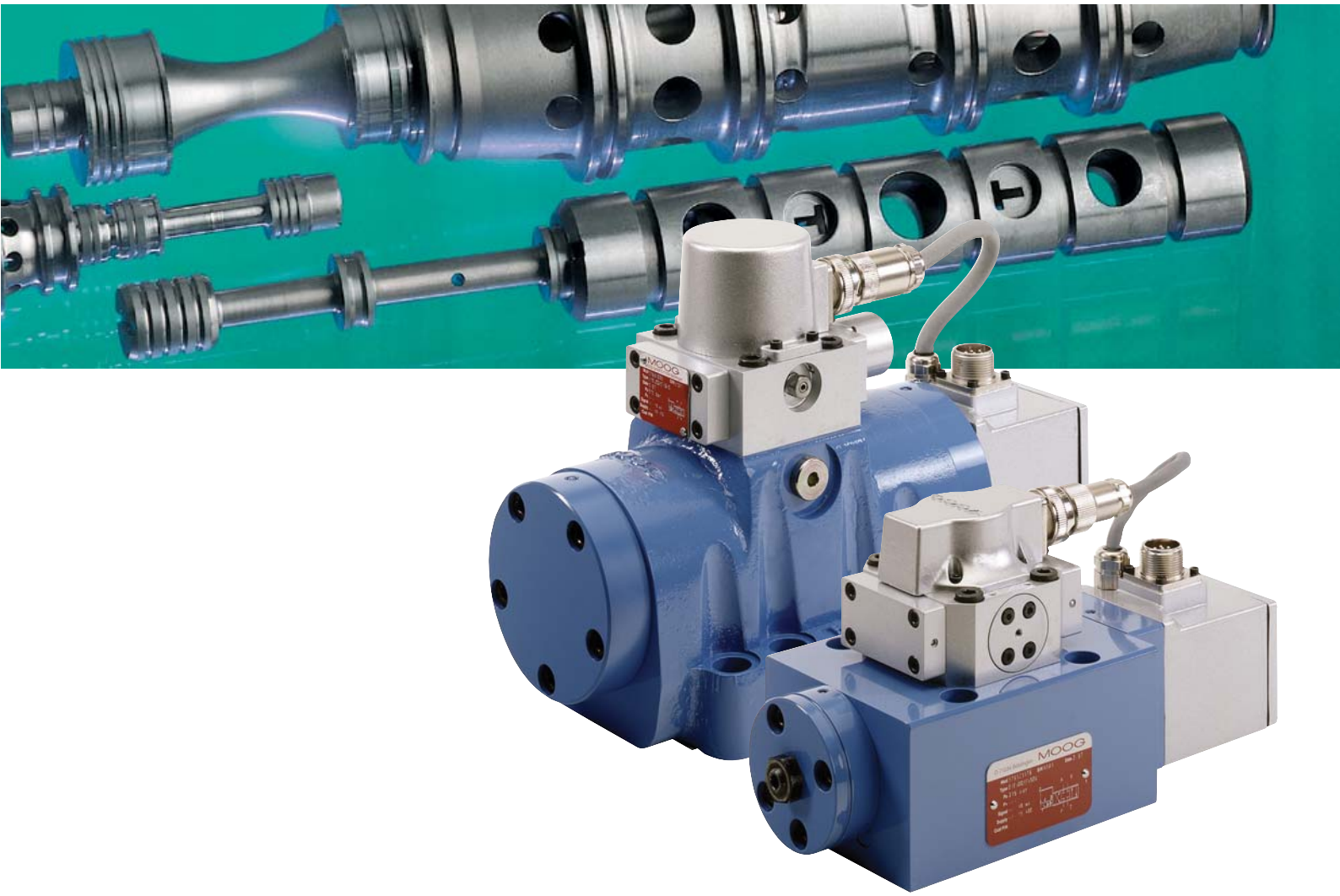
MOOG

Servovalves
with integrated Electronics
D791 and D792 Series



D791 and D792 Series
Three stage servovalves

The flow control servovalves D791 and D792 Series are throttle valves for 3-way and preferably 4-way applications. These three stage servovalves have been especially developed for such demanding applications where high flow rates and at the same time extreme dynamic performance requirements must be met. The design of these valves is based on the well known D079 Series. The integrated electronics has been replaced by a new design applying SMD technology. The valves are offered with pilot valves of D761 or D765 Series, optional standard response or high response versions are available. Series D791 can deliver rated flow up to 250 l/min, Series D792 is available with rated flow up to 1000 l/min.
These valves are suitable for pressure or force control, position and velocity control systems with high dynamic response requirements.

Principle of operation
An electrical command signal (set point, input signal) is applied to the integrated control amplifier which drives a current through the pilot valve coils. The pilot valve produces differential pressure in its control ports. This pressure difference results in a pilot flow which causes main spool displacement.
The position transducer which is excited via an oscillator measures the position of the main spool (actual value, position voltage). This signal then is demodulated and fed back to the control amplifier where it is compared with the command signal. The control amplifier drives the pilot valve until the error between command signal and feedback signal is zero. Thus, the position of the main spool is proportional to the electrical command signal.

Operational features

- ❒ Electrical position feedback with pressure isolated position transducer (LVDT), no wear
- ❒ Integrated SMD electronics with false polarity protection
- ❒ Optional external pilot supply and return connections via fifth and sixth port in valve body
- ❒ Low threshold and hysteresis, excellent null stability
- ❒ Preadjusted at factory

The valves D791 and D792 Series described in this catalogue have successfully passed EMC tests required by EC Directive. Please take notice of the respective references in the electronics section.

