D661 Series
ISO 4401 Size 05
Installation and Operation Instruction
Servo and Proportional Control Valves with Integrated Electronics

1. INTRODUCTION

This manual provides instructions and procedures necessary to install, operate and troubleshoot the Moog D661 Series Servo and Proportional Control Valves.

Series Models

Series G  Servovalve with nozzle-flapper or ServoJet® pilot stage, spool in bushing, without additional mechanical feedback
Series S  Servovalve configured like version G, but with additional mechanical feedback
Series H  Servovalve configured like version S, but with improved performance (high response)
Series P...A/B  Proportional valve with ServoJet® pilot stage, spool in body, without additional mechanical feedback
Series P...F/G  Proportional valve configured like version P...A/B, but with nozzle flapper pilot stage and additional mechanical feedback

2. OPERATION

General

The Servovalves D661-G, S and H Series and the Proportional Flow Control Valves D661-P Series are throttle valves for 2-, 3- and 4-way applications. With proportional flow control valves, 5-way applications are also possible. These valves are suitable for electrohydraulic position, velocity, pressure or force control systems with high dynamic response requirements.

D661-G, S and H

The spool of the main stage is driven by a nozzle flapper or ServoJet® pilot stage, optional with or without additional mechanical feedback (nozzle flapper only).

With versions D661-S and H in case of an electrical supply failure the spool is moved into a preferred position by action of an additional mechanical feedback.

CAUTION

DISASSEMBLY, MAINTENANCE, OR REPAIR OTHER THAN IN ACCORDANCE WITH THE INSTRUCTIONS HEREIN OR OTHER SPECIFIC WRITTEN DIRECTIONS FROM MOOG WILL INVALIDATE MOOG’S OBLIGATIONS UNDER ITS WARRANTY.
Operating Principle of the Two-Stage Valve

An electric input signal (flow rate command) is applied to the integrated control amplifier which drives a current through the coils of the pilot stage torque motor. Thus the deflected nozzle-flapper system produces a pressure difference across the drive areas of the spool and effects its movement. The position transducer which is excited via an oscillator measures the position of the spool (actual value, position voltage).

This signal is then rectified by a demodulator and is fed back to the control amplifier where it is compared with the command signal. The control amplifier drives the torque motor until command voltage and feedback voltage are equal. Thus, the position of the spool is proportional to the electric command signal.

The position transducer which is excited via an oscillator measures the position of the spool (flow rate command). This signal is then demodulated and fed back to the controller where it is compared with the command signal. The controller drives the torque motor until the error between command signal and feedback signal is zero. Thus the position of the spool is proportional to the electric command signal.

Failsafe Version D661-...P

For applications with proportional control valves where certain safety regulations are applicable, a defined metering spool position is needed in order to avoid potential damage. Therefore, failsafe versions are offered as an option for the MOOG proportional valves.

After external triggering, this failsafe function causes a defined metering spool position.

Mechanical Failsafe version (biased pilot stage with mechanical feedback)

The safe position of the spool will be obtained after cut off of pilot pressure supply (external pilot connection) or operating pressure supply (internal pilot connection).

This safe position can only be obtained with <1 bar pilot pressure.

Proportional Flow Control Valve D661-...P

The nozzle flapper design of the pilot stage has been converted into an improved version with jet pipe amplifier (ServoJet®).

The ServoJet® pilot stage consists mainly of torque motor, jet pipe and receiver.

A current through the coil displaces the jet pipe from neutral. This displacement combined with the special shape of the nozzle directs a focussed fluid jet more into one receiver bore than into the other.

The jet now produces a pressure difference in the control ports. This pressure difference results in a pilot flow, which in turn causes a spool displacement. The pilot stage drain is through the annular area around the nozzle to tank.

Operating Principle of the Two-Stage Valve

An electric input signal (flow rate command) is applied to the integrated control amplifier which drives a current through the coil of the pilot stage torque motor. Thus the deflected jet pipe produces a pressure difference across the drive areas of the spool and effects its movement.
With failsafe versions R and L, a defined spool position is reached when the electric supply to the valve electronics is switched off while the pilot pressure is still applied. With version M, the resulting spool position is undefined.

Electrically operated failsafe version
The safe position of the spool will be obtained after switching off the integrated 2/2-way solenoid seat valve.

With failsafe versions W, U and G, after cut-off of the solenoid, the spool moves to midposition. When the electric supply to the valve electronics is switched off while the pilot pressure is still effective and the solenoid is still switched on, the spool will move to a defined end position with versions U and G.

With failsafe version P, the integrated seat valve will shut off the external pilot pressure after switching off the solenoid.

### Technical Data

#### Series D661-...

(For code letter of valve version see pages 18/19)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass [kg]</td>
<td>5.7</td>
<td>5.5</td>
<td>4.2</td>
</tr>
<tr>
<td>Rated flow $Q_N$ [l/min]</td>
<td>see nameplate of the valve</td>
<td>see nameplate of the valve</td>
<td></td>
</tr>
</tbody>
</table>

**Null leakage flow**

- Total, max. [l/min]
  - G, S, F: 3.0 to 5.0
  - G, S, H: 3.5
  - G, H: 4.4

**Pilot leakage flow**

- Pilot stage only [l/min]
  - G, S, F: 2.5
  - G, S, H: 1.4
  - G, H: 2.5

**Pilot flow**

- Max. for 100% step input [l/min]
  - G, S, F: 2.5
  - G, S, H: 1.4
  - G, H: 2.5

**Max. operating pressure $P_{max}$**

- Main stage, ports P, A, B [bar]
  - 350
- Pilot stage, T (T2) with Y internal [bar]
  - 20% of pilot pressure, max.
  - 100
- Pilot stage, T (T2) with Y external [bar]
  - 350
  - 350
- With dropping orifice (on request) [bar]
  - 350
  - 350

#### Temperature range

- Ambient [°C]
  - -20 to +60
- Fluid [°C]
  - -20 to +80
- System filter
  - High pressure filter, mounted in the main flow without in the main flow without bypass, but with dirt alarm bypass, but with dirt alarm

#### Operating fluid

- Mineral oil based hydraulic fluid according to DIN 51524, part 1 to 3, others upon request
- Mineral oil based hydraulic fluid according to DIN 51524, part 1 to 3, others upon request

