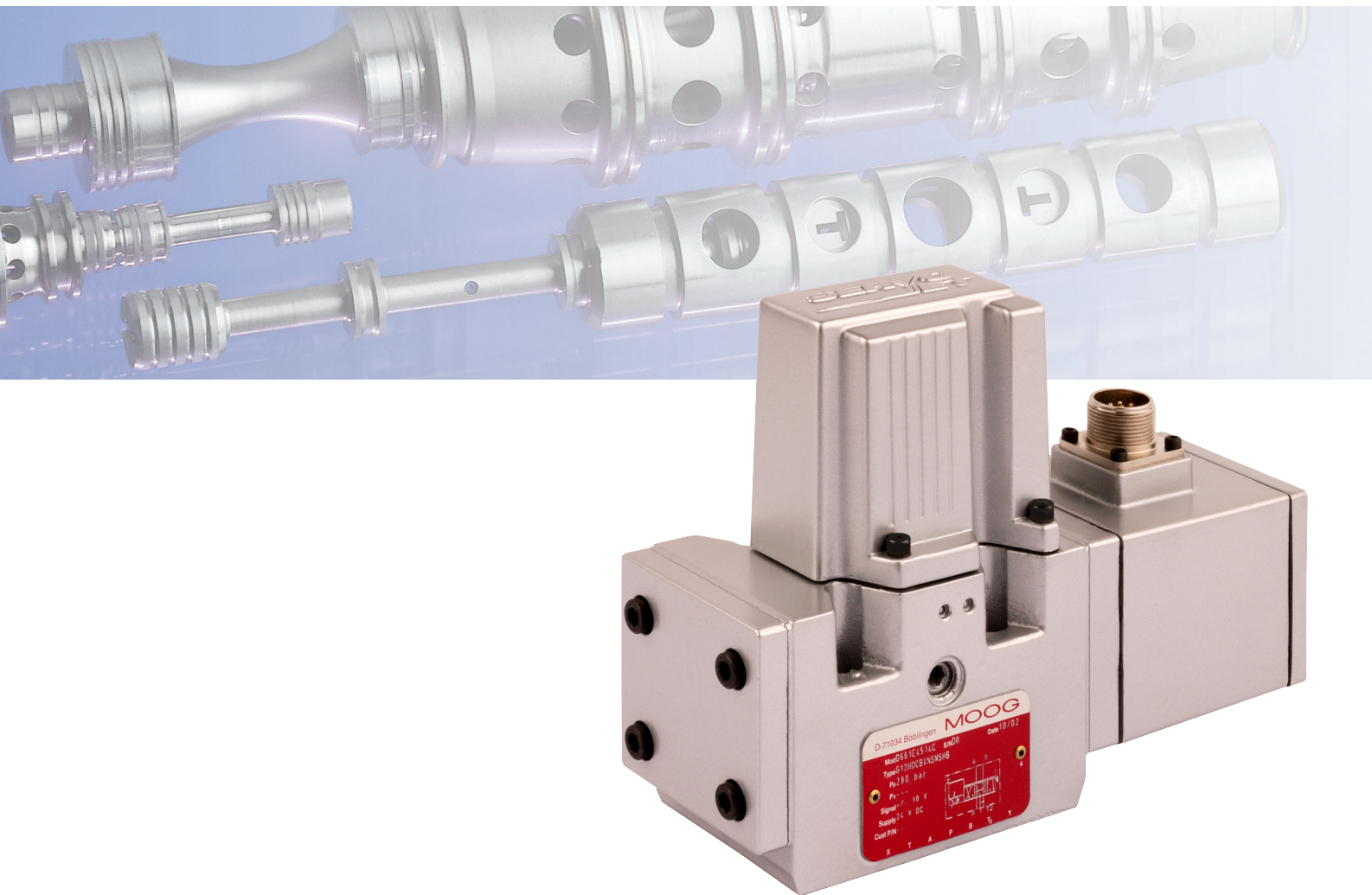


Servo valve with Bushing and integrated 24 Volt Electronics D661 Highresponse Series ISO 4401 Size 05



D661 Highresponse Series

Two stage servovalves

with highresponse pilot stage

The flow control servovalves D661 Highresponse Series are throttle valves for 2-, 3- and 4-way applications. These valves are suitable for electrohydraulic position, velocity, pressure or force control systems including those with high dynamic response requirements.

The spool of the main stage is driven by a jet pipe pilot stage in an electrically closed loop.

The integrated electronics of the valve is a new development featuring SMD technology and requires 24 VDC power supply.

Operational features of the ServoJet Highresponse pilot stage

The ServoJet Highresponse 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 opening than 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.

 The valve series described in this catalogue has successfully passed EMC tests required by EC Directive. Please take notice of the respective references in the electronics section.

