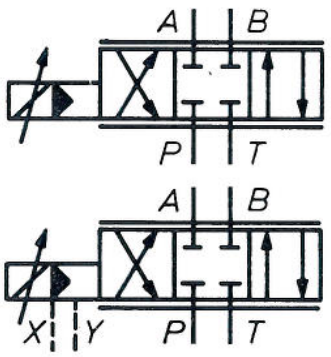
MOOG

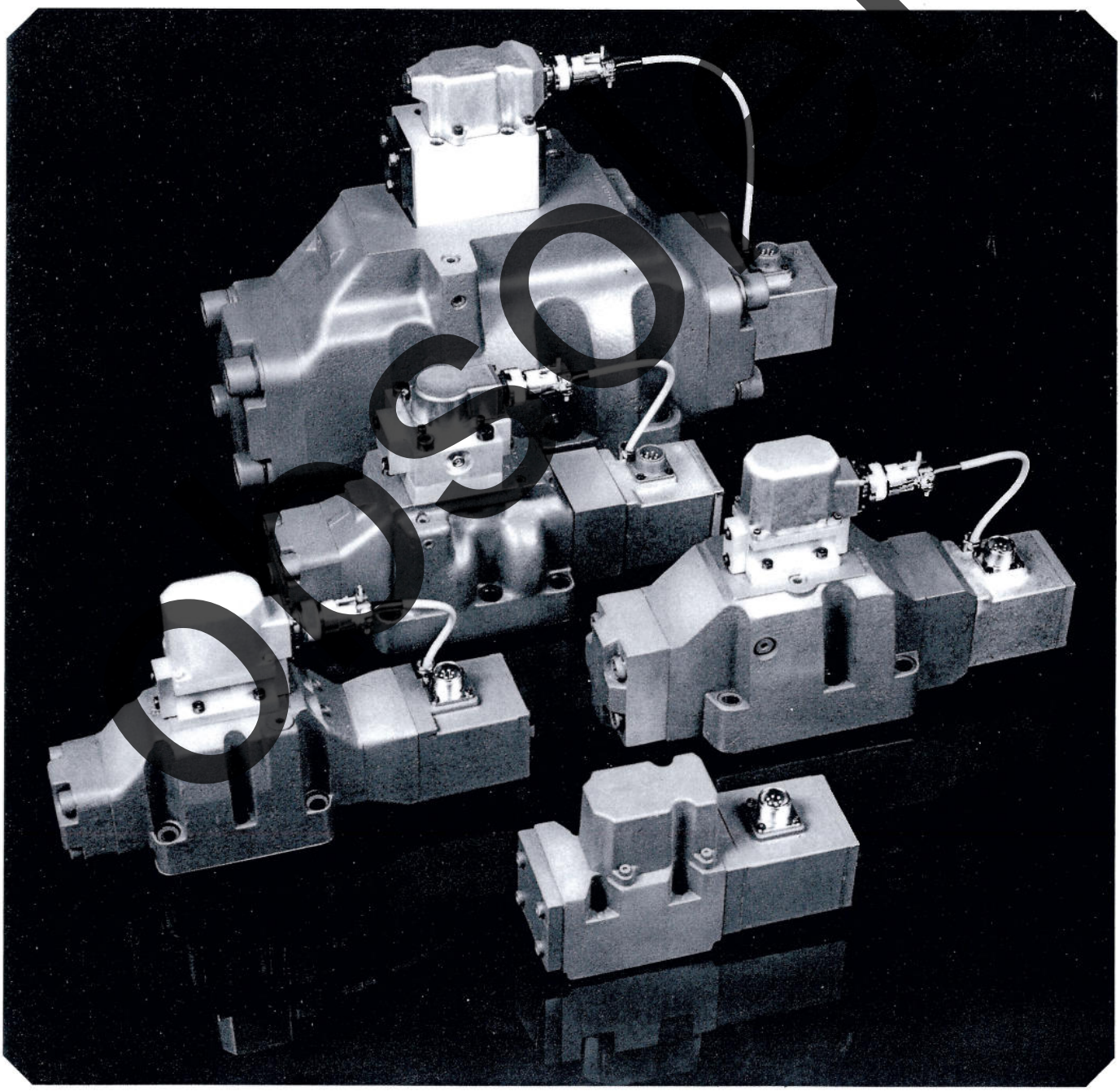


Proportional Control Valves with Integrated Electronics

Series D640

Rated flow 16...1500 l/min ($\triangle p_N$=10 bar)
Operating pressure up to 350 bar

