

3-Way Proportional Pressure Control Valves



Nominal sizes 2, 4, 8, 12, 20, 30, 40

Poppet valve with integrated electronic pressure control

Flanged design, sizes 30 and 40 with internal thread

Catalog Register
P16

Publication 7503229.06.02.98

OBSOLETE
DOCUMENT
Technical
Reference
Only

Description

General

The proportional pressure control valve allows infinite adjustment of a pneumatic pressure. The integrated electronic circuitry with pressure sensor regulates the output pressure.

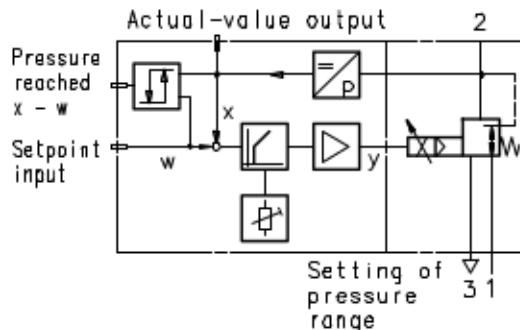
Function

Setting the pneumatic output pressure is achieved by supply of a specified level signal (command variable w). The electronic circuitry processes this signal and controls the force of the proportional solenoid at the valve by means of an electric current (final control variable y). This force effects the adjustment of the pneumatic output pressure. The output pressure is measured by an integrated pressure sensor (actual value x) and regulated by the internal electronic circuitry. The result is a proportional relationship between the specified level signal and the pneumatic output pressure.

On reduction of the specified level or system-dependent increase of the output pressure, the unit releases pressure from port 2 to 3 in order to bring the pressure down to the set level.



Block diagram



Features

- Valve and electronic control circuitry in a single unit
- Minimal hysteresis
- Good linearity
- Good response sensitivity
- Short actuating time
- Adjustable controller amplification
- Installation position to suit
- High flow capacity
- Switchable to 0 ... 10 V, 0 ... 20 mA, 4 ... 20 mA
- 8 bit digital setpoint input with storage input (latch)
- Adjustable pressure range
- Signal output for "pressure reached" (pressure-switch function)
- LEDs integrated in valve for
 - "operating voltage available"
 - "setpoint available"
 - "pressure reached"
- Low power consumption

Applications

- Remote pressure adjustment
- Program controlled pressure adjustment
- Open and closed loop control of rotational speed, position, flow volume and force by means of pressure
- Control of pneumatically actuated positioning and proportioning valves
- Mass retarding

Further versions

- Units without integrated closed-loop controller for use in open-loop control systems or in closed-loop control systems in combination with a closed-loop controller and an external actual-value generator.

Equipment list (standard units)

Nom. size	Pressure setting pv min ... pv max [bar]	Operating pressure p _e max. [bar]	Setpoint	Type of connection pneumatical	electrical	Material Body	Seal	Dimensional drawing No.	Cat. No.
2	0.03 ... 2	7	analog	Hose OD 4 mm	Connector ¹⁾	PA6	NBR	1	4093000
			digital		Connector ²⁾				4093001
	0.15 ... 10	12	analog		Connector ¹⁾				4093010
			digital		Connector ²⁾				4093011
4	0.03 ... 2	7	analog	Flanges (see Accessories, Page 16)	Connector ¹⁾	Al-alloy	NBR	2	4093100
			digital		Connector ²⁾				4093101
	0.15 ... 10	12	analog		Connector ¹⁾				4093110
			digital		Connector ²⁾				4093111
	0.24 ... 16	16.5	analog		Connector ¹⁾				4093120
			digital		Connector ²⁾				4093121
8	0.03 ... 2	7	analog	Flanges (see Accessories, Page 16)	Connector ¹⁾	Al-alloy	NBR	2	4093300
			digital		Connector ²⁾				4093301
	0.15 ... 10	12	analog		Connector ¹⁾				4093310
			digital		Connector ²⁾				4093311
	0.24 ... 16	16.5	analog		Connector ¹⁾				4093320
			digital		Connector ²⁾				4093321
12/20	0.03 ... 2	7	analog	Flanges (see Accessories, Page 16)	Connector ¹⁾	Al-alloy	NBR	2	4093400
			digital		Connector ²⁾				4093401
	0.15 ... 10	12	analog		Connector ¹⁾				4093410
			digital		Connector ²⁾				4093411
	0.24 ... 16	16.5	analog		Connector ¹⁾				4093420
			digital		Connector ²⁾				4093421
30	0.03 ... 2	7	analog	Flanges (see Accessories, Page 16)	Connector ¹⁾	Al-alloy	NBR	3	4093500
			digital		Connector ²⁾				4093501
	0.15 ... 10	12	analog		Connector ¹⁾				4093510
			digital		Connector ²⁾				4093511
40	0.03 ... 2	7	analog	Flanges (see Accessories, Page 16)	Connector ¹⁾	Al-alloy	NBR	3	4093600
			digital		Connector ²⁾				4093601
	0.15 ... 10	12	analog		Connector ¹⁾				4093610
			digital		Connector ²⁾				4093611

¹⁾ Contained in delivery

²⁾ Connector to be ordered separately, Cat. No. 0681764

Parameters

General parameters

Description	3-way proportional pressure control valve with integrated electronic pressure control
Switching symbol	
Design	Poppet valve
Connection	See equipment list
Mounting position	Any, preferably vertical
Flow direction	Defined
Actuator	Proportional solenoid
Ambient temperature [°C]	-10 ... +60
Nominal size	2, 4, 8, 12, 20, 30, 40
Material: Body Seals	See equipment list
Degree of protection	IP 54 (with mounted plug connectors)

Pneumatic parameters

Fluid	Filtered compressed air, lubricated or unlubricated
Filter [µm]	50
Fluid temperature [°C]	-10 ... +40
Operating pressure range p_e [bar]	See equipment list
Pressure setting range [bar]	0.03 ... 2 0.15 ... 10 0.24 ... 16 (except sizes 2, 30, 40)
Hysteresis [% p_v max.]	< 0.5
Repeatability [% p_v max.]	< 0.5
Linearity ¹⁾ [% p_v max.]	< 1
Response sensitivity [% p_v max.]	≤ 0.2

Electrical parameters

Power supply

Supply voltage	U_B [V]	18 ... 32 VDC
Residual ripple max.	[%]	10
Current consumption max. at setpoint < 1.5%	I_B [A] [mA]	0.8 <50

Inputs (signal)

Analog setpoints²⁾ (W) (selectable)

Voltage signal	U_E [V]	0 ... 10
Input resistance	R_I [kΩ]	> 300
Current signal	I_E [mA]	(0) 4 ... 20
Load impedance	[Ω]	≤ 135

Digital setpoints²⁾ (W)

Data inputs (parallel)	[bit]	8 bit + memory function
Level for logic	"L" ³⁾ [V]	0 ... 2
Level for logic	"H" [V]	12 ... 32
Input current	[mA]	1

Outputs (signal)

Actual value (X)

Voltage signal for pneumatic outlet pressure	U_A [V]	0 ... 10 = 0 ... p_v max.
Output current max.	I_A [mA]	1

Signal output "Pressure reached" (X = W)

Switching range [% p_v max.]	± 2
Voltage signal for pressure outside switching range (X ≠ W)	[V]
Pressure reached (X = W)	[V]
Output current max.	[mA]

U_B - 0.5 V⁴⁾

Electromagnetic compatibility (EMV)

Noise immunity	To DIN EN 50082, Part 2
Noise transmission	To DIN EN 50081, Part 1

