G631 Series Servovalves
ISO 4401 Size 05
G631 SERIES SERVOVALVES

The G631 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 1.0 to 20 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 the 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. 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
- ISO 4401 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
- Field configurable fifth port for separate pilot supply
- Field replaceable first stage disc 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/l/min = calculated flow
- \( Q_n \) gpm/l/min = rated flow
- \( \Delta p \) psi/bar = actual valve pressure drop
- \( \Delta p_n \) psi/bar = rated valve pressure drop

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.
Operating Pressure
Main stage: ports P, X, A and B 4,500 psi [315 bar]
port T 2,000 psi [140 bar]

Temperature Range
Fluid -20° to 275°F [-29° to 135°C]
Ambient -20° to 275°F [-29° to 135°C]

Seal Material*
Fluorocarbon (Viton)

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. Refer to Moog filtration catalog for recommended filtration scheme.

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 < 16/13
For longer life ISO 4406 < 15/12

Recommended Filter Rating
For normal operation β15 ≥ 75 (15 µm absolute)
For longer life β30 ≥ 75 (10 µm absolute)

Installation Operations
Any position, fixed or movable.

Vibration
15 g, 3 axes

Weight
4.7 lbs [2.1 kg]

Degree of Protection
EN 60529: class IP65, with mating connector mounted.

Shipping Plate
Delivered with an oil sealed shipping plate.

* Other seal materials available upon request

Valve Flow Diagram
Valve flow for maximum valve opening (100% command signal) as a function of the valve pressure drop.
G631 SERIES
TECHNICAL DATA

Model...Type | G631-........
Mounting Pattern | ISO 4401-05-05-0-94 (for 4 ports)
Valve Body Version | 4-way
2-stage with spool- bushing assembly
Pilot Stage | N ozzle/Flapper
Pilot Connection | O ptional, Internal or External
Fluid Supply | G631 series servovalves are intended to operate with constant supply pressure
Supply Pressure | minimum maximum standard
200 psi [14 bar] 4,500 psi [315 bar]
Rated Flow Tolerance | @ 1,000 psi ΔP [%] ±10
Symmetry | [%] < 10
Threshold | [%] < 1.0
Hysteresis | [%] < 3.0
Null Shift | at ΔT = 100°F [55°K] [%] < 4.0
for every 1,000 psi [70 bar] supply pressure change < 4.0
Spool Stroke | in [cm] .05 [.127]
Spool Drive Area | in² [cm²] 0.12 [.75]

Typical Response Characteristic Curves measured at 3,000 pilot pressure, fluid viscosity of 100 SUS and fluid temperature of 100°F.
Standard electrical connector mates with MS3106F14S-2S or equivalent.

The mounting manifold must conform to ISO 4401-05-05-094*

*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 ∆∆ finish.

For external null adjust:
Flow out of port “A” will increase with clockwise rotation of null adjust screw (1/8 hex key).
Rated current and coil resistance
A variety of coils are available for G631 Series Servovalves.

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 single operation.

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 G631 series coils)

<table>
<thead>
<tr>
<th>Connection</th>
<th>Coil Resistance [Ω]</th>
<th>Rated Current [mA]</th>
<th>Coil Inductance @ 50 Hz [H]</th>
<th>Electrical Power [W]</th>
<th>Polarity for Valve Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel</td>
<td>14</td>
<td>±100</td>
<td>0.2</td>
<td>.14</td>
<td>A and C (+), B and D (-)</td>
</tr>
<tr>
<td>Series</td>
<td>56</td>
<td>±50</td>
<td>0.8</td>
<td>.14</td>
<td>A (+), D (-), B and C connected</td>
</tr>
<tr>
<td>Single</td>
<td>28</td>
<td>±100</td>
<td>0.2</td>
<td>.28</td>
<td>A (+), B (-), C (+), D (-)</td>
</tr>
</tbody>
</table>

Note: Before applying electrical signals, the pilot stage must be pressurized.
G631 SERIES
ORDERING INFORMATION
SPARE PARTS AND ACCESSORIES