Mounting pattern to DIN 24340 (ISO 4401) Form A 10 to A 32



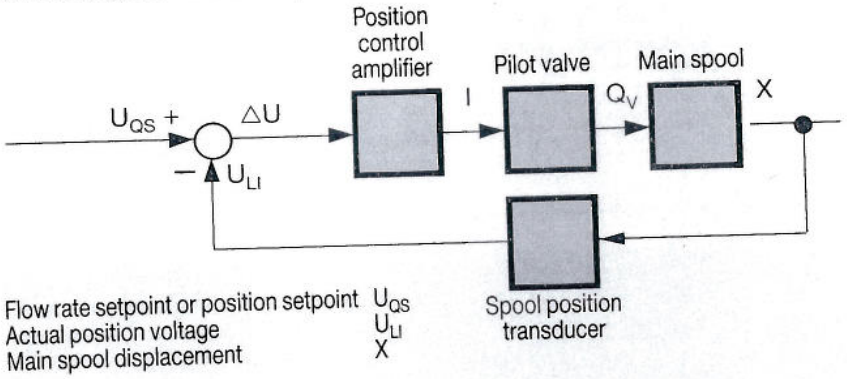
Catalogue D 233.00.01 En 2.89

Series D640 proportional control valves are 2-way, 3-way, or 4-way throttle valves for large flows at low valve pressure drop.
The valves are suitable for electro-hydraulic position, velocity, pressure or force control systems.
The main spool is driven either by a single-stage or a two-stage pilot valve. A noncontacting electrical position transducer measures the position of the main spool. The position control loop around the main stage with spool position transducer and pilot valve is closed by built-in electronics.