¹⁾ Values referred to 20°C

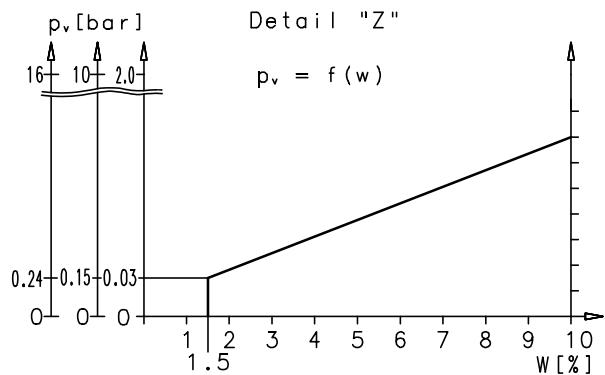
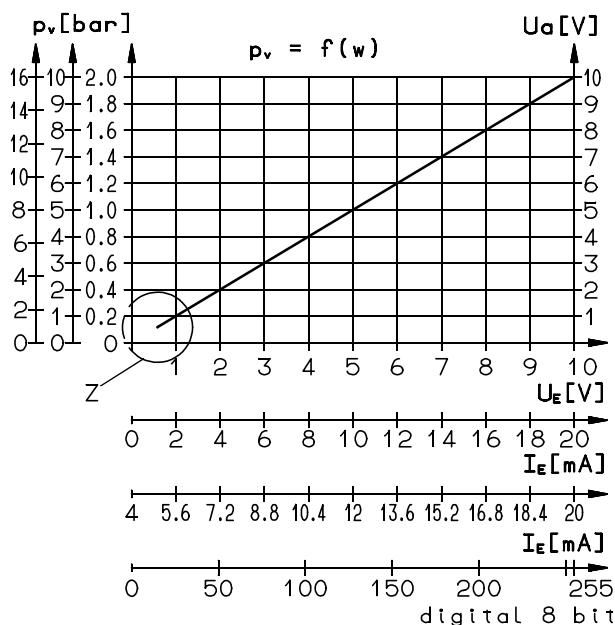
²⁾ Valve function is activated as soon as setpoint is ≥ 1.5%
If the setpoint is < 1.5%, the set pressure = 0 and the valve is in standby mode

³⁾ Input open = Logic "L"

⁴⁾ U_B = Supply voltage

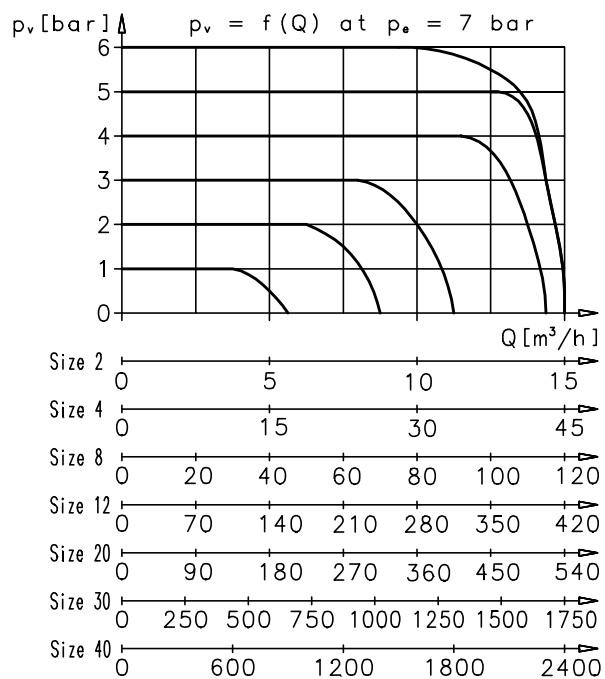
Characteristic curves

Static characteristic curve

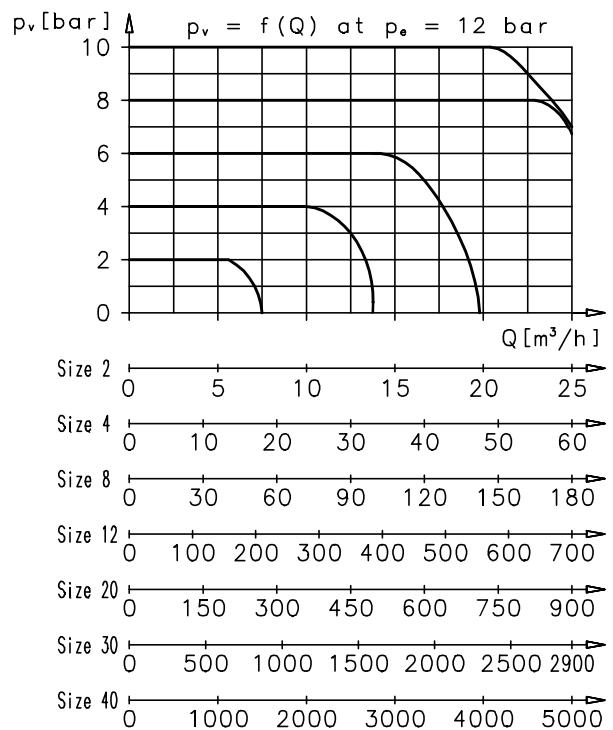


The valve function is activated as soon as the setpoint is $\geq 1.5\%$

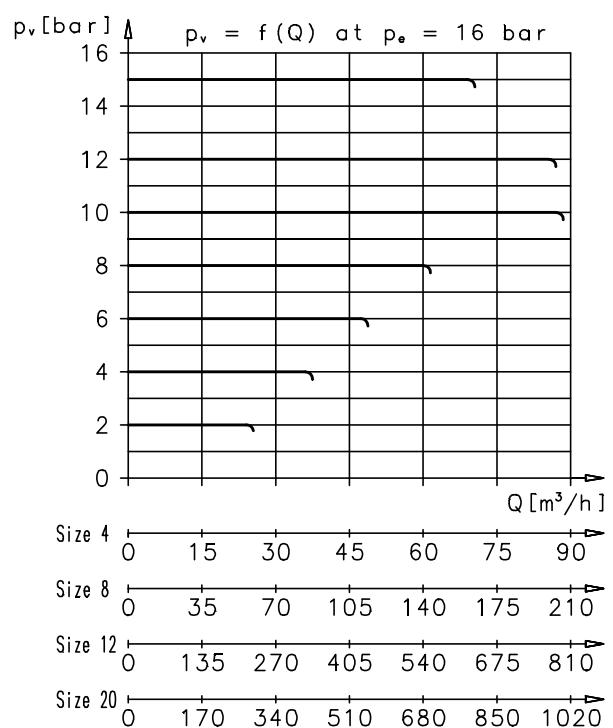
Flow characteristic at 7 bar operating pressure