#### Viscosity

- Recommended [mm²/s]
  - 5 to 45
- Allowable [mm²/s]
  - 5 to 400

#### System filter rating

- For normal operation
  - $\beta_{15}$, 75 (15 μm absolute)
  - $\beta_{10}$, 75 (10 μm absolute)
- For longer life
  - $\beta_{15}$, 75 (15 μm absolute)
  - $\beta_{10}$, 75 (10 μm absolute)

#### Class of cleanliness according to

ISO 4406

- NAS 1638
  - 16 / 13 or better
  - 7 or better

For additional technical information such as dimensions, ordering information, etc., see the D660 series catalog.
3. SAFETY INSTRUCTIONS

Warnings and Symbols
- Refers to special orders and prohibitions to prevent damage
- Refers to special orders and prohibitions to prevent injury or extensive damage

Correct Application
- The D661 Series Valves are control valves suited for electrohydraulic position, velocity, pressure and force control.
- The valves are designed for flow control in hydraulic systems that operate with mineral oil based fluids. Others upon request.
- Using the valves for purposes other than those mentioned above is considered contrary to the intended use. The user bears entirely the risk of such misuse.
- Correct application involves also observing the operating instruction and complying with the inspection and maintenance directives.

Organizational Measures
- We recommend including this operating instruction into the maintenance plan of the machine/plant.
- In addition to the operating instruction, observe also all other generally applicable legal and other mandatory regulations relevant to accident prevention and environmental protection. Instruct the operator accordingly.
- All safety and danger prevention instructions of the machine/plant must meet the requirements of EN 982.

Selection and Qualification of Personnel
- Only well-trained and instructed personnel are allowed to work with Moog control valves.
- Work with electrohydraulic valves must be carried out only by personnel having special knowledge and experience in plants running with electrohydraulic controls.

Safety Instructions for Specific Operational Phases
- Take the necessary precautions to ensure that the machine/plant is used only when in a safe and reliable state.
- Check the machine/plant at least once per working shift for obvious damage and defects (i.e., leakage). Report any changes to the responsible group/person immediately. If necessary, stop the machine immediately and secure it.
- In the event of malfunctions, stop the machine/plant immediately and secure it. Have any defects rectified immediately.
- If the machine/plant is completely shut down for maintenance and repair work at the valve, it must be secured against inadvertent start up by:
  ➢ Locking the principal control elements and removing the key.
  ➢ Attaching a warning sign to the main switch.

Safety Instructions for the Operation of Hydraulic Plants
- Work on electrohydraulic equipment must be carried out only by personnel having special knowledge and experience in electrohydraulic controls.
- Check all lines, hoses and fittings of the plant regularly for leaks and obvious damage. Repair damage immediately.
- Splashed oil may cause injury and fire.
- Before removing the valve, depressurize all system sections to be opened, pressure lines and accumulators of the hydraulic system in accordance with the specific instructions for the plant.
- When handling oil, grease and other chemical substances, observe safety regulations valid for each product.

4. INSTALLATION

General Information
- Compare model number and valve type with information from the hydraulic schematic or bill of material.
- The valve can be mounted in any direction, fixed or moving.
- Check mounting surface flatness (0.02 mm for 100 mm) and surface finish (Ra < 1 µm)
- Pay attention to cleanliness of mounting surface and surroundings when installing the valve.
- Use lint-free tissue to clean!
- Before installation, remove shipping plate from the valve and save it for later use.
- Pay attention to correct position of ports and location of o-rings during installation.
- Use M6 x 60 socket head bolts according to DIN 912 for mounting, strength class 10.9 or 12.9, and cross torque to 13 Nm (tolerance ± 10 %)

Internal/External Pilot Connection
- Conversion for operation with internal or external pilot connection.
  The pilot connection mode as shipped is indicated by the respective code letter of the type designation on the nameplate.
  With the 5-way version, where the T and T2 ports are interchanged with the P port, pilot supply port X and return port Y must be connected externally.
- Use M6 x 60 socket head bolts according to DIN 912 for mounting, strength class 10.9 or 12.9, and cross torque to 13 Nm (tolerance ± 10 %)

Selection and Qualification of Personnel
- Conversion instruction for Servovalves D661-G and Proportional valves D661-P...A/B

Organizational Measures
- Check for sufficient length (100 mm) of mounting surface!

Safety Instructions for Specific Operational Phases
- Take the necessary precautions to ensure that the machine/plant is used only when in a safe and reliable state.
- Check the machine/plant at least once per working shift for obvious damage and defects (i.e., leakage). Report any changes to the responsible group/person immediately. If necessary, stop the machine immediately and secure it.
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<table>
<thead>
<tr>
<th>Pilot Flow</th>
<th>Set Screw M4 x 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>bore 1</td>
</tr>
<tr>
<td>Internal P</td>
<td>closed</td>
</tr>
<tr>
<td>External X</td>
<td>open</td>
</tr>
<tr>
<td>Pilot Flow</td>
<td></td>
</tr>
<tr>
<td>Return</td>
<td>bore 3</td>
</tr>
<tr>
<td>Internal T</td>
<td>closed</td>
</tr>
<tr>
<td>External Y</td>
<td>open</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pilot Flow</th>
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</tr>
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<td>bore 3</td>
</tr>
<tr>
<td>Internal T</td>
<td>closed</td>
</tr>
<tr>
<td>External Y</td>
<td>open</td>
</tr>
</tbody>
</table>
5. SETTING UP

This information is valid for new installations to be put into operation as well as for repair cases.

### Filling the Hydraulic System

New oil is never clean. Therefore, the system should generally be filled by using a filling filter. This fine mesh filter should at least comply with the following requirement: $B_{10} = 75$ (10 µm absolute).

### Flushing the Hydraulic System

Before the hydraulic system is put into operation for the first time (also after modifications), it has to be flushed carefully according to the instructions of the manufacturer of the plant / machine.

a. Before flushing, suitable flushing elements have to be inserted in the pressure filters instead of the high pressure elements.

b. Before flushing, the operational temperature of the hydraulic system should be achieved. Observe temperature!

c. A flushing plate or, if the system allows, a directional valve should be mounted in place of the Moog proportional valve. The P- and T-connections are flushed through the flushing plate. The user A- and B-connections can also be flushed by the directional valve.