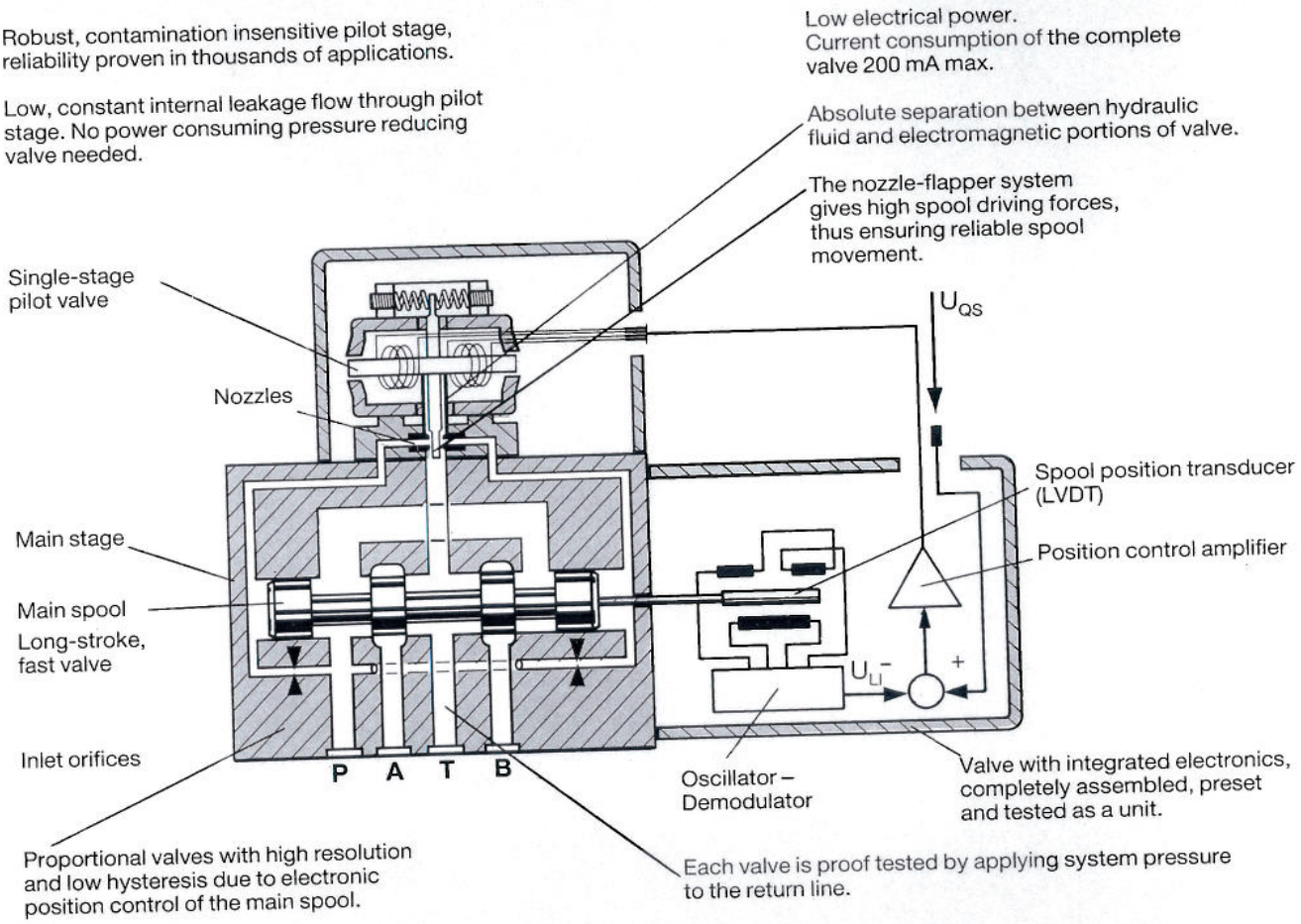
Principle of operation

An electrical command signal (setpoint U_{QS}) is supplied to the integrated control amplifier which drives the pilot valve. The flow from the pilot valve moves the main spool.
The position transducer, measures the position of the main spool (actual value U_{LI}) and produces a feedback voltage which is fed back to the control amplifier and compared with the command voltage. The control amplifier drives the pilot valve until command voltage and feedback voltage are equal. Thus, the position of the main spool is proportional to the electrical command signal.
To simplify matters, the spool position command is taken as the flow rate command. The actual flow Q_X depends on the electrical command U_{QS} and the valve pressure drop $\triangle p_x$.

Block diagram of main spool position loop



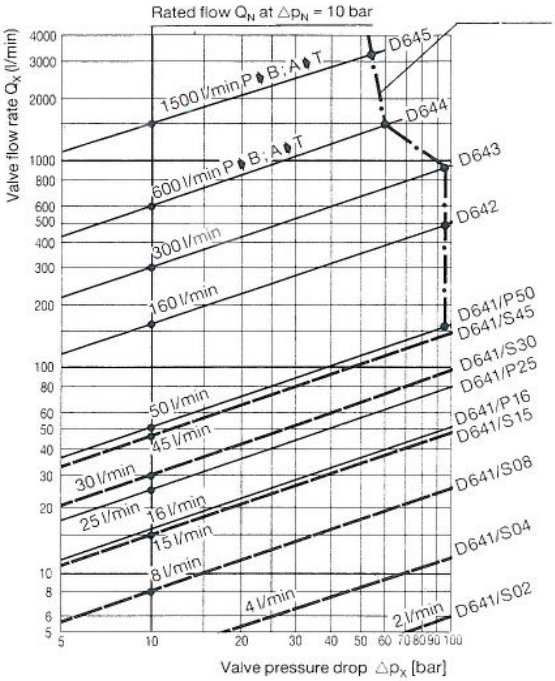
Proportional valve – 2-stage version



For different values of valve pressure drop, the flow may be determined by the square root function for a sharp-edged orifice:

$$Q_X = Q_N \sqrt{\frac{\Delta p_X}{\Delta p_N}}$$

where Q_N is the rated flow, Δp_N the rated valve pressure drop and Δp_X the actual valve pressure drop. The flow value Q_X calculated in this way should result in an average flow velocity of no more than 30 m/s in ports P,A,B,T. The next larger valve size should be chosen if a higher flow velocity results.