Flow characteristic at 12 bar operating pressure

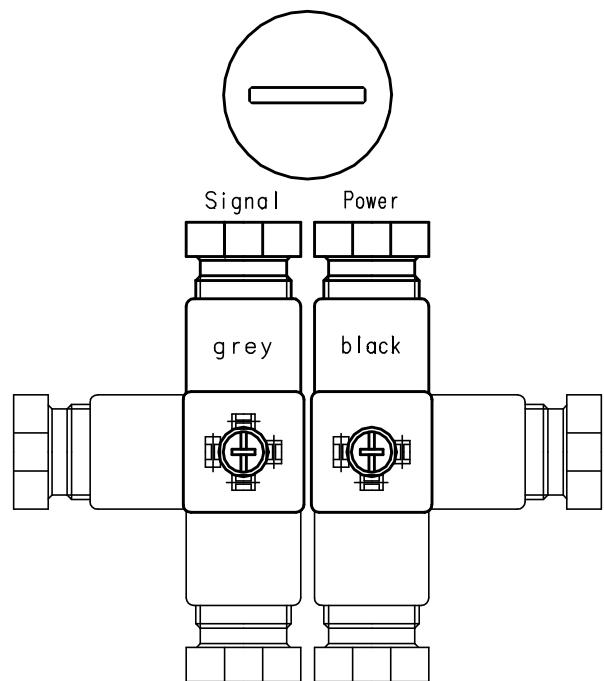
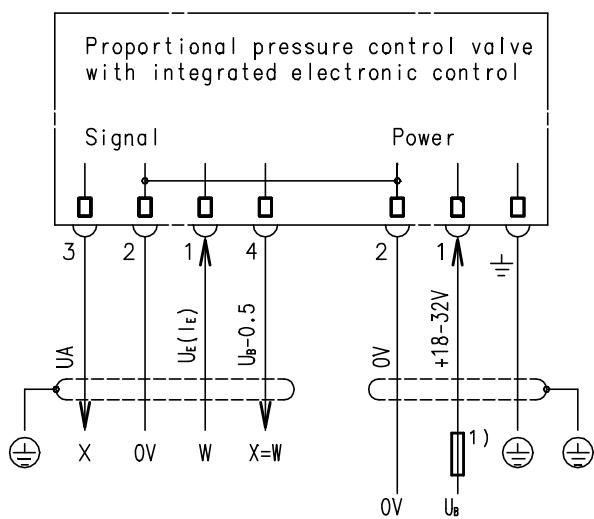


Flow characteristic at 16 bar operating pressure



Connection diagram 1

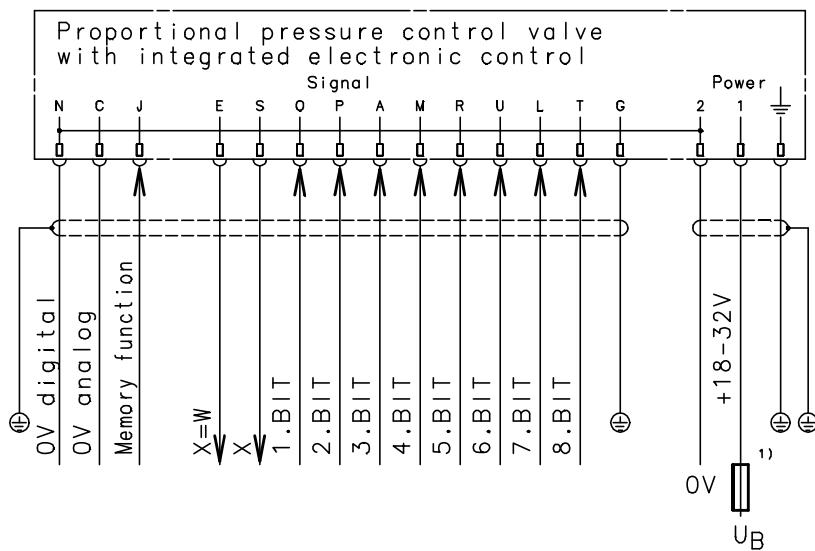
Valves with analog setpoint input



¹⁾ Recommended line fuse: M 1.0 A

Connection diagram 2

Valves with digital setpoint input



Conversion table for digital input signal

Signal at pin								Value z (decimal)	Valve version for pressure range p_v [bar]		
T	L	U	R	M	A	P	O				
L	L	L	L	L	L	L	L	0	0.000	0.000	0.000
L	L	L	L	L	L	H	L	1	0.008	0.039	0.063
L	L	L	L	L	H	L	L	2	0.016	0.078	0.125
L	L	L	L	H	L	L	L	4	0.031	0.156	0.251
L	L	L	H	L	L	L	L	8	0.063	0.314	0.502
L	L	L	H	L	L	L	L	16	0.126	0.627	1.004
L	L	H	L	L	L	L	L	32	0.251	1.255	2.008
L	H	L	L	L	L	L	L	64	0.502	2.510	4.016
H	L	L	L	L	L	L	L	128	1.004	5.020	8.031
H	H	H	H	H	H	H	H	255	2.000	10.000	16.000

$$p_v [\text{bar}] = \frac{2}{255} \times z \quad \frac{10}{255} \times z \quad \frac{16}{255} \times z$$

z = Sum of values triggered by "H"

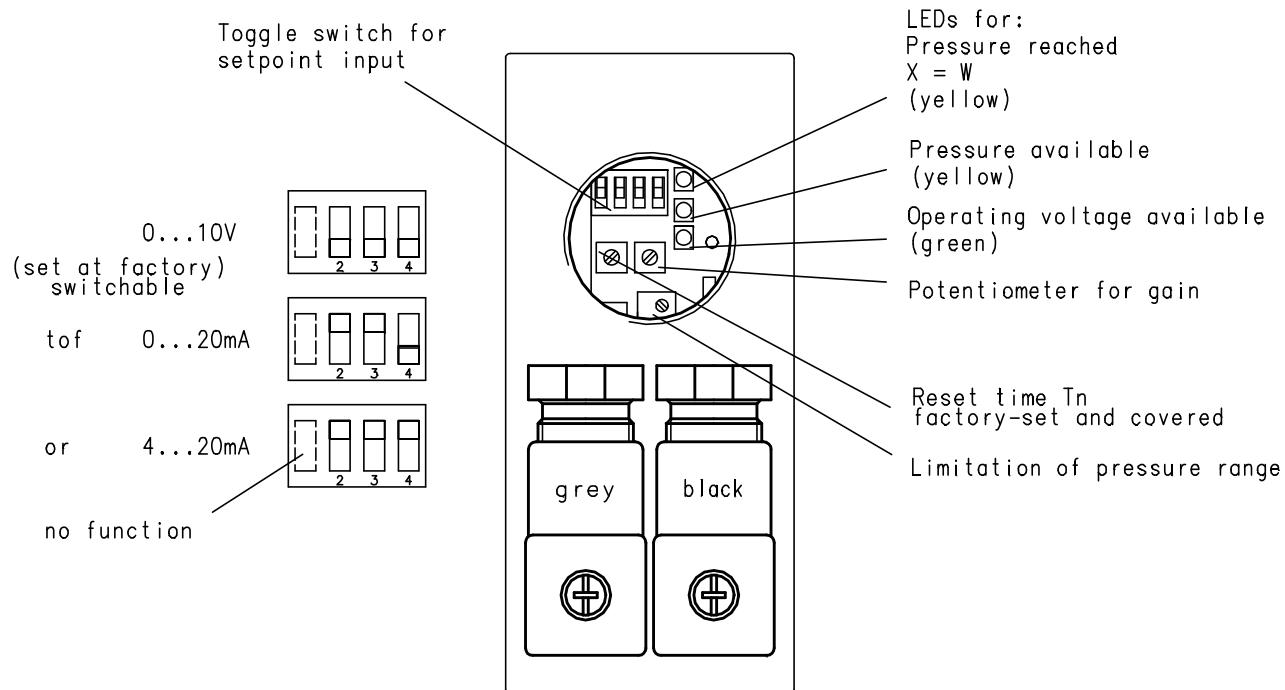
Notes on memory function²⁾

Logic table

T	L	U	R	M	A	P	O	J	Output signal
							L		As triggered at pins O to T
X	X	X	X	X	X	X	X	H	The previously-set value is stored; the triggering signals at pins O to T are ignored

²⁾ If the memory function is not required, pin C can be ignored.

