

Hand - Driven DL Type Directional Spool Valve Banks

with infinitely variable metering

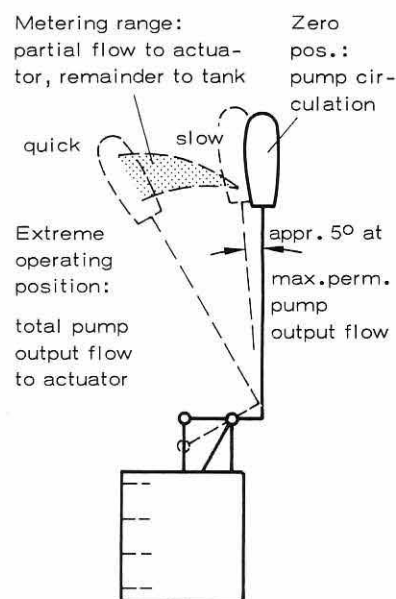
1. General

Hand-driven DL type directional control valves are incorporated in oil-hydraulic systems and generally serve to control the direction of movement of the attached single- or double-acting actuators. They also make it possible to influence the speed by throttling the pump circulation (bypass circulation).

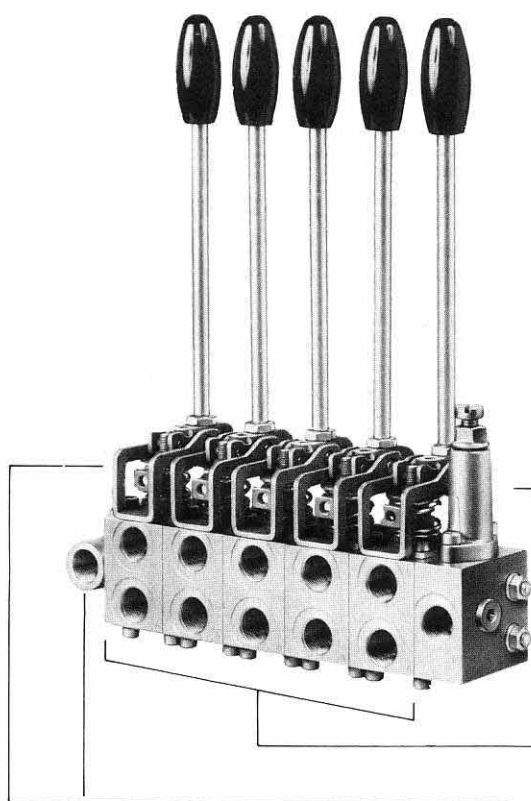
Two pump ducts are provided through the valve bank for this purpose: when the valves are in the middle position, the one duct connects the pump in series with the return (idling duct), whilst the second duct is connected in parallel with the individual actuator connections and is blocked in the zero position (pressure duct). The increase in throttle resistance of the idling circulation as the valve is gradually deflected by the hand lever acts on the actuator, setting it in motion, and exceeds the load pressure of the same. This results in good, infinitely variable control of the operating speed. The higher the load pressure and the smaller the pump output flow, the farther the lever will have to be shifted before actuator motion begins. The most sensitive speed control is thus achieved when the pump output flow is in the (permanent) flow volume range permissible for the respective size.

The valve unit is entirely of steel, thus rendering the housing insensitive to impact. Leakage (as has sometimes been observed due to hairline cracks in cast housings which migrate externally after prolonged operation), especially when utilizing permissible pressure ranges, is ruled out from the start. The hardened and ground spool valve, like the housing hole, undergoes a special final machining operation for roundness and depth of roughness while maintaining exact geometric shape (no removal or widening of the control edges). This produces a uniform sealing gap with a minimum leaking rate.

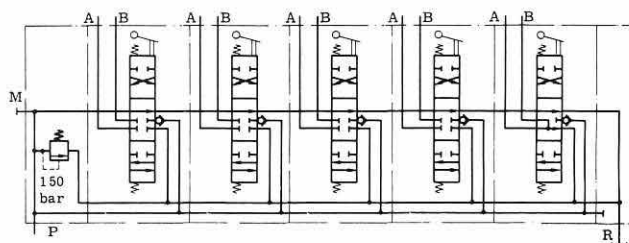
The external operating elements are constructed in an open, robust steel sheet design and are substantially protected from corrosion by appropriate surface treatment (galvanized or tenifer-coated).



