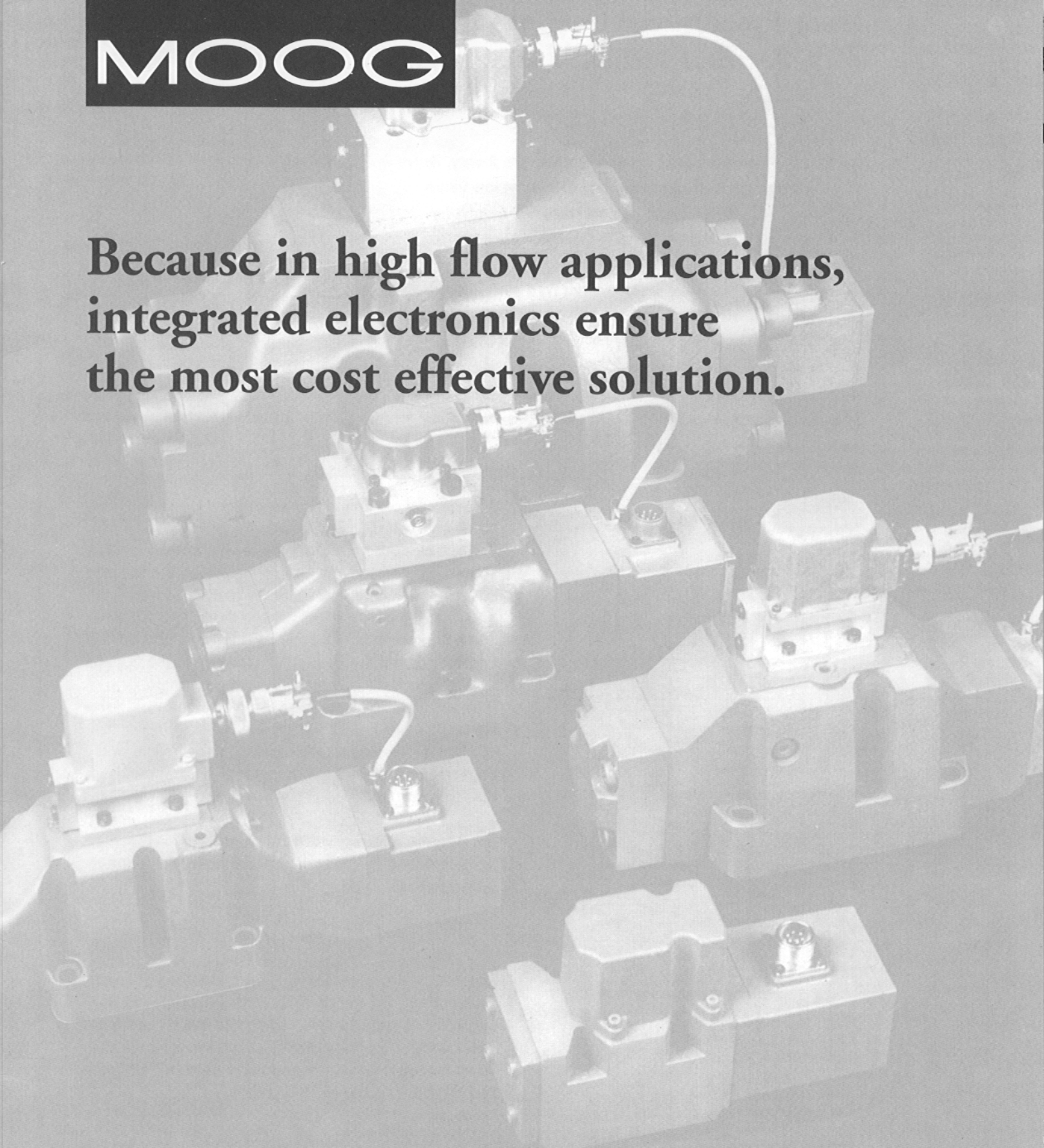
MOOG

Because in high flow applications, integrated electronics ensure the most cost effective solution.



MOOG

PROPORTIONAL CONTROL VALVES

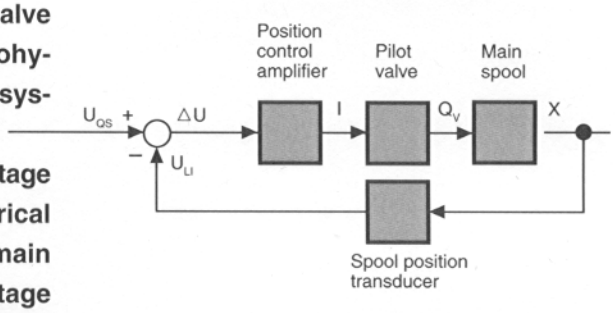
SERIES D640

Moog Proportional Control Valves, Series D640 with Electrical Feedback and Integrated Electronics

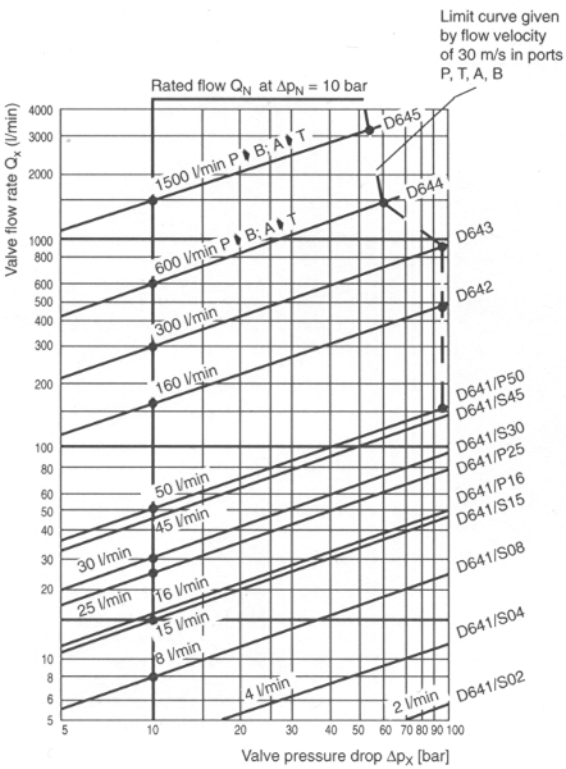
Series D640 proportional control valves are 2-way, 3-way, or 4-way throttle valves for large flows at low valve pressure drop. The valves are suitable for electrohydraulic position, velocity, pressure, or force control systems.

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. (See last page for detailed illustration.)

Block diagram of main spool position loop



Flow rate setpoint or position setpoint U_{QS}
Actual position voltage U_{LI}
Main spool displacement X



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.

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 Δp_X.