Setting elements, displays



Setting the controller gain

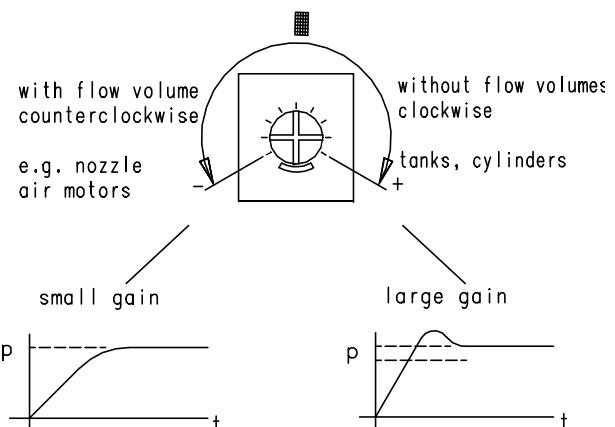
The gain of the integrated controller is set in the factory to a value which allows universal use of the valve. If necessary, the controller gain can be varied to suit a specific pneumatic application of the valve. The controller gain can be changed by turning the potentiometer (under the screw plug in the electronics cover).

Factory setting:

For continuous air consumption at valve outlet 2 or for volumes as shown in table below:

Size	for volume [cm ³]
2	0 – 100
4	50 – 500
8	100 – 1500
12/20	1000 – 8000
30	>2000
40	>5000

Gain adjustments:



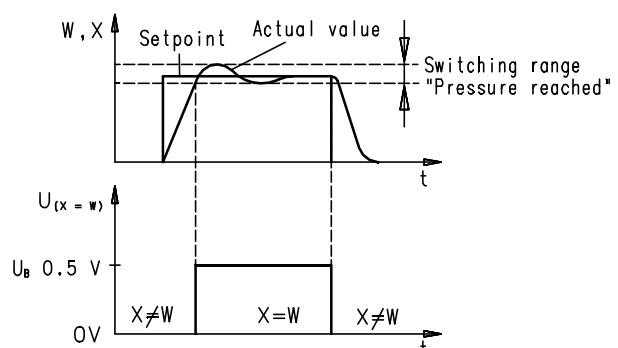
Pressure control becomes unstable
if gain is too large.

Signal output "Pressure reached" ($X = W$)

Description

The function "Pressure reached" enables the monitoring of the pressure control function:

The actual value is compared with the desired value ($X = W$). Identical values (selected pressure lying within the switching range) will cause a status signal at the output ($X = W$).



Limitation of the pressure range (p_v max. limited)

Description

When delivered, the relation between the setpoint and the output pressure is adjusted to:

Setpoint range 0 ... 100%,
corresponding to set pressure range 0 ... 100%,
corresponding to $p_{v\min}$... $p_{v\max}$
Due to the limitation of the pressure range it is possible to change this allocation on the potentiometer "Pressure Range".
Setting range:
100% ... 10% of maximum set pressure $p_{v\max}$

The valve always starts to respond at $p_{v\min} = 1.5\%$ of its maximum setting pressure.

This means

- 0.03 bar at a pressure range up to 2 bar
- 0.15 bar at a pressure range up to 10 bar
- 0.24 bar at a pressure range up to 16 bar

Dependent on the set limitation of the pressure range ($p_{v\max}$ limited), the output pressure jumps from 0 to $p_{v\min}$ according to the following formula:

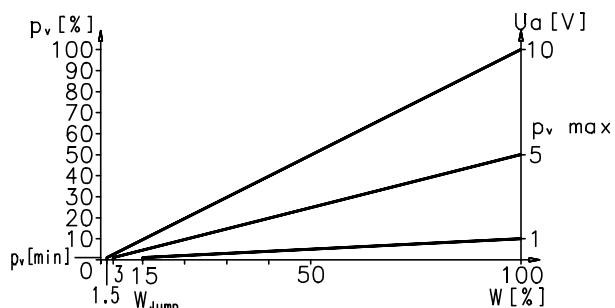
$$\text{Setpoint jump } W_{\text{Jump}} \text{ in \%} = \frac{p_{v\min}}{p_{v\max}-\text{limited}} \times 100$$

Hence follows (adopted to the possible setpoint specifications):

for setpoint

- 0 ... 10 V: W_{Jump} in V = $p_{v\min}/p_{v\max}\text{-limited} \times 10$
- 0 ... 20 mA: W_{Jump} in mA = $p_{v\min}/p_{v\max}\text{-limited} \times 20$
- 4 ... 20 mA: W_{Jump} in mA = $p_{v\min}/p_{v\max}\text{-limited} \times 16$
- Digital 8 bit W_{Jump} in value z decimal = $p_{v\min}/p_{v\max}\text{-limited} \times 255$

Characteristic curves



Example:

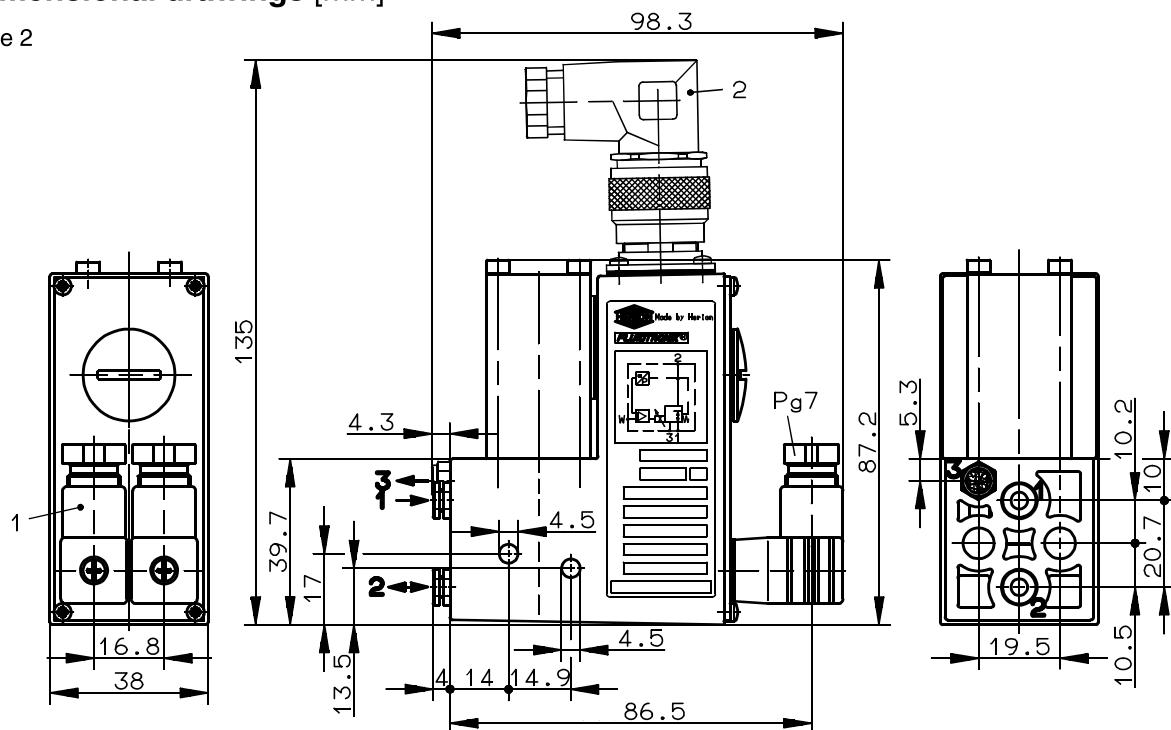
Determination of the setpoint of a valve with below mentioned data (output pressure jumping from 0 to $p_{v\min}$ with $p_{v\max}$ -limited adjusted to 6 bar):