2. General Outlay



Symbol and coding example of the illustrated directional spool valve bank



DL 31-3-GGGGD-B/E1-2-150

Connecting block (initial unit) with/without pressure limiting valve and pump connection

Directional spool valve (accessory units)

Operation/Mounting

End plate with return connection

Desired pressure setting (bar) when the connecting block is equipped with a pressure limiting valve

3. Types available

3.1. Type code, main data Also see Appendix, Section 5

Coding example:

DL 31-3-GGD-B/E1-2-150

Desired pressure setting (bar), only on version with press. limiting valve

Type of assembly (Table 3)

Operation (Table 2 and Sect. 5.2)

Table 1

Connection block (initial part) without/with pressure limiting valve ¹⁾		Con- nec- tion P	Connection size				Directional spool valve								End plates Connections R and W	
Code number	Pressure ranges from ... to (bar)		Code number	Con- nect. A, B	perm. pump outlet flow (l/min)	briefly	Valves for common applications								for lift cylind. at fork lifts H=G 1/4 (DL1.) G 3/8 (DL2.) G 1/2 (DL3.)	
DL 15	excl.	G 1/4	1	G 1/4	12	16										
DL 11	incl.															
DL 25	excl.	G 3/8	1	G 1/4	20	20										
DL 21	incl.															
DL 35	excl.	G 1/2	2	G 3/8	30	30										
DL 31	incl.															
DL 31	incl.	G 1/2	3	G 1/2	40	60										
Symbols DL 15 DL 25 DL 35 DL 11 DL 21 DL 31 M = Pressure gauge connection only in the case of DL 2.. and DL 3.. Assembly E.. → A (F..) → (B) G, B, D, E Example Code A																

Table 2		Mode of operation (standard with return spring, vers. with detent, see Sect. 5.2)				
Coding	Basic type design	Contact switch mod., for elec. data, refer to Sect. 3.4				
		Switch model			Customer-prov. switch	
		3)	4)	5)	6)	7)
with hand lever	B	B 4	B 4 S	B 40	B 6	B 8 ⁸⁾ B 81 ⁹⁾
without hand lever	B 1	B 5	B 5 S	B 50	B 7	B 9 ⁸⁾ B 91 ⁹⁾
Symbols						

Table 3		Mounting: connecting block on the left, connecting valve to the right			
Switch position		all sizes		only sizes 2 and 3	
Lever deflection at a = extends the spool into housing b = withdraws the spool from housing					
Coding		E 1	E 2	F 1	F 2
Direction of mounting		e.g. E 1		e.g. F 1	
Connections point		backwards		forwards	

¹⁾ depending on the spring determ. by the press. cited at the end of the ordering nomenclature (up to 160 or above 160 to 250 bar, or above 250 to 315 bar). Factory-adjust. variable only after loosening the lock nut (check with manometer !)

²⁾ Leakage oil limitat. by way of narrow valve fit, for lifting equipm. with single-action lifting cyl. For the lowest possible return resistance during lowering (low empty or tare weight). It is best to install A and P valves as the last ones in the block system ahead of the end plate

³⁾ with slight throttle action on the drain side in switch positions a (A → R) and b (B → R).

⁴⁾ ELAN type SEK 103/S/PG 11 K, safety class IP 64 (IP 00 possible, SEK 103/S/11, please specify when ordering). Not for size 1 !

⁵⁾ BURGESS V 3 S miniature switch with roller operation VLR 1, safety class IP 67.

⁶⁾ BURGESS V 3 YR miniature switch, safety class: housing IP 40, connections IP 00

⁷⁾ with switching cam, but without switch and switch carrier

⁸⁾ same as ⁷⁾, but with switch carrier for switch make BURGESS

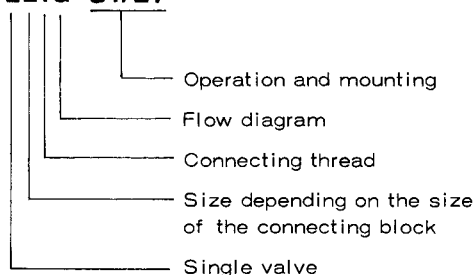
⁹⁾ same as ⁷⁾, but with switch carrier for switch make ELAN not size 1)

3.2. Ordering Nomenclature for single elements

e.g. for replacement parts, stock merchandise, etc.