Valve flow diagram
Valve flow for maximum valve opening (100% main spool stroke) as a function of the valve pressure drop.
This maximum valve flow is increased slightly in valves with axis cut null condition. Refer to the flow characteristics in the data sheets.

Technical data

Hydraulic characteristics

Operating pressure range:

Main stage	Up to 350 bar
Pilot valve	15 to 210 bar (standard) Pressures up to 350 bar upon request

Max return port pressure

at port T:	
external pilot return (NOT for stubshaft version)	350 bar
internal pilot return or port Y (NOT for stubshaft version)	20% of pilot pressure spikes up to 140 bar acceptable with D076: up to 210 bar
for stubshaft version with internal or external pilot return	20% of pilot pressure
Seal material	Buna N (others upon request)
Temperature range	–20 to +80°C
Operating fluid	mineral based hydraulic oil, viscosity 15 to 45 mm²/s (cSt)
Degree of protection	IP 65 (with mating connector)
Installation options	Any position, fixed or movable

System filter

Pilot valve	High pressure filter – without bypass, but with dirt alarm – mounted in the main flow and if possible, directly upstream of the proportional valve.
Main stage	High pressure filter as for the pilot stage. Depending upon the system return line or bypass filtration may be required.

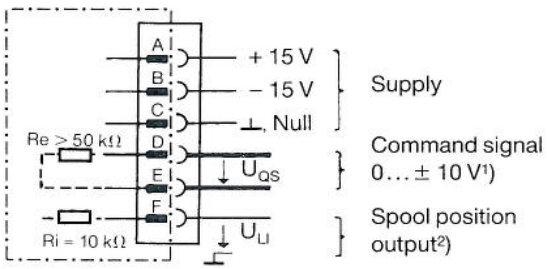
Filter rating

Main stage and pilot valve –	
for normal operation	$\beta_{25} \geqq 75$ (25 μm absolute)
for long life	$\beta_{15} \geqq 75$ (15 μm absolute) or better

