MOOG

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, velocitiy, 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.

ELECTROHYDRAULIC VALVE CUT-AWAY

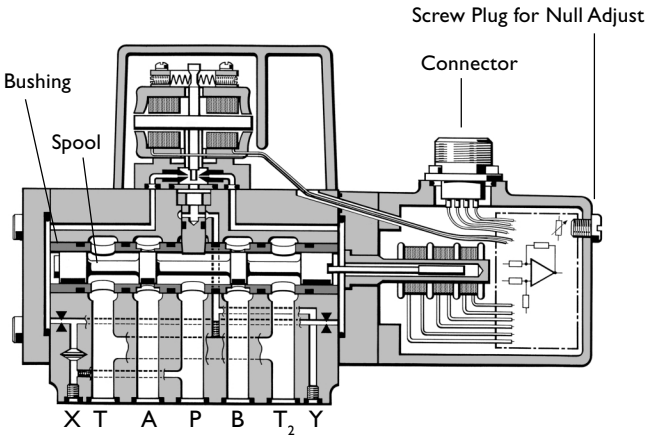
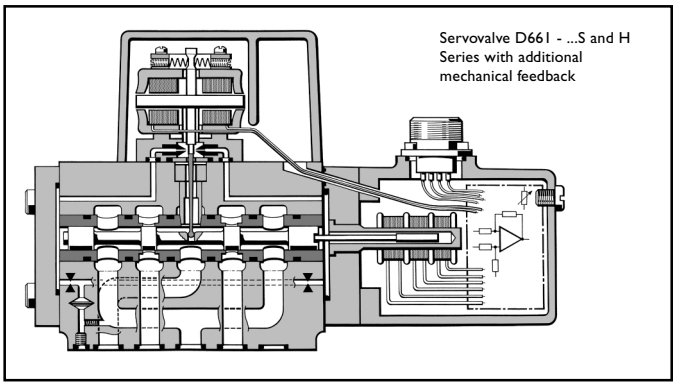


Figure 1 Moog Series D661-G Series, without additional mechanical feedback

Operating Principle of the Two-Stage Valve

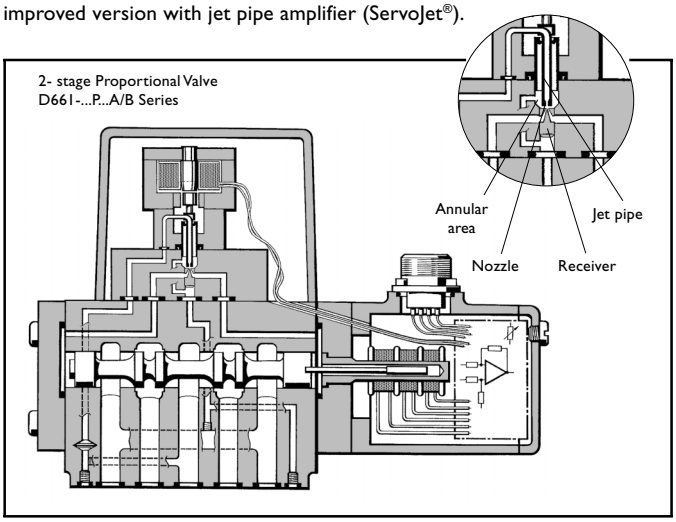
An electric input signal (flow rate command) is applied to the integrated control amplifier which drives a current through the coils of the pilot stage torque motor. Thus the deflected nozzle-flapper system produces a pressure difference across the drive areas of the spool and effects its movement. The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



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. The thus deflected jet pipe 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 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

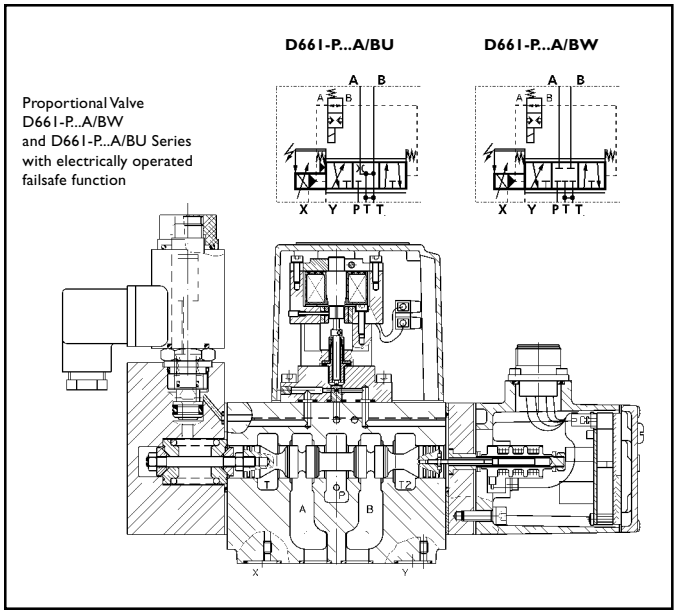
For applications with proportional control valves where certain safety regulations are applicable, a defined metering spool position is needed in order to avoid potential damage. **Therefore, failsafe versions are offered as an option for the MOOG proportional valves.**