Connecting block: DL 11, DL 21, DL 35 etc., as in Table 1, "connecting block"

Accessory units: **L21G-B1/E1**



Any tension rods which may be necessary must be specified in writing stating the number of valves. For further details, refer to the replacement part lists E 7260-1a and 7461 (DL 1..). E 7260-2a and 7261 (DL 2.. and DL 3..).

3.3. Other Characteristic Data

Design	Directional spool valve
Mounting	DL 1: M6, 8 deep (connecting block and end plate) DL 2: M8, 8 deep (in connecting block); M6, 10 deep (in end plate) DL 3: M8, 10 deep (connecting block and end plate)
Pipe connection	DIN ISO 228/1, previously DIN 259 (British Standard Withworth pipe thread), suitable for pipe fittings with screw plugs, form B, DIN 3852, page 2
Terms for connections	P..... pump connection A,B... actuator connections, positioning depends on mounting, refer to table 2 and dimensional sketches R..... return to tank (non pressurized ≤ 20 bar) when using the end plate, code No.2 (material die-cast zinc), use pipe connection with plastic sealing ring if possible. This gives better resistance to vibration and prevents distortion due to the lower tightening torque: G 1/4 \rightarrow 20...25 Nm; G 3/8 \rightarrow 40...50 Nm; G 1/2 \rightarrow 70...80 Nm W..... extended pressure-loadable connection (no-load operation channel outlet) to a downstream DL 15, DL 25 or DL 35 or any other optional directional spool valve with a neutral circulation position
Max. valve number	10
Flow direction	refer to the flow diagrams in table 1, Section 3.1
Installed position	optional
Pressure medium	Hydraulic oil conforming to DIN 51 524, Parts 1 and 2: 10...68 mm ² /s at 40°C (ISO VG 10 to VG 68 conforming to DIN 51 519) Viscosity limits: min. approx. 4; max. approx. 1500 mm ² /s Viscosity range for optimum operation approx. 10...500 mm ² /s Observe general notes in D 5488, Section 2
Temperatures	Oil and ambient: - 40 ... + 80°C; observe viscosity range

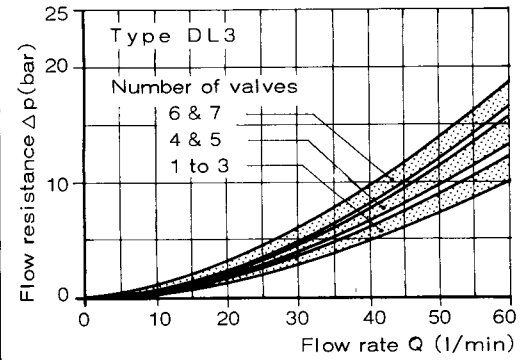
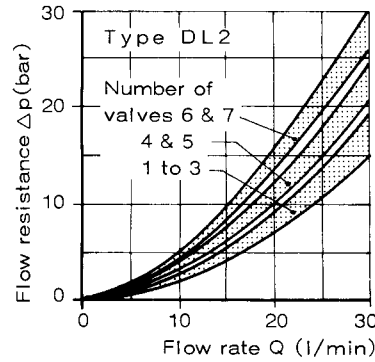
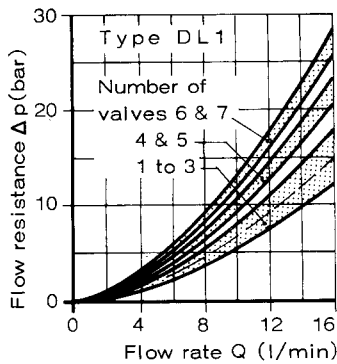
Mass
(weight) appr.kg

Type	Connecting block		Driven accessory unit	End plate	
	without pressure limiting valve	with pressure limiting valve		Code No. 2	Code No. 3
DL 1	0,3	0,4	0,5	0,1	0,3
DL 2	0,45	0,5	0,85	0,15	0,4
DL 3	0,7	0,8	1,4	0,2	0,65