The actual flow depends on the electrical command signal and the valve pressure drop. For different values of valve pressure drop, the flow may be calculated by the square root function for a sharp edged orifice:

$$Q = Q_N \sqrt{\frac{\Delta p}{\Delta p_N}}$$

Q [l/min] = calculated flow
 Q_N [l/min] = rated flow
 Δp [bar] = actual valve pressure drop
 Δp_N [bar] = rated valve pressure drop

If large flow rates with high valve pressure drop are required an appropriate higher pilot pressure has to be chosen to overcome the flow forces. An approximate value can be calculated as follows:

$$p_x \geq 1,7 \cdot 10^{-2} \cdot \frac{Q}{A_K} \cdot \sqrt{\Delta p}$$

Q [l/min] = max. flow
 Δp [bar] = valve pressure drop with Q
 A_K [cm²] = spool drive area
 p_x [bar] = pilot pressure
 The pilot pressure p_x has to be at least 25 bar above the return pressure of the pilot stage.

Principle of operation

An electric command signal (flow rate setpoint) is applied to the integrated control amplifier which drives the pilot stage. Thus the deflected ServoJet highresponse system produces a pressure difference across the drive areas of the spool and effects its movement. The position transducer which is supplied via an oscillator measures the position

of the spool (actual value, position voltage). This actual value is being rectified by a demodulator and fed back to the control amplifier where it is compared with the command value. 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.

Our quality management system is conformed to DIN EN ISO 9001.

This catalogue is for users with technical knowledge. To ensure that all necessary characteristics for function and safety of the system are given, the user has to

check the suitability of the products described herein. In case of doubt please contact MOOG.

Operating pressure range

Ports P, A and B	up to 350 bar (5000 psi)
Ports T, T ₂ for Y internal	up to 210 bar (3000 psi)
Ports T, T ₂ for Y external	up to 350 bar (5000 psi)

Temperature range

Ambient	-20° C to +60° C (-4° F to +140° F)
Fluid	-20° C to +80° C (-4° F to +176° F)

Seal material

NBR, FPM and others on request

Operating fluid

mineral oil based hydraulic fluid (DIN 51524, part 1 to 3), other fluids on request

Viscosity	recommended 15 to 100 mm ² /s (0,02 to 0,16 in ² /s)
	allowable 5 to 400 mm ² /s (0,008 to 0,62 in ² /s)

System filtration: Pilot stage: high pressure filter (without bypass, but with dirt alarm) mounted in the main flow and if possible directly upstream of the valve. **Main stage:** high pressure filter as for the pilot stage. In combination with a fast regulating variable displacement pump an off-line filter is recommended.

Class of cleanliness The cleanliness of the hydraulic fluid particularly effects the performance (spool positioning, high resolution) and wear (metering edges, pressure gain, leakage) of the valve.

Recommended cleanliness class

ISO 4406: 1999	
For normal operation:	< 19 / 16 / 13
For longer life:	< 17 / 14 / 11

Filter rating

recommended	
For normal operation:	$\beta_{15} \geq 75$ (15µm absolute)
For longer life:	$\beta_{10} \geq 75$ (10µm absolute)

Installation options

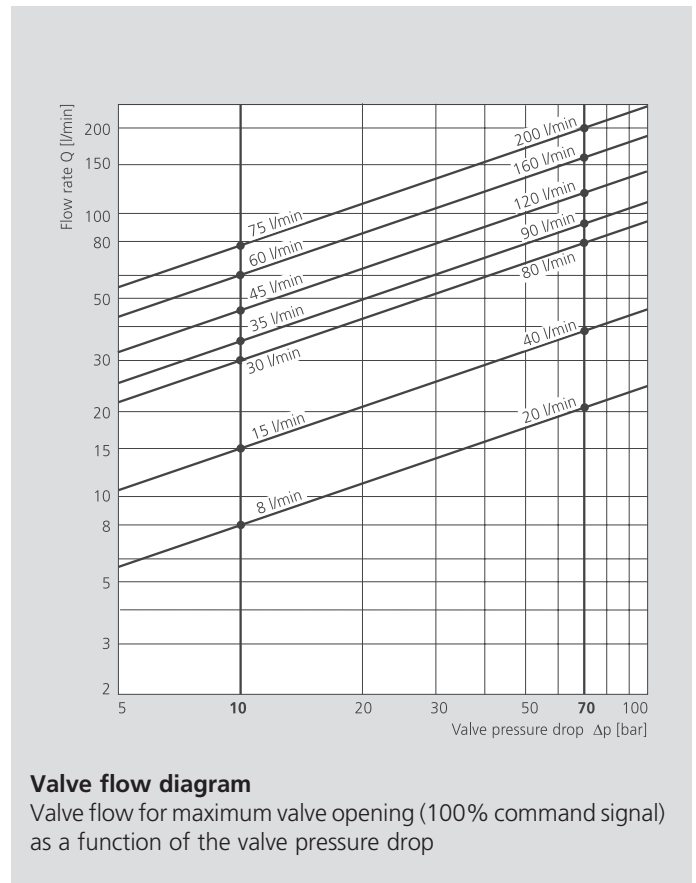
Vibration

Degree of protection

any position, fixed or movable
30 g, 3 axes
EN 60529 class IP 65, with mating connector mounted