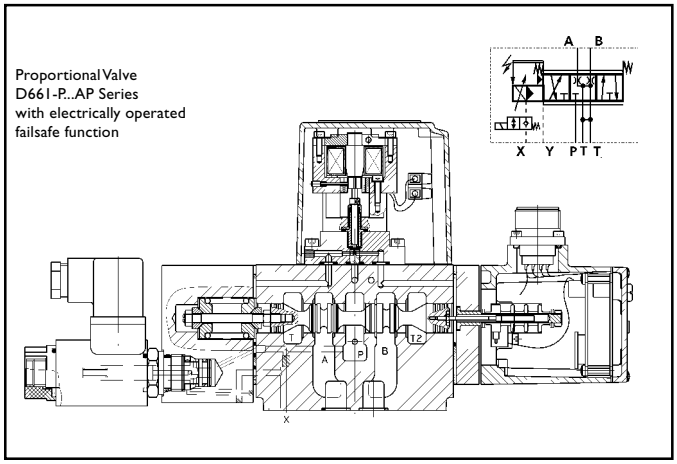
After external triggering, this failsafe function causes a defined metering spool position.

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).

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





ATTENTION 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.

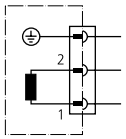
ATTENTION With failsafe versions W, U and G, after cut-off of the solenoid, the spool moves to midposition. When the electric supply to the valve electronics is switched off while the pilot pressure is still effective and the solenoid is still switched on, the spool will move to a defined end position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

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

Electric characteristics of the 2/2-way solenoid valve

Function	electro magnetic
Nominal voltage	24 VDC
Nominal power	12 W

Connector wiring



DIN 43650-1
Form A: 2+PE-PG9

Cutting off the 24 VDC supply to the solenoid operated 2/2-way seat valve

ATTENTION To protect relay contacts or semiconductors against damage, a Zener diode is required

ATTENTION Consider inductive load of the solenoid coil!

Technical Data

Series D661-... (for code letter of valve version see pages 18/19)			**G**	**S...F**	**S...G**	**H**	**P...A**	**P...B**
Mounting pattern ATTENTION With series D661-P..B 5-way version, the port designated T_2 is used as second pressure port P_2	ISO 4401, version G.. with second tank port		ISO 4401 - 05 - 05 - 0 - 94				ISO 4401 - 05 - 05 - 0 - 94	
Mass		[kg]	5.7	5.5	4.2	5.5	5.6	4.7
Rated flow Q_N at Dp_N = 5 bar per land, tolerance ±10 %		[l/min]	see nameplate of the valve				see nameplate of the valve	
Null leakage flow[1])	total, max.	[l/min]	3.0 to 5.0 (**S...F** 2.5 to 4.0)				3.5	4.4
Pilot leakage flow[1])	pilot stage only	[l/min]	2.5	1.4	2.5	2.5	1.7	2.6
Pilot flow[1])	max, for 100% step input	[l/min]	**2.5**	**1.4**	**2.5**	**2.5**	**1.7**	**2.6**
Max. operating pressure p_{max}								
Main stage	ports P, A, B	[bar]	350				350	
	port T, (T_2) with Y internal	[bar]	20% of pilot pressure, max.			100	210	
	port T, (T_2) with Y external	[bar]	350				350	
Pilot stage	regular version	[bar]	210				280	
	with dropping orifice (on request)	[bar]	350				350	
Temperature range	Ambient	[°C]	- 20 to + 60				- 20 to + 60	
	Fluid	[°C]	- 20 to + 80				- 20 to + 80	
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				15 to 45	
	allowable	[mm²/s]	5 to 400				5 to 400	
System filter			High pressure filter, mounted in the main flow without bypass, but with dirt alarm				High pressure filter, mounted in the main flow without bypass, but with dirt alarm	
Class of cleanliness according to								
ISO 4406			16 / 13 or better [2])				16 / 13 or better [2])	
NAS 1638			7 or better [2])				7 or better [2])	
Filter rating	for normal operation		β_{15} 75 (15 µm absolute)				β_{15} 75 (15 µm absolute)	
	for longer life		β_{10} 75 (10 µm absolute)				β_{10} 75 (10 µm absolute)	

[1]) With version **P** at **210** bar pilot or operating pressure, with versions **G**,**S** and **H** at **140** bar pilot or operating pressure, fluid viscosity of 32 mm˝/s and fluid temperature of 40°C.

[2]) For long life wear protection of metering lands

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

3. SAFETY INSTRUCTIONS

Warnings and Symbols

a. ATTENTION Refers to special orders and prohibitions to prevent damage

b. DANGER Refers to special orders and prohibitions to prevent injury or extensive damage

Correct Application

a. The D661 Series Valves are control valves suited for electrohydraulic position, velocity, pressure and force control.

b. The valves are designed for flow control in hydraulic systems that operate with mineral oil based fluids. Others upon request.

c. DANGER 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.

d. Correct application involves also observing the operating instruction and complying with the inspection and maintenance directives.

Organizational Measures

a. We recommend including this operating instruction into the maintenance plan of the machine/plant.

b. 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.

c. All safety and danger prevention instructions of the machine/plant must meet the requirements of EN 982.