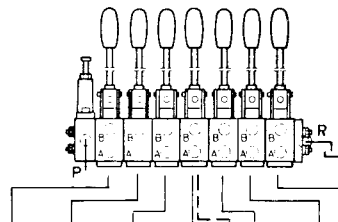
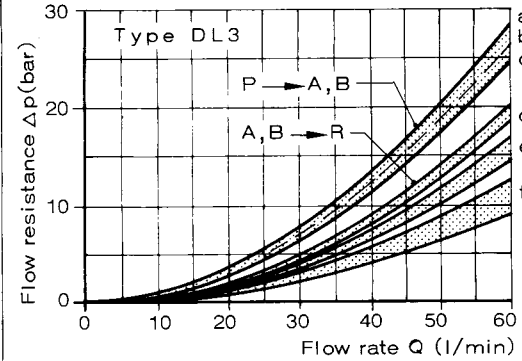
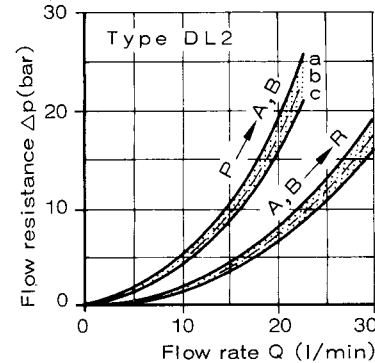
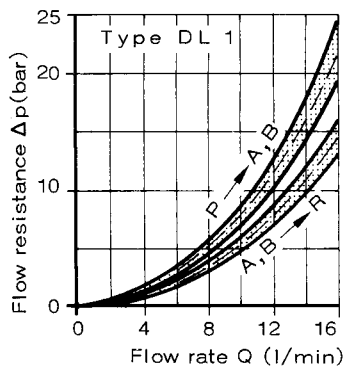
Continuation from page 3

 Δp -Q characteristics for valve code G...R. Measured on a bank with 7 valves

Pump circulation P → R



Actuator inflow and outflow in final shift positions, P → A, B and A, B → R

Oil viscosity during measurement approx. 60 mm²/s

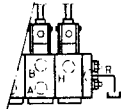
Number of valves	1	2	3	4	5	6	7
Flow direction	c/f	c/f	c/f	c/e	c/e	c/d	c/d
P → A, B / A, B → R	c/f	c/f	c/f	c/e	c/e	c/d	c/d
1st letter							
2nd letter							
1st valve	c/f	c/f	c/f	c/e	c/e	c/d	c/d
2nd valve	c/f	c/f	c/f	c/e	c/e	c/d	c/d
3rd valve			b/f	b/f	b/f	b/e	b/e
4th valve			b/f	b/f	b/f	b/e	b/e
5th valve			b/f	b/f	b/f	b/e	b/e
6th valve			b/f	b/f	b/f	a/f	a/f
7th valve			b/f	b/f	b/f	a/f	a/f

Example:

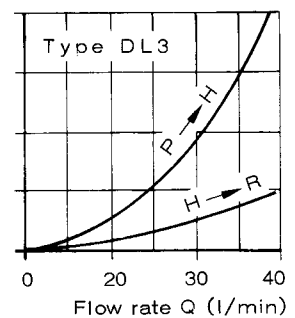
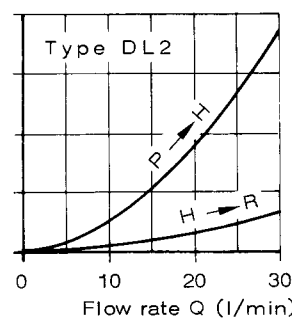
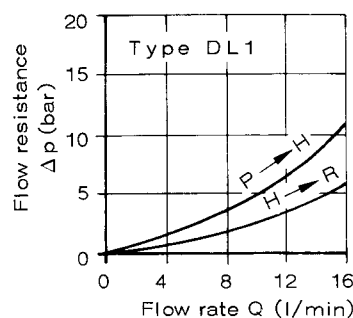
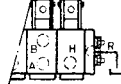
The Δp_{inlet} to the actuator must be ascertained according to curve b and the simultaneous Δp_{outlet} from the actuator must be ascertained according to curve f for the fourth valve in a bank containing a total of five valves.