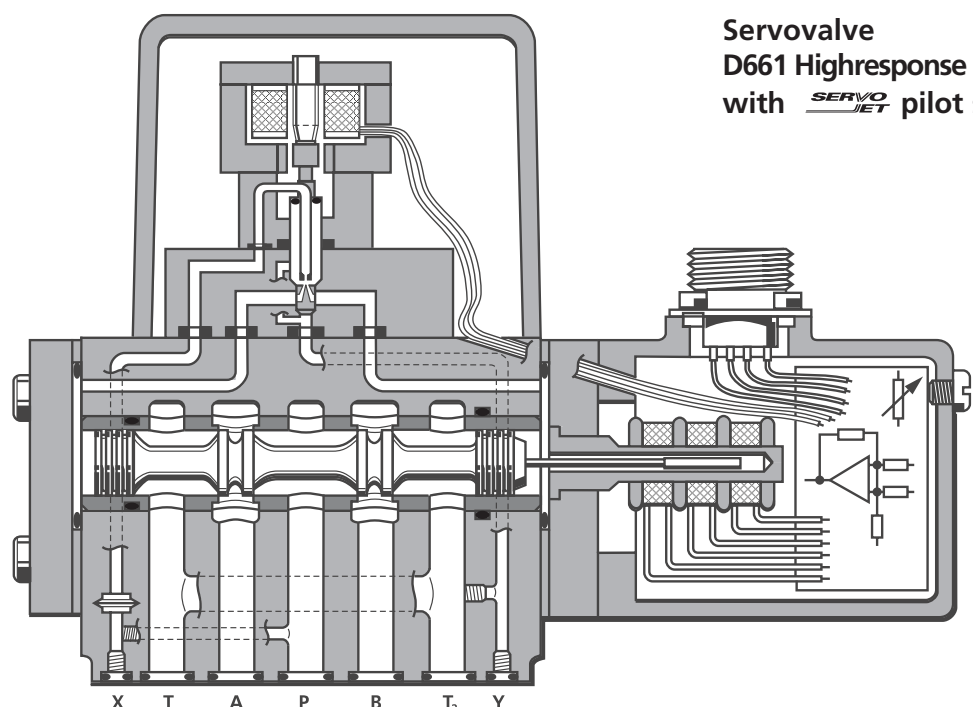
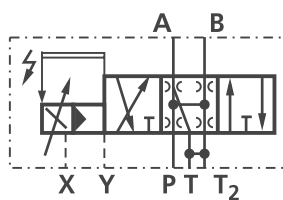
Shipping plate

Delivered with an oil sealed shipping plate



Valve flow diagram

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



Servovalve
D661 Highresponse Series
with **SERVOJET** pilot stage

D661 Highresponse Series

Technical data

Model . . . Type

Mounting pattern ISO with additional 2nd T-port

Valve version

Pilot stage

ServoJet

Pilot connection

Optional, internal or external

Mass

[kg (lb)]

Rated flow

(±10%) at $\Delta p_N = 35$ bar (500 psi) per land [l/min (gpm)]

Operating pressure

max.

Main stage:

ports P with X external, A, B

[bar (psi)]

port T, T₂ with Y internal

[bar (psi)]

port T, T₂ with Y external

[bar (psi)]

Pilot stage:

regular version

[bar (psi)]

with dropping orifice (on request)

[bar (psi)]

for 0 to 100 % stroke

[ms]

Response time*

Threshold*

Hysteresis*

Null shift

with $\Delta T = 55$ K

[%]

Null leakage flow*

total max. (~ critical lap)

[l/min (gpm)]

Pilot leakage flow*

[l/min (gpm)]

Pilot flow*

max., for 100% step input

[l/min (gpm)]

Spool stroke

[mm (in)]

Spool drive area

[cm² (sq in)]

* at operating or pilot pressure 210 bar (3000 psi), fluid viscosity of 32 mm²/s (0.05 in²/s) and fluid temperature of 40° C (104° F)

D661 - G C

ISO 4401 - 05 - 05 - 0 - 94

4-way

2- stage with bushing spool assembly

highresponse

X and Y

X and Y

X and Y

5,7 (12.6)

5,7 (12.6)