Set pressure range: $p_{v\min}$... $p_{v\max}$ = 0.15 ... 10 bar
Setpoint: 0 ... 10 V

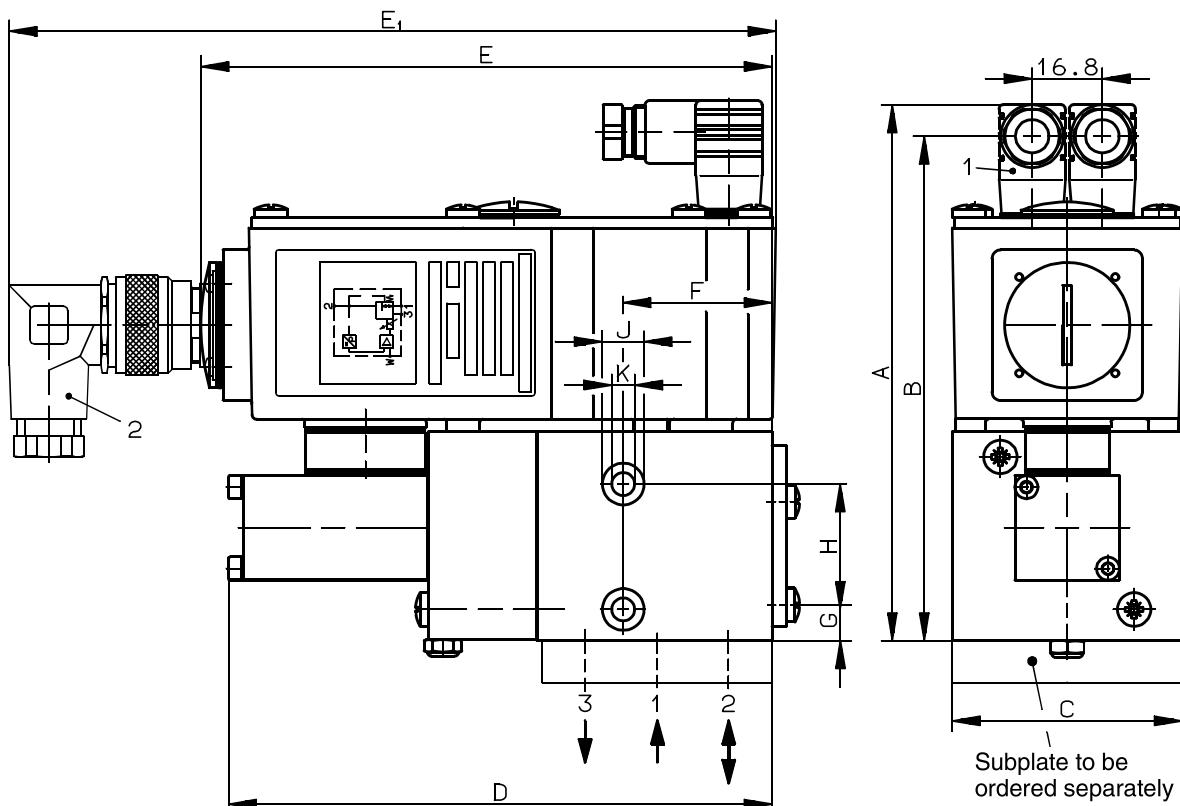
$$\begin{aligned} \text{Calculation: } W_{\text{Jump}} \text{ in V} &= p_{v\min}/p_{v\max}\text{-limited} \times 10 \\ &= 0.15 / 6 \times 10 \\ &= \underline{\underline{0.25 \text{ V}}} \end{aligned}$$

Dimensional drawings [mm]

Size 2



Sizes 4, 8, 12, 20



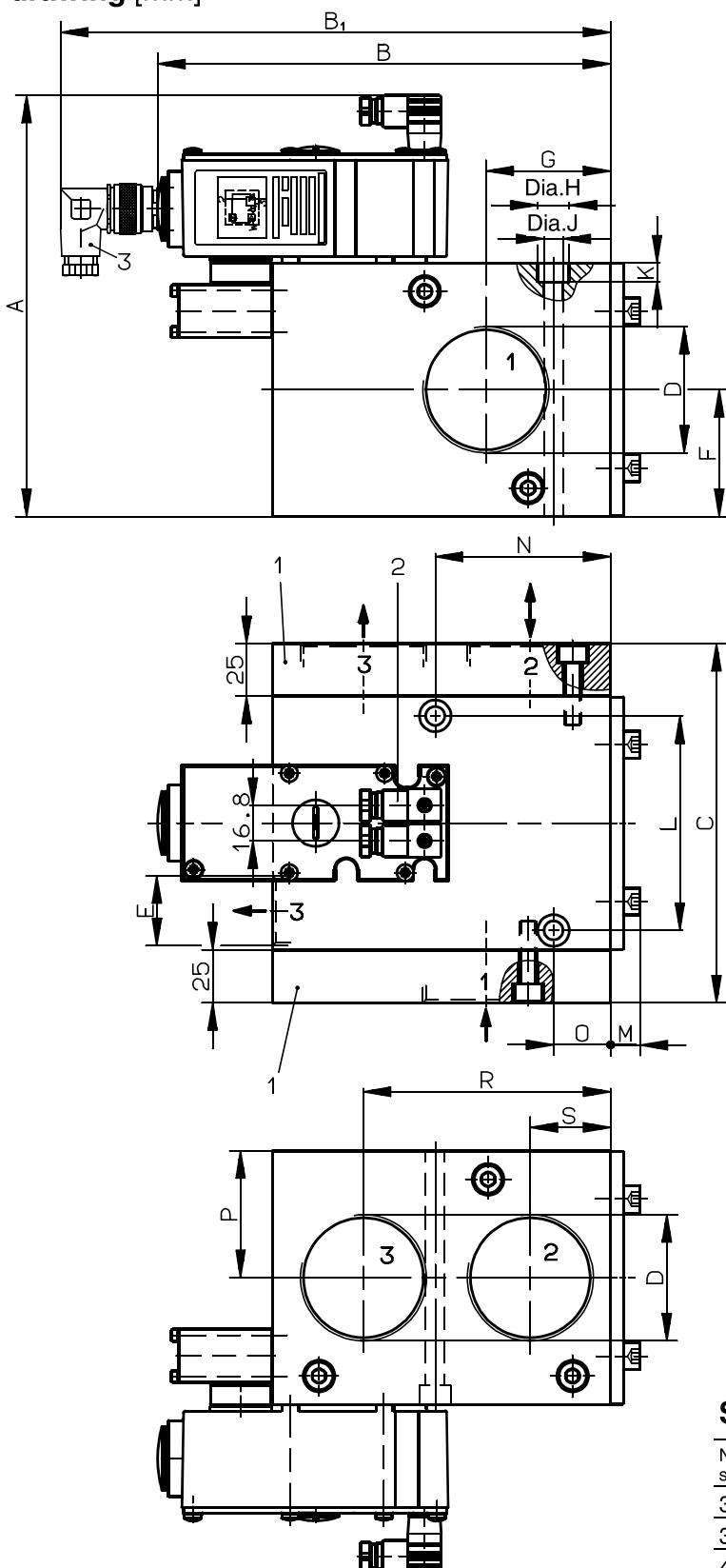
Dimensional table [mm]