 Δp -Q-characteristics for

valves code A

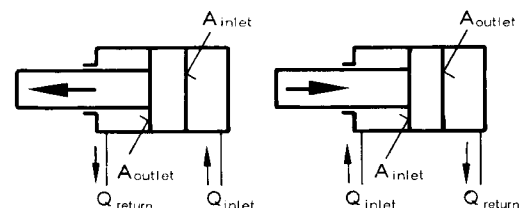


valves code P

Oil viscosity during measurement approx. 60 mm²/s

When using double-acting actuators with unequal surface area ratio (diff.cyl.), the return Q_{return} can be larger or smaller than the inflow (pump output flow) Q_{inlet} depending on the direction of movement. The flow resistance must always be based on the inflow side (connection P).

$$\Delta p_{total} = \Delta p_{inlet} + \Delta p_{outlet} \frac{A_{outlet}}{A_{inlet}}$$



$$Q_{return} = Q_{inlet} \frac{A_{outlet}}{A_{inlet}}$$

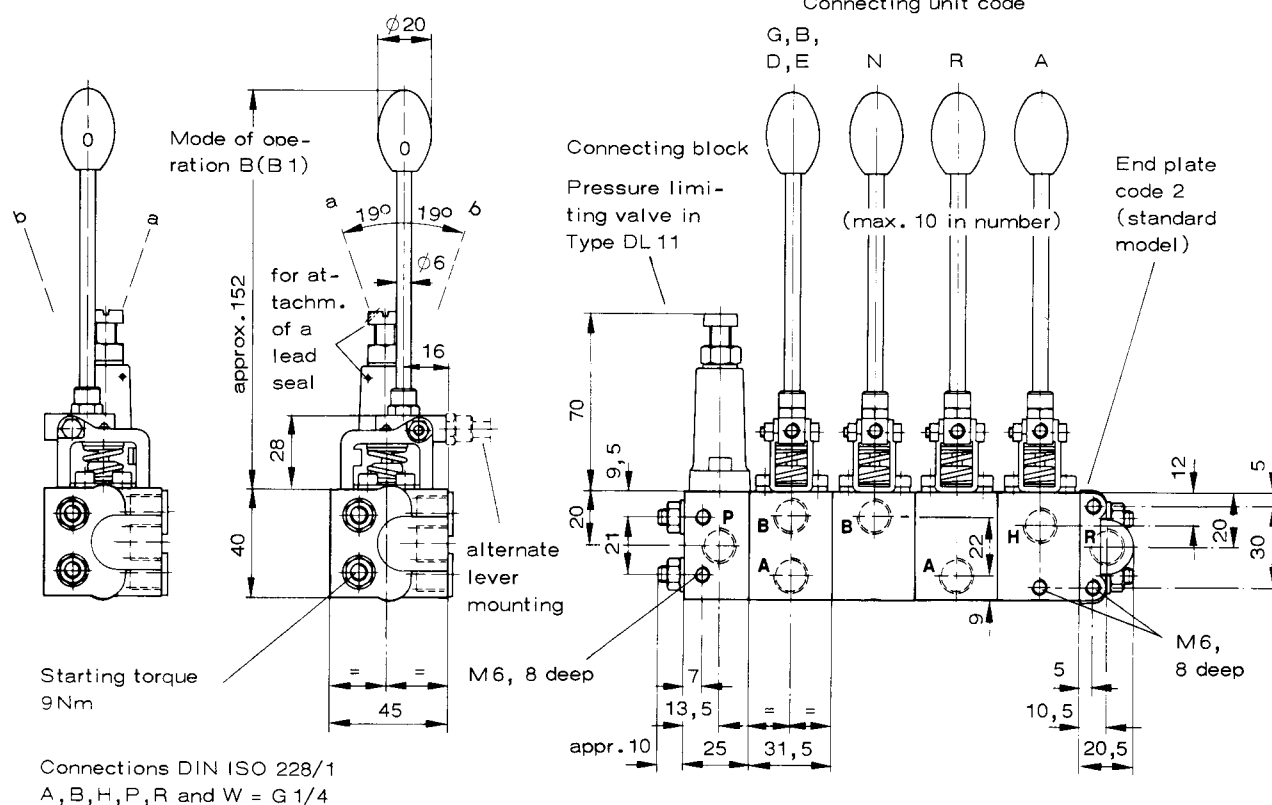
4. Dimensions of Units (All dimensions in mm. Subject to change without notice)