Attention: The directional valve can lead to unpermissible movements in the load (i.e. with parallel drives), which may result in damage of the plant / machine. Instructions of the manufacturer have to be strictly observed.

Minimum flushing time $t$ can be calculated as follows:

$$ t = \frac{V}{Q} \cdot 5 $$

$d$. The flushing process can be considered completed when a system cleanliness of 15/12 according to ISO 4406 or 6 according to NAS 1638 or better is achieved. A long life of the metering lands of the proportional valve can be expected for this cleanliness class.

e. Replace flushing elements in the pressure filters by suitable high pressure elements after flushing. Install Moog proportional valve instead of flushing plate or directional valve.

### Setting Up

a. Set up machine/plant according to the operation instructions of the manufacturer after the valves have been installed. Vent hydraulic system!

b. The safety instructions of the machine/plant manufacturer must be observed. Especially the safety requirements for machines like injection molding machines (EN 201), blow molding machines (EN 422) and die casting machines (EN 869), to name a few, are important.

c. Observe oil temperature.

d. Check hydraulic system for external leakage!

6. MAINTENANCE

Besides regular visual inspection for external leakage and filter replacement, maintenance work at the D661 Series valves is not required.

**Explosion proof valves D661K... must not be opened by the customer! Unauthorized opening will invalidate the explosion proof approval! Return failed valve to the factory.**

Moog valves can only be repaired at Moog Service Centers (for addresses see back page of this operation instructions).

### Filter Replacement

The built-in filter disk protects orifices and nozzles against coarse contaminants. With severe contamination, the valve response will be reduced.

Replace filter!

Cleaning the filter is useless and may be dangerous!

Before starting to work on the valve, clean the external surface around the filter cover!

Attention: The filter disk (21) flows from inside to the outside.

After removal of the cover (20) any contamination particles are on the inside of the disk (21) and therefore, cannot be seen from outside.

a. Remove four internal hex bolts (38) using Allen wrench (3 mm). Remove cover (20). Remove the filter disk (21) now accessible by using a scriber or a fine screwdriver as extraction tool.

b. Check o-rings (59) and (53) for damage. Replace if necessary.

c. Insert o-ring (53) first. Then insert the new filter disk (21) such that the side with the notch at the rim points outward. Mount o-ring (59) on the cover (20) using clean grease, and mount cover to the valve body. Torque the four bolts (38) to 4 Nm (35 in-lb).

d. Check valve for external leakage after pressurizing it.
ELECTRONICS INFORMATION

Valve connectors
Possible connectors

<table>
<thead>
<tr>
<th>Number of Pins</th>
<th>Supply Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>±15VDC</td>
</tr>
<tr>
<td>6 + PE</td>
<td>X</td>
</tr>
<tr>
<td>11 + PE</td>
<td>–</td>
</tr>
<tr>
<td>11 + 1 (PE) Bayonet</td>
<td>X</td>
</tr>
<tr>
<td>6 (old, without PE)</td>
<td>X</td>
</tr>
<tr>
<td>12 (old, without PE) Bayonet</td>
<td>X</td>
</tr>
</tbody>
</table>

Please note information regarding input signals on the nameplate!

Valve electronics with supply voltage ±15VDC and 6+PE pole connector

a. Command input

Command signal 0 to ±10 V

The spool stroke of the valve is proportional to \((U_D - U_E)\). 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\) is achieved at \((U_D - U_E) = +10\) V. At 0 V command the spool is in the center position.

The input stage is a differential amplifier. If only one command signal is available, pin D or E is connected to signal ground \((0\text{V})\) (pin C) according to the required operating direction (to be done at the mating connector).

Command signal 0 to ±10 mA

The spool stroke of the valve is proportional to \((I_D - I_E)\). 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\) is achieved at \((I_D - I_E) = +10\) mA. At 0 mA command the spool is in the center position.

Either pin D or E is used according to the required operating direction. The unused pin is left open (not connected at the mating connector). The input pins D and E are inverting.

b. Monitoring output

Actual value 0 to ±10 V

The actual spool position value can be measured at pin F. This signal can be used for monitoring and fault detection purposes.

The spool stroke range corresponds to ±10 V. +10 V corresponds to 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\).

Actual value 0 to ±10 mA

The actual spool position value can be measured at pin F. This signal can be used for monitoring and fault detection purposes.

The spool stroke range corresponds to ±10 mA. +10 mA corresponds to 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\).

General Requirements

➢ Supply ±15VDC ±3%, ripple <50 mVpp. Current consumption max. ±250mA
➢ All signal lines, also those of external transducers, shielded
➢ Shielding connected radially to \((0\text{V})\), power supply side and connected to the mating connector housing (EMC)
➢ EMC: Meets the requirements of EN 55011/03.91 class B, EN 50081-1/01.92, and EN 50082-2/03.95, performance criterion class A
➢ Protective grounding lead \(\geq 0.75\text{mm}^2\) (AWG 16)
➢ Note: When making electric connections to the valve (shield, protective grounding), appropriate measures must be taken to ensure that locally different earth potentials do not result in excessive ground currents. See also MOOG Application Note AM 353 E.

Connector Wiring - Type code S (see sticker on the electronics housing)

For valve with 6+PE-pole connector according DIN 43563, connector (metal) with leading ground pin (±).
Valve electronics with supply voltage ± 15 VDC and 11+1 pole bayonet connector

Alternate connector for certain valve models

a. Command input

**Command signal 0 to ±10 V**

The spool stroke of the valve is proportional to \((U_D - U_E)\). 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\) is achieved at \((U_D - U_E) = +10 V\). At 0 V command the spool is in the center position.

The input stage is a differential amplifier. If only one command signal is available, pin D or E is connected to signal ground \(\bot\) (pin C) according to the required operating direction (to be done at the mating connector).

**Command signal 0 to ±10 mA**

The spool stroke of the valve is proportional to \((I_D - I_E)\). 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\) is achieved at \((I_D - I_E) = +10 mA\). At 0 mA command the spool is in the center position. Either pin D or E is used according to the required operating direction. The unused pin is left open (not connected at the mating connector). The input pins D and E are inverting.