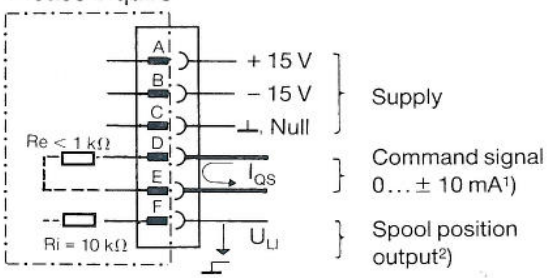
Electrical characteristics

Supply voltage	± 15 V ± 3%
Current consumption	± 200 mA maximum

Valves with voltage command
Standard



Valves with current command
Please inquire



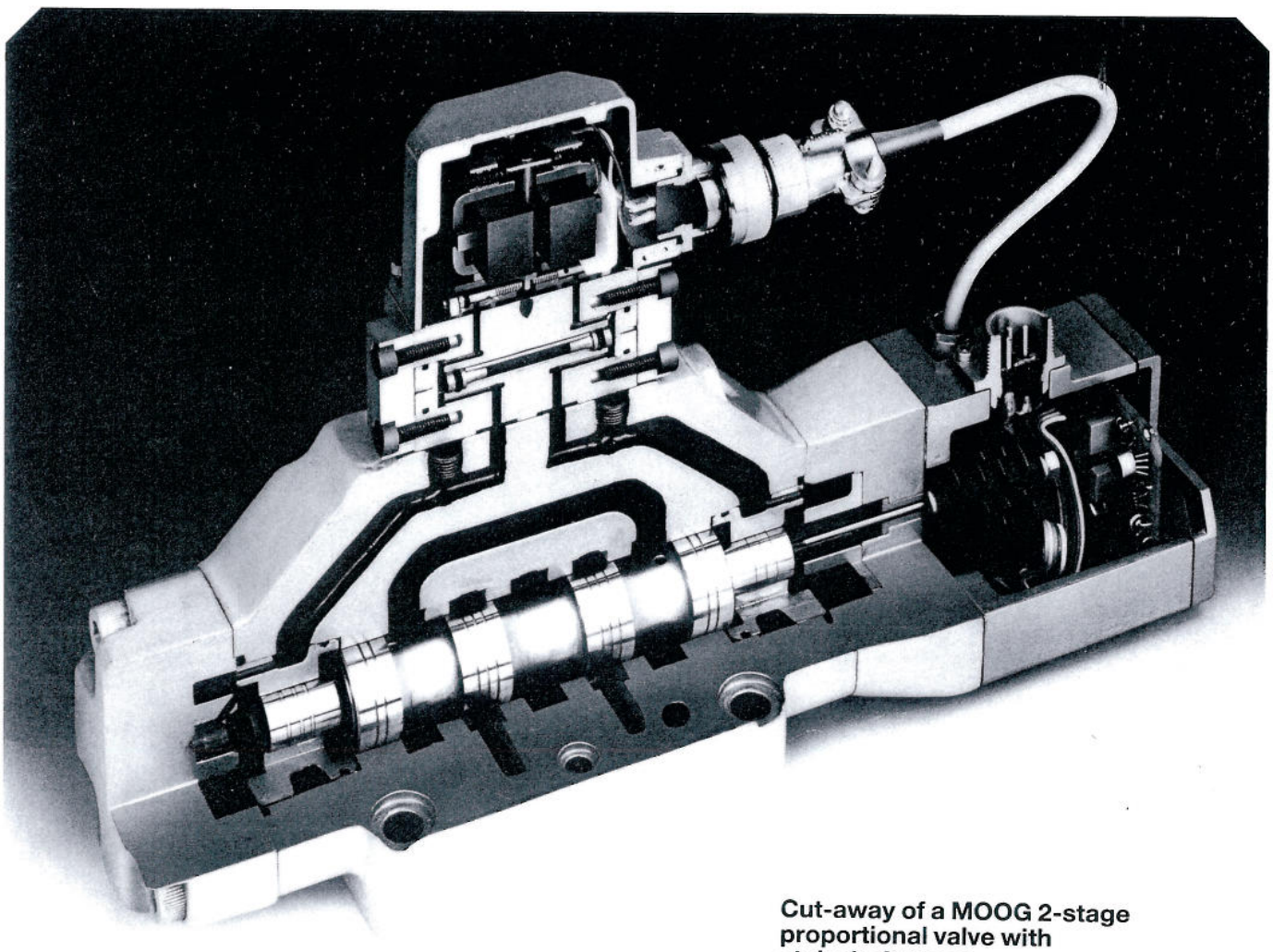
1) Command signals
U_{QS}, I_{QS}
- Analog command signals
- Positive signal (in arrow direction) causes valve opening from P ➧ A and for 4-way versions, from B ➧ T. Negative signal causes valve opening from A ➧ T and for 4-way versions, from P ➧ B.
- One input (D or E) must be connected to ⊥. If this is not possible, please consult factory.

2) Spool position output
U_{LI} ± 100% = approx. ± 1.8 V (exact value see service manual).

Summary of characteristics

Series	D641P		D641S					
Mounting pattern to DIN 24340	**Form A 10** port dia 10.5 mm		**Form A 10** port dia 10.5 mm					
Nominal flow rate Q_N (±10 %) [l/min] at $\triangle p_N$ = 10 bar[1]	16/25/50	140[2]	45/30	15/8	4/2	45/30	15/8	4/2
Valve version	2-stage	2-stage	2-stage	2-stage	2-stage	2-stage	2-stage	2-stage
Main spool configuration	spool in body	spool in body	bushing/ spool	bushing/ spool	bushing/ spool	bushing/ spool	bushing/ spool	bushing spool
Pilot valve model	Integrated pilot stage		Integrated pilot stage					
Response time [ms] for 0 to 100 % stroke*	**45**	**28**	**30**	**25**	**18**	**20**	**16**	**12**
Null leakage flow*[3] max. [l/min]	3,0	4,0	4	3,2	2,5	5	4,2	3,5
Pilot valve oil flow [l/min] at 100 % step input*	2	3	2	2	2	3	3	3
Mass [kg]	5,4	5,4	5,5	5,5	5,5	5,5	5,5	5,5