4.1. Type DL 1...

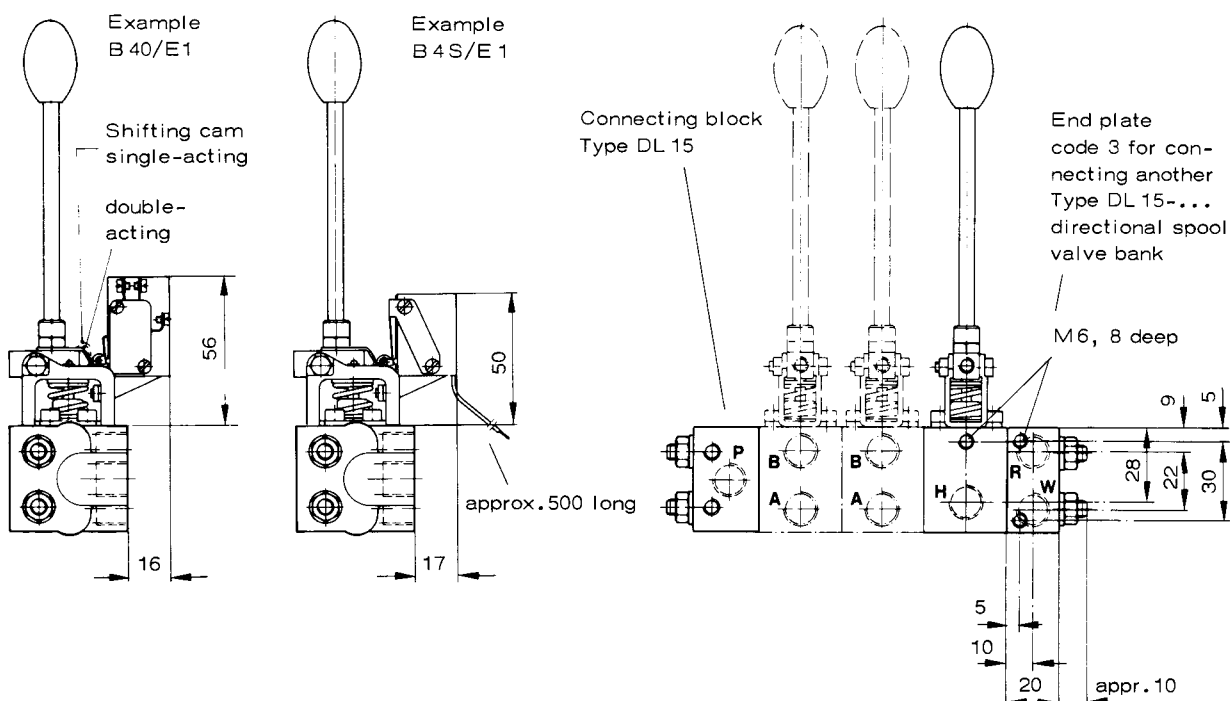
only in assembly E...

Assembly E 1

Assembly E 2



Contact switch design



For missing dimensions, refer to sketch above!

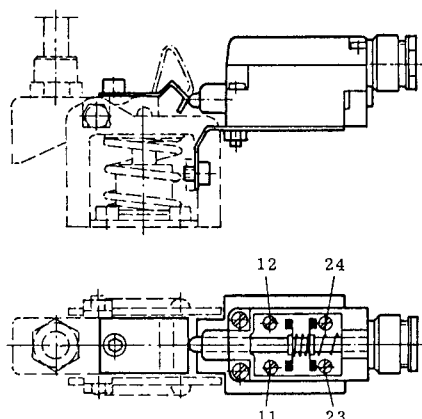
4.3. Contact switch design in accordance with Table 2, Section 3.1

4.3.1. Designs B(E)4, B(E)5, B(E)6, B(E)7, B(E)81, B(E)91

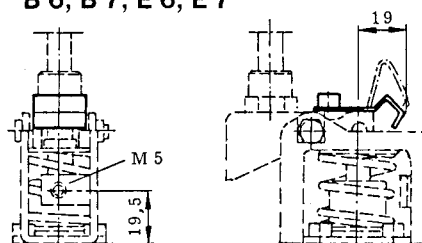
This switch allows the contact bridges 11 - 12 and 23 - 24 to be used as sliders or NC contacts as required in switch setting a or b.

The switch is pressed in slider 0 setting. Also in setting A in the case of code letters N and A.