5,7 (12.6)

20/90 (5.3/23.8)

40/80 (10.6/21.1)

120/160/200 (31.7/42.3/52.8)

350 (5000)

350 (5000)

350 (5000)

210 (3000)

210 (3000)

210 (3000)

350 (5000)

350 (5000)

350 (5000)

280 (4000)

280 (4000)

280 (4000)

350 (5000)

350 (5000)

350 (5000)

6,5

11

14

< 0,1

< 0,08

< 0,05

< 0,4

< 0,3

< 0,2

< 2,0

< 1,5

< 1,0

3,9/5,4 (1.0/1.4)

4,7 (1.2)

5,4 (1.4)

2,6 (0.7)

2,6 (0.7)

2,6 (0.7)

2,6 (0.7)

2,6 (0.7)

2,6 (0.7)

± 1,3 (0.051)

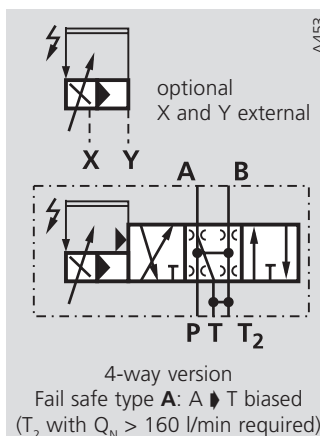
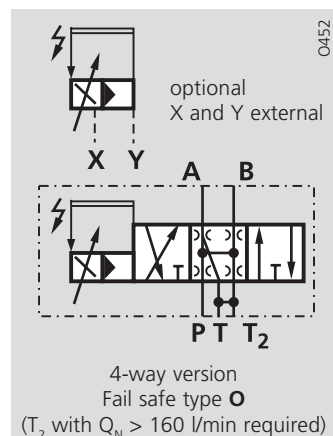
± 2,0 (0.079)

± 3,0 (0.118)

1,35 (0.21)

1,35 (0.21)

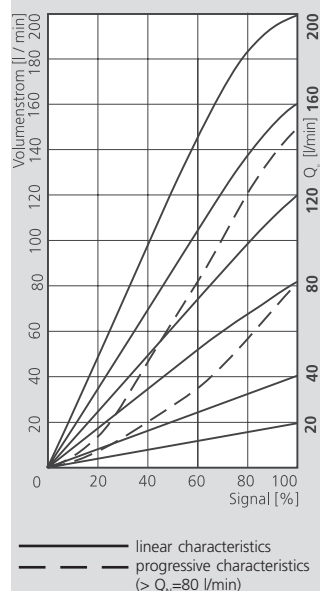
1,35 (0.21)



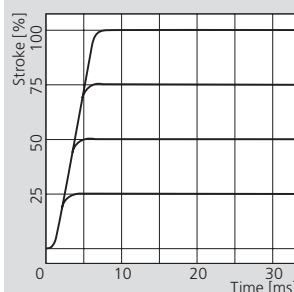
Typical characteristic curves at operating or pilot pressure 210 bar (3000 psi), fluid viscosity of 32 mm²/s (0.05 in²/s) and fluid temperature of 40° C (104° F)