**Command signal 4 to 20 mA**

The spool stroke range corresponds to 4 to 20 mA. 20 mA corresponds to 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\). The unused pin E is left open (not connected in the mating connector).

b. Monitoring output

The actual spool position value can be measured at pin F. This signal can be used for monitoring and fault detection purposes.

**Command signal 0 to ±10 V**

The spool stroke range corresponds to ±10 V. +10 V corresponds to 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\).

**Command signal 0 to ±10 mA**

The spool stroke range corresponds to ±10 mA. +10 mA corresponds to 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\).

**Command signal 4 to 20 mA**

The spool stroke range corresponds to 4 to 20 mA. 20 mA corresponds to 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\).

Please note "General Requirements" on page 6.

**Connector Wiring - Type code V** (see sticker on the electronics housing)

Valves with 11+1 pole bayonet connector to MIL C-26482-14-12 with leading protective grounding connection (K)

Mating connector: metal shell, Order-No.: B97027 012.

<table>
<thead>
<tr>
<th>Function</th>
<th>Voltage command</th>
<th>Current command</th>
<th>Current command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>+ 15 VDC ± 3%, ripple &lt;50 mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply/signal ground</td>
<td>(\bot) (0 V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input command valve flow</td>
<td>0 to ±10 V</td>
<td>0 to ±10 mA</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td></td>
<td>Input resistance 100 kΩ</td>
<td>Load resistance 400 Ω</td>
<td>Load resistance 200 Ω</td>
</tr>
<tr>
<td>Input inverted command valve flow</td>
<td>0 to ±10 V</td>
<td>0 to ±10 mA</td>
<td>not used</td>
</tr>
<tr>
<td></td>
<td>Input resistance 100 kΩ</td>
<td>Load resistance 400 Ω</td>
<td></td>
</tr>
<tr>
<td>Output actual value spool position</td>
<td>0 to ±10 V</td>
<td>0 to ±10 mA</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td></td>
<td>Output resistance 100 kΩ</td>
<td>Load resistance max. 500 Ω</td>
<td>Load resistance max. 500 Ω</td>
</tr>
<tr>
<td>Monitoring output of internal position controller</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protective ground</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leading pin of valve connector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay output</td>
<td>24 VDC, max. 0.5 A. For inductive loads a corresponding commutating diode is necessary. The relay contact opens and the pilot stage is disconnected when supply voltage becomes less than 12 V (thus also in case of cable break). The spool then moves to the determined position without electric supply. Cable break of the (\bot) wire is not monitored.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ATTENTION

Connector Wiring - Type code V (see sticker on the electronics housing)
Valve electronics with supply voltage \( \pm 15 \text{VDC} \) and 6 pole connector
(without protective grounding)

a. Command input

**Command signal 0 to ±10 V**
The spool stroke of the valve is proportional to \((U_D - U_E)\). 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\) is achieved at \((U_D - U_E) = +10 \text{V}\). At 0 V command the spool is in the center position.

The input stage is a differential amplifier. If only one command signal is available, pin D or E is connected to signal ground \(\perp\) (pin C) according to the required operating direction (to be done at the mating connector).

**Command signal 0 to ±10 mA**
The spool stroke of the valve is proportional to \((I_D - I_E)\). 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\) is achieved at \((I_D - I_E) = +10 \text{mA}\). At 0 mA command the spool is in the center position.

Either pin D or E is used according to the required operating direction. The unused pin is left open (not connected at the mating connector). The input pins D and E are inverting.

**Command signal 4 to 20 mA**
The spool stroke of the valve is proportional \((I_D - 12 \text{mA})\). 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\) at \(I_D = 20 \text{mA}\).

At 12 mA command the spool is in the center position.

The unused pin E is left open (not connected in the mating connector).

b. Monitoring output
The actual spool position value can be measured at pin F.
This signal can be used for monitoring and fault detection purposes.

**Command signal 0 to ±10 V**
The spool stroke range corresponds to ±10 V.

\(+10 \text{V}\) corresponds to 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\).  

**Command signal 0 to ±10 mA**
The spool stroke range corresponds to ±10 mA.

\(+10 \text{mA}\) corresponds to 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\).  

**Command signal 4 to 20 mA**
The spool stroke range corresponds to 4 to 20 mA.

20 mA corresponds to 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\).

---

**General Requirements**

- Supply \(\pm 15 \text{VDC} \pm 3 \%\). Ripple \(< 50 \text{mV}_{pp}\). Current consumption max. \(\pm 250 \text{mA}\).
- All signal lines, also those of external transducers, shielded
- Shielding connected radially to \(\perp\) (OV)
- Note: When making electric connections to the valve (shield, protective grounding), appropriate measures must be taken to ensure that locally different earth potentials do not result in excessive ground currents.

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**Connector Wiring - Type code 6**

Valves with 6 pole connector to MIL-C-5015/14S-6. Mating connector: metal shell. Order-No.: A26201 004

<table>
<thead>
<tr>
<th>Function</th>
<th>Voltage command 0 to ±10 V</th>
<th>Current command 0 to ±10 mA</th>
<th>Current command 4 to 20 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>(+ 15 \text{VDC} \pm 3 %, \text{ripple} &lt; 50 \text{mV}_{pp})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply</td>
<td>(- 15 \text{VDC} \pm 3 %, \text{ripple} &lt; 50 \text{mV}_{pp})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply / signal ground</td>
<td>(\perp) (OV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input rated command</td>
<td>0 to ±10 V</td>
<td>0 to ±10 mA</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>Valve flow</td>
<td>Input resistance 100 kΩ</td>
<td>Load resistance 400 Ω</td>
<td>Load resistance 200 Ω</td>
</tr>
<tr>
<td>Input invert. rated command</td>
<td>0 to ±10 V</td>
<td>0 to ±10 mA</td>
<td>not used</td>
</tr>
<tr>
<td>Valve flow</td>
<td>Input resistance 100 kΩ</td>
<td>Load resistance 400 Ω</td>
<td></td>
</tr>
<tr>
<td>Output actual value</td>
<td>0 to ±10 V</td>
<td>0 to ±10 mA</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>Spool position</td>
<td>Output resistance 10 kΩ</td>
<td>Load resistance max. 500 Ω</td>
<td>Load resistance max. 500 Ω</td>
</tr>
</tbody>
</table>
Valve electronics with supply voltage ±15 VDC and 12 pole bayonet connector (without protective grounding)

a. Command input

**Command signal 0 to ±10 V**

The spool stroke of the valve is proportional to \((U_D - U_E)\). 100% valve opening \(P \to A\) and \(B \to T\) is achieved at \((U_D - U_E) = +10\) V. At 0 V command the spool is in the center position.