B 4, B 5, E 4, E 5



B 6, B 7, E 6, E 7



Recommended values for electrical switch loads ($\approx 1 \cdot 10^6$ switching operations):

cut-off current 6 A at 220 V AC ($\cos. \varphi \geq 0,4$)

5 A at 24 V DC (time constant ≈ 40 ms)

0,02 A at 110 V DC (time constant ≈ 40 ms)

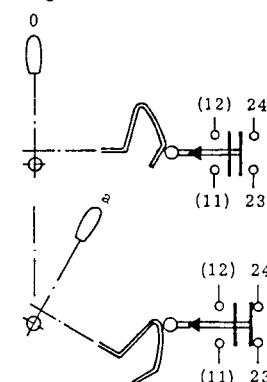
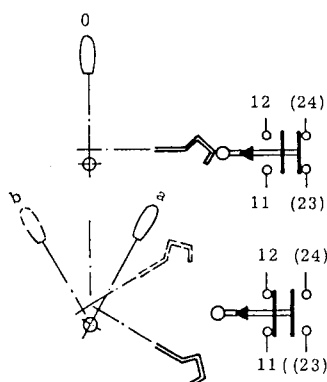
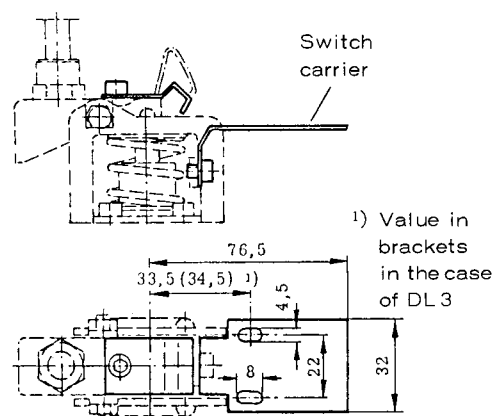
Switches G, B, C, E, N and A

Valves R and P

Switch is not adjusted. It must be adjusted when making the electrical connection

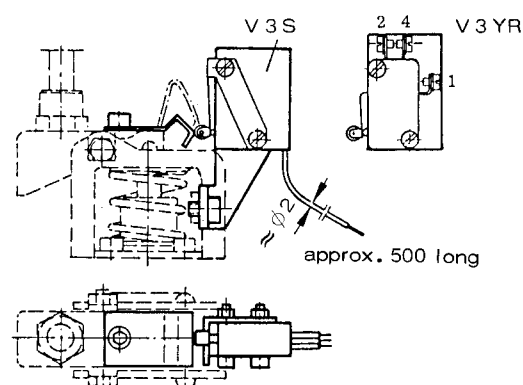
Adjust switch so, that bridge 23-24 is open in the zero setting and closed in the a setting

B 81, B 91, E 81, E 91

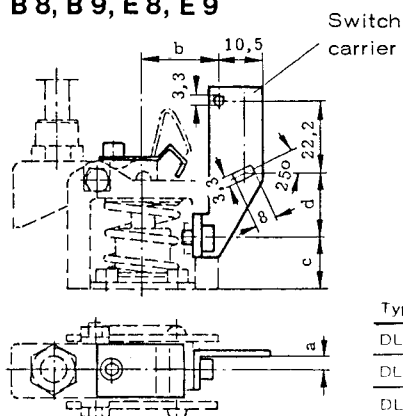


4.3.2. Design B(E)4S, B(E)5S, B(E)40, B(E)50, B(E)8, B(E)9. Not suitable for valves R and P

B(E)4S, B(E)5S, B(E)40, B(E)50



B 8, B 9, E 8, E 9



Type	a	b	c	d
DL 1	4,5	18,5	12,5	10
DL 2	6	26	17,5	17
DL 3	6	27	19,5	28,5

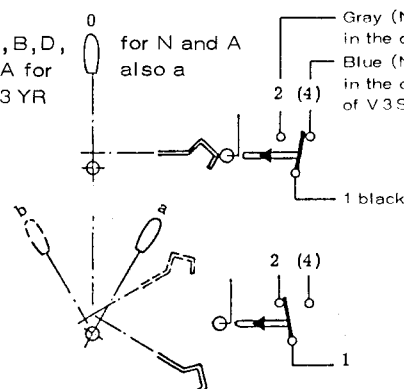
Switch	V 3 YR ²⁾	V 3 S	Reference
Safety class	IP 00 ³⁾	IP 67	---
Braking capacity	220 V AC	--	5 A
$\approx 10^5$	15 V DC	10 A	10 A
switching	30 V DC	7,5 A	7,5 A
operat.	110 V DC	--	0,07 A
	220 V DC	--	0,03 A

L/R ≈ 3 ms

Valves G, B, D, E, N and A for switch V 3 YR

for N and A also a

Gray (NC contact in the case of V 3 S)
Blue (NO contact in the case of V 3 S)



²⁾ used only for 42 V

³⁾ connections (switch IP 40)

5. Appendix

5.1. Adapter Plate with Pressure Limiting Valve for DL 2 and DL 3

For lower pressure protection of downstream valves as against the main pressure protection in the connection block in DL 21 and DL 31 or the pump side pressure limit in DL 25 and DL 35.