Selection and Qualification of Personnel

a. Only well-trained and instructed personnel are allowed to work with Moog control valves.

b. 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

a. Take the necessary precautions to ensure that the machine/plant is used only when in a safe and reliable state.

b. 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.

c. In the event of malfunctions, stop the machine/plant immediately and secure it. Have any defects rectified immediately.

d. DANGER 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

a. Work on electrohydraulic equipment must be carried out only by personnel having special knowledge and experience in electrohydraulic controls.

b. DANGER 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.

c. DANGER 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.

d. When handling oil, grease and other chemical substances, observe safety regulations valid for each product.

4. INSTALLATION

General Information

a. Compare model number and valve type with information from the hydraulic schematic or bill of material.

b. The valve can be mounted in any direction, fixed or moving.

c. Check mounting surface flatness (0.02 mm for 100 mm) and surface finish (Ra <1 µm)

d. Pay attention to cleanliness of mounting surface and surroundings when installing the valve.

e. Use lint-free tissue to clean!

f. Before installation, remove shipping plate from the valve and save it for later use.

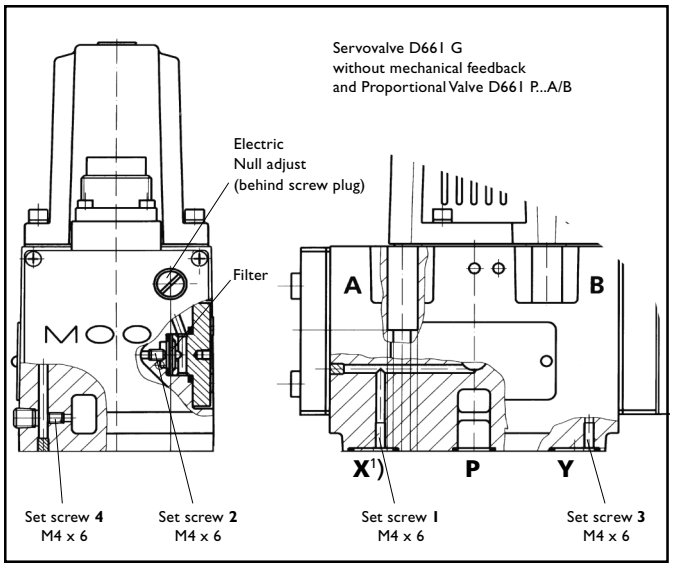
g. Pay attention to correct position of ports and location of o-rings during installation.

h. 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

a. 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.
   ATTENTION With the 5-way version, where the T and T_2 ports are interchanged with the P port, pilot supply port X and return port Y must be connected externally.

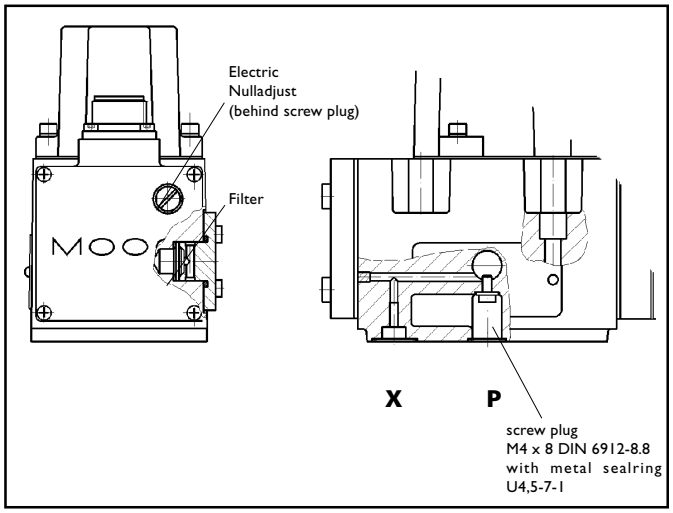
b. Conversion instruction for Servovalves D661-G and Proportional valves D661-P...A/B



ATTENTION [1]) Check for sufficient length (100 mm) of mounting surface!

Pilot Flow	Set Screw M4 x 6	
Supply	bore 1	bore 2
Internal P	closed	open
External X	open	closed
Pilot Flow	Set Screw M4 x 6	
Return	bore 3	bore 4
Internal T	closed	open
External Y	open	closed

c. Conversion instruction for Servovalves D661-S, H and P...F/G



Pilot Flow Supply	Screw Plug In Port
Internal P	X
External X	P

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

ATTENTION 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: $\beta_{10} \approx 75$ (10 µm absolute).

Flushing the Hydraulic System

ATTENTION 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 porportional 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 Attention: The directional valve can lead to unpermissable 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:

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

V = content of reservoir [gallons]
Q = flow rate of the pump [gpm]

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. DANGER 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. ATTENTION 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

ATTENTION 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.

ATTENTION Replace filter!
Cleaning the filter is useless and may be dangerous!

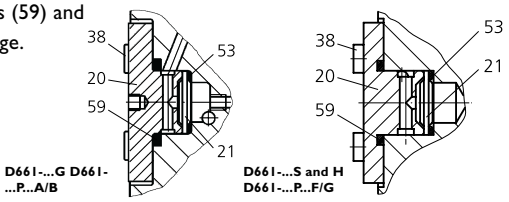
ATTENTION Before starting to work on the valve, clean the external surface around the filter cover!