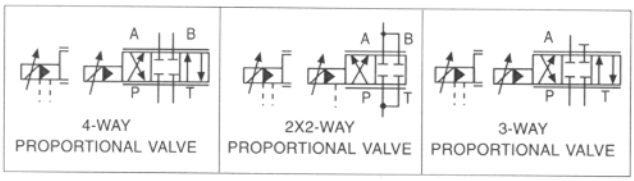
For different values of valve pressure drop, the flow may be determined by the square root function for a sharp-edged orifice:

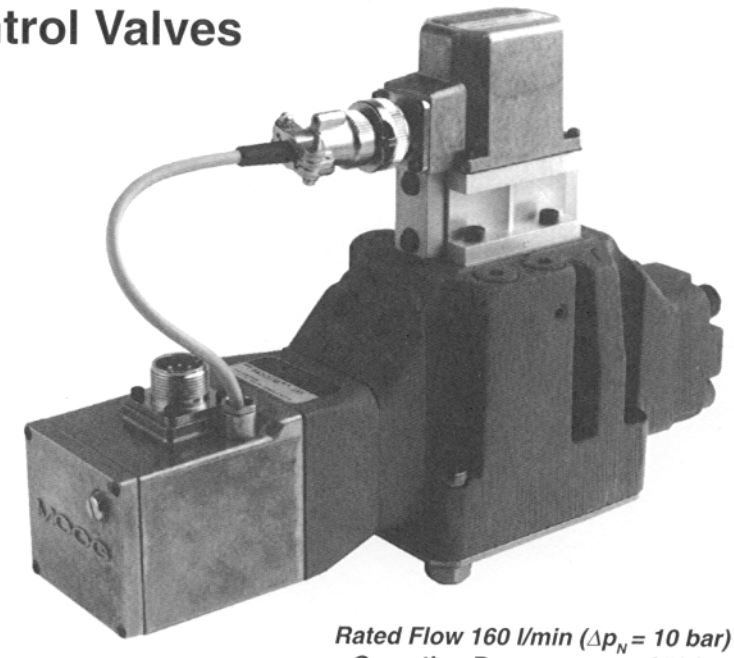
$$Q_X = Q_N \sqrt{\frac{\Delta p_X}{\Delta p_N}}$$

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.

D642 Series Proportional Control Valves with Integrated Electronics

The D642 Series proportional valves are 2-way, 3-way, or 4-way throttle valves for large flows at low valve pressure drop.





Rated Flow 160 l/min (Δp_N = 10 bar)
Operating Pressure up to 350 bar

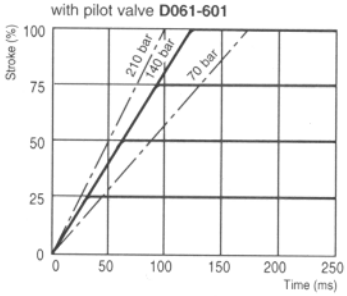
Specifications:

Port Size: dia 18mm
Valve Body Design: 5 chamber version

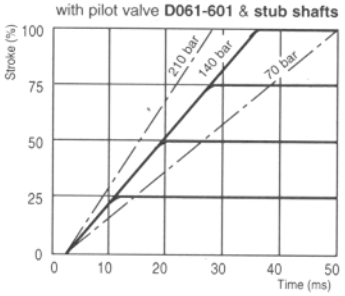
Rated Flow: (±10%) at 10 bar valve pressure drop [l/min]	160	160	160
Valve Version:	2-stage	2-stage	3-stage
Spool Configuration:	Standard	with stub shafts	Standard
Pilot Valve:	D061	D061	D076
Main Spool Stroke:	±4mm	±4mm	±4mm
Main Spool Drive Area:	7.1cm²	2cm²	7.1cm²
Response Time: for 0 to 100% stroke*	120ms	35ms	16ms
Threshold* [%]	<0.25	<0.4	<0.3
Hysteresis* [%]	<1	<1.5	<1
Null Shift: for ΔT=55°C	<1.5%	<1.5%	<2%
Null Flow: *max. (axis cut version) [l/min]	4.5	4.5	4.0
Pilot Valve Oil Flow: at 100% step input* [l/min]	3	3	20
Mass: [kg]	11.0	11.0	11.5

* at 140 bar pilot pressure or operating pressure

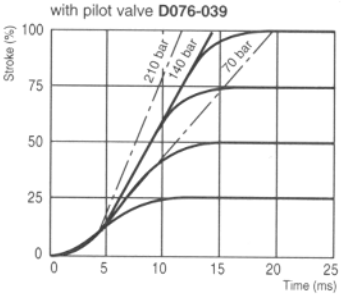
STEP RESPONSE
with pilot valve **D061-601**



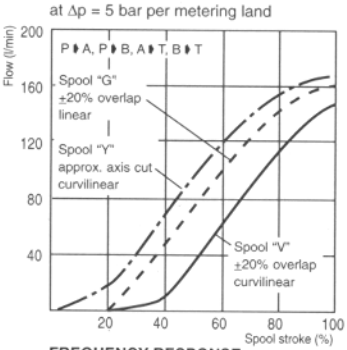
STEP RESPONSE
with pilot valve **D061-601** & **stub shafts**



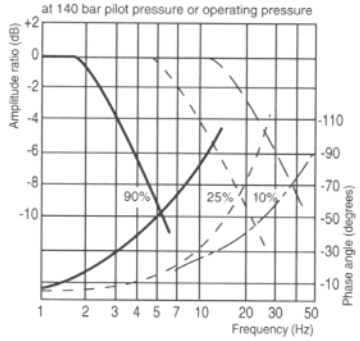
STEP RESPONSE
with pilot valve **D076-039**



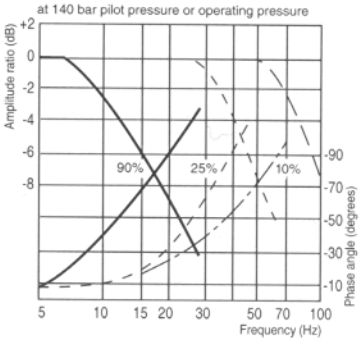
FLOW CHARACTERISTIC
at Δp = 5 bar per metering land



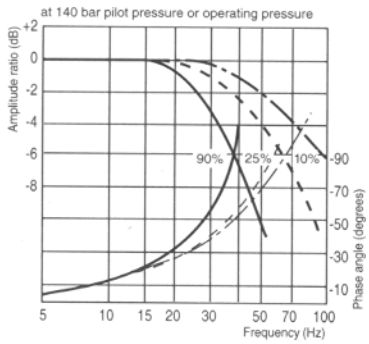
FREQUENCY RESPONSE
at 140 bar pilot pressure or operating pressure



FREQUENCY RESPONSE
at 140 bar pilot pressure or operating pressure



FREQUENCY RESPONSE
at 140 bar pilot pressure or operating pressure

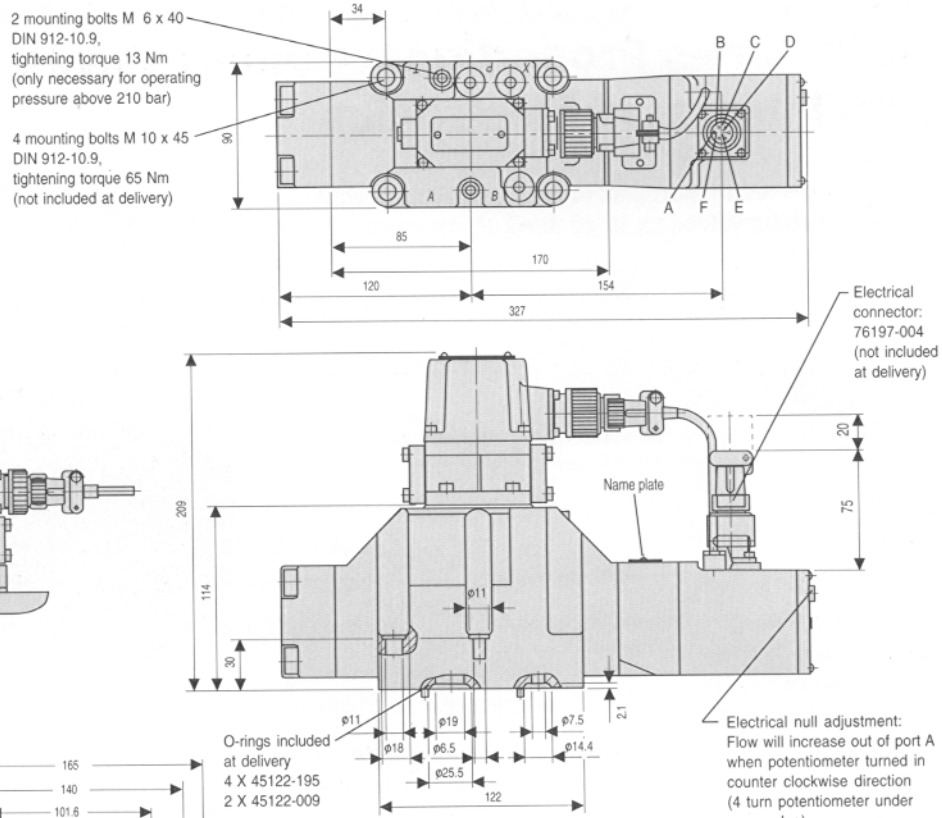


Notes:

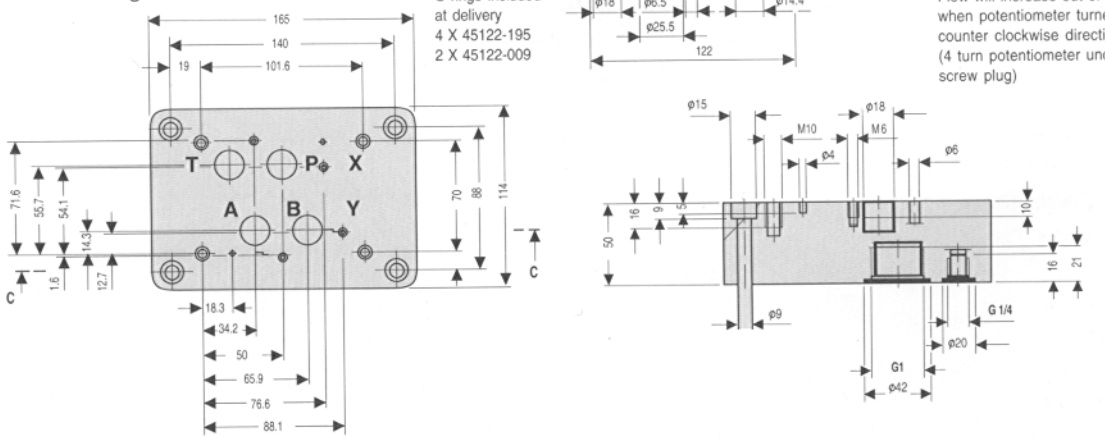
Replaceable Filter Element:
for pilot valve D061: B40414-1
for pilot valve D076: 14417-1

Flushing Plate:
A72037-1

Mounting Manifold A03239-001:
dimensions to DIN 24340
Form A 16, (ISO 4401-AD-07-4-A)
port NG 19, mounting surface flat
within 0.02 mm, average finish value
Ra better than 1 µm

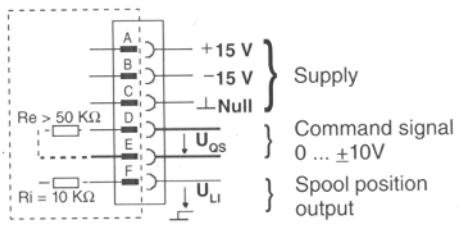


If pilot ports (X,Y) are not used, they must be plugged in mounting manifold.



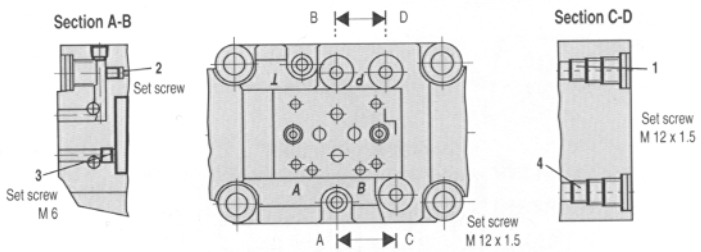
Electrical Connection:

Valves with voltage command
Standard



Conversion Instructions for main stage

The supply and return connections to the pilot valve may be either internally or externally connected as follows:

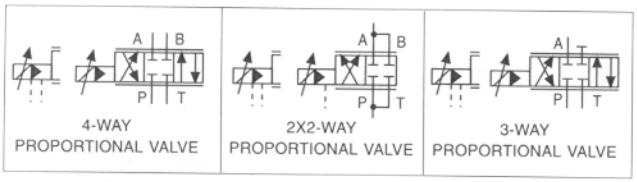


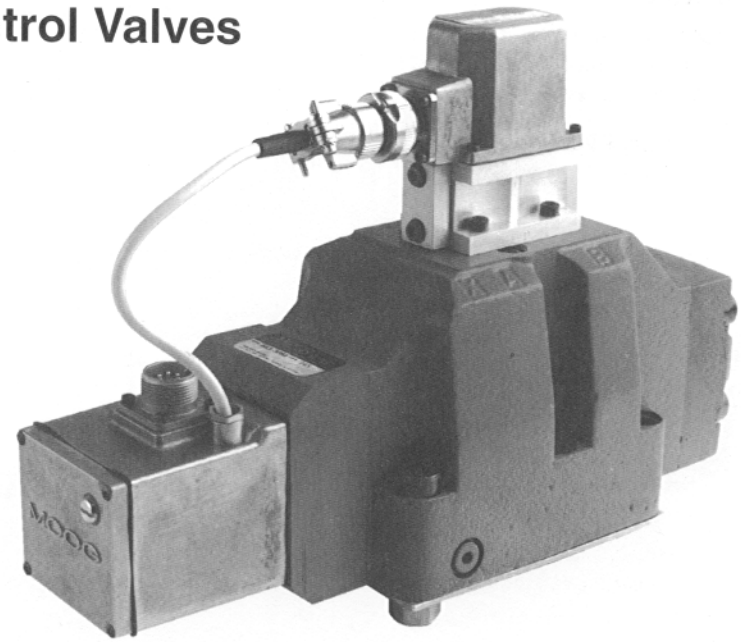
Pilot supply via	Set screw location 1	Set screw location 2	Pilot return via	Set screw location 3	Set screw location 4
internal P external X	closed open	open closed	internal T external Y	open closed	closed open

Specifications subject to change.

D643 Series Proportional Control Valves with Integrated Electronics

The D643 Series proportional valves are 2-way, 3-way, or 4-way throttle valves for large flows at low valve pressure drop.





Rated Flow 300 l/min (Δp_N = 10 bar)
Operating Pressure up to 350 bar

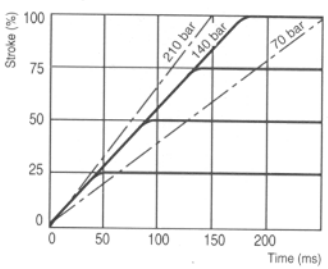
Specifications:

Port Size: dia 26mm
Valve Body Design: 5 chamber version

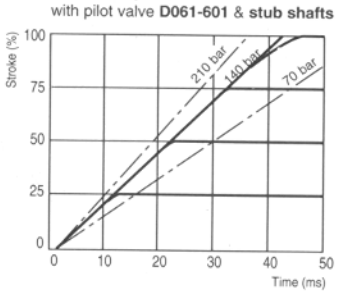
Rated Flow: (±10%) at 10 bar valve pressure drop [l/min]	300	300	300
Valve Version:	2-stage	2-stage	3-stage
Spool Configuration:	Standard	with stub shafts	Standard
Pilot Valve:	D061	D061	D076
Main Spool Stroke:	±5mm	±5mm	±5mm
Main Spool Drive Area:	7.9 cm²	2 cm²	7.9 cm²
Response Time: for 0 to 100% stroke*	170ms	45ms	18ms
Threshold* [%]	<0.25	<0.4	<0.3
Hysteresis* [%]	<1	<1.5	<1
Null Shift: for ΔT= 55°C	<1.5%	<1.5%	<2%
Null Flow: *max. (axis cut version) [l/min]	4.5	4.5	4.0
Pilot Valve Oil Flow: at 100% step input* [l/min]	3	3	20
Mass: [kg]	17.0	17.0	17.5