Code, Coding example

DL 21-2-GG **X5** D-B/E 1-2-210

as in
Sect.3.1

--- Downstream
valve

Code	Pressure range		from to bar
	fixed set- ting	ad- justa- ble	
X	1	4	(0)... 80
	2	5	(0)...160
	3	6	(0)...250

Order code for single orders, e.g.
for replacements, own stores, etc.

D 2 X 1 ... 6

D 3 X 1 ... 6

Pressure range
as in table above

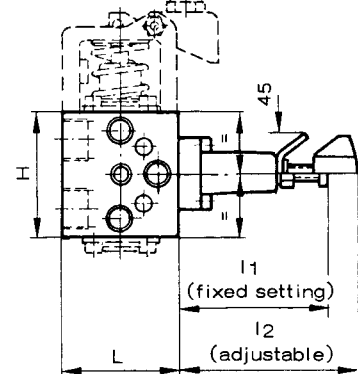
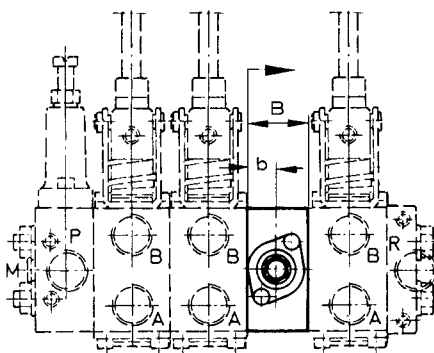
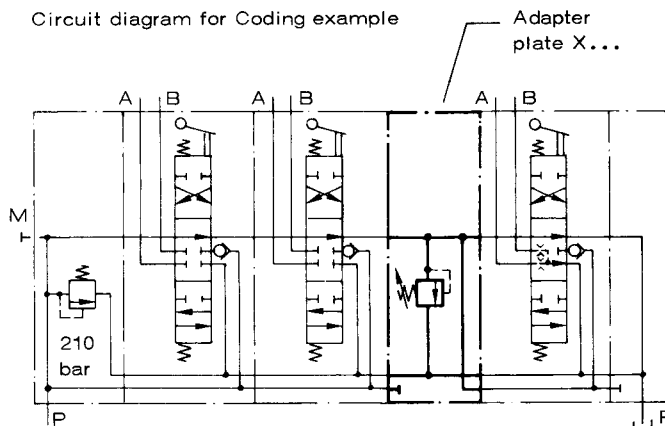
Single X block
for DL 2 or DL 3

Mass (weight) for adapter plate
X...:

suitable for DL 2 = 0,55 kg

DL 3 = 0,9 kg

Circuit diagram for Coding example



Adapter plate for	L	H	B	b	l ₁	l ₂
DL 2	50	50	25	12,5	75	87
DL 3	60	62,5	30	14	80	91

All dimensions are in mm.

Subject to change without notice !

5.2. Manual operation with detent

Code, Coding example

DL 31-3-GGND-BBB **CD** / E 1-2-200

as in
Sect.3.1

The code is listed only once for
uniform operation, e.g.

DL 31-3-GG-**C** / E 1-2-200

A mixed configuration with return
spring operations as shown in Table
2, Section 3.1, will be necessary
in the majority of cases. The opera-
tions B, C or D are then listed
individually in the same order as
the valves to which they should be-
long. The coding for the type of as-
sembly appears only once at the
end of this sequence of letters.

Version with contact switch not
available

Manual operat. with detent, here in the example for valve code letter N and D.

Types available	DL 1...	DL 2... and DL 3...
D Detent at operating position b, return spring at a 		<p> $\alpha = 19^\circ$ for DL 2.. $\alpha = 26^\circ$ for DL 3.. </p>
C Detent in both operating positions 		

Illustrations referred to type of assembly E 1. For missing see Sect.3.1