CE

The actual flow depends on the electrical command signal and the valve pressure drop, and may be calculated using the square root function for a sharp-edged orifice.
The flow value Q calculated in this way should not exceed an average flow velocity of 30 m/s in ports P, A, B and T.

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

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 drops are required, an appropriate higher pilot pressure has to be chosen to overcome the flow forces. An approximate value can be calculated as follows:

$$p_X \geq 2{,}5 \cdot 10^{-2} \cdot \frac{Q}{A_K} \sqrt{\Delta p}$$

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 15 bar above the return pressure of the pilot stage.

Our quality management system is certified in accordance with DIN EN ISO 9001.

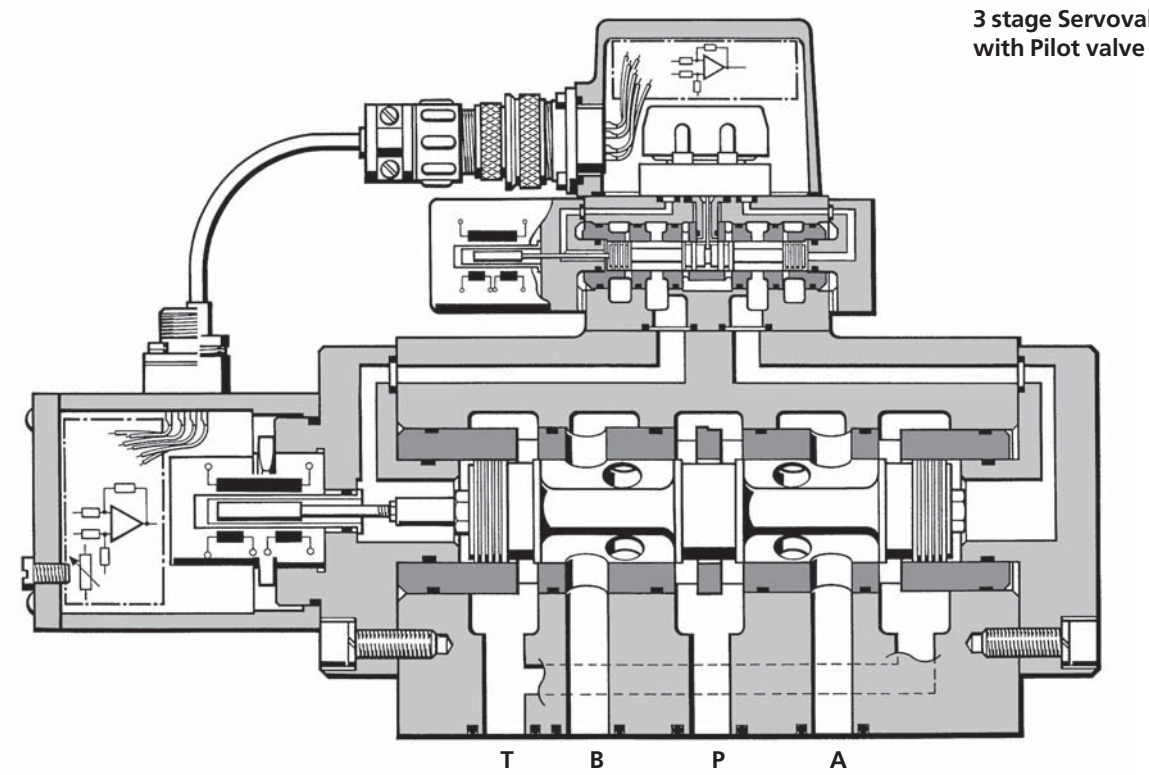
DIN ISO 9001 certified BVQi

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 here.
In case of doubt please contact Moog.

Operating pressure range	
Main stage	
Ports P, A and B	
with X internal	up to 315 bar
with X external	up to 350 bar
Port T with Y internal	up to 210 bar
Port T with Y external	up to 350 bar
Pilot valve	
Ports P, A and B	
D761, D765 Series	up to 315 bar
Port T	up to 210 bar
Temperature range	
Ambient	-20 to +60 °C
Fluid	-20 to +80 °C
Seal material	FPM, others on request
Operating fluid	Mineral oil based hydraulic fluid (to DIN 51524), others on request
Viscosity	recommended 15 to 100 mm²/s
Class of cleanliness	The cleanliness of the hydraulic fluid greatly effects the performance (spool positioning, high resolution) and wear (metering edges, pressure gain, leakage) of the valve.

Recommended cleanliness class	
for normal operation:	ISO 4406 < 17/14/11
for longer life:	ISO 4406 < 16/13/10
System filtration	
Pilot valve:	High pressure filter (without bypass, but with dirt alarm) mounted in the mainflow and if possible, directly upstream of the servovalve.
Main stage:	Main stage: high pressure filter as for the pilot stage. In combination with a fast regulating VD-pump a bypass filter is possible.
Filter rating recommended	
for normal operation:	$\beta_{10} \geq 75$ (10 µm absolute)
for longer life:	$\beta_5 \geq 75$ (5 µm absolute)
Installation options	any position, fixed or movable
Vibration	30 g, 3 axes
Degree of protection	EN 60529: IP 65 (with mating connector mounted)
Shipping plate	Delivered with an oil sealed shipping plate