* at 140 bar pilot pressure or operating pressure

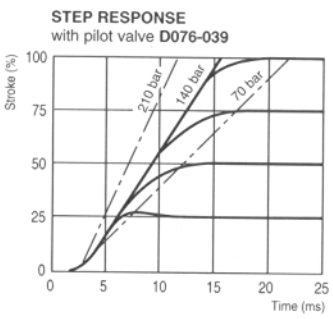
STEP RESPONSE
with pilot valve **D061-601**



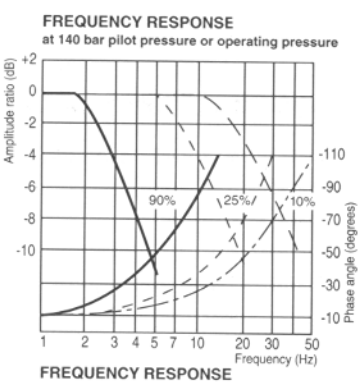
STEP RESPONSE
with pilot valve **D061-601** & **stub shafts**



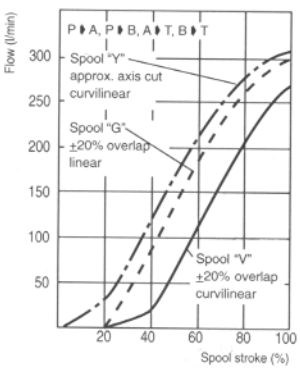
STEP RESPONSE
with pilot valve **D076-039**



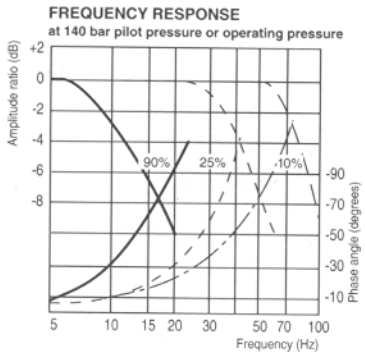
FREQUENCY RESPONSE
at 140 bar pilot pressure or operating pressure



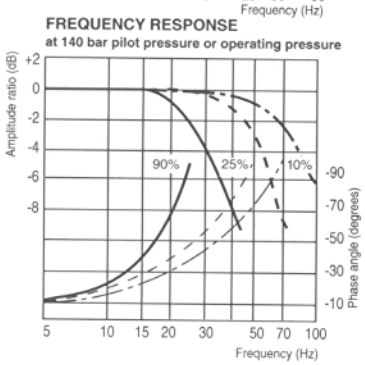
FLOW CHARACTERISTIC
at Δp = 5 bar per metering land



FREQUENCY RESPONSE
at 140 bar pilot pressure or operating pressure



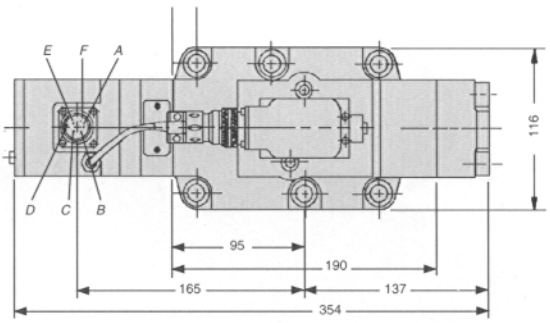
FREQUENCY RESPONSE
at 140 bar pilot pressure or operating pressure

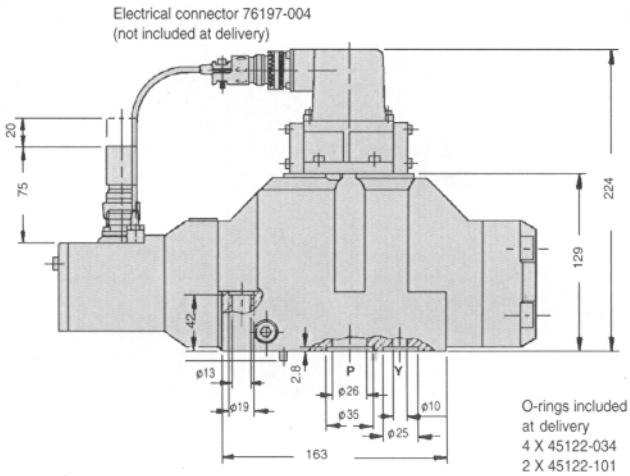


Notes:

Replaceable Filter Element:
for pilot valve D061: B40411
for pilot valve D076: 14417-1

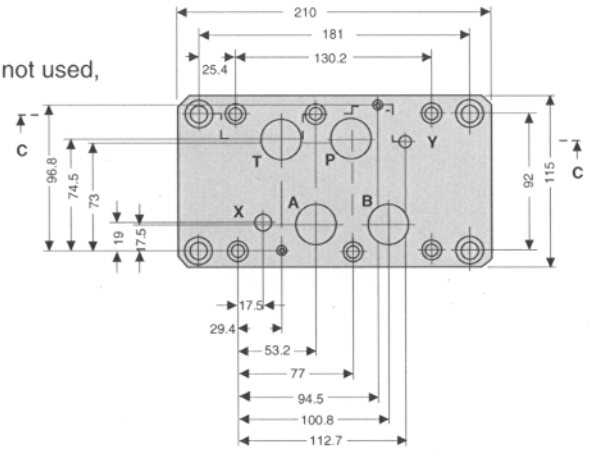
Flushing Plate:
A72017-1

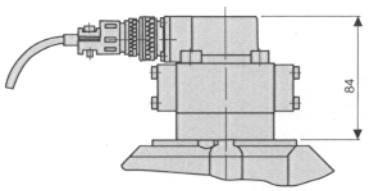




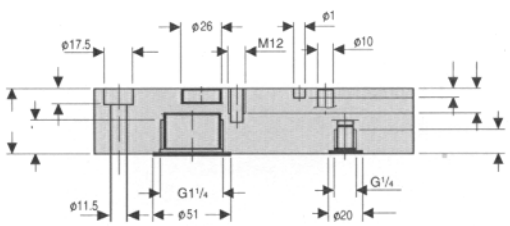
Mounting Manifold A26782-006:
dimensions to DIN 24340
Form A 25, (ISO 4401-AE-08-4-A)
port NG 26,
mounting surface flat within
0.02 mm, surface finish value
Ra better than 1 µm

If pilot ports (X,Y) are not used,
they must be plugged
in mounting manifold.