ATTENTION 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

Number of Pins	Supply Voltage ± 15 VDC	24 VDC
6 + PE	X	X
11 + PE	–	X
11 + 1 (PE) Bayonet	X	–
6 (old, without PE)	X	–
12 (old, without PE) Bayonet	X	–

ATTENTION Please note information regarding input signals on the nameplate!

Valve electronics with supply voltage ± 15 VDC 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 ➔ A and B ➔ T is achieved at ($U_D - U_E$) = +10V. At 0V 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➔A and B➔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 ➔ A and B ➔ 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.

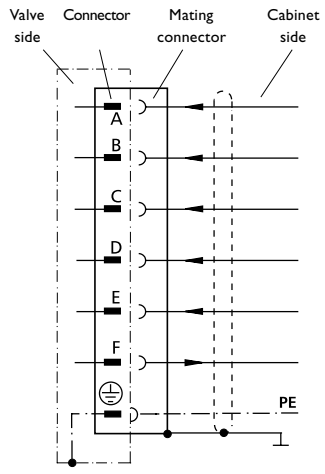
The spool stroke range corresponds to ±10 mA. +10 mA corresponds to 100% valve opening P ➔ A and B ➔ T.

General Requirements

- Supply ±15 VDC ±3%. Ripple < 50 mV_{PP}. Current consumption max. ±250mA
- 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, performance criterion class A
- Protective grounding lead ≥ 0.75mm^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 (⏚).



Function	Voltage command	Current command
Supply	+ 15 VDC ± 3%, ripple <50 mV_{PP}	
Supply	- 15 VDC ± 3%, ripple <50 mV_{PP}	
Supply/signal ground	⊥ (0 V)	
Input command valve flow	0 to ± 10 V Input resistance 100 kΩ	0 to ± 10 mA Load resistance 400 Ω
Input inverted command valve flow	0 to ± 10 V Input resistance 100 kΩ	0 to ± 10 mA Load resistance 400 Ω
Output actual value spool position	0 to ± 10 V Output resistance 10 kΩ	0 to ± 10 mA Load resistance max. 500 Ω
Protective ground		

[1]) Valves having code letter **X** at position 10 of type designation: Command signal 10 mA between pins D and E (differentially, internal resistance 1 kΩ).

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 ➔ A and B ➔ 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 ➔ A and B ➔ 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 opeming P ➔ A and B ➔ T at I_D = 20 mA. At 12mA 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 ➔ A and B ➔ T.

Command signal 0 to ±10 mA

The spool stroke range corresponds to ±10 mA.

+10 mA corresponds to 100% valve opening P ➔ A and B ➔ T.

Command signal 4 to 20 mA

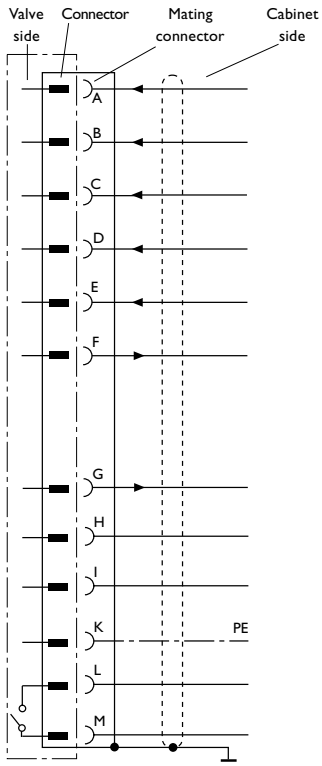
The spool stroke range corresponds to 4 to 20 mA.

20 mA corresponds to 100% valve opening P ➔ A and B ➔ 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.



Function	Voltage command	Current command	Current command
Supply	+ 15 VDC ± 3%, ripple <50 mV_{pp}		
Supply	+ 15 VDC ± 3%, ripple <50 mV_{pp}		
Supply/signal ground	⊥ (0 V)		
Input command valve flow	0 to ± 10 V Input resistance 100 kΩ	0 to ± 10 mA Load resistance 400 Ω	4 to 20 mA Load resistance 200 Ω
Input inverted command valve flow	0 to ± 10 V Input resistance 100 kΩ	0 to ± 10 mA Load resistance 400 Ω	not used
Output actual value spool position	0 to ± 10 V Output resistance 100 kΩ	0 to ± 10 mA Load resistance max. 500 Ω	4 to 20 mA Load resistance max. 500 Ω
Monitoring output of internal position controller			
Not used			
Not used			
Not used			
Protective ground	Leading pin of valve connector		
Relay output	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.		

Valve electronics with supply voltage ±15VDC 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 ➔ A and B ➔ T is achieved at ($U_D - U_E$) = +10V. At 0V 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 ➔ A and B ➔ 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 opeming P ➔ A and B ➔ T at I_D = 20 mA.

At 12mA 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 ±10V.

+10V corresponds to 100% valve opening P ➔ A and B ➔ T.

Command signal 0 to ±10 mA

The spool stroke range corresponds to ±10 mA.

+10 mA corresponds to 100% valve opening P ➔ A and B ➔ T.

Command signal 4 to 20 mA

The spool stroke range corresponds to 4 to 20 mA.