3 stage Servovalve D792 with Pilot valve D765 Series



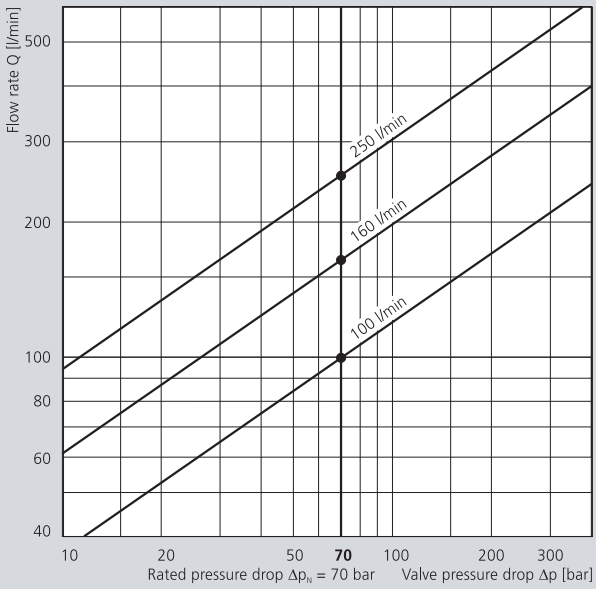
D791 Series
Technical data

Model . . . .Type		**D791 . . . . S . . .**		
Mounting pattern	ISO, but X and Y do **not** correspond to ISO	ISO 10372-06-05-0-92		
Valve body version		4-way 3-stage with bushing spool assembly		
Pilot valve		2-stage, optional D761 or D765 Series		
Pilot connection	optional, internal or external	X and Y		
Mass	[kg]	13		
Rated flow	(± 10%) at Δp_N = 35 bar per land [l/min]	**100**	**160**	**250**
Response time*	for 0 to 100% stroke (dependent on pilot valve) [ms]		**3** to **10**	
Threshold*	[%]		< 0,2	
Hysteresis*	[%]		< 0,5	
Null shift	with ΔT = 55 K [%]		< 2	
Null leakage flow*	total, max. [l/min]	5	7	10
Pilot leakage flow*	max., for 100% step input (dependent on pilot valve) [l/min]		**4** to **11**	
Main spool stroke	[mm]	1,4	1,2	2,0
Main spool drive area	[cm²]		2,85	

* measured at 210 bar pilot or operating pressure, fluid viscosity of 32 mm²/s and fluid temperature of 40 °C

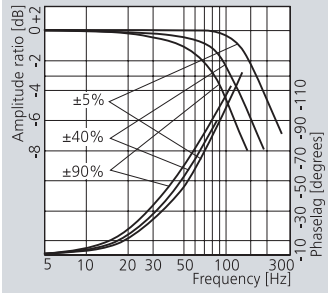
Typical characteristic curves measured at 210 bar pilot or operating pressure, fluid viscosity of 32 mm²/s and fluid temperature of 40 °C

Valve flow diagram

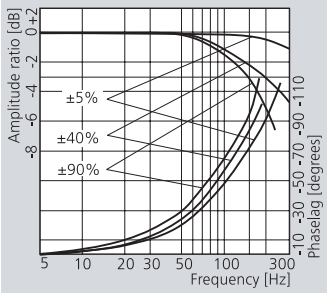


Valve flow for maximum valve opening (100% command signal) as a function of the valve pressure drop

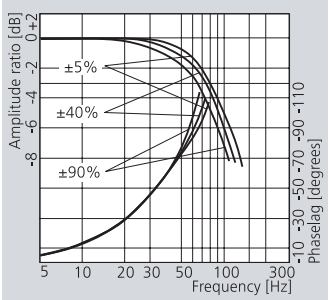
Frequency response
for valves with different rated flows and different pilot valves



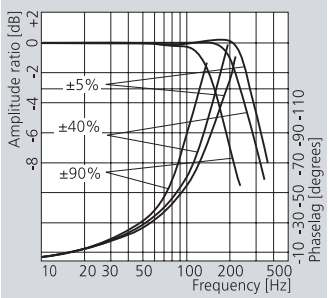
Rated flow 100/160 l/min
Pilot valve D761 Std 10 l/min



Rated flow 100/160 l/min
Pilot valve D765 HR10 l/min



Rated flow 250 l/min
Pilot valve D761 Std10 l/min



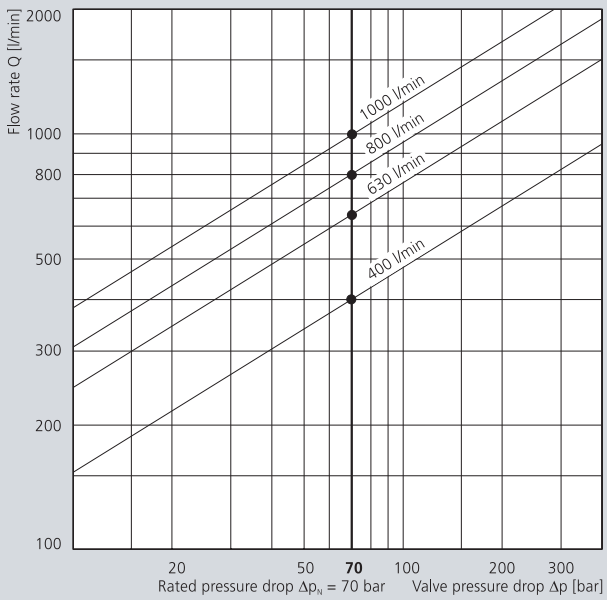
Rated flow 250 l/min
Pilot valve D761 HR 20 l/min