The input stage is a differential amplifier. If only one command signal is available, pin D or E is connected to signal ground (pin C) according to the required operating direction (to be done at the mating connector).

**Command signal 0 to ±10 mA**

The spool stroke of the valve is proportional to \((I_D - I_E)\). 100% valve opening \(P \to A\) and \(B \to T\) is achieved at \((I_D - I_E) = +10\) mA. At 0 mA command the spool is in the center position.

Either pin D or E is used according to the required operating direction. The unused pin is left open (not connected at the mating connector). The input pins D and E are inverting.

**Command signal 4 to 20 mA**

The spool stroke of the valve is proportional \((I_D - 12\) mA). 100% valve opening \(P \to A\) and \(B \to T\) at \(I_D = 20\) mA. At 12 mA command the spool is in the center position.

The unused pin E is left open (not connected in the mating connector).

b. Monitoring output

The actual spool position value can be measured at pin F.

This signal can be used for monitoring and fault detection purposes.

**Command signal 0 to ±10 V**

The spool stroke range corresponds to ±10 V. +10 V corresponds to 100% valve opening \(P \to A\) and \(B \to T\).

**Command signal 0 to ±10 mA**

The spool stroke range corresponds to ±10 mA. +10 mA corresponds to 100% valve opening \(P \to A\) and \(B \to T\).

**Command signal 4 to 20 mA**

The spool stroke range corresponds to 4 to 20 mA. 20 mA corresponds to 100% valve opening \(P \to A\) and \(B \to T\).

---

**Please note “General Requirements” on page 8.**

---

### Connector Wiring - Type code letter 0

Valves with 12 pole bayonet connector to MIL C-26482/14-12. Mating connector: metal shell, Order-No.: B97027 012.

<table>
<thead>
<tr>
<th>Function</th>
<th>Voltage command 0 to ±10 V</th>
<th>Current command 0 to ±10 mA</th>
<th>Current command 4 to 20 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>+15 VDC ±3 %, ripple &lt; 50 mVpp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply / signal ground</td>
<td>−15 VDC ±3 %, ripple &lt; 50 mVpp</td>
<td>−15 VDC ±3 %, ripple &lt; 50 mVpp</td>
<td></td>
</tr>
<tr>
<td>Input rated command</td>
<td>0 to ±10 V</td>
<td>0 to ±10 mA</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>Valve flow</td>
<td>Input resistance 100 kΩ</td>
<td>Load resistance 400 Ω</td>
<td>Load resistance 200 Ω</td>
</tr>
<tr>
<td>Input invert. rated command</td>
<td>0 to ±10 V</td>
<td>0 to ±10 mA</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>Valve flow</td>
<td>Input resistance 100 kΩ</td>
<td>Load resistance 400 Ω</td>
<td>not used</td>
</tr>
<tr>
<td>Output actual value</td>
<td>0 to ±10 V</td>
<td>0 to ±10 mA</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>Spool position</td>
<td>Output resistance 10 kΩ</td>
<td>Load resistance max. 500 Ω</td>
<td>Load resistance max. 500 Ω</td>
</tr>
<tr>
<td>Monitoring output of internal position controller</td>
<td>0 to ±12 V</td>
<td>Output resistance 10 kΩ</td>
<td></td>
</tr>
<tr>
<td>not used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>not used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay output</td>
<td>24 VDC, max. 0.5 A. For inductive loads a corresponding commutating diode is necessary. The relay contact opens and the pilot stage is disconnected when supply voltage becomes less than 12 V (thus also in case of cable break). The spool then moves to the determind position without electric supply. Cable break of the ⊥ wire is not monitored.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Valve electronics with supply voltage 24 Volt and 6+PE - pole connector

a. Command input

**Command signal 0 to ±10 V**

The spool stroke of the valve is proportional to \((U_0 - U_e)\). 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\) is achieved at \((U_0 - U_e) = +10\) V. At 0 V command the spool is in the center position.

The input stage is a differential amplifier. If only one command signal is available, pin D or E is connected to signal ground \(⊥\) (pin B) according to the required operating direction (to be done at the mating connector).

**Command signal 0 to ±10 mA**

The spool stroke of the valve is proportional to \((I_0 - I_e)\). 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\) is achieved at \((I_0 - I_e) = +10 mA\). At 0 mA command the spool is in the center position.

Either pin D or E is used according to the required operating direction.

The input pins D and E are inverting.

b. Monitoring output

**Actual value +2.5 to +13.5 V**

Valves with voltage and current command input

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 2.5 to 13.5 V. The center position is at +8 V. +13.5 V corresponds to 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\).

---

**General Requirements**

- Supply 24 VDC, min. 19 VDC, max. 32 VDC. Current consumption max. 300 mA
- All signal lines, also those of external transducers, shielded
- Shielding connected radially to \(⊥\) (0V), power supply side, and connected to the mating connector housing (EMC)
- **EMC**: Meets the requirements of EN 55011/03.91 class B, EN 50081-1/01.92, and EN 50082-2/03.95, perf. crit. class A
- Protective grounding lead > 0.75 mm² (AWG 16)
- Note: When making electric connections to the valve (shield, protective grounding), appropriate measures must be taken to ensure that locally different earth potentials do not result in excessive ground currents.

See also MOOG Application Note AM 353 E.