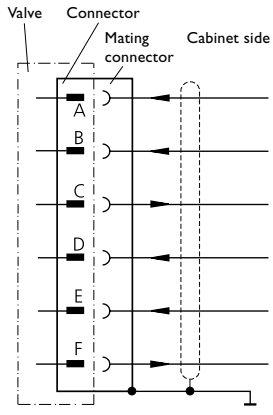
20 mA corresponds to 100% valve opening P ➔ A and B ➔ T.

General Requirements

- Supply ± 15 VDC ± 3%. Ripple < 50 mV_{PP}. Current consumption max. ± 250 mA
- All signal lines, also those of external transducers, shielded
- Shielding connected radially to ⊥ (0V)
- 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.

Connector Wiring - Type code **6**

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



Function	Voltage command 0 to ± 10 V	Current command 0 to ± 10 mA	Current command 4 to 20 mA
Supply	+ 15 VDC ± 3 %, ripple < 50 mV_{PP}		
Supply	– 15 VDC ± 3 %, ripple < 50 mV_{PP}		
Supply / signal ground	⊥ (0V)		
Input rated command Valve flow	0 to ± 10 V Input resistance 100 kΩ	0 to ± 10 mA Load resistance 400 Ω	4 to 20 mA Load resistance 200 Ω
Input invert. rated command Valve flow	0 to ± 10 V Input resistance 100 kΩ	0 to ± 10 mA Load resistance 400 Ω	not used
Output actual value Spool position	0 to ± 10 V Output resistance 10 kΩ	0 to ± 10 mA Load resistance max. 500 Ω	4 to 20 mA Load resistance max. 500 Ω

Valve electronics with supply voltage ± 15VDC and 12 pole bayonet connector (without protective grounding)

a. Command input

Command signal 0 to ±10V

The spool stroke of the valve is proportional to ($U_D - U_E$). 100% valve opening P ➔ A and B ➔ 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 ➔ A and B ➔ 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 ➔ A and B ➔ T at I_D = 20 mA. At 12mA 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 ±10V

The spool stroke range corresponds to ±10 V.

+10V corresponds to 100% valve opening P ➔ A and B ➔ T.

Command signal 0 to ±10 mA

The spool stroke range corresponds to ±10 mA.

+10 mA corresponds to 100% valve opening P ➔ A and B ➔ T.

Command signal 4 to 20 mA

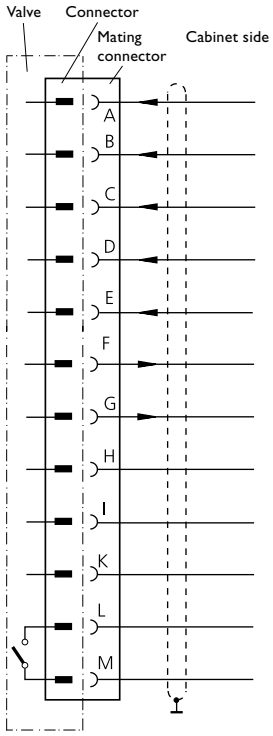
The spool stroke range corresponds to 4 to 20 mA.

20 mA corresponds to 100% valve opening P ➔ A and B ➔T.

ATTENTION **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.



Function	Voltage command 0 to ± 10 V	Current command 0 to ± 10 mA	Current command 4 to 20 mA
Supply	+ 15 VDC ± 3 %, ripple < 50 mV_{PP}		
Supply	– 15 VDC ± 3 %, ripple < 50 mV_{PP}		
Supply / signal ground	⊥ (0V)		
Input rated command Valve flow	0 to ± 10 V Input resistance 100 kΩ	0 to ± 10 mA Load resistance 400 Ω	4 to 20 mA Load resistance 200 Ω
Input invert. rated command Valve flow	0 to ± 10 V Input resistance 100 kΩ	0 to ± 10 mA Load resistance 400 Ω	not used
Output actual value Spool position	0 to ± 10 V Output resistance 10 kΩ	0 to ± 10 mA Load resistance max. 500 Ω	4 to 20 mA Load resistance max. 500 Ω
Monitoring output of internal position controller	0 to ± 12 V Output resistance 10 kΩ		
not used			
not used			
not used			
Relay output	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.		

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 $(U_D - U_E)$. 100% valve opening P → A and B → 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 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 → A and B → 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 +2,5 to +13,5 V

Valves with voltage and current command input

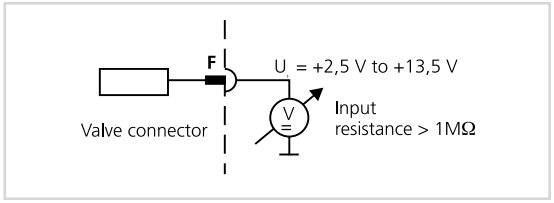
The actual spool position value can be measured at pin F (see diagram below). This signal can be used for monitoring and fault detection purposes.

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 → A and B → T.

General Requirements

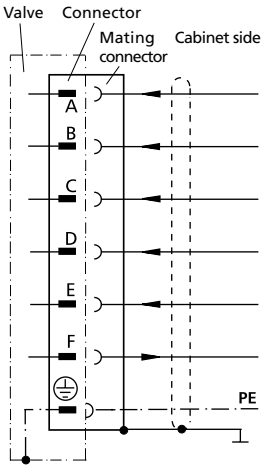
- Supply 24 VDC, min.19 VDC, max. 32 VDC. Current consumption max. 300 mA
- All signal lines, also those of external transducers, shielded
- Shielding connected radially to ⊥(0V), power supply side, and connected to the mating connector housing (EMC)
- **EMC**: Meets the requirements of EN 55011/03.91 class B, EN 50081-1/01.92, and EN 50082-2/03.95, perf. crit. class A
- Protective grounding lead > 0.75mm² (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.