Model . . . .Type			**D792 . . . . S . . .**				
Mounting pattern			Moog Standard				
Valve body version			4-way 3-stage with bushing spool assembly				
Pilot valve			2-stage, optional D761 or D765 Series				
Pilot connection	optional, internal or external		X and Y				
Mass		[kg]	17				
Rated flow	(± 10%) at Δp_N = 35 bar per land	[l/min]	**400**	**630**		**800**	**1000**
Response time*	for 0 to 100% stroke (dependent on pilot valve)	[ms]	**4** to **12**				
Threshold*		[%]	< 0,2				
Hysteresis*		[%]	< 0,5				
Null shift	with Δ T = 55 K	[%]	< 2				
Null leakage flow*	total, max.	[l/min]	10	14		14	14
Pilot leakage flow*	max., for 100% step input (dependent on pilot valve)	[l/min]	**6** to **16**				
Main spool stroke		[mm]	1,8	1,9		2,6	4,0
Main spool drive area		[cm²]	3,8	7,14		7,14	7,14

* measured at 210 bar pilot or operating pressure, fluid viscosity of 32 mm²/s and fluid temperature of 40 °C

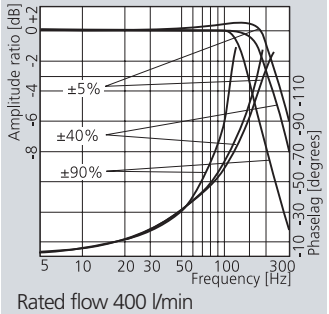
Typical characteristic curves measured at 210 bar pilot or operating pressure, fluid viscosity of 32 mm²/s and fluid temperature of 40 °C

Valve flow diagram

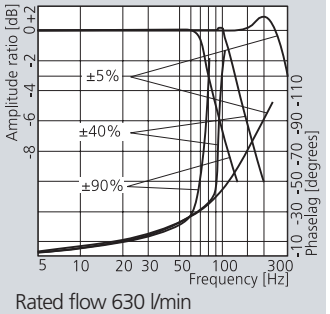


Valve flow for maximum valve opening (100% command signal) as a function of the valve pressure drop

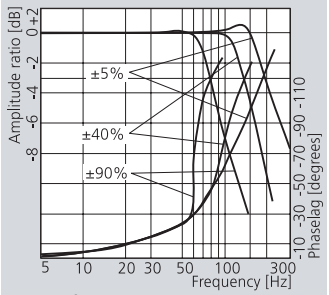
Frequency response
for valves with different rated flows and different pilot valves



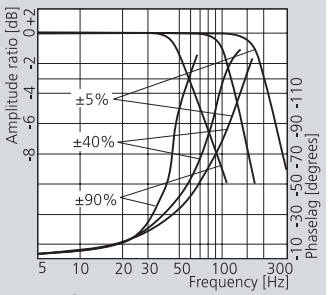
Rated flow 400 l/min
Pilot valve D761 HR 20 l/min