**Connector Wiring** - Type code letter S (see sticker on the electronics housing)

<table>
<thead>
<tr>
<th>Valve</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mating connector</td>
</tr>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
</tr>
<tr>
<td>PE</td>
<td></td>
</tr>
</tbody>
</table>

**Function** | **Voltage command** | **Current command**
---|---|---
Supply | 24 VDC (min. 19 VDC, max. 32 VDC) | \(I_{\text{max}}\): 300 mA
Supply / signal ground | \(⊥\) (0V) |
Enabled 1) | \(U_{C+} > 8.5\) VDC | \(U_{C+} < 6.5\) VDC |
Not enabled | \(I_{C+} = 1.2\) mA at 24 VDC |
Input rated command (differential) | \(U_{C+}: 0\) to \(±10\) V | \(U_{C+}\): max. \(-15\) V |
| \(R_{e}: 10\) kΩ | \(U_{C-}\): max. \(+24\) V |
Input command referenced to \(⊥\) | \(I_{C-}: 0\) to \(±10\) mA |
Input command (invert.) | \(I_{C-}: 0\) to \(±10\) mA |
Output actual value | \(U_{C+}: +2.5\) to \(+13.5\) V |
| \(R_{e}: +8\) V spool in centered position | \(R_{e}: \approx 15\) kΩ |
Protective grounding | |

1) With enable signal < +6.5 V the spool moves into the position adjusted for 0 V command signal.

---

**Circuit diagram for measurement of actual value \(U_{f}\) (position of main spool) for valves with 6+PE pole connector**

[Diagram showing circuit connections and measurement of actual value \(U_{f}\)]
Valve electronics with supply voltage 24 Volt and 11+PE - pole connector

a. Command input

**Command signal 0 to ±10 V**
The spool stroke of the valve is proportional to \((U_0 - U_e)\). 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\) is achieved at \((U_0 - U_e) = ±10 V\). At 0 V command the spool is in the center position.

The input stage is a differential amplifier. If only one command signal is available, pin D or E is connected to signal ground (pin B) according to the required operating direction (to be done at the mating connector).

**Command signal 0 to ±10 mA**
The spool stroke of the valve is proportional to \((I_D - I_E)\). 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\) is achieved at \((I_D - I_E) = ±10 mA\). At 0 mA command the spool is in the center position.

Either pin D or E is used according to the required operating direction. The unused pin is left open (not connected at the mating connector). The input pins D and E are inverting.

b. Monitoring output

**Actual value 0 to ±10 V**

Valves with voltage and current command input

The actual value, i.e. the spool position, can be measured between pins 6 and 7. This signal can be used for monitoring and fault detection purposes. The signal can only be measured using a weighted differential amplifier (see diagram below) or a voltmeter with an input impedance greater than 1 MΩ. The spool stroke range corresponds to ±10 V. The centered position is at 0 V. +10 V corresponds to 100% valve opening \(P \rightarrow A\) and \(B \rightarrow T\).

If the actual value will be used with a machine control system, the differential input circuit must be used. Another option is to use the aforementioned circuit for the 6+PE pole connector. Pin 6 according to DIN 43 651 corresponds to pin F according to DIN 43 563 (see diagram page 12).

Please note “General Requirements” on page 10.

Circuit diagram for measurement of actual value \(U_{6-7}\) (position of main spool) for valves with 11+PE pole connector

![Circuit Diagram](image)

**Connector Wiring** - Type code letter E (see sticker on the electronics housing)

<table>
<thead>
<tr>
<th>Valves with 11+PE pole connector to DIN 43 651 and mating connector (metal shell) with leading protective ground connection (⊥)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function</strong></td>
</tr>
<tr>
<td>Supply</td>
</tr>
<tr>
<td>Supply / signal ground</td>
</tr>
<tr>
<td>Enabled 1)</td>
</tr>
<tr>
<td>Not enabled</td>
</tr>
<tr>
<td>Input rated command (differential)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Output actual value (differential)</td>
</tr>
<tr>
<td>Enable and Supply acknowledged</td>
</tr>
</tbody>
</table>

Note: With valve models D661-27XX and D661-29XX supply voltage is at pin 9 and signal ground at pin 10. Pins 1 and 2 are not used.

Position error  

\(U_{b_2} > +8.5 \text{ VDC}: <30 \%\)  
\(U_{b_2} < +6.5 \text{ VDC}: >30 \%\)  
Output \(I_{\text{max}}: 20 \text{ mA}\)

Protective grounding

1) With enable signal < +6.5 V the spool moves into the position adjusted for 0V command signal.
7. ELECTRICAL NULL ADJUSTMENT

The hydraulic null of the valve is preset at the factory with a tolerance of ±2% of rated signal. If necessary, this null can be readjusted by the user of the valve.

a. Observe operating instructions for the machine/plant.
   Valves with +4 to +20 mA command signal: Do not adjust valve null! Contact machine/plant manufacturer.

b. Procedure: Remove the command signal to the valve only by disconnecting command signal lead at the cabinet.
   Do not remove valve mating connector!

   Remove cover screw on electronics housing to access the null adjust potentiometer. Use a small screwdriver (blade width 2.5 mm) to turn the potentiometer screw either clockwise or counterclockwise. Usually it will not be necessary to turn the screw more than 2 turns in either direction (±1 turn is equivalent to ±15% null shift).

c. While adjusting, watch the actuator (motor) motion to find the null position. With overlapped valves, turn the null adjust screw carefully in both directions to just start motion and then back into deadzone midposition between those two screw positions.

d. After proper null adjustment, reconnect the command signal lead and install protective cover screw again.

8. TOOLS AND EQUIPMENT

a. 5mm Allen wrench
b. 3mm Allen wrench
c. Large blade screwdriver
d. Small screwdriver
e. Scriber or small screwdriver
f. Clean grease (mounting and insertion of O-rings)

The D661 Series valves require tools for installation, set up, null adjustment and filter replacement.