Flow vs. signal curves

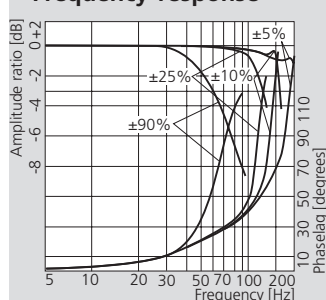
at $\Delta p_N = 35$ bar per land



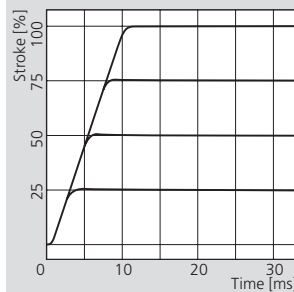
20/90 l/min Step response



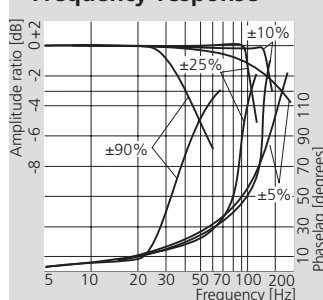
Frequency response



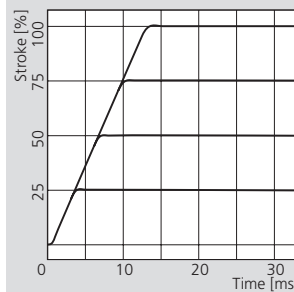
40/80 l/min Step response



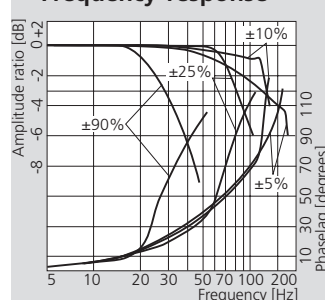
Frequency response



120/160/200 l/min Step response



Frequency response

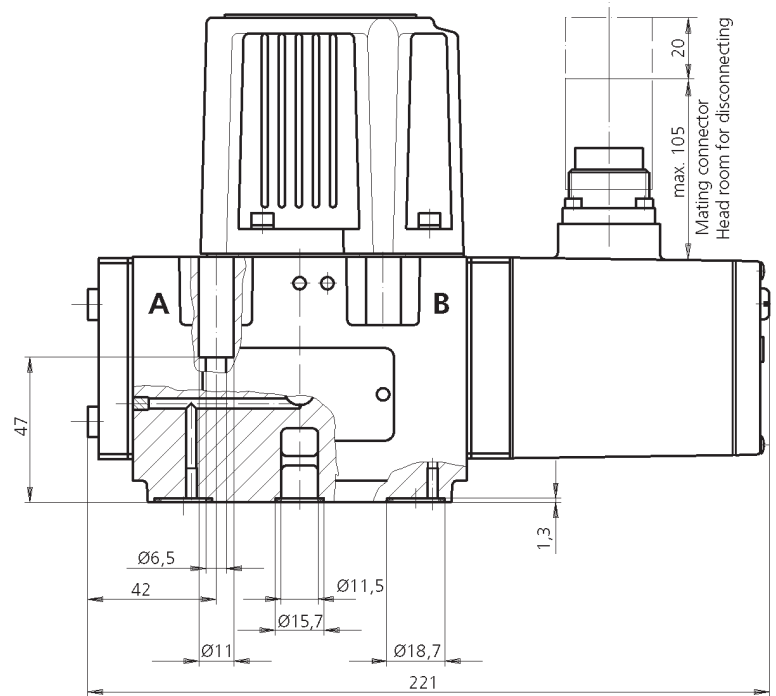
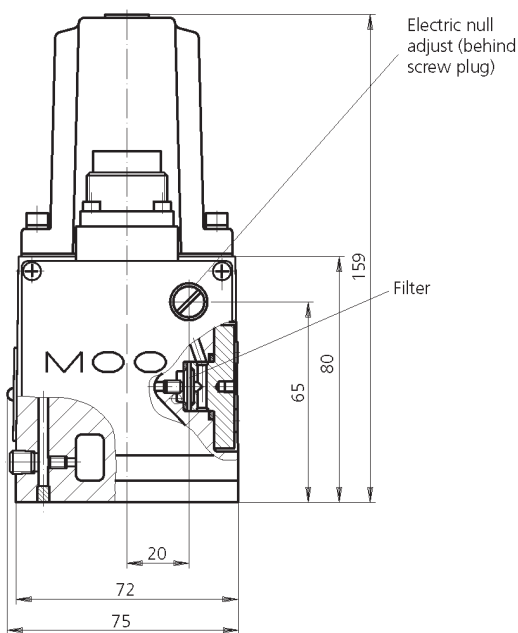


D661 Highresponse Series

Installation drawing

Spare parts, Accessories

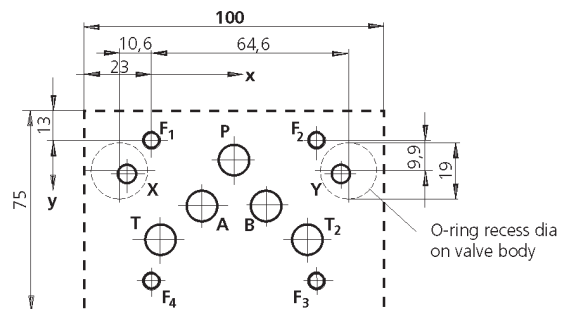
MOOG



The mounting manifold must conform to ISO 4401-05-05-0-94.
Attention:
Mounting length min. 100 mm.
Notice O-ring recess dia of X and Y ports.

For valves in 4-way version with $Q_N > 160 \text{ l/min}$ the non standard 2nd return port T_2 must be used.
 For maximum flow the manifold

ports P, T, A and B require to have **11,5 mm dia** (deviation from standard).
 Mounting surface needs to be flat within 0,01 mm over a distance of 100 mm. Average surface finish value, Ra, better than 0,8 μm .