Circuit diagram for measurement of actual value U_F (position of main spool) for valves with 6+PE pole connector



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

Valves with 6+PE pole connector to DIN 43 563 and mating connector (metal shell) with leading protective ground connection (⏚)



Function	Voltage command		Current command
Supply	24 VDC (min. 19 VDC, max. 32 VDC) I_{max}: 300 mA		
Supply / signal ground	⊥(0V)		
Enabled [1] Not enabled	U_{C-B} > +8.5 VDC U_{C-B} < +6.5 VDC	I_e = 1.2 mA at 24 VDC	
Input rated command (differential)	U_{D-E}: 0 to ± 10 V R_e : 10 kΩ	U_{D-B} and U_{E-B}: max.: –15 V max.: +24 V	Input command referenced to ⊥ I_{D-E}: 0 to ± 10 mA (load resistance 200 Ω) Input command (invert.) I_{E-D}: 0 to ± 10 mA
Output actual value	U_{F-B}: +2.5 to +13.5 V. At +8 V spool in centered position R_a : approx. 15 kΩ		
Protective grounding			

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

Valve electronics with supply voltage 24Volt and 11+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 → A and B → T is achieved at $(U_D - U_E) = +10V$. 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→A and B→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

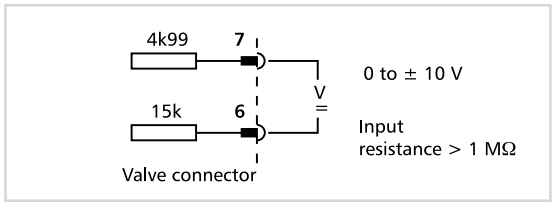
Valves with voltage and current command input

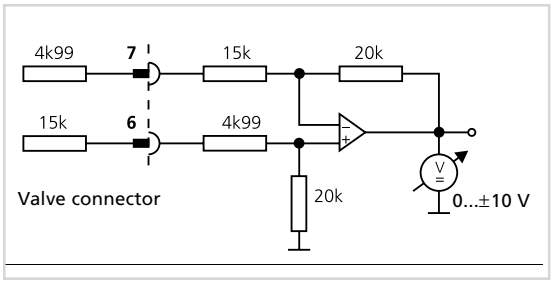
The actual value, i. e. the spool position, can be measured between pins 6 and 7. This signal can be used for monitoring and fault detection purposes. The signal can only be measured using a weighted differential amplifier (see diagram below) or a voltmeter with an input impedance greater than 1MΩ. The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

ATTENTION **Please note "General Requirements" on page 10.**

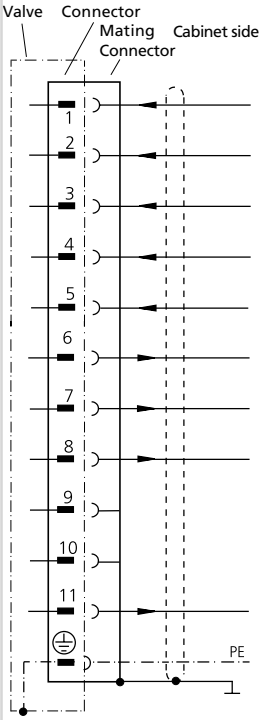
Circuit diagram for measurement of actual value U_{6-7} (position of main spool) for valves with 11+PE pole connector





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

Valves with 11+PE pole connector to DIN 43 651 and mating connector (metal shell) with leading protective ground connection (⏚)



Function	Voltage command		Current command
Supply	24 VDC (min. 19 VDC, max. 32 VDC)		I_{max}: 300 mA
Supply / signal ground	⊥ (0V)		
Enabled [1]) Not enabled	U_{3-2} > +8.5 VDC U_{3-2} < +6.5 VDC		I_e = 1.2 mA at 24 VDC
Input rated command (differential)	U_{4-5}: 0 to ±10 V R_e : 10 kΩ	U_{4-2} and U_{5-2}: max.: –15 V max.: +24 V	Input command referenced to ⊥ I_{4-5}: 0 to ±10 mA (load resistance 200Ω) Input command (invert.) ref. to ⊥ I_{5-4}: 0 to ±10 mA
Output actual value (differential)	U_{6-7} : 0 to ±10 V R_a : approx. 20 KΩ		
Enable and Supply acknowledged	U_{8-2} > +8.5 VDC: ok U_{8-2} < +6.5 VDC: not ok		Output I_{max}: 20 mA
not used	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.		
not used			
Position error	U_{11-2} > +8.5 VDC: <30 % U_{11-2} < +6.5 VDC: >30 %		Output I_{max}: 20 mA
Protective grounding			

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

ATTENTION 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

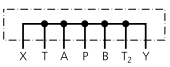
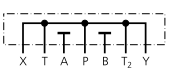
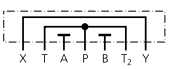
➢ Large blade screwdriver to remove the cover screw (see cut-away diagram on page 1)