*) At 140 bar system pressure or 140 bar pilot pressure
[1]) 5 bar pressure drop per metering land
[2]) 2 × 70 l/min with parallel flow pathes and 10 bar valve pressure drop
[3]) Measured for axis cut null condition including pilot valve leakage

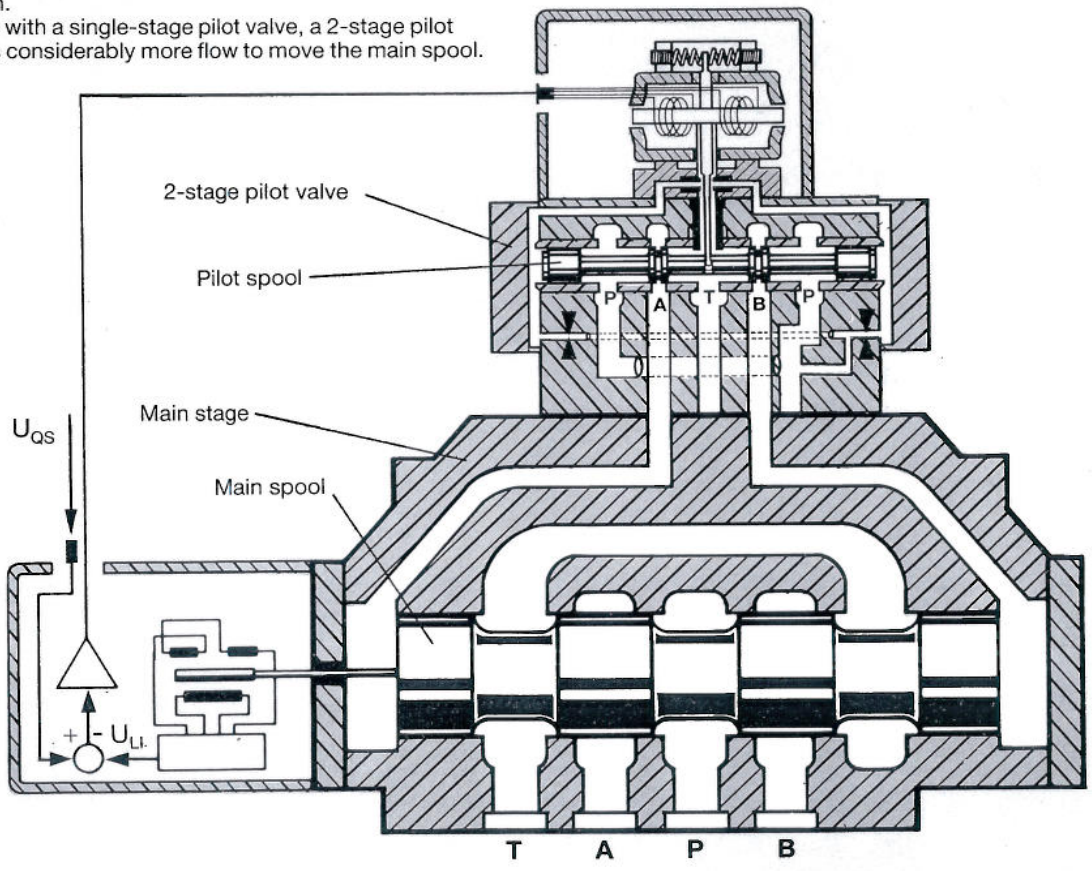


Cut-away of a MOOG 2-stage proportional valve with stub shaft spool

	D642			D643			D644		D645		
	Form A 16 port dia 18 mm			**Form A 25** port dia 25 mm			**Form A 25** port dia 32 mm		**Form A 32** port dia 50 mm		
?	160	160	160	300	300	300	600 P▸B▸A▸T 340 P▸A▸B▸T		1500 P▸B▸A▸T 1300 P▸A▸B▸T		
stage	2-stage	2-stage	3-stage	2-stage	2-stage	3-stage	2-stage	3-stage	3-stage	3-stage	3-stage
shing ool	standard spool	stub-shaft spool	standard spool	standard spool	stub-shaft spool	standard spool	stub-shaft spool	standard spool	standard spool	standard spool	stub-shaft spool
	D061	D061	D076	D061	D061	D076	D061	D076	D631	D076	D076
	120	**35**	**16**	**170**	**45**	**18**	**70**	**25**	**35**	**30**	**18**
5	4,5	4,5	4,0	4,5	4,5	4,0	5,0	4,5	7	7	7
	3	3	20	3	3	20	3	20	55	55	33
5	11	11	11,5	17	17	17,5	13,5	14	70	69,5	69,5