Rated flow 630 l/min
Pilot valve D765 HR 20 l/min

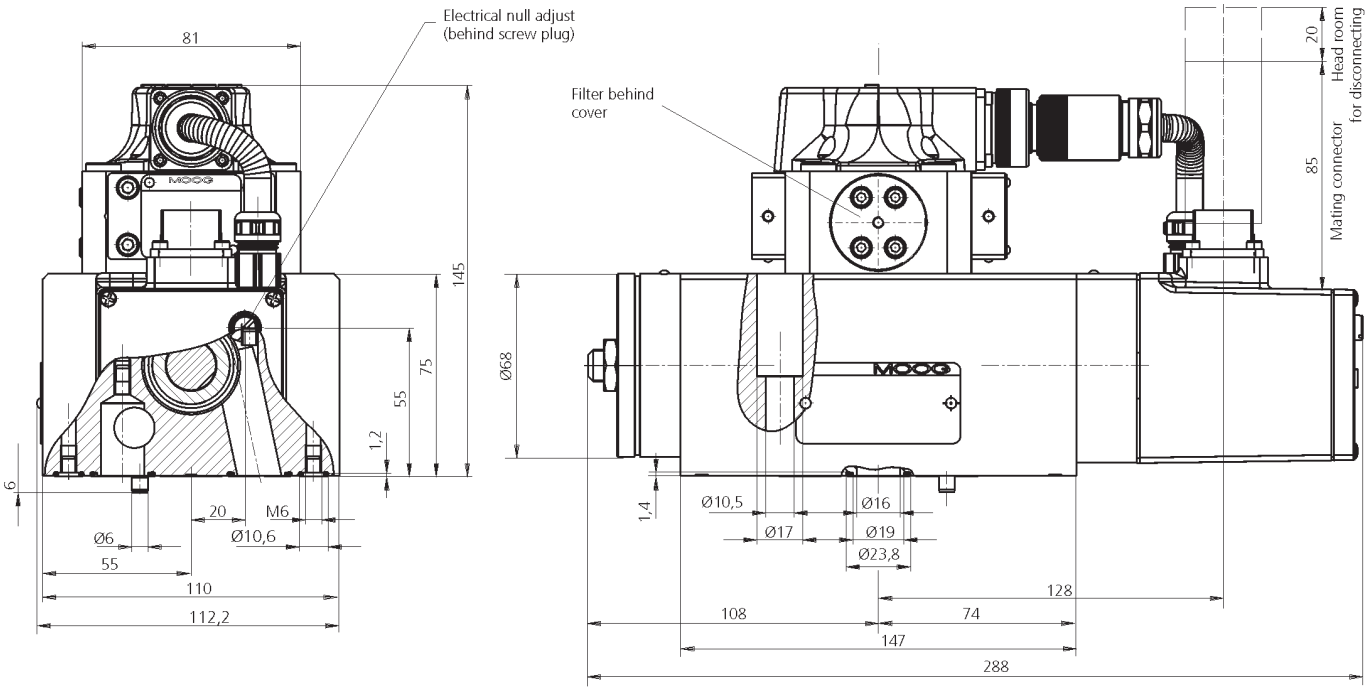


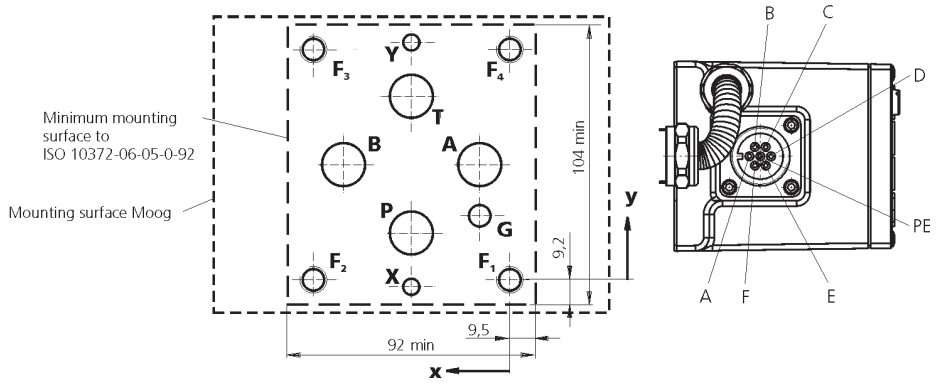
Rated flow 800 l/min
Pilot valve D761 HR 20 l/min



Rated flow 800 l/min
Pilot valve D765 HR 20 l/min

Installation drawing with Pilot valve D761 Series Conversion instruction

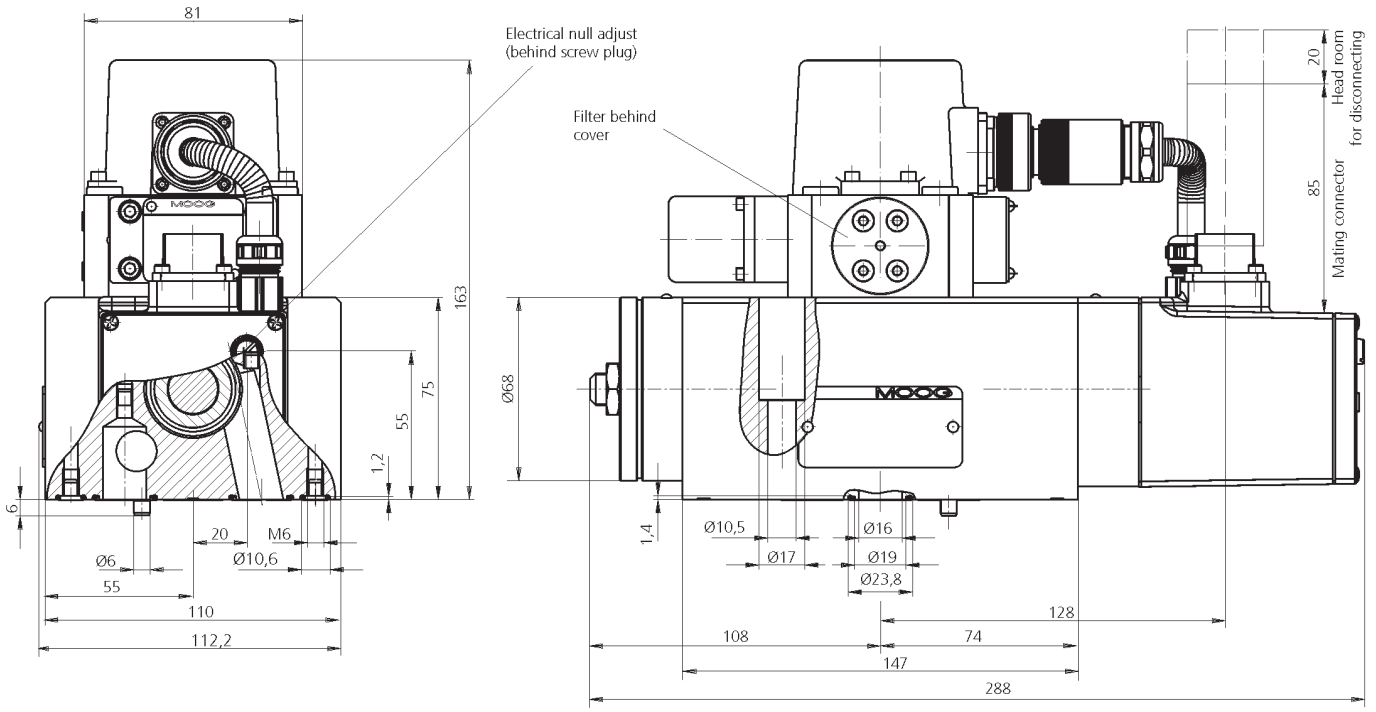


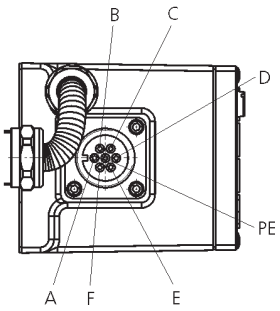


The mounting manifold must conform to ISO 10372-06-05-0-92.
Note: The X port to ISO Standard must **not** be machined. The X and Y ports of Moog valve body do **not** correspond to ISO Standard.
Mounting surface needs to be flat within 0,02 mm. Average surface finish value, Ra, better than 1µm.