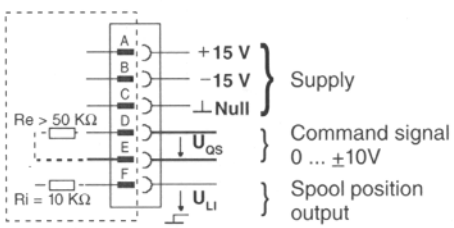


Version with
Series D076
Pilot valve

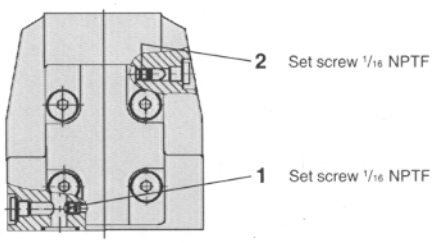


Electrical Connection:

Valves with voltage command
Standard



Conversion Instructions for main stage
The supply and return connections to the pilot valve may be either internally or externally connected as follows:

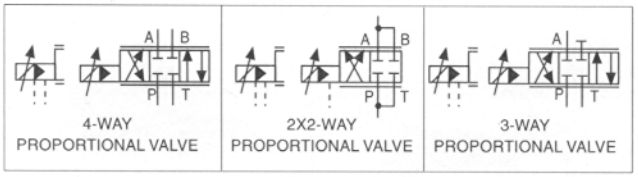


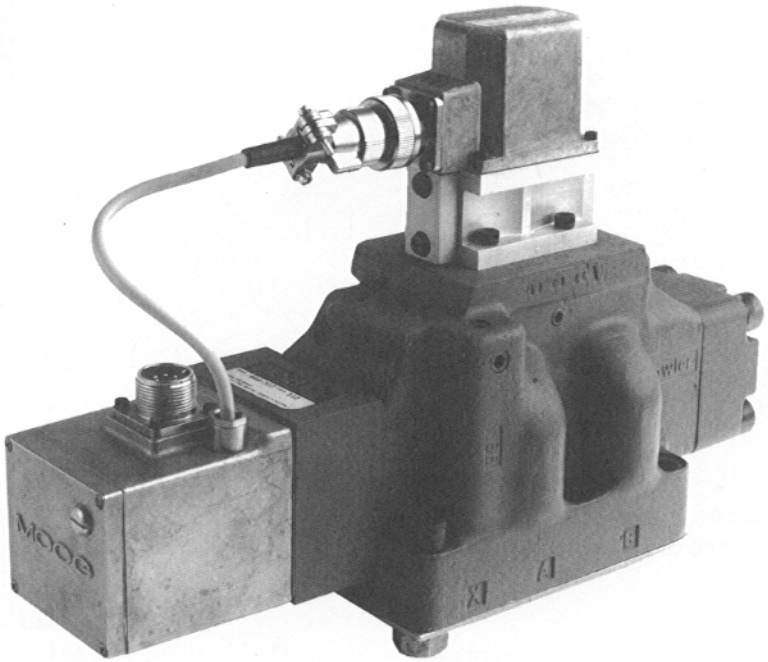
Pilot supply via	Set screw location 1	Pilot return via	Set screw location 2
internal P external X	open closed	internal T external Y	open closed

Specifications subject to change.

D644 Series Proportional Control Valves with Integrated Electronics

The D644 Series proportional valves are 2-way, 3-way, or 4-way throttle valves for large flows at low valve pressure drop.





Rated Flow 600 (340) l/min (Δp_N = 10 bar)
Operating Pressure up to 350 bar

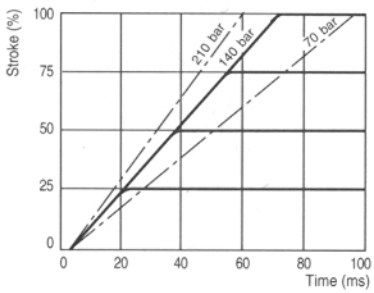
Specifications:

Port Size: dia 32mm
Valve Body Design: 4 chamber version

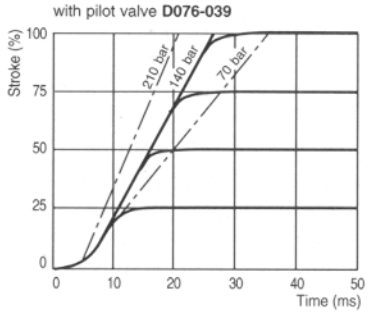
Rated Flow: (±10%) at 10 bar valve pressure drop [l/min]	600 P◗B◗A◗T 340 P◗A◗B◗T	600 P◗B◗A◗T 340 P◗A◗B◗T
Valve Version:	2-Stage	3-Stage
Spool Configuration:	with stub shafts	Standard
Pilot Valve:	D061	D076
Main Spool Stroke:	±7mm	±7mm
Main Spool Drive Area:	2cm²	10.75cm²
Response Time: for 0 to 100% stroke*	70ms	25ms
Threshold* [%]	<0.4	<0.3
Hysteresis* [%]	<1.5	<1
Null Shift: for ΔT= 55°C	<1.5%	<2%
Null Flow: *max. (axis cut version) [l/min]	5.0	4.5
Pilot Valve Oil Flow: at 100% step input* [l/min]	3	20
Mass: [kg]	13.5	14

* at 140 bar pilot pressure or operating pressure

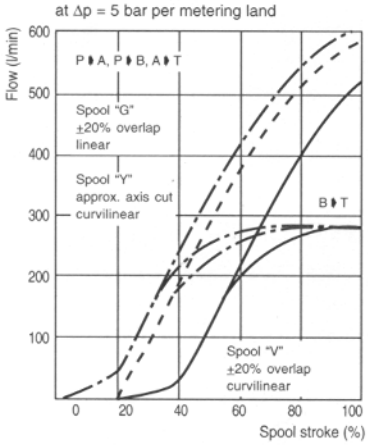
STEP RESPONSE
with pilot valve **D061-601**



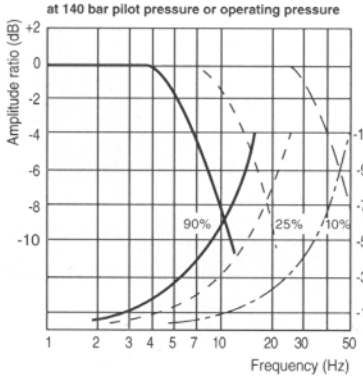
STEP RESPONSE
with pilot valve **D076-039**



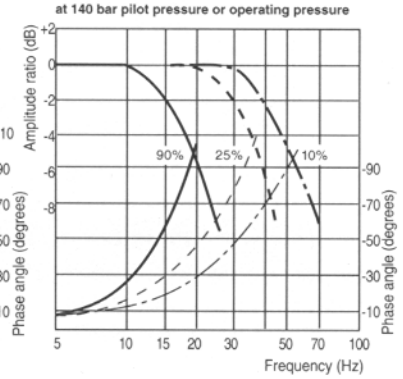
FLOW CHARACTERISTIC
at Δp = 5 bar per metering land



FREQUENCY RESPONSE
at 140 bar pilot pressure or operating pressure



FREQUENCY RESPONSE
at 140 bar pilot pressure or operating pressure

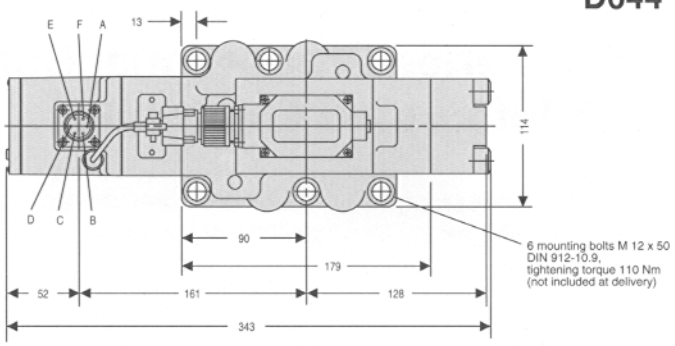


Notes:

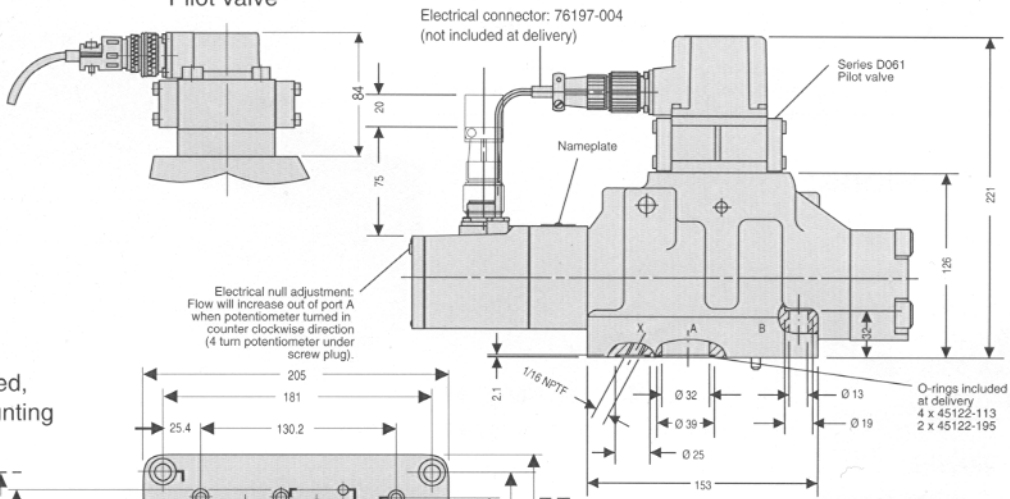
Replaceable Filter Element:
for pilot valve D061: B40414-1
for pilot valve D076: 14417-1

Flushing Plate:
A72017-1

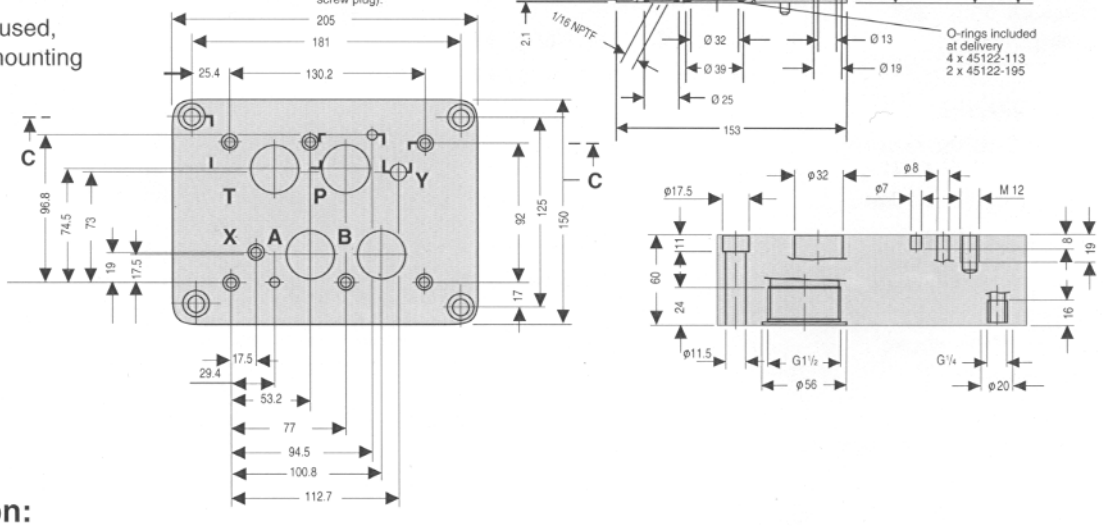
Mounting Manifold A25855-009:
dimensions to DIN 24340
Form A 25, (ISO 4401-AE-08-4-A)
port NG 32,
mounting surface flat
within 0.02 mm,
average surface finish value
Ra better than 1 µm



Series D076
Pilot Valve

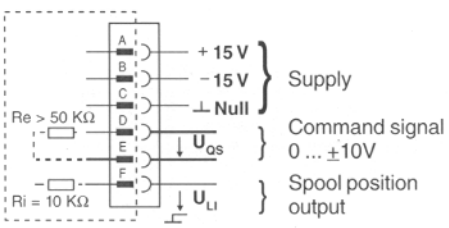


If pilot ports (X,Y) are not used, they must be plugged in mounting manifold.



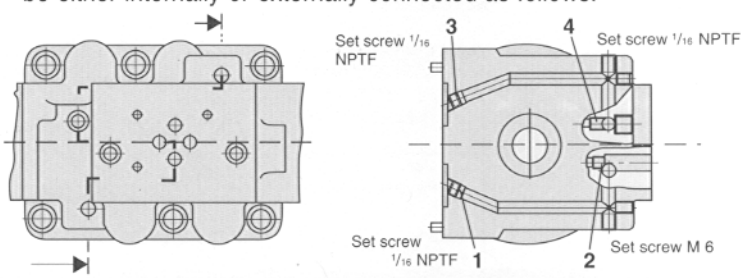
Electrical Connection:

Valves with voltage command
Standard



Conversion Instructions for main stage

The supply and return connections to the pilot valve may be either internally or externally connected as follows:

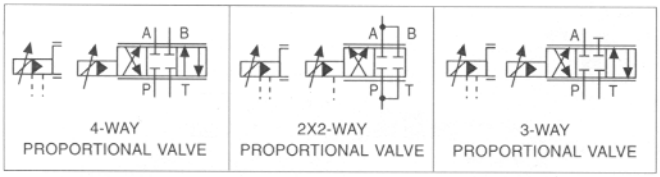


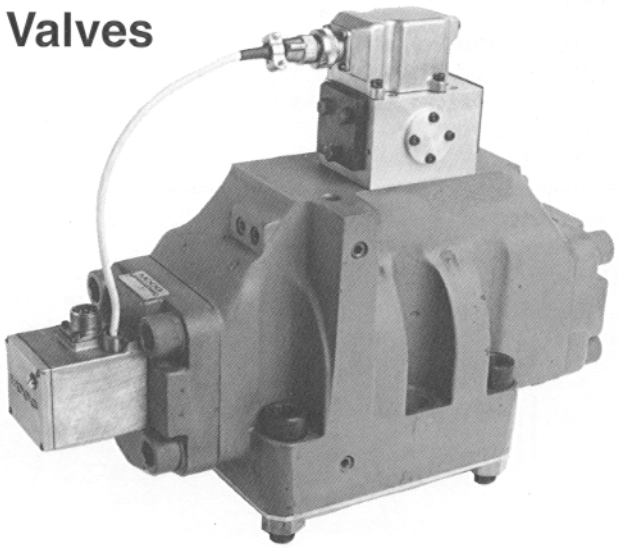
Pilot supply via	Set screw location 1	Set screw location 2	Pilot return via	Set screw location 3	Set screw location 4
internal P external X	closed open	open closed	internal T external Y	closed open	open closed

Specifications subject to change.

D645 Series Proportional Control Valves with Integrated Electronics

The D645 Series proportional valves are 2-way, 3-way, or 4-way throttle valves for large flows at low valve pressure drop.