	P	A	B	T	T ₂	X	Y	F ₁	F ₂	F ₃	F ₄
	Ø11,5	Ø11,5	Ø11,5	Ø11,5	Ø11,5	Ø6,3	Ø6,3	M6	M6	M6	M6
x	27	16,7	37,3	3,2	50,8	-8	62	0	54	54	0
y	6,3	21,4	21,4	32,5	32,5	11	11	0	0	46	46

Spare parts and Accessories

O-rings (included in delivery)											
for P, T, T ₂ , A, B	5 pieces ID 12,4 x Ø 1,8							NBR 85 Shore	FPM 85 Shore		
for X, Y	2 pieces ID 15,6 x Ø 1,8							45122 004	42082 004		
Mating connector, waterproof IP65	(not included in delivery)							45122 011	42082 011		
6+PE pole	B97007 061							for cable dia			
Flushing plates	for P, A, B, T, T ₂ , X, Y	EN 175201-804						min. 10 mm, max. 12 mm			
	B67728 001	for P, T, T ₂ , X, Y						for P, T, T ₂ , and X, Y			
	see special data sheet	B67728 002						B67728 003			
Mounting manifolds											
Mounting bolts (not included in delivery)											
M 6 x 60 DIN EN ISO 4762-10.9	A03665 060 060	required torque						required			
Replaceable filter	A67999 200	13 Nm						4 pieces			
O-rings for filter change		200 μm nominal									
filter	1 piece ID 12 x Ø 2,0	HNBR 85 Shore						NBR 85 Shore	FPM 85 Shore		
filter cover	1 piece ID 17,1 x Ø 2,6	B97009 080						66117 012 020	A25163 012 020		

D661 Highresponse Series

Valve electronics with supply voltage 24 Volt

Command signal 0 to ± 10 mA floating, Valves with current command input

The spool stroke of the valve is proportional to $I_D = -I_E$. 100 % valve opening P $\blacktriangleright$ A and B $\blacktriangleright$ T is achieved at $I_D = +10$ mA. At 0 mA command the spool is in centred position. The input pins D and E are inverting. Either pin D or E is used according to the required operating direction. The other pin is connected to signal ground at cabinet side.

Command signal 0 to ± 10 V, Valves with voltage command input

The spool stroke of the valve is proportional to $(U_D - U_E)$. 100 % valve opening P $\blacktriangleright$ A and B $\blacktriangleright$ T is achieved at $(U_D - U_E) = +10$ V. At 0 V command the spool is in centred position. The input stage is a differential amplifier. If only one command signal is available, pin D or E is connected to signal ground at cabinet side, according to the required operating direction.

Actual value 4 to 20 mA

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 4 to 20 mA. The centred position is at 12 mA. 20 mA corresponds to 100 % valve opening P $\blacktriangleright$ A and B $\blacktriangleright$ T.

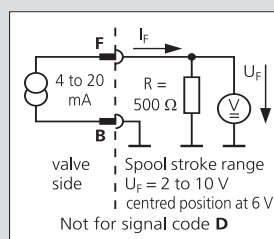
The position signal output 4 to 20 mA allows to detect a cable break when $I_F = 0$ mA.

For failure detection purposes it is advised to connect pin F of the mating connector and route this signal to the control cabinet.

General requirements

- ☐ Supply 24 VDC, min. 18 VDC, max. 32 VDC
Current consumption max. 300 mA
- ☐ All signal lines, also those of external transducers, shielded.
- ☐ Shielding connected radially to $\perp$ (0 V), power supply side, and connected to the mating connector housing (EMC).
- ☐ **EMC:** Meets the requirements of EN 55011:1998, class B, EN 50082-2:1995, performance criterion class A.
- ☐ Minimum cross-section of all leads $\geq 0,75$ mm².
Consider voltage losses between cabinet and valve.
- ☐ Note: When making electric connections to the valve (shield, protective earth) 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 I_F (position of main spool)



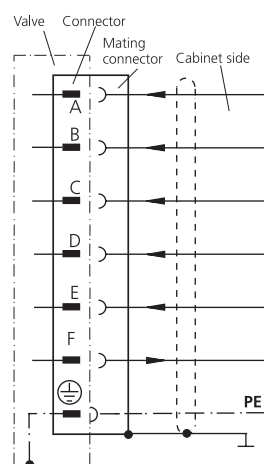
Note: Enable input

- With enable signal off, the main spool will move to a safe position.
- Centred position (unbiased pilot valve) function code **A**¹⁾
 - End position (biased pilot valve) function code **B**¹⁾

¹⁾ see type designation

Wiring for valves with 6+PE pole connector

to EN 175201 Part 804 ²⁾, and mating connector (type R and S, metal shell) with leading protective earth connection ($\neq$). See also wiring instructions AM 426 E.