	P	A	B	T	G	X	Y	F1	F2	F3	F4
	Ø16	Ø16	Ø16	Ø16	Ø8	Ø6	Ø6	M10	M10	M10	M10
x	36,5	11,1	61,9	36,5	11,1	36,5	36,5	0	73	73	0
y	17,4	42,8	42,8	68,2	23,7	-2,6	88,2	0	0	85,6	85,6

Installation drawing with Pilot valve D765 Series Spare parts, Accessories

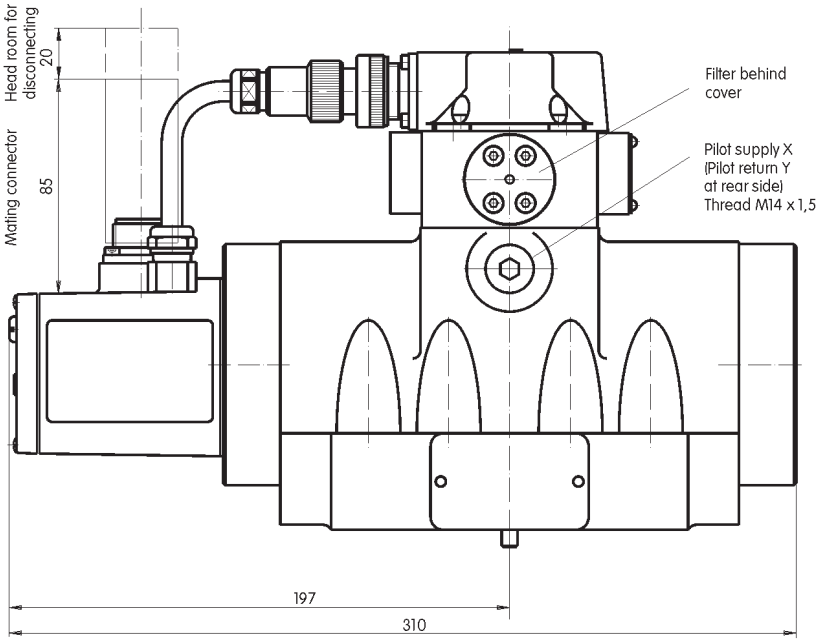


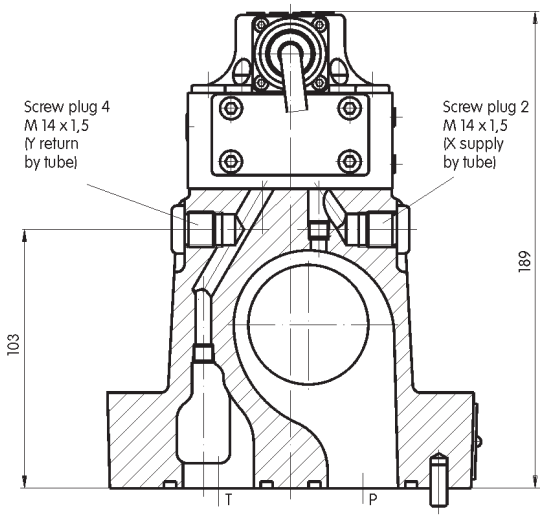


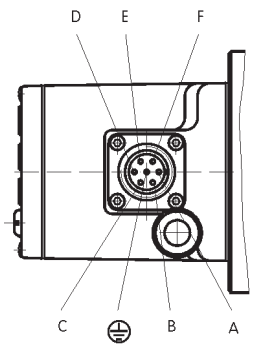
Spare parts and accessories for D791 Series

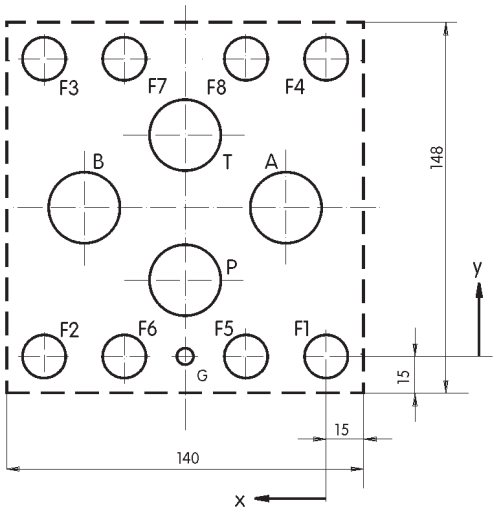
O-rings (included in delivery)			FPM 85 Shore
for P, T, A, B	4 pieces	ID 20,3 x 1,78	as service seal set
for X, Y	2 pieces	ID 7,65 x 1,78	B97215-V791-22
Mating connector, waterproof IP 65 (not included in delivery)		for cable dia	
6+PE-pole DIN 43563		min. Ø 10 mm, max. Ø 12 mm	B97007 061
Flushing plate (internal supply)			55118 001
(external supply)			A26133
Mounting bolts (not included in delivery)			
M 10 x 50 DIN 912-10.9	4 pieces	required torque 65 Nm	A03665 100 050
Replaceable filter for pilot valve		65 µm nominal	A67999 065
O-rings for filter replacement and pilot valve			FPM 85 Shore
Service seal set	1 piece		B97215-V761F76