➢ Installation of the valve
➢ Mounting of the D661 Series requires 5mm Allen wrench
➢ Null adjust of the valve at set up
➢ Large blade screwdriver to remove the cover screw (see cut-away diagram on page 1)
➢ Small screwdriver for zero setting on internal potentiometer

Replacement Parts

<table>
<thead>
<tr>
<th>Part Description</th>
<th>D661- Qty.</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-Ring, ports P, T, A, B, (T,)</td>
<td>all 5</td>
<td>42082-004</td>
</tr>
<tr>
<td>O-Ring, ports X&amp;Y</td>
<td>all 2</td>
<td>42082-011</td>
</tr>
<tr>
<td>Replaceable Filter Disk</td>
<td>P, A/B</td>
<td>1 A67999 200</td>
</tr>
<tr>
<td>Replaceable Filter Disk</td>
<td>G, S, H &amp; P, F/G</td>
<td>1 A67999 100</td>
</tr>
<tr>
<td>O-Ring, behind filter disk</td>
<td>all 1</td>
<td>A25163 013 015</td>
</tr>
<tr>
<td>O-Ring, for filter cover</td>
<td>P, A/B</td>
<td>1 B97009 080</td>
</tr>
<tr>
<td>O-Ring, for filter cover</td>
<td>G, S, H</td>
<td>1 A25163 017 020</td>
</tr>
<tr>
<td>Allen Setscrew, ports X &amp; Y</td>
<td>G &amp; P 2</td>
<td>66166 040 006</td>
</tr>
<tr>
<td>Screw plug, port X</td>
<td>S &amp; H</td>
<td>1 66098 040 006</td>
</tr>
<tr>
<td>Seal, port X</td>
<td>S &amp; H</td>
<td>1 A25528 040</td>
</tr>
</tbody>
</table>

Accessories (not part of the valve delivery)

<table>
<thead>
<tr>
<th>Part Description</th>
<th>D661- Qty.</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mating Connector, waterproof, protection IP65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6+PE-pole</td>
<td>DIN 43563</td>
<td>B97007 061</td>
</tr>
<tr>
<td>11+PE-pole</td>
<td>DIN 43651</td>
<td>B97024 111</td>
</tr>
<tr>
<td>11+1-pole (Bayonet)</td>
<td>MIL-C-26482/14-12</td>
<td>B97027 012</td>
</tr>
<tr>
<td>6-pole</td>
<td>MIL-C-5015/14S-6</td>
<td>A26201 004</td>
</tr>
<tr>
<td>12-pole (Bayonet)</td>
<td>MIL-C-26482/14-12</td>
<td>B97027 012</td>
</tr>
<tr>
<td>Mounting Manifolds</td>
<td>See special data sheet</td>
<td></td>
</tr>
<tr>
<td>Mounting Bolts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M6x60 DIN 912-10.9</td>
<td>...G and ...P</td>
<td>4 A03665-060-060</td>
</tr>
<tr>
<td>M6x55 DIN 912-10.9</td>
<td>...H and ...S</td>
<td>4 A03665-060-055</td>
</tr>
<tr>
<td>Flushing Plate</td>
<td></td>
<td>B67728-001</td>
</tr>
<tr>
<td>Flushing Plate</td>
<td></td>
<td>B67728-002</td>
</tr>
<tr>
<td>Flushing Plate</td>
<td></td>
<td>B67728-003</td>
</tr>
</tbody>
</table>
9. TROUBLESHOOTING CHART

The following troubleshooting chart lists potential troubles encountered, probable causes and remedies.

<table>
<thead>
<tr>
<th>Potential Trouble</th>
<th>Probable Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage at the mounting surface of the valve.</td>
<td>1. Seals damaged or missing.</td>
<td>1. Make sure all seals are installed at ports A, B, P, T, X and Y are ok.</td>
</tr>
<tr>
<td></td>
<td>2. Required torque is incorrect.</td>
<td>2. Tighten mounting bolts.</td>
</tr>
<tr>
<td>No hydraulic response of the valve.</td>
<td>1. Loss of hydraulic pressure.</td>
<td>1. Check all signals from Pin A to Pin F.</td>
</tr>
<tr>
<td></td>
<td>2. Loss of supply voltage.</td>
<td>2. Check the mating connector for corrosion.</td>
</tr>
<tr>
<td>Instability of the system, plant oscillates.</td>
<td>1. Unstable external loop.</td>
<td>1. Check whether output signal at Pin F (6) is following exactly the command signal at Pin D.</td>
</tr>
<tr>
<td></td>
<td>2. Valve electronics defective.</td>
<td>2. Send to Moog factory for repair.</td>
</tr>
<tr>
<td>With zero command signal, the load drifts slowly off position (open loop).</td>
<td>1. Power supply problem.</td>
<td>1. With ±15 VDC supply, check for supply voltage at pins A and B being stable within ±3% of 15V</td>
</tr>
<tr>
<td></td>
<td>2. Incorrect null adjust.</td>
<td>2. With both ±15 VDC and 24 VDC supply, at zero command and normal operation temperature, stop load motion by adjusting nulladjust potentiometer (behind screw plug).</td>
</tr>
<tr>
<td>With hydraulics on, valve goes hardover.</td>
<td>1. Orifice contaminated.</td>
<td>1. Send to Moog factory for repair.</td>
</tr>
</tbody>
</table>

10. AUTHORIZED REPAIR FACILITIES

If servovalve continues to malfunction after all recommended corrective action procedures are performed, defective valve should be returned to Moog for repair. Moog does not authorize any facilities other than Moog or Moog subsidiaries to repair its servovalves. It is recommended you contact Moog at (716)655-3000 to locate your closest Moog repair facility. Repair by an independent (unauthorized) repair house will result in voiding the Moog warranty and could lead to performance degradation or safety problems.

11. DECLARATION OF MANUFACTURER

A Declaration of Manufacturer according to EC machine directive 89/392/EWG, Annex II B, is available for servo and proportional valves D661 Series and will be supplied upon request.
ORDERING INFORMATION

**Model-Number**

<table>
<thead>
<tr>
<th>D661-G, S and H</th>
</tr>
</thead>
<tbody>
<tr>
<td>──── ──── ────</td>
</tr>
</tbody>
</table>

**Type designation**

<table>
<thead>
<tr>
<th>Model-Number</th>
<th>Type designation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Specification status**

- Series specification
- Preseries specification
- Special specification

**Model designation**

assigned at the factory

**Factory identification**

Preferred configurations are highlighted.
All combinations may not be available.

Options may increase price.
Technical changes are reserved.