➢ Small screwdriver for zero setting on internal potentiometer

Replacement Parts

Part Description	D661-	Qty.	Part Number
O-Ring, ports P, T, A, B, (T_2)	all	5	42082-004
O-Ring, ports X&Y	all	2	42082-011
Replaceable Filter Disk	P...A/B	1	A67999 200
Replaceable Filter Disk	G, S, H & P...F/G	1	A67999 100
O-Ring, behind filter disk	all	1	A25163 013 015
O-Ring, for filter cover	P...A/B	1	B97009 080
O-Ring, for filter cover	G, S, H	1	A25163 017 020
Allen Setscrew, ports X & Y	G & P	2	66166 040 006
Screw plug, port X	S & H	1	66098 040 006
Seal, port X	S & H	1	A25528 040

Accessories (not part of the valve delivery)

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

9. TROUBLESHOOTING CHART

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

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

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 Type designation

D661-G, S and H . . . .

Specification status

–	Series specification
E	Preseries specification
Z	Special specification

Model designation

	assigned at the factory

Factory identification

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 max. 100 bar
H	High response bushing, with mechanical feedback p_T max. 100 bar

Rated flow

	Q_N [l/min] at Dp_N 70 bar	10 bar	Valve version		
04	10	4	G	S	H
08	20	8	G	S	H
15	40	15	G	S	H
30	80	30	G	S	H
45	120	45	G	–	–
55	140	55	–	S	H
65	170	65	G	–	–
	With curvilinear characteristic (Y) reduced rated flow (see curves)				

Maximum operating pressure

F	210 bar. At $p_X \leq$ 210 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=80 l/min
X	Special bushing on request

Electric supply

0	± 15 VDC	± 3%
2	24 VDC	(18-32 VDC)

Signals for 100% spool stroke

	Command	Output
A	±10 V	±10 V
B	±10 mA	±10 mA

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

	Former Code	Supply	Return	Valve vers.
4	A, J	internal	internal	G, S, H
5	C, L	external	internal	G, S, H
6	B, K	external	external	G
7	D, M	internal	external	G

Spool position without electric supply

O	undefined	valve version G only
A	P→ B, A→ T interconnected	
M	Mid position by mech. feedback	valve versions S and H only

Pilot stage version (pilot pressure 15 to 210 bar)

	Pilot flow at p_X = 140 bar		Valve version		
E	without mechanical feedback	1.15 l/min	G	–	–
G	with mechanical feedback	1.15 l/min	–	S	H
F	with mechanical feedback	0.65 l/min	–	S	H
A	Servojet®		G	–	–

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

Options may increase price.
Technical changes are reserved.

Model-Number Type designation

D661 . . . . . . P . . . .

Specification status	
–	Series specification
E	Preseries specification
Z	Special specification

Model designation	
	assigned at the factory

Factory identification

Valve version	
P	Standard spool

Rated flow		
	Q_N [l/min] at Dp_N = 5 bar per land	Valve version
16	16	P...F/G –
25	25	P...F/G –
30	30	– P...A/B
60	60	P...F/G P...A/B
80	80	– P...A/B

Maximum operating pressure p_P		**Pilot valve**
B	70 bar. At $p_X \leq 70$ bar (X and Y external) operating pressure in port P, A, B and T up to 350 bar possible.	A/B
F	210 bar. At $p_X \leq 210$ bar (X external) operating pressure in port P, A, B and T up to 350 bar possible.	A/B
H	280 bar. At $p_X \leq 280$ bar (X and Y external) operating pressure in port P, A, B and T up to 350 bar possible.	A/B
K	350 bar (with dropping orifice in filter cover)	A/B, F/G

Main spool type	
A	4-way: ~ critical lap, linear characteristic
D	4-way: 10 % overlap, linear characteristic
P	4-way: P → A, A → T: ~ critical lap, curvilinear characteristic P → B: 60 % overlap, curvilinear characteristic B → T: 50 % underlap, linear characteristic
U	5-way: P → A, P_2 → B, A → T:~crit. lap, curvil. character.
Y	4-way: ~ critical lap, curvilinear characteristic
X	Special spool on request

Pilot stage			
		Pilot flow at p_X = 140 bar	Pilot pressure p_X
A	ServoJet	1.3	15 – 280
B	ServoJet	2.0	15 – 280
F	Nozzle/Flapper	1.15	15 – 280
G	Nozzle/Flapper	0.65	15 – 280

Electric supply		
0	± 15 VDC	± 3%
2	24 VDC	(19 to 32 VDC)

Signals for 100% spool stroke				
	Command	Output	for supply voltage	
A	±10 VDC	±10 VDC	0	2 (11+PE diff)
B	±10 mA	±10 mA	0	—
C	±10 mA	±10 VDC	—	2 (11+PE diff)
F	±10 VDC	+2.5 to +13.5 V, enable	—	2 (6+PE)
G	±10 mA	+2.5 to +13.5 V, enable	—	2 (6+PE)
T	±10 VDC	±10 V deadband comp.	0	2 (11+PE diff)