Size	A	B	C	D	E	E ₁	F	G	H	J	K
4	114	107	55	130	136.7	183	36.8	6.5	22	10	5.5
8	128.2	120.7	55	130	136.7	183	35.6	7.5	30	10	5.5
12	148.2	140.7	70	159.8	166.5	212	59	8.5	49.8	11	6.6
20	148.2	140.7	70	159.8	166.5	212	59	8.5	49.8	11	6.6

Item 1: Only with valves with analog setpoint
Item 2: Only with valves with digital setpoint

Dimensional drawing [mm]

Sizes 30, 40



Set of subplates

Nominal size	Port size	Cat. No.
30	G 1 1/4	0546412
30	G 1 1/2	0546410
40	G 2	0798598

Dimensional table [mm]

Size	A	B	B ₁	C	D	E	F	G	Dia. H	Dia. J	K	L	M	N	O	P	R	S
30	170	179	225	140	G 1 1/2	G 3/4	45	42.5	11	6.6	6.8	74	6	65	27.5	45	92	32
40	199	214	260	170	G 2	G 1	60	59	15	9	9	101.5	14	83	27	60	117	38

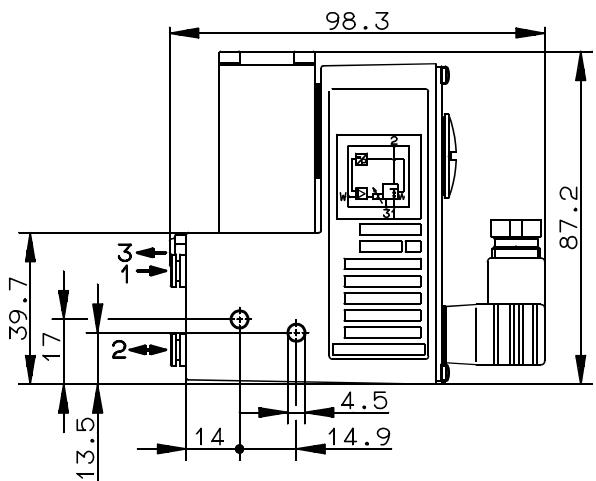
Item 1: Set of subplates must be ordered separately

Item 2: Only with valves with analog setpoint

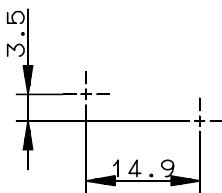
Item 3: Only with valves with digital setpoint

Types of mounting for valves with nominal size 2 [mm]

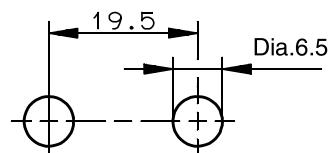
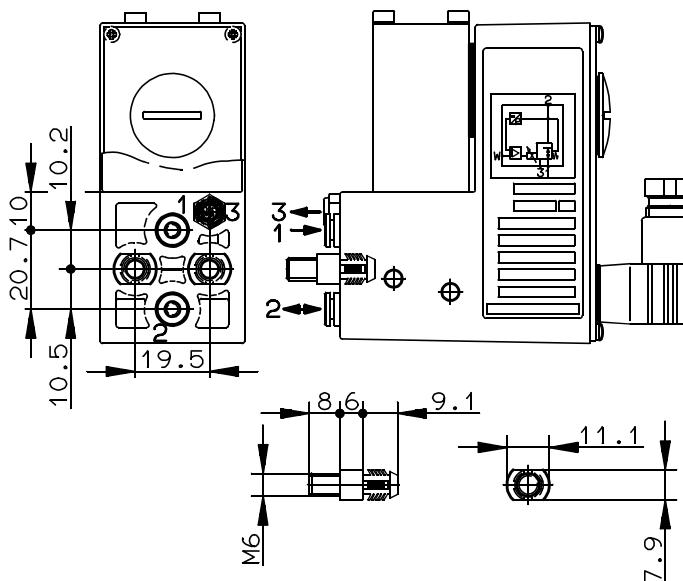
2 mounting holes, dia. 4.5



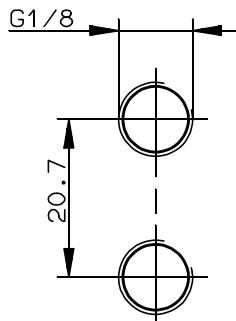
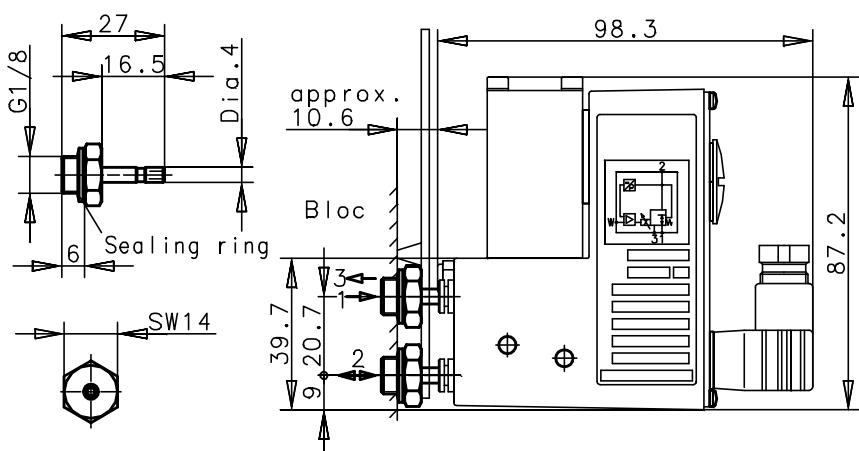
Hole pattern M 1 : 1



2 threaded bolt M 6



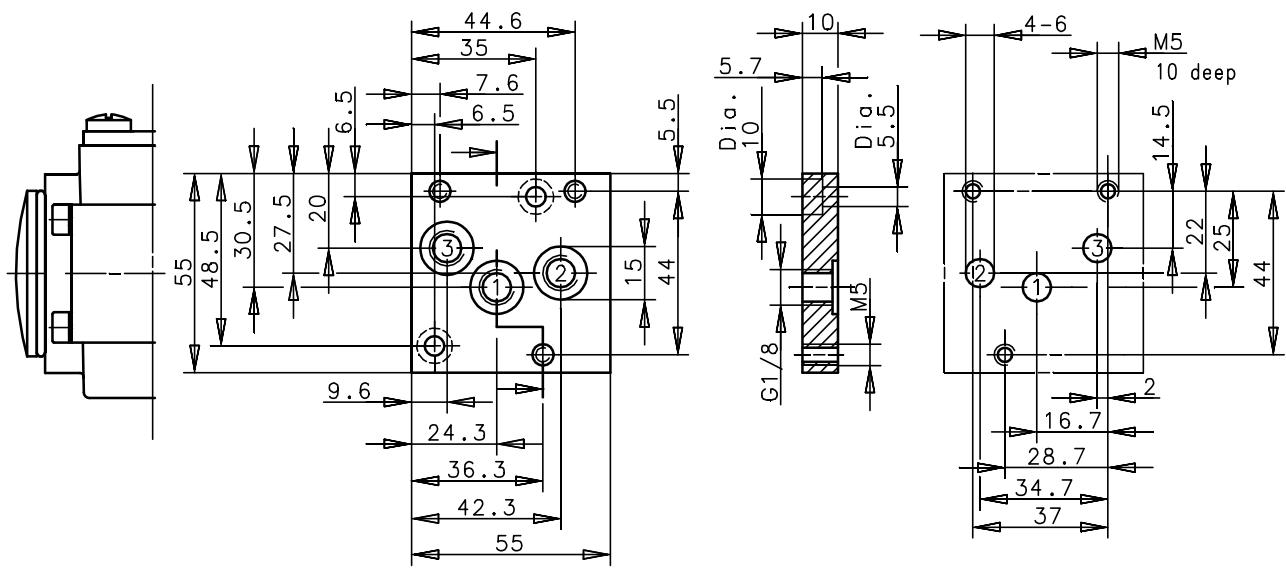
2 threaded attaching plugs



Dimensional drawing [mm]

