MOOG TWO STAGE FLOW CONTROL SERVOVALVES OFFER HIGH SPOOL DRIVING FORCES AND A RUGGED LONG-LIFE.
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 $\beta_{15} \geq 75$ (15 µm absolute)
- For longer life $\beta_{10} \geq 75$ (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**
- EN60529: 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**

<table>
<thead>
<tr>
<th>Model...Type</th>
<th>G631-.........</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting Pattern</td>
<td>ISO 4401-05-05-0-94 (for 4 ports)</td>
</tr>
<tr>
<td>Valve Body Version</td>
<td>4-way</td>
</tr>
<tr>
<td></td>
<td>2-stage with spool–bushing assembly</td>
</tr>
<tr>
<td>Pilot Stage</td>
<td>Nozzle/Flapper</td>
</tr>
<tr>
<td>Pilot Connection</td>
<td>Optional, Internal or External</td>
</tr>
<tr>
<td>Fluid Supply</td>
<td>G631 series servovalves are intended to operate with constant supply pressure</td>
</tr>
<tr>
<td>Supply Pressure</td>
<td>minimum 200 psi [14 bar]</td>
</tr>
<tr>
<td></td>
<td>maximum standard 4,500 psi [315 bar]</td>
</tr>
<tr>
<td>Rated Flow Tolerance</td>
<td>@ 1,000 psi (\Delta P_N) [%] ±10</td>
</tr>
<tr>
<td>Symmetry</td>
<td>[%] &lt; 10</td>
</tr>
<tr>
<td>Threshold</td>
<td>[%] &lt; 1.0</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>[%] &lt; 3.0</td>
</tr>
<tr>
<td>Null Shift</td>
<td>at (\Delta T = 100,^\circ F \ [55,^\circ K]) [%] &lt; 4.0</td>
</tr>
<tr>
<td></td>
<td>for every 1,000 psi [70 bar] supply pressure change &lt; 4.0</td>
</tr>
<tr>
<td>Spool Stroke</td>
<td>in [cm] .05 [.127]</td>
</tr>
<tr>
<td>Spool Drive Area</td>
<td>in(^2) [cm(^2)] 0.12 [.75]</td>
</tr>
</tbody>
</table>

**Typical Response Characteristic Curves** measured at 3,000 pilot pressure, fluid viscosity of 100 SUS and fluid temperature of 100°F.

**Frequency Response**

![Frequency Response Graph]

**Step Response**

![Step Response Graph]
**Standard electrical connector mates with MS3106F14S-2S or equivalent.**

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 ∆∆ finish.

For external null adjust:
Flow out of port “A” will increase with clockwise rotation of null adjust screw (1/8 hex key).

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**CONVERSION INSTRUCTION**

For operation with internal or external pilot connection.

<table>
<thead>
<tr>
<th>Pilot flow supply</th>
<th>Screw &amp; Seal Washer Location (M4 X 6 DIN EN ISO 4762)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bore 1</strong></td>
<td><strong>Bore 2</strong></td>
</tr>
<tr>
<td>Internal P</td>
<td>closed</td>
</tr>
<tr>
<td>External X</td>
<td>open</td>
</tr>
</tbody>
</table>

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**G631 SERIES INSTALLATION DRAWINGS**
**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.

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**ELECTRICAL CONNECTIONS**
(Examples with typical G631 series coils)

<table>
<thead>
<tr>
<th>Coil Resistance [Ω]</th>
<th>Rated Current ±100 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></td>
<td></td>
<td>0.2</td>
<td>.14</td>
<td>A and C (+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.8</td>
<td>.14</td>
<td>B and D (-)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.2</td>
<td>.28</td>
<td>A (+), B (-)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>or C (+), D (-)</td>
</tr>
</tbody>
</table>

Note: Before applying electrical signals, the pilot stage must be pressurized.
**STANDARD MODELS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Type Designation</th>
<th>Rated Flow (at 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>G631-3001A</td>
<td>H05JOFM4VBR</td>
<td>1.0</td>
<td>0.52</td>
<td>100</td>
<td>28</td>
</tr>
<tr>
<td>G631-3002A</td>
<td>H10JOFM4VBR</td>
<td>2.5</td>
<td>1.0</td>
<td>100</td>
<td>28</td>
</tr>
<tr>
<td>G631-3003A</td>
<td>H20JOFM4VBR</td>
<td>5.0</td>
<td>0.70</td>
<td>100</td>
<td>28</td>
</tr>
<tr>
<td>G631-3004A</td>
<td>H40JOFM4VBR</td>
<td>10.0</td>
<td>0.78</td>
<td>100</td>
<td>28</td>
</tr>
<tr>
<td>G631-3005A</td>
<td>H60JOFM4VBR</td>
<td>15.0</td>
<td>0.86</td>
<td>100</td>
<td>28</td>
</tr>
<tr>
<td>G631-3006A</td>
<td>H75JOFM4VBR</td>
<td>20.0</td>
<td>0.96</td>
<td>100</td>
<td>28</td>
</tr>
</tbody>
</table>

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

**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>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></td>
<td></td>
</tr>
<tr>
<td>Flushing Block</td>
<td>P/N 49054F014S002(553106F14S-2S)</td>
<td></td>
</tr>
<tr>
<td>Mounting Bolts (not included in delivery)</td>
<td>1/4 - 20 NC x 2-3/4 long (4 pieces) [M6 x 1.0 x 70 mm]</td>
<td>P/N A67999-100</td>
</tr>
<tr>
<td>Replaceable Filter</td>
<td>P/N A31324-144B</td>
<td></td>
</tr>
<tr>
<td>Filter Replacement Kit (includes service manual)</td>
<td>P/N B5255SRK200K001</td>
<td></td>
</tr>
</tbody>
</table>
Solutions for flow control of high performance applications are available around the world. For more information, visit our Web site or contact one of the locations below.

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