STANDARD MODELS

<table>
<thead>
<tr>
<th>Model</th>
<th>Type Designation</th>
<th>Rated Flow ((\Delta 1,000) psi)</th>
<th>Internal Leakage (at 3,000 psi)</th>
<th>Rated Current (Single Coil)*</th>
<th>Nominal Coil Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>gpm</td>
<td>lpm</td>
<td>gpm</td>
<td>lpm</td>
</tr>
<tr>
<td>G631-3001A</td>
<td>H05/O FM4VBR</td>
<td>1.0</td>
<td>5.0</td>
<td>&lt; 0.52</td>
<td>&lt; 2.0</td>
</tr>
<tr>
<td>G631-3002A</td>
<td>H10/O FM4VBR</td>
<td>2.5</td>
<td>10</td>
<td>&lt; 0.60</td>
<td>&lt; 2.3</td>
</tr>
<tr>
<td>G631-3003A</td>
<td>H20/O FM4VBR</td>
<td>5.0</td>
<td>20</td>
<td>&lt; 0.70</td>
<td>&lt; 2.6</td>
</tr>
<tr>
<td>G631-3004A</td>
<td>H40/O FM4VBR</td>
<td>10.0</td>
<td>40</td>
<td>&lt; 0.78</td>
<td>&lt; 3.0</td>
</tr>
<tr>
<td>G631-3005A</td>
<td>H60/O FM4VBR</td>
<td>15.0</td>
<td>60</td>
<td>&lt; 0.86</td>
<td>&lt; 3.2</td>
</tr>
<tr>
<td>G631-3006A</td>
<td>H75/O FM4VBR</td>
<td>20.0</td>
<td>75</td>
<td>&lt; 0.96</td>
<td>&lt; 3.6</td>
</tr>
</tbody>
</table>

*Overdrive more than 10% of rated current is NOT recommended.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Type Designation</th>
<th>Special Equipment</th>
<th>Signals for 100% Spool Stroke</th>
<th>Valve Connector</th>
<th>Seal Material</th>
<th>Pilot Connections and Pressure</th>
<th>Spool Position without Electrical Signal</th>
<th>Pilot Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>G631 • • • • A</td>
<td>H • • • • F M V B • -</td>
<td>- None</td>
<td>Q ±15 mA (series)</td>
<td>B Connector over B-side</td>
<td>V FPM (Viton)</td>
<td>4 Internal</td>
<td>M Mid-position</td>
<td>F Standard Flow, Nozzle-Flapper</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rated Flow (Q_n) gpm [lpm]</th>
<th>Internal Leakage ((\Delta 3,000) psi) gpm [lpm]</th>
<th>Rated Current (Single Coil)* mA</th>
<th>Nominal Coil Resistance Ohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>At (\Delta P = 75) psi ([5) bar] per land</td>
<td>At (\Delta P = 500) psi ([35) bar] per land</td>
<td>05</td>
<td>1.5 [3]</td>
</tr>
<tr>
<td>10</td>
<td>2 [7]</td>
<td>2.3 [10]</td>
<td>100</td>
</tr>
<tr>
<td>40</td>
<td>6 [22]</td>
<td>6 [20]</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Operating Pressure (P) and Body Material</th>
<th>Bushing/Spool Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,500 psi ([315) bar] Aluminum</td>
<td>O 4-way / axis cut / linear</td>
</tr>
<tr>
<td></td>
<td>D 4-way / ±10% overlap / linear</td>
</tr>
</tbody>
</table>

SPARE PARTS AND ACCESSORIES

<table>
<thead>
<tr>
<th>Moog Part</th>
<th>Size</th>
<th>Moog Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-Rings (included in delivery), for P,T,A and B</td>
<td>FPM 85 Shore</td>
<td>G2141-012-020</td>
</tr>
<tr>
<td>O-Rings (included in delivery), for X</td>
<td>ID 0.472 x 0.079</td>
<td>G2141-008-020</td>
</tr>
<tr>
<td>Mating Connector (not included in delivery)</td>
<td>ID 0.315 x 0.079</td>
<td>P/N 49054F0145002S(M53106F14S-25)</td>
</tr>
<tr>
<td>Flushing Block</td>
<td>P/N B67728-002</td>
<td></td>
</tr>
<tr>
<td>Mounting Bolts (not included in delivery)</td>
<td>1/4 - 20 N C x 2-3/4 long (4 pieces) [M6 x 1.0 x 70 mm]</td>
<td>P/N A31324-144B</td>
</tr>
<tr>
<td>Replaceable Filter</td>
<td>P/N A67999-100</td>
<td></td>
</tr>
<tr>
<td>Filter Replacement Kit (includes service manual)</td>
<td>P/N B52555RK200K001</td>
<td></td>
</tr>
</tbody>
</table>