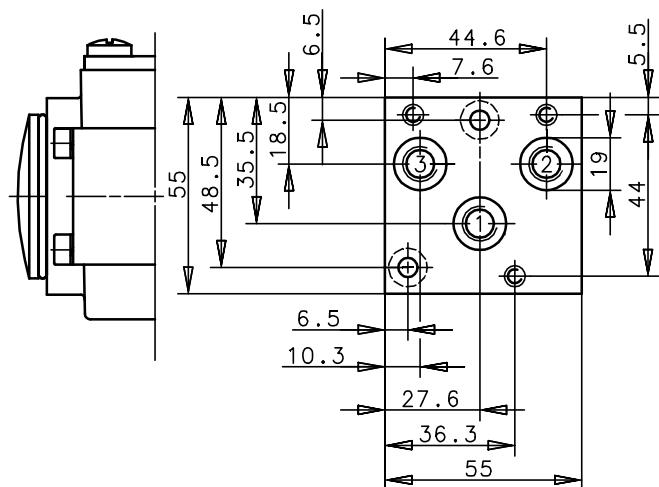
Subplate G 1/8 for Size 4 to be ordered separately
Cat. No. 0542848

Hole pattern

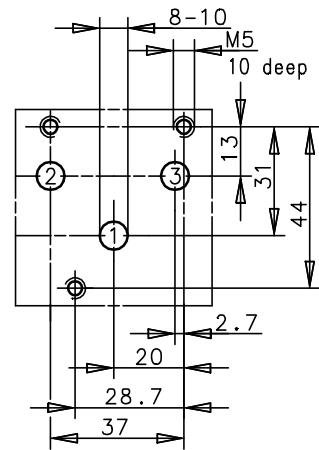
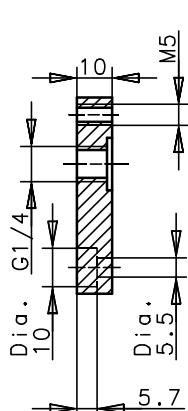


Dimensional drawings [mm]

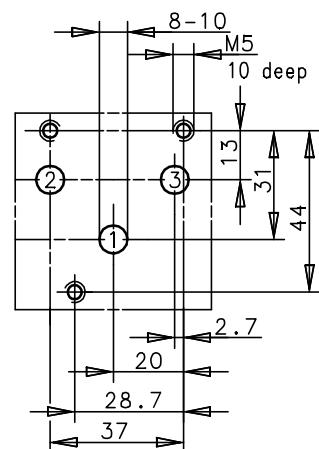
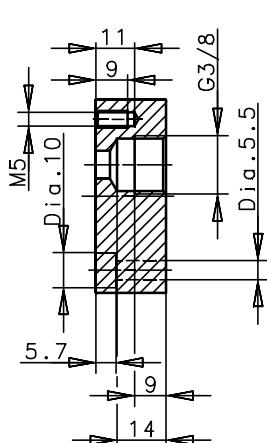
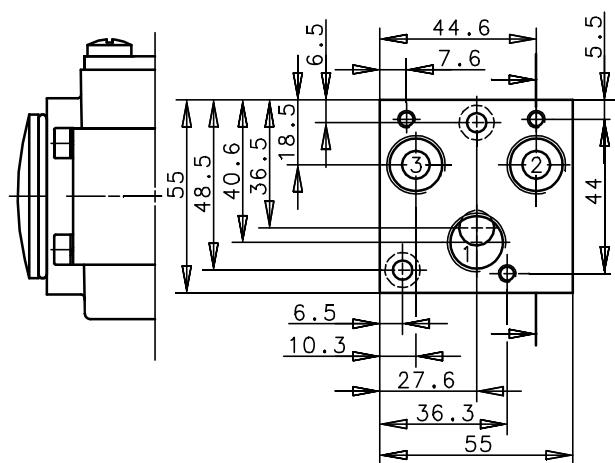
Subplate G 1/4 for Size 8 to be ordered separately
Cat. No. 0542636



Hole pattern



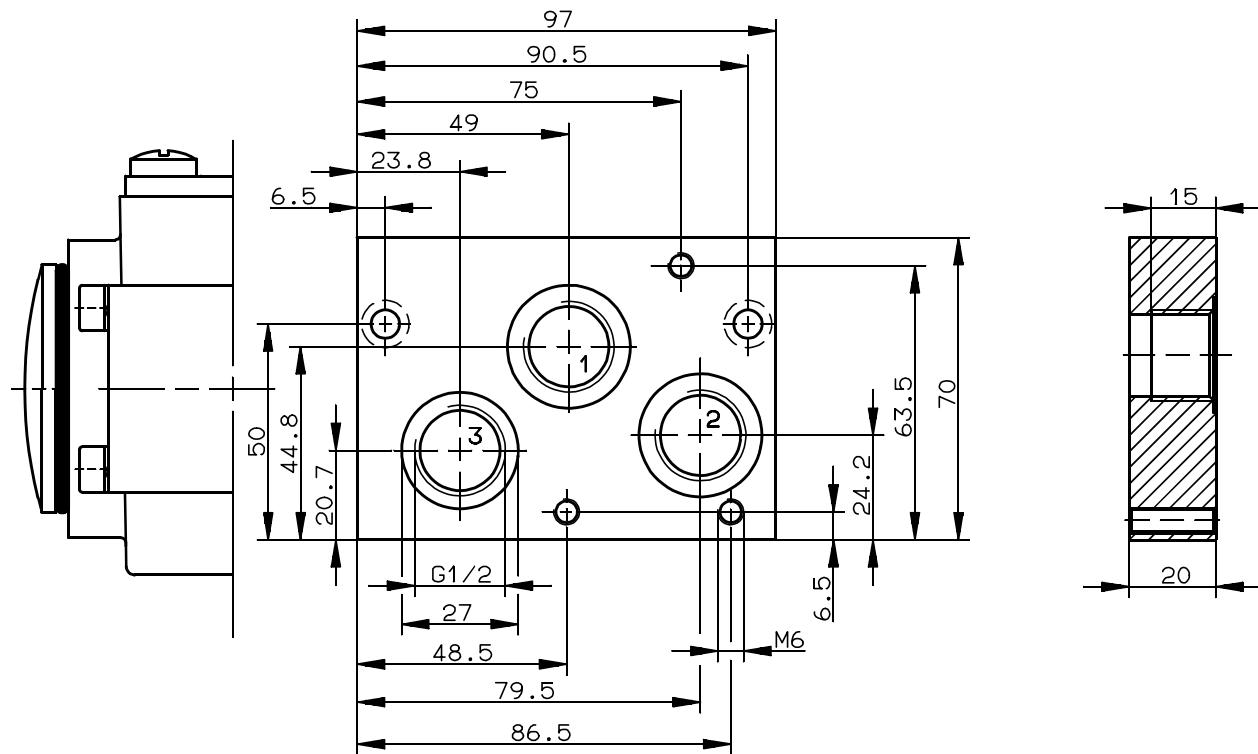
Subplate G 3/8 for Size 8 to be ordered separately
Cat. No. 0543705