Rated Flow 1500 (1300) l/min (Δp_N = 10 bar)
Operating Pressure up to 350 bar

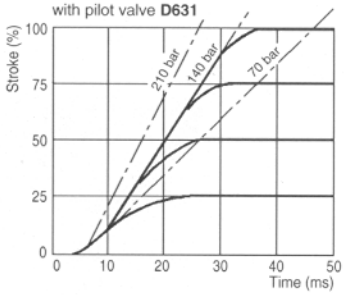
Specifications:

Port Size: dia 50mm
Valve Body Design: 5 chamber version
Rated Flow: (±10%)
at 10 bar valve pressure drop [l/min]

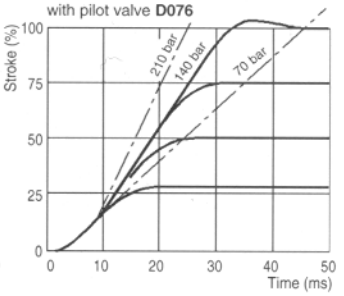
	1500 P◗B◗A◗T 1300 P◗A◗B◗T	1500 P◗B◗A◗T 1300 P◗A◗B◗T	1500 P◗B◗A◗T 1300 P◗A◗B◗T
Valve Version:	3-stage	3-stage	3-stage
Spool Configuration:	Standard	Standard	Stub shafts
Pilot Valve:	D631-3	D076	D076
Main Spool Stroke:	±8mm	±8mm	±8mm
Main Spool Drive Area:	33.2cm²	33.2cm²	9.6cm²
Response Time: for 8 to 100% stroke*	35ms	30ms	18ms
Threshold* [%]	<0.3	<0.4	<0.3
Hysteresis* [%]	<1	<1	<1
Null Shift: for ΔT= 55°C	<2%	<2%	<2%
Null Flow: *max. (axis cut version) [l/min]	7	7	7
Pilot Valve Oil Flow: at 100% step input* [l/min]	55	55	33
Mass: [kg]	70	69.5	69.5

*at 140 bar pilot pressure or operating pressure

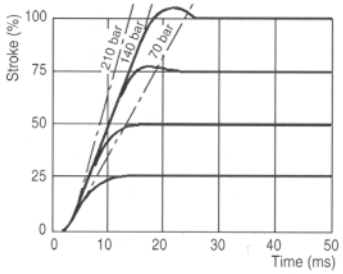
STEP RESPONSE
with pilot valve **D631**



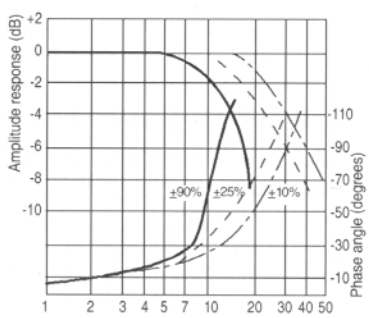
STEP RESPONSE
with pilot valve **D076**



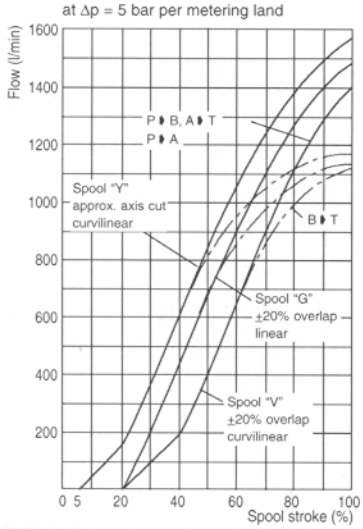
STEP RESPONSE
with pilot valve **D076 and stub shafts**



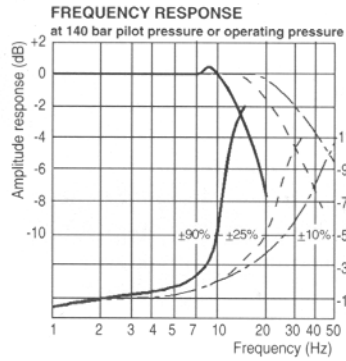
FREQUENCY RESPONSE
at 140 bar pilot pressure or operating pressure



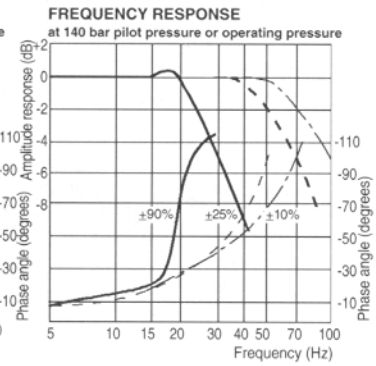
FLOW CHARACTERISTIC
at Δp = 5 bar per metering land



FREQUENCY RESPONSE
at 140 bar pilot pressure or operating pressure



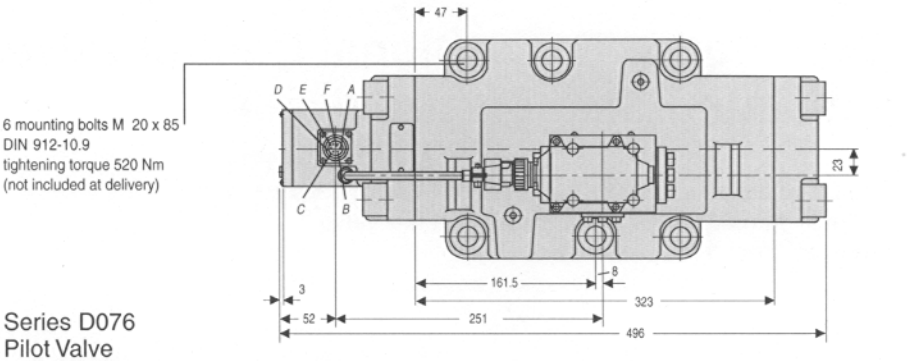
FREQUENCY RESPONSE
at 140 bar pilot pressure or operating pressure



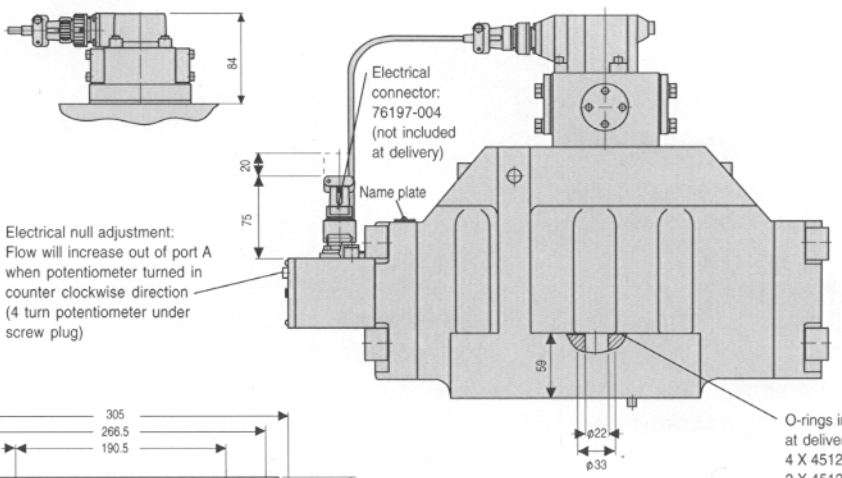
Notes:

Mounting Manifold A25856-001:

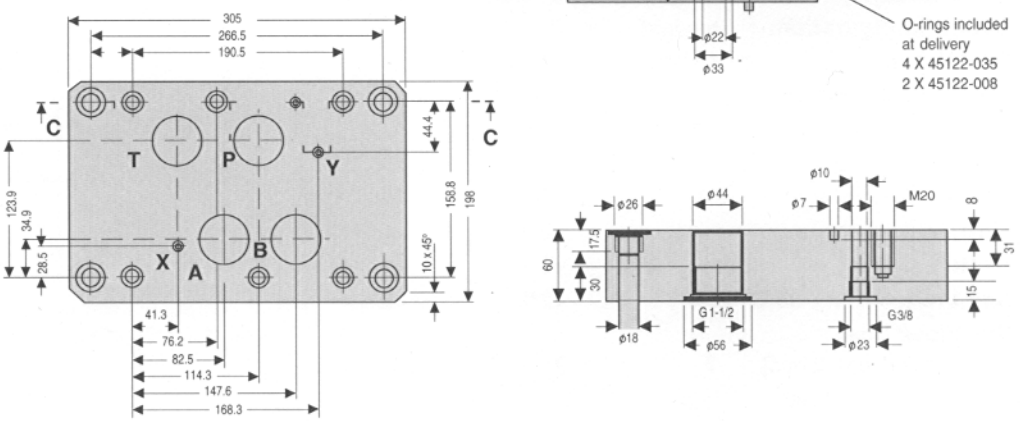
dimensions to DIN 24340
Form A 32, (ISO 4401-AF-10-4-A)
port NG 40,
(up to max. 1400 l/min):
mounting surface flat
within 0.02 mm,
surface finish value
Ra better than 1 µm



Series D076
Pilot Valve

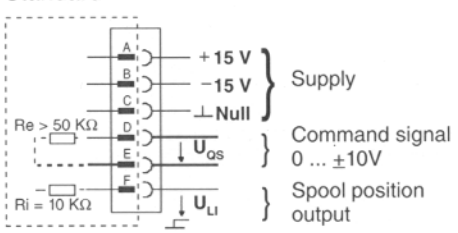


If pilot ports (X,Y) are not used, they must be plugged in mounting manifold.