**Valve version**

- G: Standard bushing, without mechanical feedback
  \( p_T = 100 \% p_P \), only possible with external Y
- S: Standard bushing, with mechanical feedback
  \( p_T \text{ max.} 100 \text{ bar} \)
- H: High response bushing, with mechanical feedback
  \( p_T \text{ max.} 100 \text{ bar} \)

**Rated flow**

<table>
<thead>
<tr>
<th>( Q_{N}[\text{l/min}] ) at ( p_{N}\text{-Valve version} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 bar</td>
</tr>
<tr>
<td>04</td>
</tr>
<tr>
<td>08</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>45</td>
</tr>
<tr>
<td>55</td>
</tr>
<tr>
<td>65</td>
</tr>
</tbody>
</table>

With curvilinear characteristic (Y) reduced rated flow (see curves)

**Maximum operating pressure**

- F: 210 bar. At \( p_X \leq 210 \text{ bar} \) (X and Y external) operating pressure in ports P, A, B and T up to 350 bar possible.
- K: 350 bar (with dropping orifice in filter cover)

**Bushing / spool type**

- O: 4- way: critical lap, linear characteristic
- Y: 4- way: critical lap, curvilinear characteristic, \( Q_{N} \geq 80 \text{ l/min} \)
- X: Special bushing on request

**Electric supply**

<table>
<thead>
<tr>
<th>Command</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>( \pm 15 \text{ VDC} ) ( \pm 3% )</td>
</tr>
<tr>
<td>2</td>
<td>( 24 \text{ VDC} ) (18-32 VDC)</td>
</tr>
</tbody>
</table>

**Signals for 100% spool stroke**

<table>
<thead>
<tr>
<th>Command</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>( \pm 10 \text{ V} ) ( \pm 10 \text{ V} )</td>
</tr>
<tr>
<td>B</td>
<td>( \pm 10 \text{ mA} ) ( \pm 10 \text{ mA} )</td>
</tr>
</tbody>
</table>

**Valve connector**

- S: 6+ PE-pole EN 175201 Part 804
- E: 11+ PE-pole EN 175201 Part 804

**Seal material**

- N: NBR Standard
- V: FPM (Viton) optional
- others on request

**Pilot connections**

<table>
<thead>
<tr>
<th>Former Code</th>
<th>Supply</th>
<th>Return</th>
<th>Valve vers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>A, J</td>
<td>internal</td>
<td>G, S, H</td>
</tr>
<tr>
<td>5</td>
<td>C, L</td>
<td>external</td>
<td>G, S, H</td>
</tr>
<tr>
<td>6</td>
<td>B, K</td>
<td>external</td>
<td>G</td>
</tr>
<tr>
<td>7</td>
<td>D, M</td>
<td>internal</td>
<td>G</td>
</tr>
</tbody>
</table>

**Spool position without electric supply**

- O: undefined
- A: P \( \rightarrow \) B, A \( \rightarrow \) T interconnected
- M: Mid position by mech. feedback

**Pilot stage version (pilot pressure 15 to 210 bar)**

<table>
<thead>
<tr>
<th>Pilot flow at ( p_X = 140 \text{ bar} )</th>
<th>Valve version</th>
</tr>
</thead>
<tbody>
<tr>
<td>E: without mechanical feedback ( 1.15 \text{ l/min} )</td>
<td>G – –</td>
</tr>
<tr>
<td>G: with mechanical feedback ( 1.15 \text{ l/min} )</td>
<td>– S H</td>
</tr>
<tr>
<td>F: with mechanical feedback ( 0.65 \text{ l/min} )</td>
<td>– S H</td>
</tr>
<tr>
<td>A: Servojet®</td>
<td>G – –</td>
</tr>
</tbody>
</table>
### Electric supply
- ±15 VDC ±3%
- 24 VDC (19 to 32 VDC)

### Signals for 100% spool stroke

<table>
<thead>
<tr>
<th>Command</th>
<th>Output</th>
<th>for supply voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>±10 VDC</td>
<td>±10 VDC</td>
</tr>
<tr>
<td>B</td>
<td>±10 mA</td>
<td>±10 mA</td>
</tr>
<tr>
<td>C</td>
<td>±10 mA</td>
<td>±10 VDC</td>
</tr>
<tr>
<td>F</td>
<td>±10 VDC</td>
<td>+2.5 to +13.5 V, enable</td>
</tr>
<tr>
<td>G</td>
<td>±10 mA</td>
<td>+2.5 to +13.5 V, enable</td>
</tr>
<tr>
<td>T</td>
<td>±10 VDC</td>
<td>±10 V deadband comp.</td>
</tr>
</tbody>
</table>

### Valve connector for supply voltage
- S 6 + PE-pole DIN 43563 0 2
- E 11 + PE-pole DIN 43651 — 2

### Spool position of main stage without electric or hydraulic supply

<table>
<thead>
<tr>
<th>O</th>
<th>undefined</th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>A, E, J</td>
<td>internal</td>
</tr>
<tr>
<td>5</td>
<td>C, F, L</td>
<td>internal</td>
</tr>
<tr>
<td>6</td>
<td>B, G, K</td>
<td>external</td>
</tr>
<tr>
<td>7</td>
<td>D, H, M</td>
<td>external</td>
</tr>
</tbody>
</table>

### Mechanical failsafe version

- Position \( p_x \) [bar]
- \( p_x \) extern [bar]
| A | P → B, A → T | ≥15 | ≥15 |
| M | Mid position | ≥15 | <1 |
| R | Mid position | ≥15 | <1 |

### Electrically controlled failsafe version

- Position \( p_x \) [bar]
- \( p_x \) ext [bar]
| W | Mid position | ≥15 | ≥15 |
| U | Mid position | ≥15 | <1 |

### Pilot connections

- Former code | Supply | Return |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>A, E, J</td>
<td>internal</td>
</tr>
<tr>
<td>5</td>
<td>C, F, L</td>
<td>internal</td>
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<tr>
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<td>B, G, K</td>
<td>external</td>
</tr>
<tr>
<td>7</td>
<td>D, H, M</td>
<td>internal</td>
</tr>
</tbody>
</table>

### Seal material
- NBR: Standard
- FPM (Viton): optional
- Others on request

### Preferred configurations are highlighted.
All combinations may not be available.

### Options may increase price.
Technical changes are reserved.