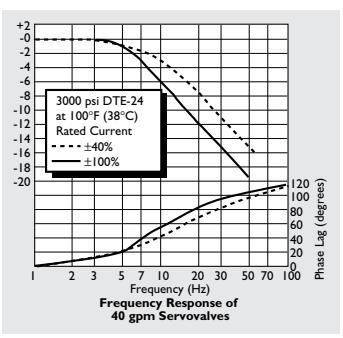
Full Amplitude Step Response

Typical characteristic curves with ±40% and ±100% input signal, measured at 3,000 operating pressure.

Standard Valves

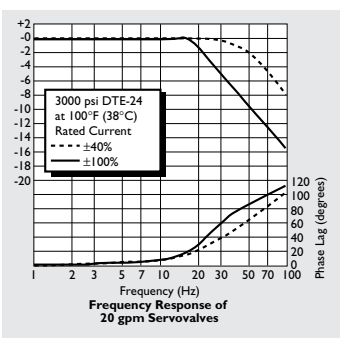


Frequency Response of 20 and 30 gpm Servovalves

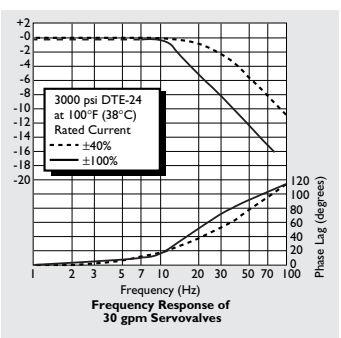


Frequency Response of 40 gpm Servovalves

High Response Valves

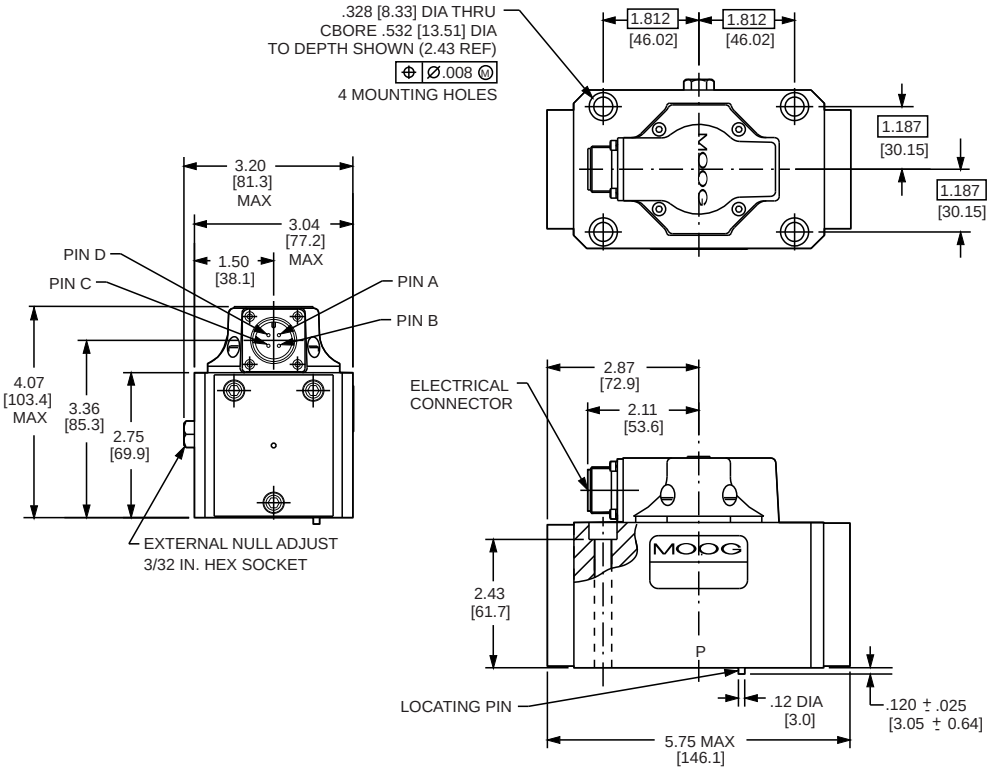


Frequency Response of 20 gpm Servovalves

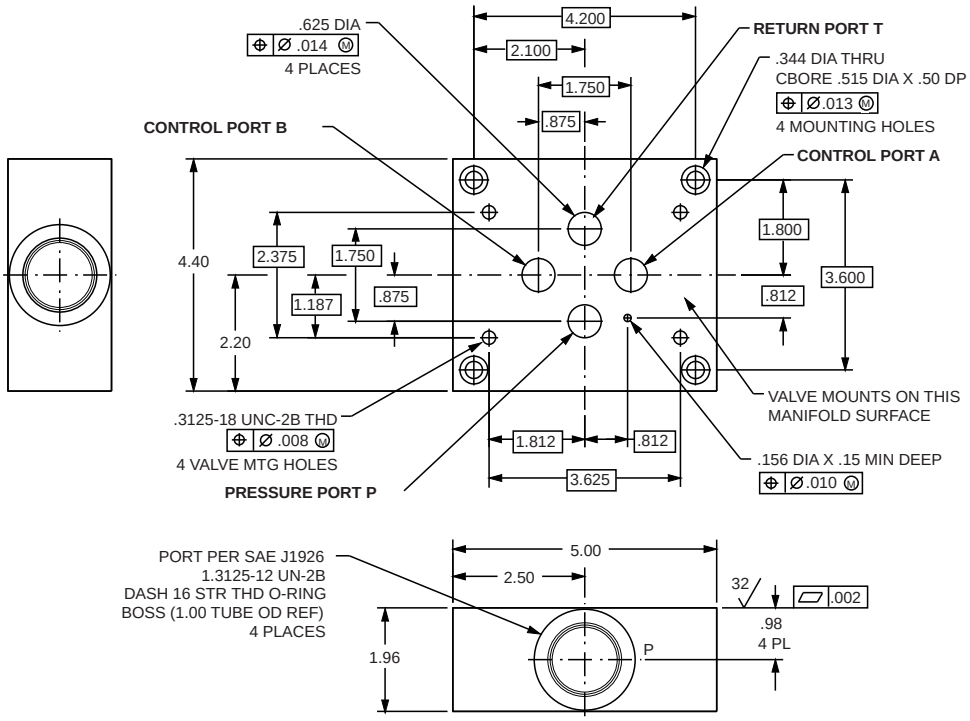


Frequency Response of 30 gpm Servovalves

INSTALLATION DRAWINGS



TYPICAL SUBPLATE MANIFOLD



Null Adjust: Flow out of Control Port A will increase with clockwise rotation of null adjust screw ($^{3}/_{32}$ hex key).

Surface to which valve is mounted requires a 32 [ΔΔ] finish, flat within 0.002[0.05] TIR.

ELECTRICAL CONNECTIONS

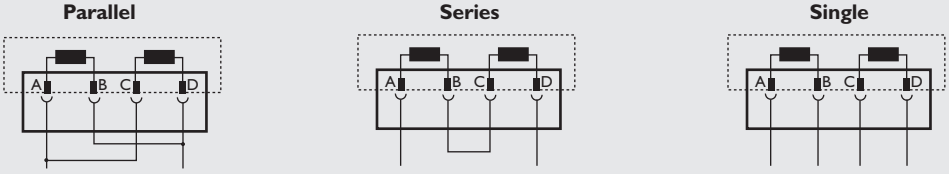
Rated current and coil resistance
A variety of coils are available for 78 Series Servovalves, which offer a wide choice of rated current. See Table 1.

Coil connections
A four-pin electrical connector (that mates with an MS3106F14S/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.

78 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 78 series coils)



		Parallel	Series	Single
Coil Resistance	[Ω]	100	400	200
Rated Current	[mA]	±15	±7.5	±15
Electrical Power	[W]	.023	.023	.045
Connections 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
80	±40	±20	0.12	0.36	0.10
200	±15	±7.5	0.72	2.20	0.59
1000	±8	±4	3.20	9.70	2.60

* Measured at 50 Hz

ORDERING INFORMATION
SPARE PARTS AND ACCESSORIES

Model Number

78 • • • • • •

Type Designation

• • • • • • • • • • • •

Optional Feature	
	Series specification
K	Intrinsically safe
N	Explosion Proof

Model Designation	
	Assigned at the factory

Factory Identification (Revision Level)

Valve Version	
S	Standard response