Proportional valve – 3-stage version

This version must be used when the response time of a 2-stage valve that has large main spool strokes is not sufficient for the application.
In comparison with a single-stage pilot valve, a 2-stage pilot valve provides considerably more flow to move the main spool.



Ordering information for:

D641 P (Ordering information for D641S can be found on the data sheet)

Model number Type designation

D641 – XXX XP XX X X X X X X N X

Model designation
(assigned at the factory; includes all specifications)

Factory identification

Flow code	Nominal flow rate Q_N at valve pressure drop $\Delta p_N = 10$ bar
16	16 l/min
25	25 l/min
50	50 l/min and 140 l/min for 2 × 2-way and 5-way versions

Maximum operating pressure for main stage

F	210 bar with $P_x = 210$ bar: operating pressure mainstage 350 bar
K	350 bar with internal or external pilot

Spool version main stage

D	4-way, ± 10 % overlap, linear
P	3-way P ➧ A, A ➧ T, axis cut, linear
Q	5-way P ➧ A, P_2 ➧ B, A ➧ T, approx. axis cut, linear 140 l/min at $\Delta p = 10$ bar P ➧ A, P_2 ➧ B (70 l/min at $\Delta p = 10$ bar A ➧ T)
Z	2 × 2-way P ➧ A and P ➧ B (140 l/min at $\Delta p = 10$ bar) 10 % overlap, linear
X	special spools upon request

Electronics board
A, B, C, . . .
(assigned at the factory)
± 10 mA current command upon request

Seal material

N	Buna N, others upon request

Pilot connection and supply pressure

A	Internally via P
C	Externally via X, 15 bis 210 bar
L	Externally via X, 25 bis 350 bar

Spool position on main stage
without electrical supply

0	Undefined
1	mid-position
2	At full end position P ➧ B, A ➧ T
3	At full end position P ➧ A, B ➧ T

Response time

A	28 ms	0 to 100 % stroke and 140 bar pilot pressure
P	45 ms	

Pilot valve

1	Without mechanical feedback (only possible with spool positions 0, 2 and 3)
5	With additional mechanical feedback (only possible with spool position 1)

D642, D643, D644, D645

Model number Type designation

D642 – XXX X X 02 KX X X X X N X
D643 – XXX X X 03 KX X X X X N X
D644 – XXX X X 04 KX X X X X N X
D645 – XXX X X 12 KX X X X X N X

Model designation
(assigned at the factory; includes all specifications)

Factory identification

Main spool configuration

P	standard spool
H	spool with stub shafts

Spool version main stage

G	± 20 % overlap, linear
P	3-way version axis cut, curvilinear P ➧ A, A ➧ T, 40 % overlap, linear P ➧ B, B ➧ T,
V	± 20 % overlap, curvilinear
Y	approx. axis cut, curvilinear
X	special spools upon request

Pilot valve	Series
6	D076
1	D061*
4	D631 only for D645

*External pilot return – pilot connection B or D recommended

Electronics board
A, B, C, . . . (assigned at the factory)
± 10 mA current command upon request

Seal material

N	Buna N, others upon request

Pilot connection and supply pressure

		Supply	Return
A	15 to 210 bar	Internal	Internal
B	15 to 210 bar	External	External
C	15 to 210 bar	External	Internal
D	15 to 210 bar	Internal	External
	280/350 bar upon request		

Spool position on main stage
Without electrical supply

0	Undefined
2	At full end position P ➧ B, A ➧ T
3	At full end position P ➧ A, B ➧ T

Rated flow of pilot valve
at 70 bar valve pressure drop

A	1 l/min with pilot valve D061
D	10 l/min with pilot valve D076
E	20 l/min with series D645 with stub-shafts
F	40 l/min with series D645

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