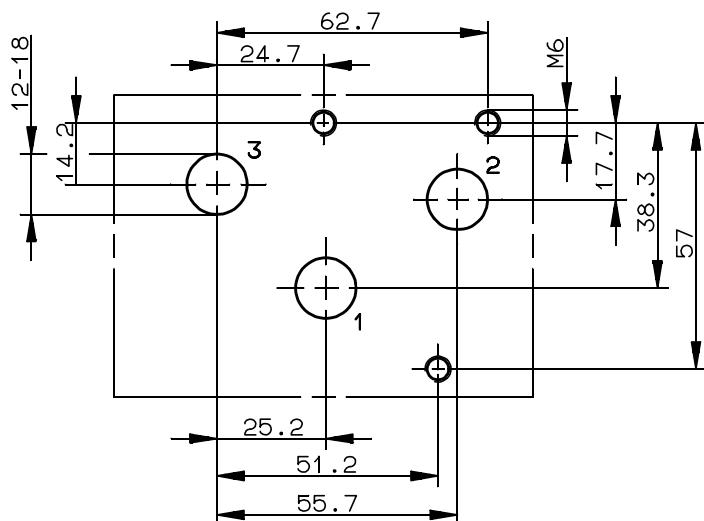
Surface finish in
sealing area: Rz16

Dimensional drawing [mm]

Subplate G 1/2 for Size 12 to be ordered separately
Cat. No. 0542814



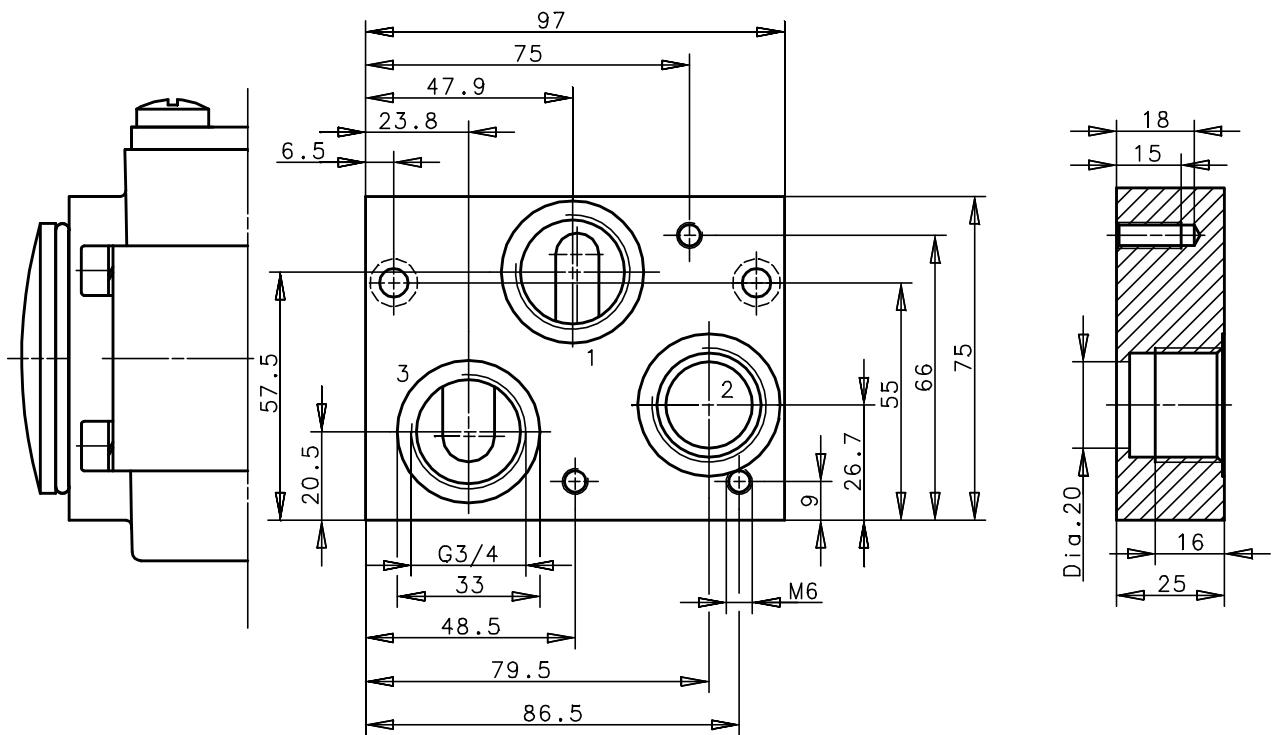
Hole pattern



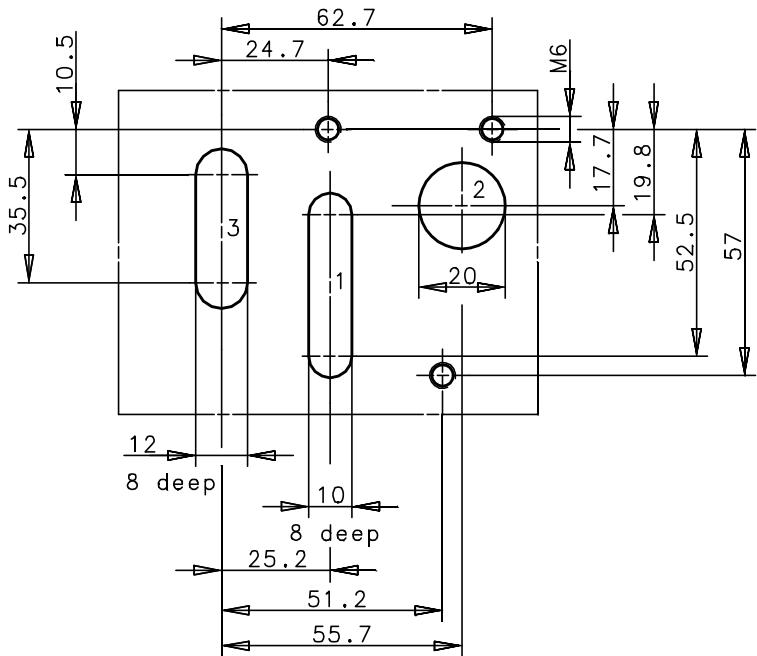
Surface finish in
sealing area: R_z 16

Dimensional drawing [mm]

Subplate G 3/4 for Size 20 to be ordered separately
Cat. No. 0542840



Hole pattern



Surface finish in
sealing area: Rz16

Accessories

Designation	Specification	Publication No.	Cat. No.
Transformer TR 21	110/220 VAC/50-60 Hz 24 VDC 3.0 A	7501789	5998609
Transformer TR 22	380 VAC/50-60 Hz 24 VDC 6.0 A	7501789	5998611
Subplates	Size 4 G 1/8		0542848
	Size 8 G 1/4		0542636
	Size 8 G 3/8		0543705
	Size 12 G 1/2		0542814
	Size 20 G 3/4		0542840
	Size 30 G 1 1/4		0546412²⁾
	Size 30 G 1 1/2		0546410²⁾
	Size 40 G 2		0798598²⁾
Silencer for venting port at subplate up to size 20, for sizes 30 and 40 in housing	G 1/8	7501079	0014510
	G 1/4		0014610
	G 3/8		0014710
	G 1/2		0014810
	G 3/4		0014910
	G 1 1/2		0016630
	G 2		0016730
Mounting material for size 2	Thread bolt M 6	—	0681641¹⁾
	Threaded Connectors G 1/4		0545259¹⁾
Connector	15-pin without cable	—	0681764
	15-pin with cable, 2 m		0799205
	15-pin with cable, 5 m		0799206

¹⁾ 2 pieces are required per valve
²⁾ Subplate kit, assembly