H	High response

Rated Flow	
	Q_N[gpm] at Δp_N = 1,000 psi
07	20
11	30
15	40

Maximum Operating Pressure p_p and Body Material	
F	3,000 psi aluminum

Main Spool Type	
O	4-way / axis cut / linear
D	4-way / +/-10% overlap / linear
X	Special*

Signals for 100% Spool Stroke	
4	±4 mA series (±8 mA parallel)
H	±7.5 mA series (±15 mA parallel)
L	±20 mA series (±40 mA parallel)
Z	±100 mA series (±200 mA parallel)
Y	Special signal (see spec. sheet)*

Valve Connector	
A	Connector C1 (A) – side (RH)
B	Connector C2 (B) – side (LH)
X	Special connector*

Seal Material	
V	Viton
N	NBR
	Others on request*

Pilot Connections and Pressure		
	Pressure [psi]	Supply
4	250 to 3,000	internal

Spool Position without Electrical Signal	
M	Mid position

Pilot Stage	
F	Standard dynamics
G	Improved dynamics

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

* Optional designs are available with intrinsically safe coils (FM approved), and/or special spool bushing lap configuration. Available seal materials: VITON (Std.), BUNA or EPR.

SPARE PARTS AND ACCESSORIES

O-Rings (included in delivery), for P, T, A and B	FPM 85 Shore ID 0.739 x .070	Moog P/N 42082-021
Mating Connector, waterproof IP 65 (not included in delivery)		49054F14S2S (MS3106F14S-2S)
Flushing Block Kit		A37333-1K1
Mounting Bolts (not included in delivery) 5/16 - 18 NC x 3.0 long (4 pieces)		A31324-248B
Replaceable Filter		14417-1
Filter Replacement Kit		B52555RK52K1

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

Hong Kong	Hong Kong
India	Bangalore
Ireland	Ringaskiddy
Italy	Malnate
Japan	Hiratsuka
Korea	Seoul
Philippines	Baguio
Singapore	Singapore
Spain	Orio
Sweden	Askim
USA	East Aurora

MOOG
Industrial Controls Division
Moog Inc., East Aurora, NY 14052-0018
Telephone: 716/655-3000
Fax: 716/655-1803
Toll Free: 1-800-272-MOOG
www.moog.com

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