Installation drawing with Pilot valve D761 Series Conversion instruction





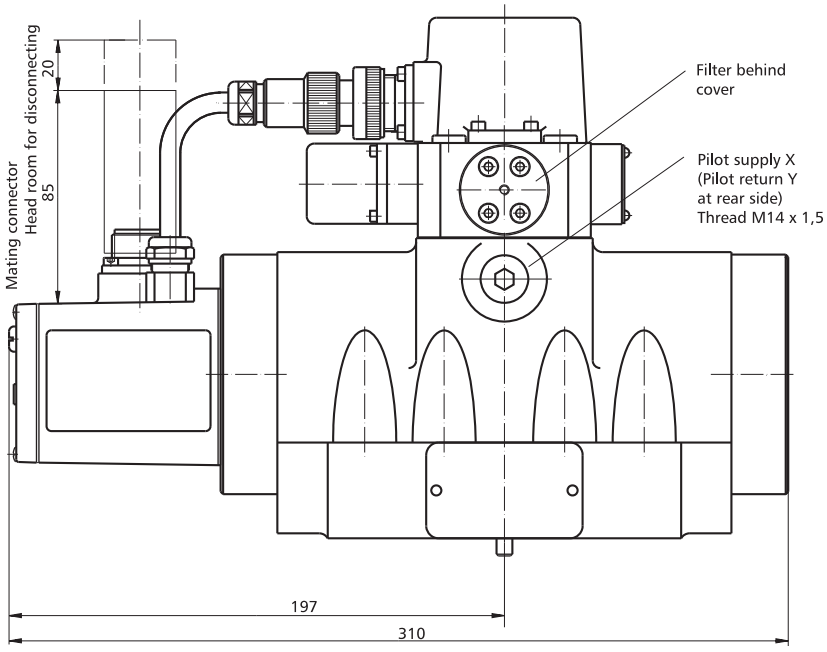


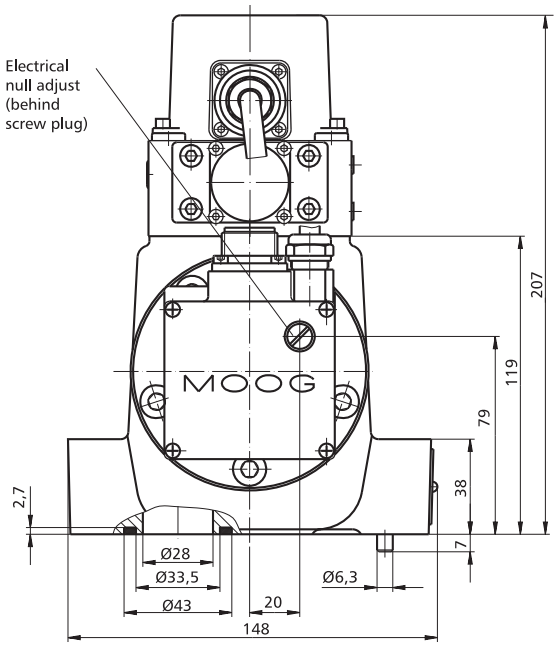


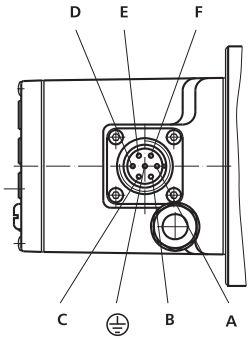
Note: The X and Y tubes have to be connected to the Moog valve body by fittings.
Mounting surface needs to be flat within 0,02 mm. Average surface finish value, Ra, better than 1µm.

	P	A	B	T	G	F1	F2	F3	F4	F5	F6	F7	F8
	Ø28	Ø28	Ø28	Ø28	Ø8	M16	M16	M16	M16	M16	M16	M16	M16
x	55,4	15,8	95,0	55,4	55,4	0	110,8	110,8	0	31,5	79,3	79,3	31,5
y	30,1	58,7	58,7	87,3	0	0	0	117,4	117,4	0	0	117,4	117,4

Installation drawing with Pilot valve D765 Series Spare parts, Accessories







Spare parts and accessories for D792 Series

O-rings (included in delivery)			FPM 85 Shore
for P, T, A, B	4 pieces	ID 36 x 3,5	as service seal set B97215-V792-22
Mating connector, waterproof IP 65 (not included in delivery)		for cable dia	
6+PE-pole DIN 43563		min. Ø 10 mm, max. Ø 12 mm	B97007 061
Flushing plate			76216 001
Mounting bolts (not included in delivery)	required		
M 16 x 60 DIN 912-10.9	8 pieces	required torque 290 Nm	A03665 160 060
Replaceable filter for pilot valve		65 µm nominale	A67999 065
O-rings for filter replacement and pilot valve			FPM 85 Shore
Service seal set	1 piece		B97215-V761F76

D791 and D792 Series
Valve electronics with supply voltage ± 15 Volt

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 ◗ A and B ◗ T is achieved at $(U_D - U_E) = +10$ V. At 0 V command the spool is in a 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 ⊥ (pin C) according to the required operating direction (to be done at the mating connector).

Command signal 0 to ±10 mA
Valves with current command input
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 a centred 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.