Function	Voltage command	Current command
Supply	24 VDC (min. 18 VDC, max. 32 VDC). $I_{max} = 300$ mA	
Supply / Signal ground	$\perp$ (0 V)	
Enabled Not enabled	$U_{C-B} > +8,5$ VDC $U_{C-B} < +6,5$ VDC	$I_e = 2,0$ mA at 24 VDC (see note above)
Input rated command (differential)	$U_{D-E} = 0$ to ± 10 V $R_e = 10$ k Ω Input voltage for U_{D-B} and U_{E-B} for both signal types is limited to min. -15 V and max. $+32$ V	Input command $I_D = -I_E$: 0 to ± 10 mA ($R_e = 200$ Ω) Input command (inverted) $I_E = -I_D$: 0 to ± 10 mA
Output actual value spool position	$I_{F-B} = 4$ to 20 mA. At 12 mA spool is in centred position. $R_L = 100$ to 500 Ω Signal code D (see page 7): $U_{F-B} = 2$ to 10 V. At 6 V spool is in centred position. $R_a = 500$ Ω	
Protective earth		

²⁾ formerly DIN 43563

D661 Highresponse Series

Ordering information

MOOG

Model-Number				Type designation																																													
D661				G C . . . S . 2 H .																																													
Specification status – Series specification K Explosion proof version on request Z Special specification				Function code O No enable input. Pin C not used A Without enable signal applied the spool moves to adjustable centred position B Without enable signal applied the spool moves to defined position A $\blacktriangleright$ T or B $\blacktriangleright$ T																																													
Model designation assigned at the factory				Valve dynamics H High performance																																													
Factory identification				Electric supply 2 24 V DC (18 to 32 VDC)																																													
Valve version G Standard spool				Signals for 100% spool stroke <table border="1"> <thead> <tr> <th></th> <th>Command</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>D</td> <td>± 10 V</td> <td>2 to 10 V</td> </tr> <tr> <td>M</td> <td>± 10 V</td> <td>4 to 20 mA</td> </tr> <tr> <td>X</td> <td>± 10 mA</td> <td>4 to 20 mA</td> </tr> </tbody> </table>													Command	Output	D	± 10 V	2 to 10 V	M	± 10 V	4 to 20 mA	X	± 10 mA	4 to 20 mA																						
	Command	Output																																															
D	± 10 V	2 to 10 V																																															
M	± 10 V	4 to 20 mA																																															
X	± 10 mA	4 to 20 mA																																															
Rated flow <table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="2">Q_N [l/min] at Δp_N</th> <th rowspan="2">stroke [mm]</th> </tr> <tr> <th>70 bar</th> <th>10 bar</th> </tr> </thead> <tbody> <tr> <td>08</td> <td>20</td> <td>8</td> <td>$\pm 1,3$</td> </tr> <tr> <td>15</td> <td>40</td> <td>15</td> <td>$\pm 2,0$</td> </tr> <tr> <td>30</td> <td>80</td> <td>30</td> <td>$\pm 2,0$</td> </tr> <tr> <td>35</td> <td>90</td> <td>35</td> <td>$\pm 1,3$</td> </tr> <tr> <td>45</td> <td>120</td> <td>45</td> <td>$\pm 3,0$</td> </tr> <tr> <td>60</td> <td>160</td> <td>60</td> <td>$\pm 3,0$</td> </tr> <tr> <td>75</td> <td>200</td> <td>75</td> <td>$\pm 3,0$</td> </tr> </tbody> </table>					Q_N [l/min] at Δp_N		stroke [mm]	70 bar	10 bar	08	20	8	$\pm 1,3$	15	40	15	$\pm 2,0$	30	80	30	$\pm 2,0$	35	90	35	$\pm 1,3$	45	120	45	$\pm 3,0$	60	160	60	$\pm 3,0$	75	200	75	$\pm 3,0$	Valve connector S 6 + PE - pole EN 175201-804 Type R or S											
	Q_N [l/min] at Δp_N		stroke [mm]																																														
	70 bar	10 bar																																															
08	20	8	$\pm 1,3$																																														
15	40	15	$\pm 2,0$																																														
30	80	30	$\pm 2,0$																																														
35	90	35	$\pm 1,3$																																														
45	120	45	$\pm 3,0$																																														
60	160	60	$\pm 3,0$																																														
75	200	75	$\pm 3,0$																																														
Maximum operating pressure B 70 bar H 280 bar. At $p_x \leq 280$ bar (X and Y external) operating pressure in ports P, A, B and T up to 350 bar allowed. K 350 bar				Seal material N NBR Standard V FPM (Viton) option																																													
Bushing / spool type O 4- way: critical lap, linear characteristic S 4- way: critical lap, curvilinear characteristic, $Q_N = 80$ l/min X Special bushing on request				Pilot connections <table border="1"> <thead> <tr> <th></th> <th>Supply</th> <th>Return</th> </tr> </thead> <tbody> <tr> <td>4</td> <td>internal</td> <td>internal</td> </tr> <tr> <td>5</td> <td>external</td> <td>internal</td> </tr> <tr> <td>6</td> <td>external</td> <td>external</td> </tr> <tr> <td>7</td> <td>internal</td> <td>external</td> </tr> </tbody> </table>													Supply	Return	4	internal	internal	5	external	internal	6	external	external	7	internal	external																			
	Supply	Return																																															
4	internal	internal																																															
5	external	internal																																															
6	external	external																																															
7	internal	external																																															
Pilot stage version C ServoJet-Highresponse				Spool position without electric supply O undefined (no fail safe function)																																													
				Mechanical fail safe versions <table border="1"> <thead> <tr> <th></th> <th>Configuration</th> <th>achieved at</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>P $\blacktriangleright$ B, A $\blacktriangleright$ T connected</td> <td>$p_x > 25$ bar</td> </tr> <tr> <td>B</td> <td>P $\blacktriangleright$ A, B $\blacktriangleright$ T connected</td> <td>$p_x > 25$ bar</td> </tr> </tbody> </table>													Configuration	achieved at	A	P $\blacktriangleright$ B, A $\blacktriangleright$ T connected	$p_x > 25$ bar	B	P $\blacktriangleright$ A, B $\blacktriangleright$ T connected	$p_x > 25$ bar																									
	Configuration	achieved at																																															
A	P $\blacktriangleright$ B, A $\blacktriangleright$ T connected	$p_x > 25$ bar																																															
B	P $\blacktriangleright$ A, B $\blacktriangleright$ T connected	$p_x > 25$ bar																																															