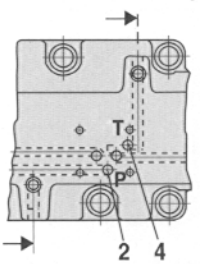
Electrical Connection:

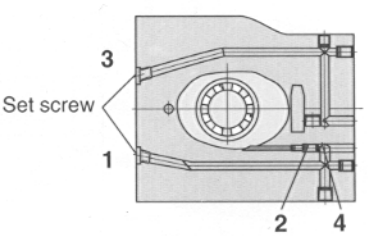
Valves with voltage command
Standard



Conversion Instructions for main stage

The supply and return connections to the pilot valve may be either internally or externally connected as follows:





Pilot supply via	Set screw location 1	Set screw location 2	Pilot return via	Set screw location 3	Set screw location 4
internal P	closed	open	internal T	closed	open
external X	open	closed	external Y	open	closed

Specifications subject to change.

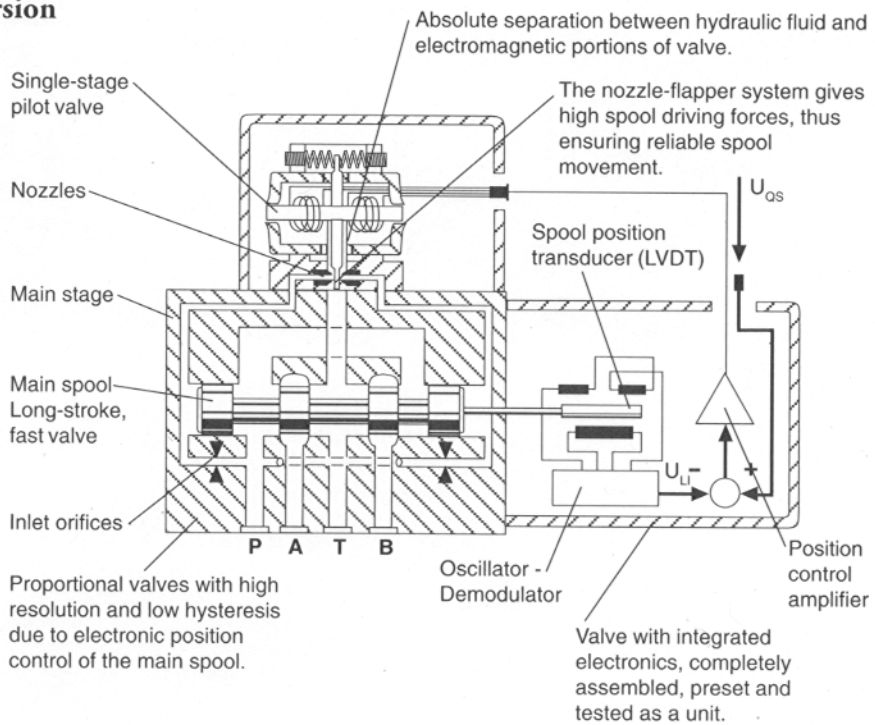
RELIABILITY

Proportional Valve - 2 Stage Version

Robust, contamination insensitive pilot stage. Reliability proven in thousands of applications.

Low, constant internal leakage flow through pilot stage. No power consuming pressure reducing valve needed.

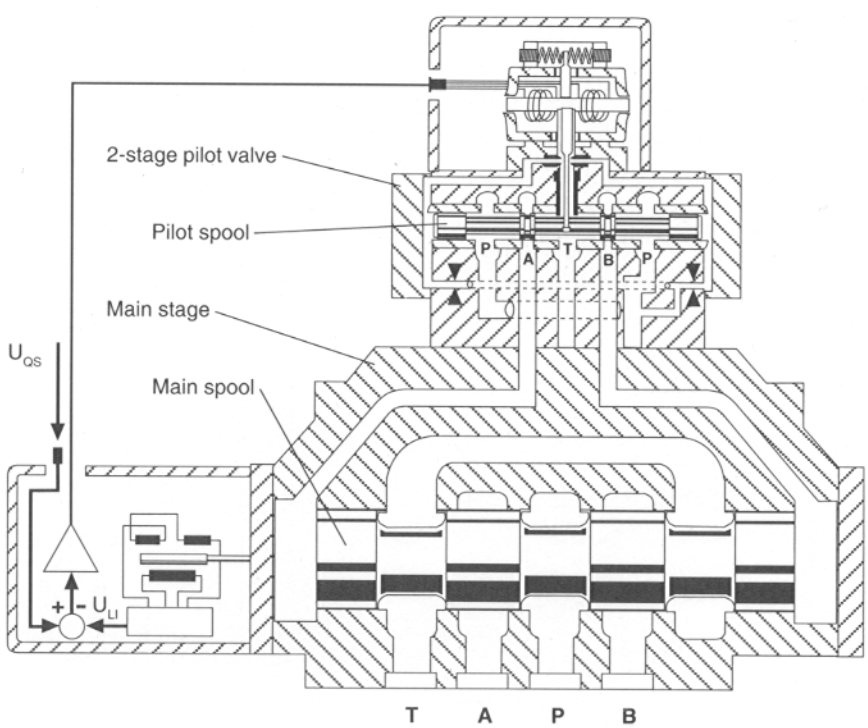
Low electrical power. Current consumption of the complete valve 200mA max.



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.



Technical Data

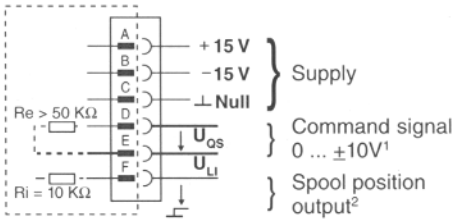
Hydraulic Characteristics

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 mm^2/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	$\beta_{25} \geq 75$ (25 µm absolute)
for long life	$\beta_{15} \geq 75$ (15 µm absolute) or better

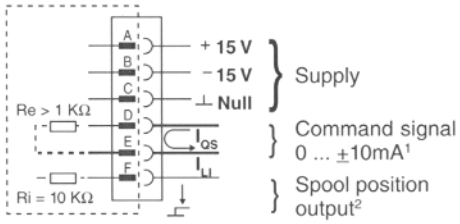
Electrical Characteristics

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. ±1.8V
   (exact value see service manual).

Ordering Information

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

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

Spool position on main stage (Without electrical supply)
0 Undefined
2 At full end P ◗ B, A ◗ T
3 At full end P ◗ A, B ◗ T

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		

Seal material
N Buna N, others upon request

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

MOOG

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