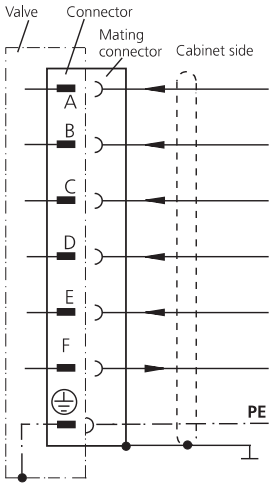
Actual value 0 to ±10 V
Valves with voltage command input
The actual spool position value can be measured at pin F. This signal can be used for monitoring and fault detection purposes.
The spool stroke range corresponds to ±10 V. 100% valve opening P ◗ A and B ◗ T corresponds to +10 V.

Actual value 0 to ±10 mA or 4 to 20 mA
Valves with current command input
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 (4 to 20 mA). 100% valve opening P ◗ A and B ◗ T corresponds to +10 mA (20 mA).

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), 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 ≥ 0,75mm²
- ❒ Note: When making electrical 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.

Wiring for valves with 6+PE pole connector to DIN 43563 and mating connector (metal shell) with leading protective grounding connection (⏚).



Function	Current command	Voltage command
Supply	+ 15 VDC ± 3	
Supply	– 15 VDC ± 3	
Supply / signal ground	⊥ (0V)	
Input rated command Valve flow	0 to ± 10 mA Load resistance (diff.) 1 kΩ	0 to ± 10 V Input resistance 10 kΩ
Input rated command (differential) Valve flow	Input command $I_D = -I_E$: 0 to ±10 mA Input command (inverted) $I_E = -I_D$: 0 to ±10 mA (R_e = 200 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	U_{D-E} = 0 to ±10 V (R_e = 10 kΩ)
Output actual value Main spool position	0 to ± 10 mA Load resistance max. 500 Ω	0 to ± 10 V Output resistance 50 Ω
Protective grounding		

D791 and D792 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 ◗ A and B ◗ 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 ◗ A and B ◗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 ◗ A and B ◗ T.

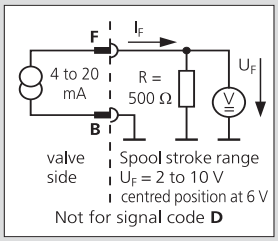
The position signal output 4 to 20 mA allows to detect a cable break when I_F = 0 mA.

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 ⊥ (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 ≥ 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)



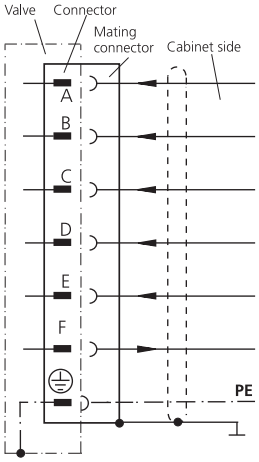
Note: Enable input

With enable signal off, the main spool will move to a safe position.
a) Centred position (unbiased pilot valve) function code **A**[1])
b) 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 (≒). See also wiring instructions AM 426 E.



Function	Current command	Voltage command
Supply	24 VDC (min. 18 VDC, max. 32 VDC). I_{max} = 300 mA	
Supply / Signal ground	⊥ (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)	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 Input voltage for U_{D-B} and U_{E-B} for both signal types is limited to min. –15 V and max. +32 V	U_{D-E} = 0 to ±10 V (R_e = 10 kΩ)
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

Notes

Model-Number Type designation

D791, D792 . . . . – .

Specification status

-	Series specification
E	Preseries specification
Z	Special specification

Model designation

	assigned at the factory

Factory identification

	assigned at the factory

Valve version

S	Servovalve 3-stage

Rated flow

	Q_N [l/min] at Δp_N = 35 bar per land	Series
10	100	D791
16	160	D791
25	250	D791
40	400	D792
63	630	D792
80	800	D792
99	1 000	D792

Maximum operating pressure p_P

J	315 bar. At $p_X \leq 315$ bar (X and Y external) operating pressure in ports P, A, B and T up to 350 bar possible
K	350 bar

Main spool type

O	4-way: axis cut, linear characteristic

Pilot valve

P	D761	Standard	
Q	D761	High response	
R	D765	High response [1]	[1] only together with ± 15 V
S	D765	Standard [1]	(see supply voltage)

Spool position of main stage without electrical supply

	Position	Pilot pressure [bar]
O	undefined	≥15
A	P ◗ B, A ◗ T	≥15
B	P ◗ A, B ◗ T	≥15
	others on request	

Pilot connections and pressure

	Supply X	Return Y	
4	internal	internal	Parameters of the control electronics are adapted to the pilot pressure. See operating pressure on the nameplate and in this ordering information.
5	external	internal	
6	external	external	
7	internal	external	

Seal material

U	FPM (Viton), PUR (Ultrathan) only for bushing
V	FPM (Viton)

Valve connector

S	6 + PE-pole DIN 43563

Signals for 100% spool stroke

	Input	Output
A	±10 V	±10 V
X	±10 mA, floating	±10 mA

Supply voltage

0	± 15 VDC ± 3%, Ripple < 50 mV_{pp}	
2	24 VDC	(18 to 32 VDC)

Function code

O	24 V	Without enable input
P	15 V	Without enable input
A	24 V	Without enable signal applied the spool moves to adjustable centered position (see page 13).
B	24 V	Without enable signal applied the spool moves into defined end position A ◗ T bzw. B ◗ T (see page 13).

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

Options may increase price.
Technical changes are reserved.

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Moog GmbH
Hanns-Klemm-Straße 28
D - 71034 Böblingen
Postfach 1670
D - 71006 Böblingen
Telefon (07031) 622-0
Telefax (07031) 622-191

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