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

Seal material		
N	NBR	Standard
V	FPM	(Viton) optional
	Others on request	

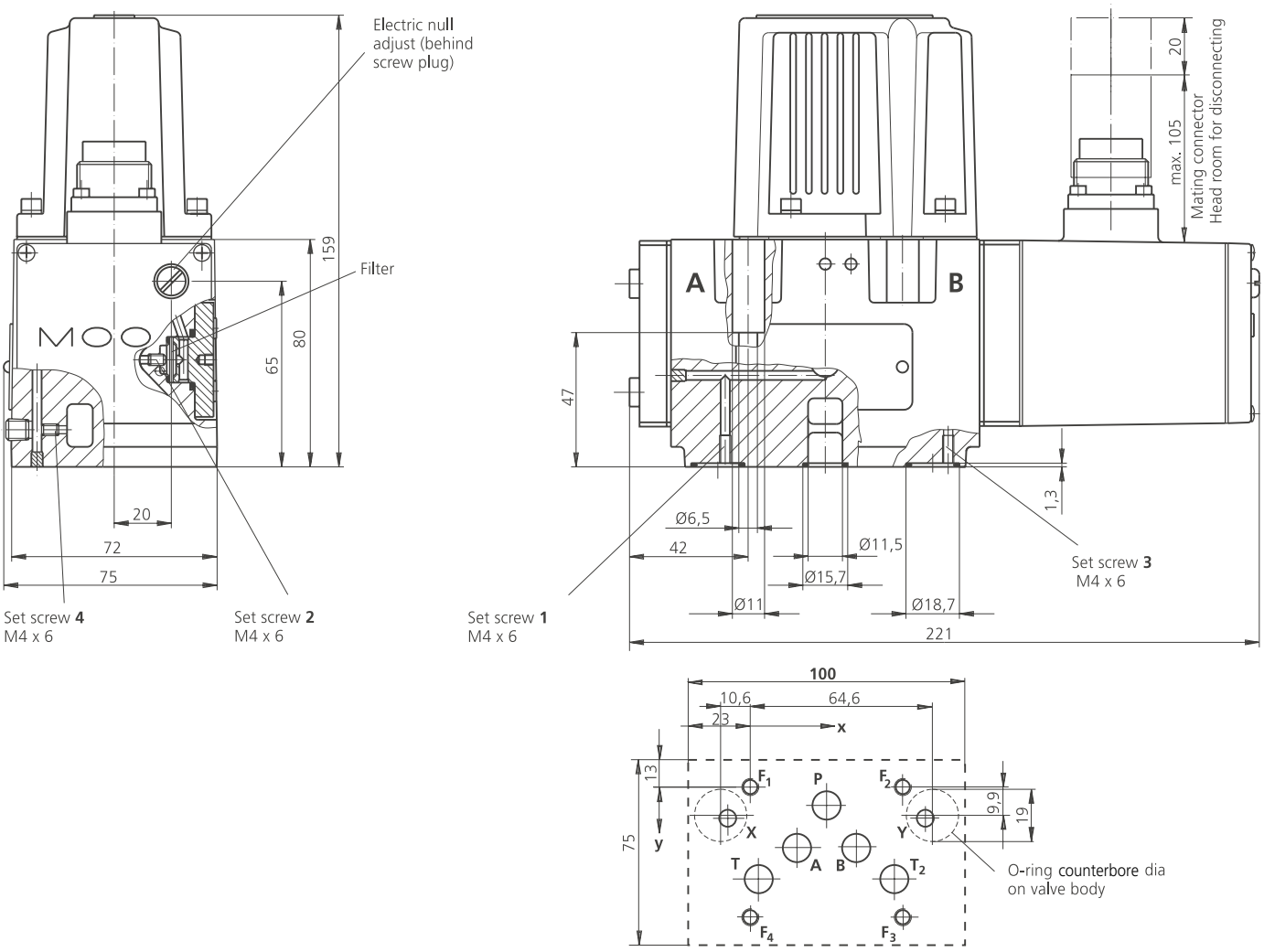
Pilot connections			
	Former code	Supply	Return
4	A, E, J	internal	internal
5	C, F, L	external	internal
6	B, G, K	external	external
7	D, H, M	internal	external

Spool position of main stage without electric or hydraulic supply						
O	undefined	for all valve types				
	Mechanical failsafe version					
	Position	p_P [bar]	p_X extern [bar]			
A	P → B, A → T	≥15	≥15			
M	Mid position	≥15	<1			
	undefined	≥15	≥15			
R	Mid position	≥15	<1			
	P → B, A → T	≥15	≥15			
L	Mid position	≥15	<1			
	P → A, B → T	≥15	≥15			
	Electrically controlled failsafe version					
	Position	p_P [bar]	p_X ext	SV*	VE**	
W	Mid position	≥15	≥15	off	on	
	Mid position	≥15	<1	on	on	
U	Mid position	≥15	≥15	off	on	
	P → B, A → T	≥15	≥15	on	off	(without electric supply)
V	P → B, A → T	≥15	≥15	off	on	
	P → B, A → T	≥15	≥15	on	off	(without electric supply)
P	definiert ~30%	≥15	≥15	off	on	(P_X Torquemotor < 2 bar)
	P → B, A → T	≥15	≥15	on	off	

*SV: Solenoid valve
**VE: Valve electronics

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

Options may increase price.
Technical changes are reserved.



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