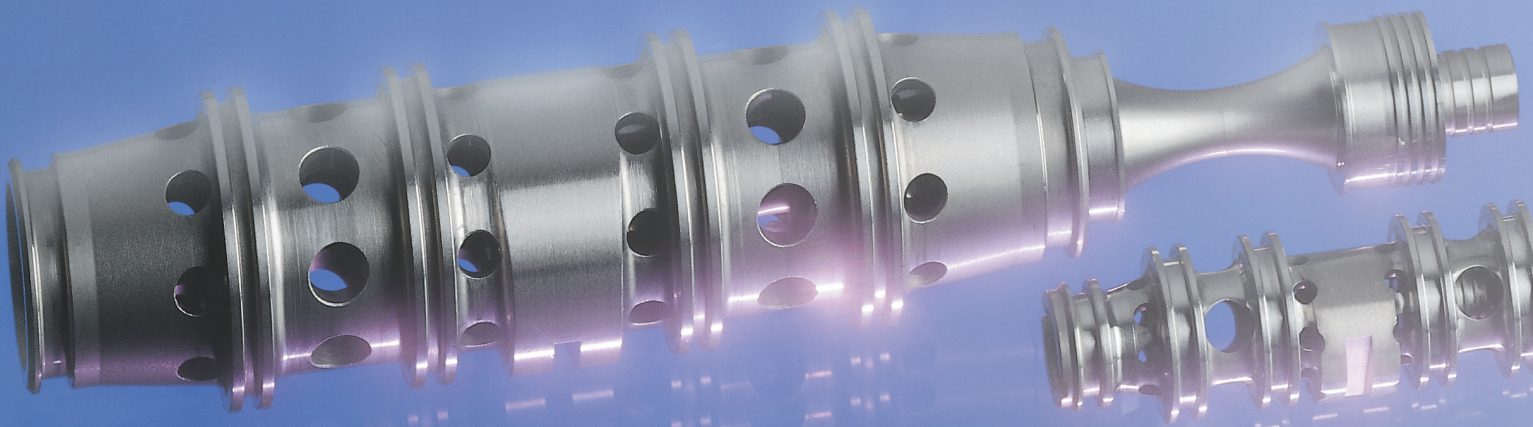
Options may increase price.
All combinations may not be available.

Preferred configurations are highlighted.
Technical changes are reserved.

MOOG



Argentina	Buenos Aires
Australia	Melbourne
Austria	Vienna
Brazil	São Paulo
China	Shanghai
China	Hong Kong
England	Tewkesbury
Finland	Helsinki
France	Rungis (Paris)
Germany	Böblingen



India	Bangalore
Ireland	Ringaskiddy (Cork)
Italy	Malnate (VA)
Japan	Hiratsuka
Korea	Kwangju
Luxembourg	Luxembourg
Philippines	Baguio
Russia	Pavlovo
Singapore	Singapore
Spain	Orio
Sweden	Gothenburg
USA	East Aurora (NY)

MOOG GmbH
Hanns-Klemm-Straße 28
D - 71034 Böblingen
Postfach 1670
D - 71006 Böblingen
Telephone +49 (0)7031 622-0
Telefax +49 (0)7031 622-191
e-mail: sales@moog.de
Internet: www.moog.com

D661-G.C-EN / 04.03